A Process Model for Selecting the Most Appropriate Production Site

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An Application-oriented Approach for OEMs based on a Literature Analysis

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List of Abbreviations

ACEA	European Automobile Manufacturers' Association
ASEAN	Association of Southeast Asian Nations
bn	billion
BEV	Battery Electric Vehicle
BRIICS	Brazil, the Russian Federation, India, Indonesia, China, South Africa
CETA	Comprehensive Economic and Trade Agreement
CIA	United States Central Intelligence Agency
CKD	Completely-knocked-down
CPI	Consumer Price Index
CPS	Cyber-Physical Systems
DVA	Domestic Value Added
ECB	European Central Bank
EG	Economic Geography
EME	Emerging Market Economy
EIU	Economist Intelligence Unit
ETI	Global Enabling Trade Index
EU	European Union
EUR	Euro
EV	Electric Vehicle
EVA	Economic Value Added
ESI	Export Similarity Index
FC	Fixed Costs
FDI	Foreign Direct Investment
FED	Federal Reserve System
FTA	Free Trade Agreement
FVA	Foreign Value Added
FX	Foreign Exchange
GCI	Global Competitiveness Index
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GPI	Global Peace Index
GST	Goods and Service Tax
GVC	Global Value Chain
HDI	Human Development Index
IB	International Business
ICC	International Chamber of Commerce
ICT	Information and Communication Technology
IFC	International Finance Corporation
ILO	International Labour Organization

IMF	International Monetary Fund
IT	Information Technology
JIS	Just-In-Sequence
LP	Logistics Service Provider
LPI	Logistics Performance Index
MFN	Most-Favored Nation
mn	million
MNE	Multinational Enterprise
NAFTA	North American Free Trade Agreement
NEG	New Economic Geography
NTB	Non-tariff Barriers to Trade
OECD	Organization for Economic Co-operation and Development
OEM	Original Equipment Manufacturer
OPEC	Organization of the Petroleum Exporting Countries
PACI	Partnering Against Corruption Initiative
PPP	Purchasing Power Parity
PV	Personal Vehicle
R&D	Research and Development
RE	Regional Economics
REM	Rare Earth Material
RS	Regional Science
SKD	Semi-knocked-down
SME	Small-and Medium Size Enterprises
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TFP	Total Factor Productivity
TI	Transparency International
TRIPS	Trade-Related Aspects of Intellectual Property Rights
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
U.K.	United Kingdom
U.S.	United States
US$	US Dollar
VC	Variable Costs
VDA	Verband der Automobilindustrie (German Association of the Automotive Industry)
VPN	Virtual Private Networks
WACC	Weighted Average Cost of Capital
WEF	World Economic Forum
WTO	World Trade Organization

1 Introduction

1.1 Strategic Relevance of Selecting Production Sites for OEMs

The selection of production sites is among the most important decisions for an Original Equipment Manufacturer (OEM); it is a 'constitutive' decision, since it is long-term, difficult to reverse and sets the framework for many subsequent decisions (Balderjahn, 2014, 37; Kappler and Wegmann, 1985, 232). The selection of a production site is also one of the most complex tasks an OEM will undertake, given the variety of different factors that must be considered for a successful selection. In addition, the automotive industry is one of the most globalized industries as OEMs produce components for or the final products of, mainly, cars, buses, or trucks around the world, and thus, the global scope of the selection of a production site of an OEM increases the task's complexity. The global selection of production sites will remain of key importance for OEMs, since OEMs continue internationalizing their production to sustain their competitiveness as a result of their rapidly diversifying and challenging environment: traditional export markets, such as the European or the U.S. market, are partially saturated, and new global growth markets, especially the Chinese market, have emerged. Moreover, while the international economy is characterized by globalization, tendencies of economic nationalism or regionalism increasingly lead to a strong revival of protectionism in the form of, for example, imposing tariffs or implementing non-tariff barriers to trade. Such protectionist policies often specifically target the automotive industry, as it is a key industry in many countries. Furthermore, the emergence of new competitors, new technologies, like electric vehicles or autonomous driving, and new trends, like shared mobility, are disruptive innovations which represent changes with unforeseeable consequences for the automotive industry. In addition, ever increasing customer demands require OEMs to produce innovative, individualized, and complex products faster, at a higher quality and lower prices (see Klug, 2018, 47). Other serious recent problems include the diesel scandal or supply chain interruptions (e.g., due to the coronavirus pandemic).

This environment is the playing field on which an OEM must position itself in an advantageous manner to stay competitive, which requires searching for and taking advantage of any upcoming opportunities. Internationalizing production is key to sustained competitiveness, profitability and success for an OEM as a means to ensure proximity to sales markets, to take advantage of lower input costs, especially lower labor costs, to overcome both tariff barriers and non-tariff barriers to trade, to attract talent, to access raw materials (see Sule, 2008, 611-617; Meyer, 2006a, 36), or to deal with capacity constraints in the domestic market (e.g., Germany) (see Kinkel and Maloca, 2009, 30).

Yet, internationalizing production requires OEMs to locate production sites on a global scale, integrated in a comprehensively established global production network. Locating production sites requires making a 'location decision', hence selecting where exactly a new production site should be located (Strange and Magnani, 2018, 62). Selecting production sites is long-term and strategic in nature, as production sites are usually operated for an extended period. For instance, automotive production sites normally have a lifetime of more than 10 years (see Kauder and Meyr, 2009, 508). Moreover, selecting production sites sets the framework for many subsequent decisions, such as those related to investing in capacity and new product lines (see Friedli et al., 2013, 19, 88). In addition to the long-term character of the production site selection, the required sizeable investment[1] for establishing a new production site, and the fact that this decision is only reversible at great cost, also makes the selection of a production site strategically relevant for the OEM (see Friedli et al., 2013, 7; Daskin et al., 2005, 40; Kappler and Wegmann, 1985, 232). Therefore, new production sites must be selected carefully: If the operation of the new production site fails, it is likely to be a serious burden and a rather significant failed investment. Instead, if the new production site is successful in economic terms, it may provide an opportunity to create a sustained competitive advantage for the OEM (see Friedli et al., 2013, 5).

The risk of failure in selecting production sites on a global scale becomes obvious when looking at firms that relocate their production from abroad back home (reshore) or that close production sites abroad due to unacceptably low levels of profitability. While firms from many industries are also forced to take such actions (see Kinkel, 2009c, 4), firms from the automotive industry must reshore or close their production sites abroad more frequently (see Kinkel and Maloca, 2009, 27-28). The main reasons for reshoring or closing production sites abroad include higher than expected costs, lower than necessary quality, longer than expected time to establish the production process at new production sites (see Kinkel, 2009c, 4; Kinkel and Maloca, 2009, 30-32) or loss of intellectual property (see Uluskan et al., 2016, 93; Hikmet and Enderwick, 2015, 14). Notably, the

[1] The investment associated with a new production site of an OEM is considerably large: the investment is somewhere between 500 mn US$ and 1.3 bn US$ (see Ohnsman and Muller, 2018; Capgemini, 2020). The investment size depends on many characteristics of the production site, such as the degree of automation, digitalization, the produced product, and implemented production process, as well as, of course, the size of the production site. For instance, the investment costs for a smart or digital production site are an estimated 1 bn US$ to 1.3 bn US$ (see Capgemini, 2020). Moreover, the required investment size depends on many conditions at the new production site reflected in location factors, such as the availability of transportation, water, energy, waste disposal or sewerage facilities.

failure of offshored production sites and their frequent reshoring or closure are often rooted in firms' processes for selecting production sites (see Kinkel, 2009c, 5) resulting in bad decisions. Due to weak processes for selecting production sites, firms overestimate the savings potential of locating production sites abroad, underestimate overall costs and are unable to realize expected potentials (see Meyer, 2006b, 103). Shortcomings of selection processes for production sites include not involving all relevant functions, being merely cost-driven, deciding too quickly, and failing to comprehensively take the firms' strategic goals into consideration (see Kinkel, 2009c, 4-5; Kinkel and Maloca, 2009, 31). Focusing solely on costs leads firms to disregard strategic and network-related aspects, and to neglect risks related to the potential loss of quality and flexibility. Scarcity of skilled labor, as well as of local high-quality suppliers, and insufficient local infrastructure add to the possible downsides of investments in production sites abroad (see Kinkel and Maloca, 2009, 30-32; Friedli et al., 2013, 5, 17). Furthermore, problems include misjudging local labor costs, as well as the time needed to establish the planned production site, plus additional costs that must be covered in the initial phase of production (see Kinkel, 2009c, 5-10).

Hence, there are many aspects that must be considered in the selection of a production site. The multitude and variety of factors which must be taken into consideration, together with the numerous options to choose from, the long planning horizon and the high degree of uncertainty associated with the selection of a production site, result in a highly complex selection process. In turn, the inherent complexity combined with the significant consequences of the decision for the OEM are accompanied by rather severe time and resource constraints, so that the production site selection process is both of outstanding importance for the OEM and very challenging in nature.

Despite the high degree of complexity of the selection and the inherent risk of failure, OEMs will continue to locate production sites globally in the face of a highly competitive automotive industry, rising customer demands and increasingly hindersome trade barriers. Moreover, producing in or close to large markets, gaining access to crucial know-how, technology and raw materials, as well as reducing production costs and raising productivity, constitute ongoing challenges to OEMs (see Balderjahn, 2014, 43-44; Mariel and Minner, 2015, 687). Accordingly, OEMs will continue to shape their global production network as a prerequisite for sustained competitiveness and thus they will have to continue to select new production sites on a global scale.

To facilitate this highly complex and strategically very important selection of production sites for OEMs, the goal of this work is to develop a generic process model for selecting production sites on a global scale that OEMs can apply in practice.

1.2 Goal of this Work

Reviewing the relevant literature to develop a process model for selecting production sites for OEMs illustrates that no selection process model has yet been developed that firms and, in particular, OEMs can apply in practice to select the most appropriate production site for their specific production activity. This is the existing gap in the literature, which this work addresses. While existing selection process models highlight many relevant aspects for developing a process model for selecting a production site, they are not detailed enough, do not include all necessary aspects for their application (e.g., instructions on evaluating location factors) or neglect strategic considerations. The academic contribution of this work is to develop a generic process model which OEMs can apply in practice to select the most appropriate production site for their specific production activity. Therefore, this work combines two academic approaches: it will analyze and combine existing relevant sources in the literature, and it will utilize an application-oriented approach[2] as it develops a process model, which is applicable in practice for OEMs' strategically important selection of a production site.

Thus, to close the identified gap in the academic literature this work develops a generic process model with which OEMs can select the most appropriate production site for their specific production activity in practice. This selection process model is constructed so that it can be applied by each OEM[3] to select a production site for any kind of production activity. With this aim in mind, the selection process model provides sufficient flexibility to be adjusted to the needs of each OEM

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[2] The application-oriented approach of this selection process model does not imply that theoretical models are not applicable in practice, as the goal of a theoretical model is also to be applicable in practice. Instead, the application-oriented approach of this selection process model implies the focus that is set on its efficiency and its ability to prove itself in its development. More specifically, the ability to prove itself means that the model can make a significant contribution to improve a certain process or task in practice, in this case the selection of a production site, while efficiency means that the model helps the process be implemented or task be fulfilled more efficiently in practice, hence with adequate effort in terms of time and costs. Instead, a theoretical model aims first and foremost at (forecast) accuracy. Thus, in the tradeoff between efficiency and the ability to prove itself on one hand, and (forecast) accuracy on the other, the primary goal of a theoretical model is (forecast) accuracy, and the ability to prove itself and efficiency are, rather, secondary goals. Hence a theoretical model foregoes any unit of efficiency for an extra unit of accuracy, while a model with an application-oriented approach forgoes (forecast) accuracy for efficiency and the ability to prove itself to a certain acceptable degree (see Berner, 2017).

[3] The selection process model is developed to satisfy the extremely complex production site selection of OEMs. This complexity is especially driven by their complex products, production and production networks, and the resulting high requirements on numerous conditions at their production sites (e.g., availability of skills, transportation facilities or connectivity to the OEM's other production sites and suppliers). The selection process model can, of course, also be applied for less complex production site selections like, for instance, in the textile industry. Besides satisfying the high complexity of OEMs' production site selection, this selection process model also focuses on the requirements of OEMs in the discussion of relevant location factors in Chapter 4. Despite this focus, many of the discussed location factors in Chapter 4 are also relevant for the selection of production sites of firms in other industries.

and the specific production activity for which they are searching for a production site, while simultaneously being detailed enough to ensure the applicability of the selection process model for OEMs for their specific selection of a production site. The selection process model achieves this by providing, on the one hand, a generically defined procedure with a combination of detailed instructions for preparing the selection process and choosing, as well as evaluating, location factors and, on the other hand, by adding, as an integral part of the selection process model, a discussion of location factors, which are possibly relevant to selecting a production site for OEMs, with all necessary specifications for choosing and evaluating each location factor included therein.

This selection process model satisfies the complexity of the production site selection of an OEM and the strategic importance for the OEM of the long-term, sizeable investment associated with a new production site. The selection process model achieves this, as it is not only developed to ensure the isolated selection of an individual production site, but of a production site that is part of the global production network and supply chain of the OEM and that additionally advances its strategic goals. Hence, the selection process model applies a strategic and network perspective and takes aspects into account which are relevant to the design of the supply chain. Furthermore, the selection process model is developed on the premise that a purely quantitative model cannot realistically solve the complex selection of a production site of an OEM. Additionally, the selection process model is based on the assumptions that the realistic analysis of the conditions at potential production sites requires evaluating the change of these conditions over the planning horizon of the production site and that the future development of many of these conditions can only be assessed with uncertainty.

Moreover, in developing the selection process model it is assumed that macroeconomic location factors such as the exchange rate, gross domestic product, inflation, investment, productivity, or the wage level are important in determining the general environment in which the production site must be constructed and operated, but that they also have a direct effect on constructing and operating the production site. These macroeconomic location factors are not only particularly important for the successful construction and operation of the production site, but they are also especially complex. These complex macroeconomic location factors must be evaluated in the selection process by the project team, which usually consists of business experts who do not necessarily have an Economics background. For this reason, the discussion of location factors includes many macroeconomic location factors, with a special focus on their macroeconomic driving forces and their specific macroeconomic effects on constructing and operating a production site. This macroeconomic focus is an additional means for the selection process model to facilitate an OEM's selection of a production site.

In short, this work aims at making a significant academic contribution by developing a generic process model with which OEMs can select the most appropriate production site for their specific production activity in practice.

1.3 Structure of this Work

This work consists of an introduction (Chapter 1), three main chapters (Chapters 2-4) and a conclusion (Chapter 5). Chapter 1 introduces the strategic relevance of selecting production sites for OEMs, defines the goal of this work and lays out its structure.

In Chapter 2, key concepts for this work are defined and the relevant literature for developing a process model for selecting production sites is presented and analyzed. As the goal of this work is to develop a generic process model for selecting production sites, which is a specific kind of location, and the goal of location theory is to solve the firm's location problem, location theory is the most relevant theory for this work. First, the relevant parts of location theory are classified, and its various categories are introduced. This also includes other relevant fields of research, which have contributed to solving the firm's location problem and hence to location theory (e.g., Economic Geography, Regional Economics, International Business and New Economic Geography). After the classification of location theory, different categories of location theory are introduced and the empirical-realistic location determining theory and the location planning theory are discussed in more detail. Likewise, the selection process models developed in location planning theory are separated into those that are developed in the field of marketing, those that are designed to identify the most appropriate production site, and those that are designed to plan or optimize an entire production network. These selection process models are introduced, their applicability to the selection of a production site of OEMs is analyzed and relevant aspects for developing a process model for selecting production sites for OEMs are identified. Moreover, this chapter also considers relevant contributions from the literature on supply chain design to develop a process model for selecting production sites. The overview of the relevant literature ends with an introduction and discussion of the theory on location factors, which is part of location theory.

In Chapter 3, the process model for selecting a production site for OEMs is developed and laid out in three parts: first, the framework in which the selection process takes place in an OEM is described and the necessary preparation for a successful application of the selection process is determined. Second, the properties of the selection process model, which are required to be met for the successful selection of a production site, are defined, and necessary instructions for choosing location factors (from the discussion thereof in Chapter 4) and subsequently evaluating them are provided. Third, the procedure of the selection process model is laid out and the tasks and characteristics of each phase of the procedure are specified on a generic level.

Chapter 4 provides a discussion of location factors, which are possibly relevant for OEMs when selecting a production site. This discussion contains a description of each location factor and, if relevant, a macroeconomic analysis of each, as well as an explanation of their relevance for constructing and operating a production site, additional information for choosing relevant location factors, and information and instructions on evaluating them in the selection process model (laid out in Chapter 3). The location factors included in Chapter 4 are categorized into 14 topics: *Regulations and Policies*, *Political and Legal Framework*, *Natural Hazards*, *Community*, *Economic Environment*, *Labor Market*, *Access to Raw Materials*, *Infrastructure*, *Production Network*, *Industrial Clusters*, *Market Size and Market Share*, *Production Site*, *Costs for Deploying Expatriates* and *Availability of Potential Partners for Strategic Alliances or Joint Ventures*.

Chapter 5 concludes this work by reiterating how this work closes the identified gap in the literature and makes an academic contribution, as well as by illustrating how the developed selection process model satisfies the complexity and strategic relevance of the production site selection for OEMs. Moreover, limitations of the structure of the developed selection process model and a path for further research building on this work are pointed out.

2 Definitions and Literature Review

2.1 Definitions

Under Definitions, key concepts for this work are defined. These include Production and Production Network as the goal of this work is to develop a generic selection process model for a production site for OEMs and as OEMs produce in global production networks and individual production sites which must be selected as part of their production network to operate profitably. Moreover, the automotive industry and OEMs are briefly introduced. Additionally, what is considered a production site is defined and, further, the geographic dimension of its analysis, which is applied in this work, is discussed. Furthermore, what is considered a selection process, and, in particular, a selection process model, is shortly discussed.

Production

The goal of this work is to develop a generic process model for selecting production sites for OEMs. Hence, from a functional perspective, the process model focuses on selecting sites for the business function of production. The narrow definition of production restricts it to the managed use of production factors, such as raw materials or intermediate goods or labor, to produce goods or services. Managing the use of production factors includes planning, organizing, controlling, and monitoring production, as well as selecting the means of production (see Bloech et al., 2014, 3). However, this narrow definition does not satisfy the comprehensive approach of the selection process model developed in this work. Instead, a broader concept of production in the literature is defined as any combination of production factors. This broader concept includes—in addition to manufacturing, procurement, transportation, and warehousing—everything else that happens in a firm related to production, thus including even sales, investment, and management (see Wöhe et al., 2020, 263-264). From a sector perspective, production occurs in the agricultural, industrial, and service sectors (see Bloech et al., 2014, 5). In this work, the term production is restricted to industrial firms' manufacturing of industrial products and excludes the production of services or agricultural products. In particular, as this work focuses on the selection of production sites for OEMs, the term production is limited to the production of industrial products, which OEMs produce, thus comprising both their components and final products. With regard to function, this work applies an inclusive concept of production to satisfy the complex selection process of production sites of OEMs, taking into account aspects related to all functions which are necessary for the successful construction and operation of a production site, such as procurement, logistics, distribution, supply chain management, research & development, sales, investment and management.

Production Network

OEMs not only operate individual production sites, but instead engage in global production networks into which individual production sites must be integrated to operate successfully. Shi and Gregory define the production network as 'a factory network with manufacturing connections, where each node (i.e. factory) affects the other nodes and hence cannot be managed in isolation' (Rudberg and Olhager, 2003, 30).[4] Production networks have received increasing attention: while production management in the past has only been responsible for organizing individual production sites independent of the firms' other production sites, the focus has shifted from a production site perspective towards concentrating on the position and role of individual production sites within a production network. The network itself has shifted into focus with network specific topics, such as 'strategic value added'. Overall, a shift in thinking occurred as the network came to be considered more than just the 'sum of its parts' (Rudberg and Olhager, 2003, 29). Nevertheless, in defining production networks, different concepts diverge over the question whether to include only the firm's own sites or also include units not owned by the firm, such as suppliers (see Friedli et al., 2013, 15-18).[5] Accordingly, Rudberg and Olhager differentiate between intra-firm networks and inter-firm networks depending on the number of organizations within the network. While the intra-firm network is a 'single-organization' network, the inter-firm network is a 'multi-organization' network (Rudberg and Olhager, 2003, 35).[6] According to Coe and Yeung the nature of production networks has recently gone through an organizational change from having been mostly intra-firm to being more inter-firm in their organization (see Coe and Yeung, 2015, 34). Moreover, they point

[4] Rudberg and Olhager provide this definition of a production network in reference to Shi and Gregory (1998).
[5] Production networks have mainly been studied from the supply chain or the operations management perspective. The supply chain perspective, due to its origin in the field of logistics, deals primarily with managing the flow of materials, but also incorporates external customers and suppliers into its analysis of production networks. In contrast, the operations management branch focuses on the organization of plants, of the network and of its coordination, narrowing its analysis merely to internal, such as fully firm-owned units, their function, capabilities, and design (see Friedli et al., 2013, 15-18).
[6] Rudberg and Olhager classify systems based on the number of organizations participating in the network and the number of sites of the participating organizations. If there is only one site and one organization, it is a plant (single-organization, single-site). If there are multiple organizations but only one site per organization, it is a supply chain (multiple-organization, single-site). If there is only one organization but multiple sites per organization, it is an intra-firm network (single-organization, multiple-site) and if there are multiple organizations and multiple sites per organization, it is an inter-firm network (multiple-organization, multiple-site). Hence, for a system to classify as a network it needs to have multiple sites per organization (Rudberg and Olhager, 2003, 35).

out that also extra-firm institutions, such as governments and so-called 'intermediaries'[7] (e.g., financial institutions), play an important role in production networks (extra-firm network) (see Coe and Yeung, 2015, 49-50).

Miltenburg analyzes production networks not with regard to actors but instead in terms of the geographic spread of their production sites. He differentiates networks with a national (domestic and domestic export networks), regional (international and multi-domestic networks), multinational (multinational or global networks) and global (global and transnational networks) spread of their production sites. For Miltenburg, firms with production sites that are distributed nationally or regionally have a 'simple network', while firms with multinationally or even globally distributed production sites have a 'complex network' (Miltenburg, 2009, 6185). Coe and Yeung combine these two perspectives, i.e., the participating actors and the geographic spread of production sites, defining production in the form of networks as the 'collective participation in value-adding activity by a variety of actors in different sectors, industries, and locations to create finished goods or services' (Coe and Yeung, 2015, 34).

This inclusive concept of a production network is used in this work: therefore, the production network of an OEM is considered complex (global and transnational), inter-firm and extra-firm (including governments and so-called 'intermediaries'). The use of such an inclusive concept of production network is especially important in the face of the complexity of the production of an OEM given the large number of required components and the extensively integrated value chain of the automotive industry. Hence, in this work, a production network includes all actors that are required to make the global production of an OEM successful (e.g., those who supply parts that are further used in the production process, make the operations at the production site possible, transport products to other places, or provide other kinds of logistics services).[8]

Automotive Industry and Original Equipment Manufacturers

The automotive industry includes producers of motor vehicles and engines, of trailers and superstructures but also producers of motor vehicle components and accessories (see Wallentowitz

[7] According to Coe and Yeung, 'intermediaries' bring different actors of the production network together, especially with regard to financing, logistics and the setting of standards, and are crucial for the functioning of production networks (see Coe and Yeung, 2015, 50-51).

[8] The concept of a production network and a global supply chain are very closely related and difficult to differentiate (for a discussion of the differentiation see Wiendahl and Lutz (2002, 474-475)). However, the discussion of the differentiation of the two concepts is beyond the scope of this work. In this work, the supply chain is considered as part of the production network.

et al., 2009, 1). More recently, some firms of the automotive industry have also produced electric vehicles. The final products of the automotive industry include cars, trucks, buses, vans, or trailers. These vehicles are also categorized as personal vehicles (PVs) or commercial vehicle (CVs). In contrast to the personal use of PVs, CVs include all vehicles used for the transport of goods or paying passengers. The automotive industry includes 'Original Equipment Manufacturers' (OEMs), suppliers, and logistics service providers. OEMs—such as Daimler, BMW, or VW, which are examples of German OEMs, and Ford or Hyundai, which are examples of U.S. or South Korean OEMs, produce and sell or rent vehicles. To produce these vehicles, OEMs use either components that they produce themselves or components that they source from suppliers (see Wallentowitz et al., 2009, 1). Suppliers are categorized according to their position in the supply chain: first-tier (or tier-1) suppliers produce complex systems or modules and supply these directly to OEMs; second-tier (or tier-2) suppliers produce components and supply these to first-tier suppliers; meanwhile, third-tier (or tier-3) suppliers produce simple components or process raw materials and supply these to second-tier suppliers (see Diez et al., 2016, 4-5; Bilbao-Ubillos and Camino-Beldarrain, 2008, 152; Wallentowitz et al., 2009, 2, 40; Gehr, 2007, 6). Logistics service providers are responsible for supply security, reliable delivery, and all interfaces in the production network thereby ensuring stable production processes in production networks (see Mantel and Stommel, 2007, 16-17).

The automotive industry is rather complex as it produces its final products in global production networks. OEMs and countless suppliers, as well as logistics service providers and many other actors, cooperate in said networks. OEMs only produce a relatively small part of the final product, while varied suppliers deliver components. What's more, the high degree of fragmentation and specialization of production processes in the industry's production networks at different locations across the globe has increased drastically in recent years (see Blyde and Molina, 2015, 319). This intensified the high interdependencies between the numerous actors collaborating in the production networks of the automotive industry. In addition, shorter product life cycles and increasing variation in products add to the production networks' complexity (see Kauder and Meyr, 2009, 507).

Despite serious recent problems, including the diesel scandal, the difficult transition to producing electric vehicles and the multiple unanswered technical, political and legal questions with regard to autonomous driving, the automotive industry has been a very expansionary industry if considered over a longer period of time: between 2005 and 2019 sales of total motor vehicles increased by 37.2% to 90.4 mn units. A more detailed view shows that PV sales rose by 40.4% and

CV sales by 30.1% to 63.7 mn and 26.7 mn, respectively. Given the sharp increase in global sales between 2005 and 2019, the number of globally produced motor vehicles (PVs and CVs) also increased significantly by 37.6% (see Table 1).[9] In 2020, both global sales and production decreased significantly during the coronavirus pandemic (see Table 1), but have since started to recover and are expected to continue this recovery (see Ferraris, 2021).

Table 1: Global Production and Sales of Motor Vehicles in the Automotive Industry (in mn and %)

		2005 (in mn)	2019 (in mn)	2019 vs 2005 (in %)	2020 (in mn)	2020 vs 2019 (in %)
Production	Total	66,7	91,8	37.6%	77,6	-15.4%
	PV	47,1	67,2	42.7%	55,8	-16.9%
	CV	19,7	24,6	25.2%	21,8	-11.6%
Sales	Total	65,9	90,4	37.2%	78,0	-13.8%
	PV	45,4	63,7	40,4%	53,6	-15.9%
	CV	20,5	26,7	30,1%	24,4	-8.7%

(Source: OICA, n.d.a; OICA, n.d.b; OICA, n.d.c; OICA, n.d.d; OICA, n.d.e)

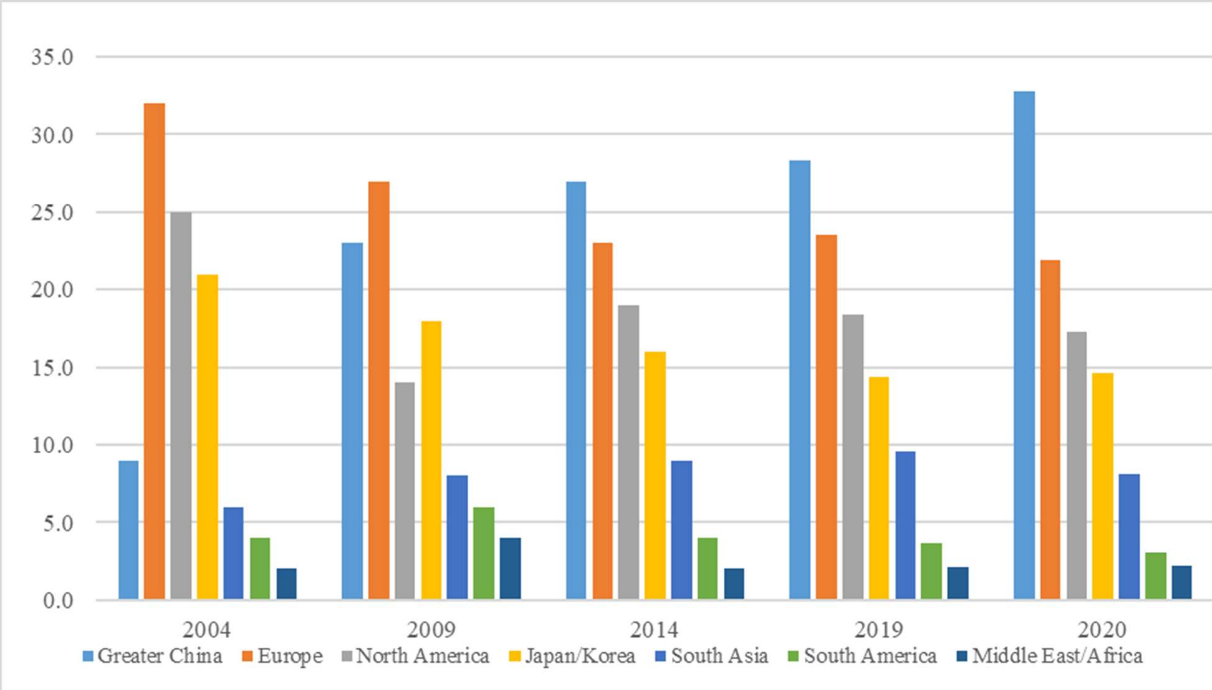
Besides the remarkable overall increase in global sales and production figures, OEMs also continue to internationalize their production; as a result, they continue increasing their production abroad. An example of this is the internationalization of the PV production of German OEMs: In 2010, German OEMs started to produce more PVs abroad than in Germany so that production abroad has more than doubled between 2009 and 2017. In 2017, two out of three PVs produced by German OEMs were produced abroad. In 2017 alone, German OEMs increased their production of PVs abroad by 7%, thereby raising their production of PVs abroad to 10.8 mn units (see VDA, n.d.a).

Figure 1 illustrates the geographic distribution of the global production of motor vehicles in 2004, 2009, 2014, 2019 and 2020. While in 2004 most motor vehicles were produced in Europe, followed by North America, in 2009 there was a shift, with most motor vehicles still being produced in Europe but followed instead by Greater China (China, Taiwan, Hong Kong and Macao). Then, in 2014 and 2019 most motor vehicles were produced in Greater China, followed by Europe and North America. During the coronavirus pandemic in 2020, production dropped only slightly (by 2.2%) in Greater China, while it fell significantly almost everywhere else (e.g., in Europe by

[9] Sales and production figures have been declining since 2018 and 2019, respectively.

21.5% and in North America by 20.5%) as compared to 2019. This development further raised the share of global production in Greater China (see ACEA, n.d.a; ACEA, n.d.b).

Figure 1: World Motor Vehicle Production (in %)



(Source: ACEA, n.d.a; ACEA, n.d.b)

Production Site

As the goal of this work is to develop a generic process model with which OEMs can select the most appropriate production site for their specific production activity, the term 'production site' as used in this work must be defined. For the purposes of this work, a production site is a location, at which the OEM produces or processes its products and to which the individual production is bound (see Kappler and Wegmann, 1985, 232). Hence, the production site is a clearly defined industrial location.

In the literature, the concept of location evolved over time. Von Thünen (1875) still considered location explicitly as agricultural, while, later, Launhardt (1882), Weber (1909 and 1922) and Lösch (1940 and 1941) focused on the industrial location (see Schöler, 2005, 23).[10] With regard to industrial location, location is a geographic place, or a 'certain place in space' (Schöler, 2005,

[10] More recently, the literature also considers the location of parts of the service sector, of public institutions, or of cities (see Schöler, 2005, 23).

23), where a firm produces or processes products. Originally, the concept of industrial location referred to the place of an entire firm[11] (see Kontny, 1999, 36; Behrens, 1971, 39; Rüschenpöhler, 1958, 27), but the concept has subsequently been extended to include not only the place where the entire firm is located, but also places where only individual parts of the firm (e.g., production sites) are located (see Behrens, 1971, 40). Another aspect regarding location is its geographic extension. Location can generally refer to a country, a region, a city, or a specific plot of land, to name a few, and therefore its geographic extension can vary significantly. Moreover, any kind of location must be considered as an 'open system', as locations are interdependent with their environment (Ottmann and Lifka, 2010, 26) or with locations of the same or other geographic extension. Hence, the conditions at a certain location are impacted by conditions at other locations. These other locations can be of the same geographic extension (e.g., the conditions in one country can be impacted by the conditions in another) or the conditions at a location can be impacted by the conditions at a location of a different geographic extension (e.g., the conditions in a country can impact the conditions at a certain production site *within* that country). Consequently, the analysis of a location cannot be an isolated analysis, rather the effects of locations with the same or other geographic extensions must be considered. In the case of a production site, the analysis cannot be an isolated local analysis. Instead, regional, national, or even supranational factors that impact the conditions at the production site must be taken into account.

In this work, the focus lies on industrial location. In particular, location is only considered as a site on which a production plant can be or is constructed and operated. This clearly defined industrial location is referred to as a production site. Hence, production site refers, in this work, to a clearly defined industrial location at which the OEM produces or processes its products and, in reference to Kappler and Wegmann, to which the individual production is bound. However, this production site is part of a region, country and possibly even of supranational unions, and thus the conditions at the production site are not only affected by local factors, but also by regional, national, and even supranational factors. Based on this understanding of location as a production site affected by local, regional, national, and supranational factors, the analysis applied in this work is a local

[11] Originally the term location referred not only to the location of an entire business but also to the specific 'in-house' location for employees, machinery, or production steps (Kontny, 1999, 36; see Behrens, 1971, 39; Rüschenpöhler, 1958, 27). As suggested by Kappler and Wegmann, the selection of in-house locations is ignored in the process model for selecting a production site developed in this work (see Kappler and Wegmann, 1985, 232-233).

analysis and factors that are considered at a supranational, national, or regional level are only considered with regard to their effect on the production site.

Selection Process Model

The production site selection is a decision of the OEM to construct and operate a production site at a certain location. In this selection, the OEM evaluates possible alternatives and analyzes the extent to which they advance the OEM's relevant strategic goals. For this evaluation and analysis to be successful, it must occur in a well-structured process, which must consist of subsequent phases or activities and be structured to accomplish a certain task. As in the case of firms, processes are a means to organize employees and other resources to accomplish clearly defined tasks. In this work, the task of the process is to select the most appropriate production site for any given OEM's specific production activity. Hence, it is a selection process. However, this work does not develop a specific process for selecting a production site for a specific production process, a specific product, and specific strategic goals. Instead, this work develops a generic selection process model, which details how to evaluate potential production sites ('alternatives') and eventually select the most appropriate option. A model is a schematic, generic and simplified portrayal of real, complex systems (see Adam, 1996, 88). As is characteristic for a model, this model portrays the real selection process in a schematic, generic and simplified way. This model is generic as it is only specified in terms of industry (automotive industry), kind of firm (OEM) and function (production). Thus, the generic selection process model requires specification for an application in practice (e.g., in terms of the production process, product or strategic goals ('target system')) (see Klein and Scholl, 2011, 31, 37- 39).[12]

2.2 Introduction to Location Theory

As the goal of this work is to develop a generic process model for selecting a production site, which is a specific kind of location, and the goal of location theory is to clarify the geographic

[12] In computer science, like in other sciences, a model is a simplified representation of a system, which is constructed to 'experiment on the model and use the results to understand and explain the behavior of the actual system'. In contrast to models in other sciences, e.g. physics, models in computer science – which are referred to as computational models or simulation models – are 'a set of mathematical equations and/or algorithmic procedures that capture the fundamental properties and behaviors of a system'; these models can be translated into a computer program (Schneider and Gersting, 2019, 639). Process models in computer sciences are normally software process models, which describe the procedure for developing a software-system in various phases (Hanser, 2010, 1; Herold et al., 2017, 547) and include the definition of individual activities, as well as the roles and necessary qualifications of employees who are responsible for the implementation thereof (Hanser, 2010, 1).

dimension of firms' activities, hence, to solve the firm's location problem, location theory is the relevant theory for this work. Location theory explains, in particular, where firms conduct their activities and thus deals with the question, 'who produces what goods and services in which location and why' (Lee and Wilhelm, 2010, 227). At the core of location theory is the so-called 'location problem' (Farahani and Hekmatfar, 2009, 1), which is defined as 'the modeling, formulation, and solution of a class of problems that can be best described as locating facilities in some given spaces' (Farahani and Hekmatfar, 2009, 1). The location problem includes a 'location decision' (Dubé et al., 2016, 144) or a 'location choice of firms' (Capello, 2019, 26), in which a firm 'selects the best possible place among a given set of choices and constraints' (Dubé et al., 2016, 144). Location theory focuses on the behavior of firms (see Lee and Wilhelm, 2010, 277-228) and thus exclusively considers the firm's location problem, or as da Silva puts it, 'economic agents are the elemental audience for these theories' (da Silva, 2004, 38). A special focus of location theory is location factors, hence on 'special factors' (Rogalska, 2020, 601) based on which firms determine where to locate their activities (see Rogalska, 2020, 601; Dziemianowicz et al., 2019, 1184). Besides investigating 'the location choices of firms', location theory also examines 'the spatial distribution of activities', especially with regard to externalities or agglomeration (Capello, 2019, 26). Hence, location theory can be normative as well as positive: it is normative, when attempting to determine the most appropriate location for a firm, and positive when attempting to explain why firms locate their activities at certain locations (see Schöler, 2005, 23) and not others (Dubé et al., 2016, 144).

Furthermore, location theory is traditionally part of the theory of Economic Geography (EG), as well as of the theory of Regional Economics (RE). Within EG and RE, location theory focuses on the behavior of firms; this is the main difference between location theory and other categories of these two fields of research (see Lee and Wilhelm, 2010, 227-228). Moreover, additional fields of research have contributed to solving the firms' location problem, and, hence, to location theory as well. These fields of research include International Business (IB) and the New Economic Geography (NEG). Representatives from the field of IB address the issue of which locations and for which reasons firms locate specific activities at particular locations. The NEG tries to end the 'marginalization' of location theory in economic theory (Krugman, 1998, 16).

Likewise, location theory consists of different categories, which have been distinguished based on their scientific objective (Autschbach, 1997, 125). Early authors, such as Meyer-Lindemann (1951) and Behrens (1960, 1961, 1971), introduce four categories of location theory. Location determining theory[13] examines how a new location can be determined. Meanwhile, location effect theory[14] analyzes how technical, economic, or social characteristics at pre-existing locations impact the operations therein. Location development theory[15] focuses on the historical development of the structure of locations. Finally, location organization theory[16] looks at the organization of geographic areas where firms locate their activities from an economic policy perspective (see Autschbach, 1997, 29). In later works (Timmermann (1972) and Küpper (1982)), location planning theory[17] emerged as an additional category of location theory, which analyzes the entire decision-making process of firms' location decision and searches for the best location planning model (see Autschbach, 1997, 133).

Of these categories, location determining theory and location planning theory are the most relevant theories to the firm's location problem, as they lay out the fundamental theory on how firm's select their locations (see Goette, 1994, 50). Furthermore, location determining theory and location planning theory are normative, as they both suggest models and approaches as instruments for firms to solve their location problem (see Swoboda and Schwarz, 2004, 262); other categories of location theory are positive. Thus, location determining theory and location planning theory are the most relevant theories to developing a process model for selecting a production site that OEMs can apply in practice, which is also a normative approach to the firm's location problem.

In more detail, the objective of location determining theory is to identify the most appropriate location for a firm by identifying location factors that are relevant to its decision-making process in its search and by developing models to evaluate these relevant location factors (see Goette, 1994, 51). In particular, the empirical-realistic location determining theory attempts to help firms solve their location problem by identifying relevant location factors, developing systematizations of location factors, and raising the awareness of the variety and complexity of location factors that firms should consider when making a location decision. Location planning theory attempts to analyze firms' entire location decision-making process by systematically examining the different phases of firms' selection process and formulating models that help them find the most appropriate location,

[13] Author's translation for Standortbestimmungslehre (see Autschbach, 1997, 133).
[14] Author's translation for Standortwirkungslehre (see Autschbach, 1997, 133).
[15] Author's translation for Standortentwicklungslehre (see Autschbach, 1997, 133).
[16] Author's translation for Standortgestaltungslehre (see Autschbach, 1997, 133).
[17] Author's translation for Standortplanungslehre (see Autschbach, 1997, 133).

hence, the location with the characteristics that best match the firm's requirements (see Friedli et al., 2013, 24; Autschbach, 1997, 133, 193).

In the location determining theory, a variety of models have been developed to solve the firm's location problem, though they only take cost-related quantitative aspects into account (see 2.4.1 Location Determining Theory). However, the firm's location problem is too complex to be solved by a purely quantitative model or approach. By 1972, Timmermann had already noticed that models developed to solve the firm's location problem which are exclusively mathematical (theoretical) are too abstract to provide an applicable process model for selecting firms' location (see Timmermann, 1972, 389). Likewise, Schmenner suggests that the attempt to 'simplify the decision-making' by evaluating only quantitative location factors cannot lead to a successful identification of the most appropriate location (Schmenner, 1979, 132). Despite today's possibility to use business and artificial intelligence, this work is written on the premise that a purely quantitative model cannot realistically solve the firm's location problem due to the great complexity and numerous qualitative aspects that must be considered in location selection, especially that of a production site.[18] Therefore, purely quantitative models to the location problem are not discussed. Instead, the focus is on non-purely quantitative approaches, which are analyzed in terms of their ability to reconcile the 'world of models' created by those representatives of location theory, whose primary means of solving the location problem is to minimize all related costs, with those answering the practical problem that firms face when selecting a location for their activities, and, in particular, their production (Ottmann and Lifka, 2010, 2). Hence, these non-purely quantitative approaches include the evaluation of qualitative, as well as quantitative, location factors and are developed to solve firms' location problem in practice.

The remainder of this chapter first briefly introduces how RE, EG, IB and NEG contributed to solving the location problem and those aspects they reveal to be relevant for developing a process model for selecting a production site. Second, both location determining and location planning theory are introduced with a focus on non-purely quantitative models, leaving all purely quantitative models out. For a thorough analysis of location planning theory, non-purely quantitative models to the firm's location problem are separated into three groups: first, process models which are developed in the field of marketing to identify the most attractive sales markets, second, process

[18] Of course, business intelligence and artificial intelligence should certainly be used for selecting a production site (e.g., to simulate and analyze various risk scenarios or analyze the multitude of available information and data).

models which are drafted to identify the most appropriate production sites, and third, process models which are designed to plan or optimize entire production networks. These process models are analyzed regarding steps, aspects, and ideas which are useful for developing a process model for selecting a production site. Third, the literature on supply chain design is introduced to highlight relevant aspects for developing a process model for selecting a production site. Finally, this chapter ends by introducing the theory on location factors, which is part of location theory. With regard to the literature on location factors, existing systematizations thereof are introduced, while different forms of location factors are differentiated, and it is explained how the relevance of some location factors depends on the industry, the firm, its strategy or the endeavor for which the location is being searched.

2.3 Classification of Location Theory

EG is the economic, and thus social science, branch of Geography. EG examines 'the places and spaces in which economic activities are carried out and circulate' (Barnes and Sheppard, 2018, 115). According to Krugman, EG considers 'the location of production in space' and deals with where economic activities occur 'in relation to one another' (Krugman, 1991, 1). Hence, EG focuses on the location of firms' activities, especially production, or the impact the locations of different activities have on each other or on other factors (see Krugman, 1991, 1-5), and on the underlying 'patterns' of their 'uneven spatial distribution' (Coe et al, 2020, 11, 13).[19] Economic Geographers examine the 'interactions of economic variables' which 'are responsible for the agglomeration of economic activities' (Brakman et al, 2020, 6). Economic Geographers have acknowledged the relevance of analyzing 'sub-national' levels (Nielsen et al., 2018, 190) given the 'sub-national spatial heterogeneity' (Coe, 2018, 157) and included regions, states, provinces, clusters, or cities in their analysis (see Nielsen et al., 2018, 190). The literature of EG differentiates the concepts of place, space, and scale, wherein place is understood as the 'physical and political location', space as the 'interaction between places', and scale refers to the 'size of agencies involved in interaction in space – local, regional, national and global.' Therefore, Economic Geographers focus on the spatial dimension of economics, thus recognizing the 'sub-national spatial heterogeneity' (Gammelgaard and McDonald, 2018, 297). Besides analyzing the distribution of economic

[19] A somewhat different definition of EG emphasizes the broadness of the field of research: 'an explanatory emphasis upon, the substantive implication of space, place, scale, landscape, and environment in […] "economic" processes' (Barnes and Christophers, 2018, 28).

activities and the underlying reasons, Economic Geographers seek to ‘mak[e] recommendations’ to governments and ‘the private sector … about particular geographical issues’ (MacKinnon and Cumbers, 2019, 15).

EG literature has analyzed, in great detail, issues related the distribution of economic activities in space. These issues include:

- global production networks (see Coe and Yeung, 2019; Faulconbridge, 2019; Curran et al., 2019, Coe, 2018; Baglioni, 2018; Coe and Yeung, 2015; Yeung, 2018b)
- agglomerations (see Rupasingha and Marré, 2020; Tanaka and Hashiguchi, 2020; Eriksson and Lengyel, 2019; Duranton and Kerr, 2018; Martin and Sunley, 2003)
- agglomeration and learning (see Peters, 2020), as well as agglomeration and infrastructure (see Ahlfeldt and Feddersen, 2018) and agglomeration and government policy (see Brülhart and Simpson, 2019)
- proximity and learning (Bode et al., 2020)
- clusters and economic development (see Behrens et al., 2020; Guo, et al., 2020)
- economic zones (see Frick et al., 2019)
- relationships between the firm and their regional environment (‘relational thinking’) (Murphy, 2018, 170; see Beugelsdijk, 2007)
- the effect of the rising use of the internet on the location of economic activities (see Leamer and Storper, 2014, 63-93)
- the concept of ‘spatial embeddedness’ or ‘territorial embeddedness’ (Bedreaga et al., 2018, 430), trade flows (see Jakubik and Stolzenburg, 2021)
- global value chains and economic development (see Zi, 2020; Whitfield et al., 2020; Van Assche, 2019)
- infrastructure and economic development (Gibbons and Wu, 2020), as well as infrastructure and worker mobility (Heuermann and Schmieder, 2019)
- skill and labor (see Peck, 2018; Florida and Mellander, 2018)
- consequences of BREXIT for corporation (see Fuller, 2021)
- immigration (see Iskander and Lowe, 2018)
- migration and productivity (Buchholz, 2021), as well as migration and the labor market (Braun et al. 2021)

- or regional income inequalities (see Marchand et al., 2020), just to name a few.

RE, which is a branch of economics, examines why certain spatial economic structures emerge, persist or change resulting in different intensities of economic activities (see Schöler, 2005, 1). Further, RE analyzes how and why economic activity is distributed 'over space.' Hence, RE looks at where economic activity takes place 'in relation to other economic activity', including aspects such as 'proximity, concentration, dispersion, and similarity or disparity of spatial patterns' (see Hoover and Giarratani, 2020, 12). In detail, RE explains why spatial development occurs unevenly (see Thisse, 2011, 141) and studies the 'differentiation and interrelationship of areas in a universe of unevenly distributed and imperfectly mobile resources' 'from the viewpoint of economics' (Dubey, 1964, 28). Regional Economists analyze how this uneven distribution of resources (e.g., raw materials, skilled labor, know-how) impacts the geographic distribution of economic activities, economic growth, and standards of living (see Capello, 2016, 1-3). As such, RE examines the 'spatial dimension' of economics, emphasizing that all 'economic activity arises, grows and develops in space' (Capello, 2016, 1). In order to include the aspect of 'space' into the analysis of how the market works and how firms and households make their decisions, Regional Economists develop models which include space in the explanation of price developments, supply and demand, output, development levels or income distribution (Capello, 2016, 1-3).[20] RE normally focuses on issues that are associated with 'larger spatial areas' (McCann, 2013, xxi), such as regions or provinces, and not with individual cities or specific spaces to locate an investment. In their comparison of economic development, Regional Economists analyze 'spatial parts of the same country or of groups of adjacent countries' (McCann, 2013, xxi) as a geographic unit of analysis. Regional Economists have studied the 'spatial dimension' of economics in a variety of aspects:

- regional specialization and trade (see McCann, 2013, 154-192)
- the effect of regional production factors (e.g., human capital) (see Faggian and McCann, 2009)

[20] RE examines, on the one hand, the 'economic logic' of 'location choices of firms and households' and 'the configuration for large territorial systems (e.g., city systems)' (Capello, 2016, 2) and, on the other hand, the reasons for differences in the level of development between different regions or cities. While the former is addressed by the location theory branch of RE (which is the early location theory), the latter is focused on by the regional growth (and development) theory (see Capello, 2016, 3). Moreover, other subtheories of RE include local development theories and local growth theories (see Capello, 2011, 5).

- human capital and regional development (see Faggian et al., 2019), as well as entrepreneurship and regional development (see Fischer and Nijkamp, 2019), infrastructure and regional development (see Bröcker et al., 2019), FDI, global value chains and regional development (see Resmini, 2019), R&D spillovers and regional development (see Denti, 2019), and knowledge and regional development (see Johansson and Karlsson, 2019)
- global cities and the clustering of firms and labor (see Beaverstock, 2002; Friedmann, 1986; Jacobs, 1984)
- agglomerations (see Combes and Gobillon, 2015), as well as agglomerations and innovation (see Carlino and Kerr, 2015), and agglomerations and regional growth (see Cohen et al., 2019; Baldwin and Martin, 2004)
- institutions and regional economic development (see Stough, 2019; Lakshmanan and Button, 2019)
- knowledge spillovers and innovation (see Audretsch and Aldridge, 2009; de Groot et al., 2009; Audretsch and Feldman, 2004)
- agglomeration and regional development (see McCann and van Oort, 2019), as well as agglomerations and clusters (see McCann, 2013), and clusters and regional development (see Koutit and Gordon, 2020)
- transport and communication services (see Hoover and Giarratani, 2020)
- productivity and regional development (see Azis, 2020)
- regional and interregional labor markets (see McCann, 2013, 193-233)
- static versus dynamic analysis of Regional Economics (see Störmann, 2009)
- the effect of infrastructure on regional development (see Bröcker and Rietveld, 2009), as well as the effect of knowledge on regional development (see Johansson and Karlsson, 2009), and institutions on regional development (see Azis, 2020; Lakshmanan and Button, 2009)
- regional growth (see Maier and Trippl, 2019; McCann, 2013), and policy and regional development (see Azis, 2020; McCann, 2013; Störmann, 2009; Eckey, 2008; Cremer and Pestieau, 2004)
- regional convergence or divergence (see Erthur and Le Gallo, 2009; Magrini, 2004)
- and special economic zones (see Friedrich and Nam, 2009) or patterns of urbanizations within regions (see Hoover and Giarratani, 2020, 12).

Closely related to RE is the field of research of Regional Science (RS), which also examines how economic activity is geographically distributed and which places a special focus on urban and regional economic development and the 'geographic dimensions of urban and regional economies, human settlements, and policies related to cities and regions' (Brakman, et al., n.d.). Hence, in terms of space, RS has an urban and regional focus in its analysis of economic activity. Aspects examined in RS include the effect of public employment on the local labor market, suggesting a crowding-in effect of public on private employment (Jofre-Monseny et al., 2020) or the positive effect of the concentration of skills on wages in the local labor market through externalities (see Ehrl, and Monasterio, 2020); other aspects are the effect of location on firms' ability to innovate and to benefit from their innovation (see Urban et al., 2018) or how location affects the expansion of start-ups, as start-ups in more urbanized regions are more likely to expand their businesses to foreign markets (see Bjuggren and Laufe, 2018), how geography has a significant impact on the effect of FDI spill-overs on productivity, and how agglomerations are significant for enhancing inter-industry and intra-industry spill-overs related to FDI (see Jordaan and Monastiriotis, 2018). Another important phenomenon for Regional Scientists is that agglomeration and urbanization attracts economic activity and, in particular, innovation (see Cornett, 2017). Moreover, they study how the convergence of labor productivity at different geographical levels depends on structural change and policies aiming at reallocating human capital and know-how to high-productivity sectors (see Naveed, 2017).

Representatives from the field of IB contributed to location theory by addressing the issue of which locations firms choose for their specific activities and for which reasons firms locate specific activities at specific locations (see Alcácer and Chung, 2007; Nachum and Wymbs, 2005; Porter, 2001). IB literature focuses on the behavior of firms and their organization, more recently focusing the behavior of multinational enterprises (MNEs). IB literature analyzes how firms are organized across different countries (see Cook and Pandit, 2018, 228, 230-231) and how firms disperse or concentrate their economic activity geographically (see Cantwell, 2009, 37). Notably, the most recent rise of interest in IB literature on location and firms' concentrated or dispersed economic activities is stimulated by the 'apparent paradox' between the decreasing importance of distance—for instance, due to progress in information and communication technologies—and overall decreases in transport costs (like in Friedman's 'Flat World') on the one hand, and on the other hand, the rising relevance of agglomeration and industrial clusters (e.g., for knowledge spillovers) (see Cantwell, 2014, 264). IB literature has, for the most part, remained on the national level in their analysis of location or considers location merely 'as "locations" in Cartesian space' not analyzing the subnational spaces (Coe, 2018, 157). Rather, IB studies have analyzed international trade zones or supranational regions (see Fuller, 2018, 218-119) (e.g., the EU, NAFTA, or South America). The conceptualization of location in IB literature remains on the national level and the literature itself considers spatial differences as the result of the distance between different countries in terms of their 'geographical, economic, political, institutional and cultural distance' (Gammelgaard and McDonald, 2018, 297). As such, IB literature analyzes the distance between countries on the macro-level, for instance, in terms of trade flows. Similarly, it addresses differences between locations on the micro-level, mainly using the concept of the liability of foreignness (see Beugelsdijk and Mudambi, 2014, 9). In IB literature, the eclectic OLI Paradigm (with its dimension ownership (O), location (L) and internationalization (I)) developed by Dunning (1977, 1979, 1988, 2001) has been the fundamental concept for considering location (see Fuller, 2018, 118). In the OLI Paradigm, location (L) is one driver of firms' internationalization in general (see Cook and Pandit, 2018, 230-231). While the IB literature has most recently also included the analysis of the subnational level, the bulk of its analysis remains on the state level (e.g., in the US) or on the province level (e.g., in China) and continues to neglect the micro-level heterogeneity of location (see Nielsen et al., 2018, 190-191). Hence, IB literature does not take into consideration that firms are choosing a 'specific place' when choosing locations for their investments (Goerzen et al., 2014, 139).

Representatives of IB literature have analyzed the 'spatial dimension' and how firms are organized across different countries with regard to a variety of aspects:

- geographic scope (see Asmussen, 2009; Goerzen and Beamish, 2003)
- expatriates (see Belderbos and Heijltjes, 2005)
- the effect of culture and transaction costs (see Makino and Neupert, 2000)
- social networks in international business (see Cuypers et al., 2020)
- entry mode (see Tihanyi et al., 2005)
- taxes (see Busso et al., 2013; Kolko et al., 2013; Rainey and McNamara, 2002)
- financial incentives (see Billings, 2009; Bondonio and Greenbaum, 2007; Hanson and Rohlin, 2011)
- minimum wage laws (see Mejean and Patureau, 2010)
- infrastructure (see Berechman et al., 2006; McCann and Shefer, 2004)

- logistics costs (see McCann, 1998)
- the regional nature of MNEs (see Rugman et al., 2016; Rugman, 2005 and 2009), as well as the regional and global scope and strategies of MNEs (Rosa et al., 2020; Jeong and Siegel, 2020), the fact that foreign subsidiaries of MNEs work in a regional area and not on a global scale (see Nguyen and Rugman, 2015; Nguyen, 2014), regionalization of MNEs (see Rugman et al., 2011), the effect of regional integration of subsidiaries of MNEs on the creation of new competence versus the exploitation of existing competence (see Cantwell and Mudambi, 2005), political strategies and roles of MNEs (Witt, 2019), internationalization of R&D and innovation by MNEs (see Papanastassiou et al., 2020), and taxation and MNEs (see Foss et al., 2019; McGaughey and Raimondos, 2019)
- global value chains (see Fortanier et al., 2020; Kano et al., 2020)
- learning and foreign operation mode combinations and flexibility within value chain interdependencies (see Benito et al., 2019)
- the location and the related role of subsidies (see Meyer et al., 2011; Papanastassiou and Pearce, 2009; Buckley, 2009; Cantwell and Mudambi, 2005)
- the relevance of clusters and networks for subsidiaries (see Figueiredo, 2011; Yamin and Andersson, 2011), as well as foreign subsidiaries and internal capital markets (see Fisch and Schmeisser, 2020), foreign subsidiaries and corporate social responsibility (see Zhou and Wang, 2020) or foreign subsidiaries and global tax systems (see Kohlhase and Pierk, 2020).

NEG also contributed to location theory with the goal of ending its 'marginalization' in economic theory (Krugman, 1998, 16). In short, NEG 'combines elements from international economics, industrial organization, economic geography, spatial and urban economics, and endogenous growth' (Brakman and van Marrewijk, 2018, 38), and explains 'the formation of a large variety of economic agglomeration (or concentration) in geographic space (Fujita and Krugman, 2004, 140), and hence, 'how very large scale spatial imbalances may arise as a result of the process of increasing economic integration' (Gaspar, 2021, 46). Krugman, as one of the main representatives of NEG, explains that, from a theoretical point of view, one main contribution of NEG to location theory is that location theory traditionally deals with partial equilibrium models, but NEG formulates general equilibrium models, 'in which spatial structure emerges from invisible-hand processes' (Krugman, 1998, 9). While prices are considered as exogenously given in traditional location theory, they are considered endogenous in some subsequent models thereof. Geographic aspects, such as the location of demand or of input factors, are still taken as exogenous variables in models of location theory. In contrast, in the general equilibrium models of NEG, the 'geographic distributions of population, demand, and supply are endogenous'. Thus, general equilibrium models capture the reciprocal relationship between individual agents and geographic distributions in the location decision (Krugman, 1998, 9). Based on this analysis, Krugman developed the core-periphery model, a general equilibrium model, to explain how 'increasing returns at the level of the firm, transport costs and factor mobility can cause spatial economic structures to emerge and change' (Fujita and Krugman, 2004, 145). The model captures how increasing returns to scale, on the one hand, and factor mobility, on the other hand, drive the agglomeration of economic activity and lead to the rise of core regions and peripheries, and hence, to 'uneven spatial development across different regions and countries' (Gaspar, 2021, 46).

Another theoretical shortcoming of location theory that had to be overcome from an economic perspective in order to successfully integrate it into economic theory is that many important concepts 'in location theory rely implicitly or explicitly on the assumption that there are [....] economies of scale enforcing', for instance, 'geographic concentration' and perfectly competitive markets. From an economic theory point of view, this assumption is not possible, as economies of scale can only arise in imperfectly competitive markets. NEG overcomes this theoretical shortcoming by explaining, 'the spatial structure of the economy using certain technical tricks to produce models in which there are increasing returns and markets are characterized by imperfect competition' (Krugman, 1998, 10).

Moreover, NEG examines 'the formation of a large variety of economic agglomeration (or concentration) in geographical space' (Fujita and Krugman, 2004, 140), 'patterns of economic agglomerations in space' (Donaghy, 2019, 63) and explains the formation of geographical agglomeration or concentration as a result of 'forces that tend to promote geographical concentration' ('centripetal [forces]') and forces 'that tend to oppose it' ('centrifugal forces'). Specially, market size effects and their linkages are considered to be the main centripetal forces, while immobile factors (e.g., natural resource deposits) are viewed as the main centrifugal forces (Krugman, 1998, 8). In their general equilibrium models, representatives of the NEG capture economic concepts—such as increasing returns to scale, imperfect competition, iceberg transport costs and external economies (see Krugman, 1998, 10-11)—to explain how the struggle between these centrifugal and centripetal forces leads to agglomeration. Like Economic Geographers, representatives from the NEG literature also recognize the 'sub-national spatial heterogeneity' (Coe, 2018, 157) and the importance of the spatial dimension in their economic analysis. They have analyzed a variety of issues related to location, such as the impact of trade on urban economics (see Krugman and Elizondo, 1996), the impact of market size on factor accumulation (see Baldwin and Forslid, 2000), the forward and backward linkages of concentration (see Fujita and Krugman, 1995) or externalities as a source of agglomerations—for instance, with regard to the provision of infrastructure, diffusion of knowledge (learning) and availability of suppliers, as well as the possibility of specialization and pooling of labor (see Farhauer and Kröll, 2014, 58-104), agglomeration (see Commendatore et al., 2017), demographics and economic integration (Goto and Minamimura. 2019), transportation costs affecting migration and regional labor markets (see Brandsma et al., 2014), the effect of absolute advantage and comparative advantage on the geographic distribution of economic activities (Commendatore et al., 2018), or the effect of the geographic distribution of economic activity on the use of natural resources (see González-Val and Fernando, 2019).

The fact that these four fields of research—EG, RE, IB and NEG—have contributed to location theory illustrates that the location problem lies between these fields of research and cannot be solved by merely taking aspects from one field into consideration. EG and RE deal with why economic activity takes place at certain locations, as well as the reasons for and impact of the interaction between locations. EG approaches these questions from a geographic starting point, namely focusing on why certain locations attract certain economic activities, while RE starts from an economic perspective by asking why certain economic activities take place at certain locations. Thus, EG approaches economic activity from the perspective of location, while RE approaches location from the perspective of economic activities. Instead, IB literature focuses on the geographical distribution of firm's activities and their cross-national organization. NEG attempts to develop theoretical approaches for location theory to be compatible with economic theory.

Mudambi points out that, notwithstanding intensifying research on location theory in the field of IB, as well as those of EG, RE and NEG, there is a paucity of authors who draw on all four fields of research to combine the business-related aspects with a location and an economic perspective when analyzing firms' location problem (Mudambi, 2008, 701). Recently, there has been an increasing number of authors who draw on EG literature and IB literature in order to combine the business-related aspects with a location perspective, when analyzing firms' location problem. Aspects of EG and IB literature have been brought together by Yeung, who introduces a 'relational economic-geographical perspective' into the discussion of spatiality in IB literature (Yeung, 2018a, 183-185) suggesting firms adopt a 'spatial strategy' (Yeung, 2018a, 186). Moreover, Fuller combined the knowledge on MNEs' organization (from IB) with that of how production networks are organized geographically in national and subnational spaces (from EG) (see Fuller, 2018, 221-223). Beugelsdijk and Mudambi developed the idea to 'unpackage' the L in the OLI paradigm into spaces that allow for heterogeneity on the sub-national level (Beugelsdijk and Mudambi, 2014, 9). Furthermore, Goerzen et al. addressed how microeconomic advantages provided by agglomeration can offset the disadvantages due to the liability of foreignness for MNEs (see Goerzen et al., 2014, 166) while Gugler analyzed the competitiveness of locations from both an EG and IB perspective (see Gugler, 2018, 442-449). Still, there remains much room for further studies drawing from all or some of the discussed fields of research.

This brief classification of location theory illustrates that the firm's location problem (and the problem of selecting a production site in particular) can only be solved by taking aspects from all four fields - EG, RE, IB and NEG - into consideration, as the problem lies between these fields of research. For developing a process model for selecting a production site, all four fields of research reveal interesting aspects in their contribution to location theory. The geographic perspective of EG and the economic perspective of RE emphasize that a production site must be analyzed in terms of its geographic position and its connection with other production sites, clusters, natural resource deposits or transportation facilities from both a geographic and an economic perspective, respectively. Furthermore, IB literature reveals that business-related aspects of locations, thus those directly impacting the firm's operation—such as labor costs, availability of skill or functioning infrastructure, as well as the geographic organization and structure of the firm —must play a major role in selecting a production site. Moreover, representatives of NEG discussed aspects of location theory which are important to understand when developing a process model for selecting a production site: first, economies of scale, which lead to a geographic concentration of economic activities, mainly production, are one reason for the internationalization of production. Scale effects especially matter in terms of the availability of infrastructure and in negotiations with suppliers who are trying themselves to take advantage of scale effects in their production. Second, imperfectly competitive markets; the assumption that markets are not perfect is realistic and, as mentioned above, a necessary condition for the existence of scale effects. Imperfectly competitive markets are relevant when selecting production sites as they pertain to the sourcing of components and raw materials. Markets for both raw materials and components are often characterized by few firms and high fixed costs, while the degree of concentration in those sectors is considerably lower in some emerging countries than in those more advanced (see 4.8.2 Access to General Raw Materials). The degree of competitiveness of sales markets is also interesting, if, as for instance in China, local competitors are strongly subsidized and can offer their products at lower prices or can run deficits without consequences, the markets are not perfectly competitive. Third, external effects are at the source of the emergence of clusters, which are an important location factor and relevant to the quality of local suppliers, infrastructure, supply chain and the availability of skills. Besides these important aspects, this brief classification of location theory also reveals that the different fields of research have different concepts of space, and hence, different geographic units of analysis. This is important for developing a process model for selecting a production site as the goal of the selection process is to identify the most appropriate production site, which is an individual location; however, the analysis of potential production sites requires taking aspects from the local, regional, national, as well as supranational, level into account

2.4 Categories of Location Theory

2.4.1 Location Determining Theory

The objective of location determining theory is to identify the most appropriate production site for a firm by identifying location factors that are relevant to the firm's decision-making process in its search for locations and by developing models to evaluate these relevant location factors (see Goette, 1994, 51). Autschbach further differentiates location determining theory into three subcategories depending on the direction of their research: the pure (exact) location determining theory, the empirical-realistic location determining theory, and the geometric location determining theory (see Autschbach, 1997, 126-127). These theories are briefly introduced to explain that the empirical-realistic location determining theory is the most relevant to developing a process model for selecting a production site, as it establishes the importance of location factors for the selection process and emphasizes the large variety of possibly relevant location factors for firms selecting a location.

The pure (exact) location determining theory originated in the quantitative analysis of von

Thünen (1875) and Weber (1909 and 1922).[21] Von Thünen assumes in his book *Der isolierte Staat in Beziehung auf Landwirtschaft und Nationalökonomie* ('The Isolated State in Relation to Agriculture and Economics') from 1875 that the land use around a city with a market is determined by the access to that market or the distance from it. Von Thünen's analysis focuses on agricultural production (see Schöler, 2005, 23). In 1909, Weber developed in his book, *Über den Standort der Industrien* ('Theory of the Location of Industries'), a theory according to which the optimal production site can be found with the help of a triangle model based on the location of markets and sources of the two main resources needed to produce the finished good[22] (see Weber, 1922, 54; Farhauer and Kröll, 2014, 21-23). Weber's model remains static and closed and considers only a few cost-related quantitative location factors (see Kinkel and Zanker, 2007, 152). This quantitative approach has been further developed into the Steiner-Weber model, which aims to identify the location with the lowest costs for a production site[23] given the locations of sources of materials and destinations for sales[24] (see Fischer, 1997, 62). The pure (exact) location determining theory, in general, and Weber's approach, in particular, have been criticized for their one-dimensional analysis of cost-related aspects, mainly of transport costs, and their omission of other quantitative location factors, not to mention the complete omission of qualitative location factors (see Autschbach, 1997, 128; Goette, 1994, 53-54). As the pure (exact) location determining theory does not allow for the inclusion of multiple location factors and of no qualitative location factors in the analysis of locations, the determination of a location remains exclusively the 'result of a firm-specific combination of minimal costs' (Schöler, 2005, 47). Since this by no means satisfies the requirements of a process model for selecting the most appropriate production site, these approaches are not taken into further consideration.

The objective of (mathematical) geometric location determining theory is to formulate (mathematical) geometric models to determine a location. To exclude all subjective influences from the decision-making process, the representatives of this approach reduce their models as to only analyze quantitative, or at least quantifiable, location factors in their models, which can be

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[21] In 1922, Weber published a second edition of his book *Über den Standort der Industrien*, which he originally published in 1909.

[22] Weber's goal was to first determine the location with the lowest costs in terms of transport costs for raw materials and finished goods and, subsequently, to determine the location with the lowest labor costs (see Weber, 1922, 40-120).

[23] In addition to a production site, the Steiner-Weber model also analyzes a location for a distribution center (see Fischer, 1997, 62).

[24] The Steiner-Weber model minimizes 'the weighted distances' between the production location, the destination of products (sales markets), and the sources of required raw materials (Fischer, 1997, 62).

evaluated through mathematical operations[25] (see Autschbach, 1997, 132; Goette, 1994, 61-62). Autschbach and Goette explain that, in the 1960s and 1970s, the geographic (mathematical) analysis of the location problem had become the main focus of location theory. While this mathematical analysis was initially purely one-dimensional, as it considered only one location factor, most often transport costs, it was later expanded, as more complex models were developed. These more complex models borrowed concepts from other sciences (e.g., operations research or statistics) and included multiple location factors.[26] In this tradition of (mathematical) geometric determining location theory there exists an extensive body of literature focusing on the firm's positioning in a 'heterogeneous space' (Mai and Shieh, 1984, 225; see also Isard, 1956; Moses, 1958; Saskashita, 1967; Bradfield, 1971; Woodward, 1972; Marthur, 1979 and 1982).

Both the pure (exact) location determining theory and the (mathematical) geometric location determining theory build the basis for the more recent field of research, Location Science, which formulates 'facility location problems' to find 'the "best" location for one or several facilities' under certain 'constraints' and 'optimality criteria' (Laporte et al., 2015, 1). Location Science has been developed for particular use in the field of 'computers and operational research methods' (Church and Murray, 2018, 5) and applies various 'modeling frameworks' and 'solution techniques' (Laporte et al., 2015, 2). Even though these qualitative models[27] take a variety of

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[25] This geometric approach, which is based on Hotelling (1929), analyzes the location problem in a linear location space (see d'Aspremont et al., 1979; Gabszewicz and Thisse, 1992; Osborne and Pitchik, 1987).

[26] The more complex models, which include multiple location factors, are separated in spatial-continuous and spatial-discontinuous models. In spatial-continuous models, all places are potential locations, and the optimal location is determined by mathematical operations, such as infinitesimal calculus, while in spatial-discontinuous models potential places for locations are limited and the optimal location is to be found through mathematical optimization (see Autschbach, 1997, 132; Goette, 1994, 61-62).

[27] In analyzing the facility location, the Simple Plant Location Problem is considered one of the basic models for locating facilities to minimize costs. In this model, costs are either fixed costs from building the facility or transport costs arising from the distribution of products from the facility to the consumers. This model assumes no capacity constraint. The model captures the 'trade-off between fixed production costs and transportation costs' (Fujita and Thisse, 2002, 50). (For the so-called single location problem, see Moradi and Bidkhori (2009); for the so-called multi-facility location problem, see Daneshz and Shoeleh (2009).) The single-location problem has also been analyzed by Thisse and Perreur, who consider a firm which produces several products and uses several input factors. They formulate the relation between the possible best location for a production site by minimizing transport costs and maximizing profits (see Thisse and Perreur, 1977). Hurter and Martinich developed deterministic and stochastic location models for the identification of production sites. These production-location models were formulated as models on a line, and networks on a plane. They adjusted these models so that they depict the effect of policy regulations, incentives, or taxes on the location (see Hurter and Martinich, 1989). Like Hurter and Martinich, a number of authors (e.g., Peeters and Thisse, 2000; Stolletz and Stolletz, 2008) have analyzed, revisited and tested the so-called production-location problem and reformulated it as the 'p-Median Problem and Generalizations' (Mirchandani, 1990), continuous p-median problem (see Brimberg and Salhi, 2019), the p-Center Problems (see Salhi and Brimberg, 2019; Handler, 1990), continuous location problems (see Wesolowsky, 2019), integer location problems (see Schöbel, 2019), the 'Location with Spatial Interactions: Competitive Locations and Games' (Hakimi, 1990), the 'planar single- and multiple-location

factors into account to solve the location problem, they still fail to capture its complexity and are based on the false assumption that all factors, as well as all interdependencies with other locations which are relevant to the firm's location problem, can be quantified.

The third subtheory of location determining theory is the empirical-realistic theory, which focuses on analyzing the microeconomic, or firm-related, location decision from a systematic

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problem' and the 'ordered median problem' that can be applied to continuous, network and discrete location problems (Nickel and Puerto, 2005). Other models include a discrete facility model which takes competition and risk into account (see Zhang et al., 2016), or competitive facility problems and gravity models (see Drezner, 2019). Other techniques include mixed integer programming models (e.g. Gendron et al., 2017; Correia and Melo, 2017; Wei et al., 2019; Drezner et al., 2016, Pochet and Wolsey, 2006; Canel and Khumawala, 1996; Haug, 1985 and 1992; Cohen and Lee, 1989), mean variance models (e.g., Hanink, 1985; Hodder and Jucker, 1985; Hodder and Dincer, 1986) and models using multiobjective methods (see Karatas, 2017; Hajidimitriou and Georgiou, 2000; Schniederjans and Hoffman, 1992; Min and Melachrinoudis, 1996) (see Hajidimitriou and Georgiou, 2000, 88). Bhutta et al. extend previously existing mixed integer linear models on location decisions taken by multinational corporations by including exogenous variables like exchange rates and tariff rates, and by taking aspects of production, distribution, investment (see Bhutta et al., 2003), risk (see Buckley et al., 2018) or inventory and product design (see Hadjinicola and Kumar, 2002) into account. Moreover, several models have been developed to formulate issues related to the configuration of facilities. These models are based on mathematical modeling techniques, such as break-even analysis, the maximization and optimization models (see Correia et al, 2018; Boonmee at al., 2017; Ortiz-Astorquiza et al., 2015), discrete choice models based on a random utility maximization framework (see Dubé et al., 2016), a single minisum location problem (see Plastria, 2020), a dynamic lagrangien heuristic (see Carvalho and Nescimento, 2018) or a kernel search (see Carvalho and Nescimento, 2016). Some models incorporate a multi-period analysis in their formulation of the location problem (see Wei et al., 2019; Correia et al, 2018; Marković et al., 2017; Correia and Melo, 2017; Marufuzzaman et al., 2016; Albareda-Sambola et al., 2013; Syam, 2000). Other authors formulated mathematical models that focus on specific aspects, such as locations with regard to hubs (Tiwari et al. 2021; Correia et al., 2018; Alinaghian et al., 2017; Farahani et al., 2013; Campbell et al., 2002; Hekmatfar and Pishvaee, 2009), locations as part of a supply chain (Alizadeh, 2009), externalities (Brandeau et al.,1995), competition (see Tiwari et al. 2021; Maia and Lodi, 2020; Arbib et al., 2020; Ahmadi and Ghezavati, 2020; Fernández et al., 2017; Wang and Chen, 2017; Drezner et al., 2015; Karimifar et al., 2009; Drezner, 1995; Peeters and Thisse, 1995), the role of consumers (Drezner and Eiselt, 2002) or the effect of interest rates and corporate taxes on the profitability of a location (see Ishikawa, 2016, 78-81). Further models also take network aspects into consideration as they are formulated for single-plant network problems and for multi-plant network problems (see Fushimi et al., 2020; Xin and Wang, 2019; Kung and Liao, 2018; Toroa et al., 2017; Hurter and Martinich, 1989; van Roy, 1986). Chan provides, in his chapter on 'Facility-location models', a summary of quantitative methods that have been developed to solve firms' location problem (Chan, 2005). Hübner also provides a literature overview on quantitative location analysis in the third and fourth chapters of his book *Strategic Supply Chain Management in Process Industries: An Application to Specialty Chemicals Production Network Design* (see Hübner, 2007, 89-147). Hübner draws, e.g., on Krarup and Pruzan (1990), Plastria (2002), Bauer and Domschke (1993), Gosh and Harche (1993) or Current et al. (1990), and refers the reader to literature reviews on classical location theory, such as those by ReVelle and Eiselt (2005) and Hale and Moberg (2003) (see Hübner, 2007, 53). A literature overview on quantitative supply network optimization is provided by Hübner (see Hübner, 2007, 53-54), who refers the reader to existing literature reviews on supply network organization models, such as the ones developed by Daskin et al. (2005), Melo et al. (2005), Bhutta (2004) and Goetschalckx et al. (2002). Numerous models based on quantitative methods have been developed to depict specific parts of production networks (see Hübner, 2007; Grunow et al., 2006; Fleischmann et al., 2006; Jacob, 2005; Wouda et al., 2002; Henrich, 2002; Papadopoulos et al., 2002; Arntzen et al., 1995). Some of these models focus their analysis on the production network of a specific industry or even company, such as the pharmaceutical industry (see Grunow et al., 2003), the electrical components industry (see Grunow et al., 2006), the Digital Equipment Corporation (see Arntzen et al., 1995) or BMW (see Fleischmann et al., 2006).

perspective with the goal of facilitating the firm's location problem. Rüschenpöhler (1958), Meyer (1960) and Behrens (1961) are the main representatives of this theory. Rüschenpöhler acknowledged that in order to solve the firm's location problem the firm's requirements on a location must be met by the conditions at the location. These conditions are reflected in location factors. Rüschenpöhler further points out that not only quantitative location factors but also qualitative location factors must be considered when assessing the match between the requirements, which the firm has on the location, and the conditions at the location, which are reflected in location factors. Thus, Rüschenpöhler goes beyond the purely cost-focused approach of the pure (exact) location determining theory as well as the purely quantitative approach of the (mathematical) geometric location determining theory (see Autschbach, 1997, 129-130; Goette, 1994, 54-55; Rüschenpöhler, 1958, 65-67). Meyer confirms Rüschenpöhler's idea that, in practice, firms not only consider cost-related factors in their location decisions but also non-cost-related factors, especially the potential market size (see Meyer, 1960, 70). Likewise, Behrens is convinced that only the analysis of both cost-related and non-cost-related factors (he refers to them as sales-related factors) can lead to a successful location decision. Therefore, his systematization of location factors developed to systematically analyze all location factors that are relevant to the firm's location decision includes cost-related, as well as sales-related location factors (see Behrens, 1971, 44).

This first comprehensive systematization of location factors illustrates the relevance that was given to location factors in the empirical-realistic location determining theory. Given their goal of facilitating solving the firm's location problem, for Behrens as well as for other representatives of the empirical-realistic location determining theory, it was important to evaluate, which location factors should be included in the analysis of locations. Consequently, they developed numerous systematizations of location factors (see Autschbach, 1997, 131; Goette, 1994, 57-59), thereby emphasizing the variety and complexity of location factors and the relevance of their systematization for solving the firm's location problem. (For location factors and their systematizations see 2.5.2 Content-related Systematizations of Location Factors.) The empirical-realistic location determining theory is the most relevant subtheory of location determining theory for developing a process model for selecting a production site for an OEM in practice: it facilitates solving the firm's location problem in general and aligning, in particular, the firm's requirements on the location with the conditions at potential locations by identifying relevant location factors, developing systematizations, and raising the awareness of the variety and complexity of location factors that firms should consider when making a location decision.

In summary, the pure (exact) location determining theory and the (mathematical) geometric location determining theory aim to formulate the firm's location problem in models, which are unable to capture the complexity of the problem firms face in practice when selecting a location in general or a production site in particular. Neither of these two theories allow for the consideration of qualitative location factors, which are crucially important for selecting a production site. The endeavor to formulate a model that captures and depicts all location factors that are relevant to the selection of a location, as well as all relevant interdependencies with other locations, and to distinctly determine the most appropriate location in such a model, is not realistic and does not solve the complex problem that firms face in practice. Instead, representatives of the empirical-realistic location determining theory address the variety of location factors, acknowledge their importance, and provide systematizations thereof to facilitate the solution of firms' location problem; however, none of them develop a process model that can be used for the successful selection of a production site in practice.

2.4.2 Location Planning Theory

2.4.2.1 Process Models Developed in the Field of Marketing

Several location selection process models have been developed in the field of marketing as the selection of promising foreign markets is among the most fundamental strategic decisions of international marketing management. In marketing, the goal of location selection is to identify the most attractive sales markets for the firm. Hence, in the marketing context, location refers to the entire market and not to a specific production site. Even though selection process models developed in the field of marketing focus on sales markets and have different features, such as market segmentation[28] or the form of market entry[29] which are not relevant to the selection process of a production site, other aspects which they consider are also important for the selection process of a

[28] To identify the most attractive markets, the market segments in these most attractive markets are analyzed. Market segments are combinations of product requirements and consumers with certain characteristics; thus, market segments consist of relatively homogeneous consumers with relatively homogeneous requirements on products and are significantly different from other market segments. International market segmentation can either be an intra-national market segmentation, meaning that the individual market segments are identified only for one country, or it can be an international market segmentation, meaning that cross-country consumer groups are identified (see Berndt et al., 2020, 145-150).

[29] The form of market entry (e.g., export or local production) is not necessarily predefined at the beginning of the selection process model of a sales market, but instead must be chosen during the selection process. Thus, some selection process models include, or at least consider, the decision about market entry forms.

production site. Thus, in this section, seven selection process models, that have been developed in the field of marketing are briefly introduced in order to point out what can be learned from these selection process models for developing a process model for selecting a production site: namely, the process models developed by Seidel (1977), Henzler (1979), Stahr (1982), Schneider and Müller (1989), Köhler and Hüttemann (1989), Backhaus and Voeth (2010) and Balderjahn (2014).[30]

Seidel developed a process model to identify the most promising sales market. He assumes that this promising sales market, once it is identified, will be served by exports or by local production depending on the firm's goals. Seidel's process model consists of three selection steps and results in the identification of the final market. For each of these three steps, Seidel defines a method of analysis (exclusion criteria, utility analysis and risk analysis), as well as the location factors, which must be analyzed. Seidel's approach contains several aspects that are relevant to the selection process of a production site. First, Seidel not only specifies the process model step-by-step, but also determines the location factors that must be taken into account at each step and explains the evaluation methods. Second, he raises awareness of the relevance of the motives of the search for a new location for the selection process. Third, he identifies four fundamental problems that the decision-makers face: the multi-dimensionality of goals regarding the location, the costs of information, and the need to consider quantitative, as well as qualitative, information and the uncertainty of this information (see Seidel, 1977, 122-169).

Henzler developed a model for selecting sales markets to be served through foreign direct investments. Henzler's process model also consists of three phases: the selection of country markets (phase one), the determination of a strategic procedure (phase two) and the development and adoption of strategic plans (phase three). The selection process model is developed under the realistic assumption that the availability of information is limited and that the time and resources firms allocate to selecting a sales market are constrained. In phase one, country markets are eliminated in three steps: first, defined negative criteria with regard to political and legal framework conditions that make an investment in a country unreasonable are evaluated with the help of checklists. Second, among the remaining candidates, those countries with a market size as measured in terms of population and per-capita income which is not promising are eliminated.

[30] Further selection process models in the field of marketing have been developed, e.g., by Kulhavy (1989), Meffert and Althans (1982), Douglas and Craig (1983), Berekoven (1985), Cavusgli (1984), Meissner (1988), Root (1994), Kumar et al. (1994), Hoffman (1997), Brewer (2001), Koch (2001), Bradley (2004), Andersen and Buvik (2002), Johansson (2003), Rahman (2003). See also Scharrer (2000, 101-113) and Swoboda and Schwarz (2004, 269) for overviews of process models developed in the field of marketing for selecting markets.

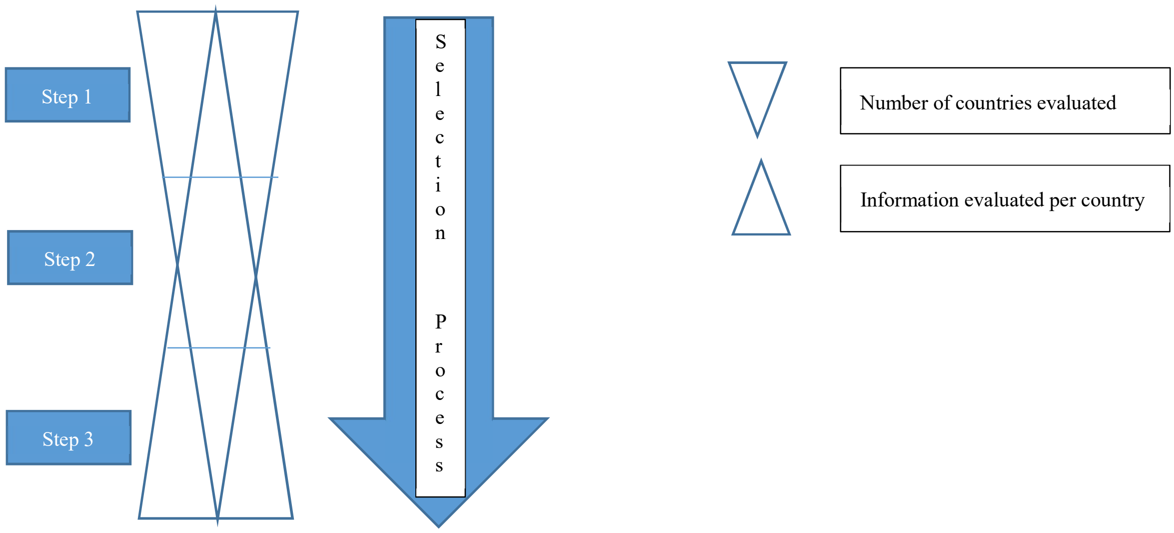
Third, the remaining countries are further analyzed with regard to the following five criteria, which must be further specified to firm-specific and product-specific requirements: availability of resources, future demand and economic strength, distribution of wealth, country-specific requirements on the technical level of products, and impact on other economic regions. Each country is assigned a score regarding each of these five criteria, which are then totaled per country using a score rating procedure into an index that reflects the total attractiveness of that country. The least attractive countries are eliminated at the end of this step. In phase two, the remaining countries are categorized depending on their economic development into prephase, boom and saturation countries and for each of these three categories a location strategy (including the market entry mode) is developed. In phase three, each of the remaining countries are assigned products and resources depending on their individual category and location strategy (see Henzler, 1979, 123-129). While the market (country) selection process is limited to phase one, as phases two and three consist of the market segmentation, choice of market entry mode or location strategy, there are several aspects about Henzler's approach which are interesting for developing a process model for selecting a production site. First, the time and resource constraints of firms limit the amount of information that can be analyzed. Second, he assigns the evaluation of certain location factors to the different steps of phase one. Third, he asserts that there are firm-specific or product-specific location factors, and fourth, he includes the economic development into the analysis of the countries, and thus acknowledges the need for the dynamic analysis of some location factors in the selection process.

Stahr formulates a process model to identify the most attractive market for exports. Similar to Henzler and Seidel, Stahr also developed a selection process model that consists of three phases. The three phases in Stahr's model are the preselection, the rough selection, and the main selection. In the preselection phase, all countries that do not meet certain exclusion criteria are eliminated. These exclusion criteria are defined as negative criteria that make a corporate endeavor in that country impossible, such as political instability, legal restrictions, or insufficient per-capita income. In the rough selection phase, the remaining countries are analyzed with regard to four categories of criteria (product-specific requirements in the market, sales potential, market dynamics and requirements of marketing policy) and the least attractive countries are eliminated. In the main selection phase, the remaining countries are evaluated using profitability analyses, like the break-even or the cash-flow analysis, and ordered according to their attractiveness as sales markets (see Stahr, 1982, 59-61). Stahr's selection process model is noteworthy in a couple of ways: dynamic aspects, as well as product-specific requirements, are incorporated in the evaluation of sales markets; also, he identifies evaluation methods for the three phases of his selection process model.

Schneider and Müller developed a process model to identify the most promising sales market regarding the long-term opportunities for the firm, including several forms of market entry. Schneider and Müller's process model is a database-driven approach also consisting of three selection steps. The first two steps constitute the rough selection, and the third step is the detailed selection. In the first step of the rough selection, countries which do not meet certain exclusion criteria (which Schneider and Müller refer to as 'must criteria' or 'restrictions') are eliminated. In the second step of the rough selection, the remaining countries are analyzed based on so-called 'A-criteria', which are strategy-specific (strategy-oriented) and reflect development trends of the world region and the country, as well as the strategic position of the country in connection with others. Furthermore, the remaining countries are evaluated based on so-called 'B-criteria', which are strategy-specific (strategic-oriented), as well as operation-oriented, and aim to assess the market size for the firm's product or service, such as market volume, import conditions or the competitive or risk environment. Both, 'A-criteria' and 'B-criteria' are evaluated for the remaining countries using scoring models and the profile method. In the third step, the detailed selection, follows a detailed analysis of the remaining countries using country portfolios of their attractiveness, relative competitive advantage, and country risks. Based on these portfolios, the remaining countries are then divided into core-markets, hope-markets, and periphery-markets. For these three kinds of markets, the possible market entry strategies are evaluated and, depending on this evaluation, the most attractive market is chosen (see Schneider and Müller, 1989, 17-55).

Overall, Schneider and Müller's selection process model is interesting in several ways for developing a process model for selecting a production site. The first element of interest is their differentiation between strategic and operational criteria, although they do not explain them in detail. Second is their application of country portfolios as a method of evaluation, and third, their awareness of the necessity to take the dynamic nature of the country into account. Lastly is their observation that local norms and regulations with regard to the product, as well as with regard to production processes, must be taken into consideration. Finally, especially noteworthy is Schneider and Müller's acknowledgment that, in the face of the time and resource constraints of firms, a systematic selection process must be structured so that during the selection process the number of evaluated countries decreases while the amount of information evaluated per country increases (see Schneider and Müller, 1989, 13). For an illustration see Figure 2.

Figure 2: Number of Countries and Information per Country Evaluated over the Course of the Selection Process



(Author illustration in reference to Schneider and Müller, 1989, 13)

Köhler and Hüttemann developed another process model for selecting a sales market. Their process model also consists of three steps: in the first step, countries are eliminated based on objective reasons, specific moral attitudes of the management, strategic considerations, or general standards. In the second step, the 'social, cultural, political and especially economic framework' are analyzed by dividing the analysis into economic, socio-cultural, legal-political, and natural-technical components. Among all possible variables which belong to these dimensions, 'key variables' are evaluated using 'country portfolios', to reduce the number of markets in the subsequent detailed analysis 'without excluding any promising markets' (Köhler and Hüttemann, 1989, 1434). These key variables should focus on business risks, market potential or growth, costs required for the business operation and product-specific market data. In the third step, or the final selection, possible forms of market entry and relevant market segments in the remaining 'attractive' markets are analyzed and the most fitting bundle of market segments and form of entry with regard to the firm's strategy is chosen (Köhler and Hüttemann, 1989, 1430-1436). With regard to developing a process model for selecting a production site, only steps 1 and 2 are of interest, while step 3 focuses on the market entry mode and market segmentation. Noteworthy in regard to Köhler and Hüttemann's selection process model, like Henzler's as well as Schneider and Müller's, is their awareness of the time and resource constraints of firms. It is also interesting that the selection process model starts with the consideration of certain predefined strategies, goals, guidelines, and requirements that are given by the firm's management, based upon which the world region is determined within which the sales market is subsequently selected. However, these considerations are not further detailed. Moreover, Köhler and Hüttemann acknowledge the significant risk for any kind of selection process posed by 'excluding any promising markets' (Köhler and Hüttemann, 1989, 1434), but they unfortunately do not delve further into this consideration.

More recently, Backhaus and Voeth have proposed a process model for selecting sales markets, also consisting of three steps, which starts with a strategic preselection, followed by a rough selection, and ends with a final detailed selection. Based on the firm's strategic orientation[31], the strategic preselection increases the efficiency of the selection process, as it reduces the number of countries which must be subsequently analyzed. According to Backhaus and Voeth the preselection depends on the internationalization strategy, which they refer to as the management's fundamental orientation to configure the international activities (ethnocentric, polycentric, or geocentric). Once the strategic preselection has identified attractive countries, these countries are evaluated in the rough selection based on aggregated, often qualitative criteria. The countries are categorized into core-markets, hope-markets, opportunity-markets, and abstinence-markets depending on their market attractiveness and market barriers. The market attractiveness is evaluated in terms of sales (e.g., market size, market growth, purchasing power), as well as costs (e.g., labor costs, working hours, sourcing conditions), while market barriers include economic, protectionist or behavioral barriers, as well as country risks. Backhaus and Voeth emphasize that the criteria for the market attractiveness and market barriers are firm-specific and product-specific. Furthermore, they point out that the attractiveness of markets cannot properly be evaluated in isolation, given interdependencies with other existing or new markets. Backhaus and Voeth refer to these interdependencies as feedback effects[32] and explain that there are demand-related, supply-related, as well as competition-related, feedback effects. In the last step, the detailed analysis, the most attractive markets are further analyzed using a business plan to identify the single most

[31] The strategy orientation of the firms in this regard is mainly determined by the firm's internationalization strategy, which refers to the fundamental orientation of the firm's management regarding the conduct of its international activities. Backhaus and Voeth differentiate between an ethnocentric, polycentric, and geocentric strategic orientation (see Backhaus and Voeth, 2010, 67).

[32] Feedback effects include all effects that the market selection has on the domestic market, as well as on all other markets, in which the firm is active. The intensity of feedback effects, as well as the need for coordination, depends on the number of countries already served and on the number of markets that are planned to be accessed (see Backhaus and Voeth, 2010, 63-66).

attractive market. The business plan consists of a market and competition analysis, an assessment of opportunities and risks, financial planning in the form of capital budgeting, as well as simulation and sensitivity analysis (all applied with the goal of answering the basic question: 'Is it worth it?') (Backhaus and Voeth, 2010, 63-94).

There are several interesting aspects of Backhaus and Voeth's approach for developing a process model for selecting a production site. First, they suggest that the selection process starts with a consideration of the firm's strategy and goals to confine the selection to a certain world region. Second, the consideration of the time and resource constraints is realistic and makes the rough selection of countries and their categorization into core-markets, hope-markets, opportunity-markets, and abstinence-markets interesting, even though the link between the categorization and the elimination of countries between the rough selection and the detailed selection is not clear. Third, they suggest three steps, for which they provide general methods (e.g., business plan). Fourth, they consider feedback effects between the new market and other markets. Fifth, they provide a helpful list of possibly relevant location factors that can be evaluated in the rough selection and detailed selection, and sixth, they emphasize the importance of a sensitivity analysis or simulation to take dynamic aspects into account.

Balderjahn developed a further process model to determine the most attractive sales market. Unlike the previous models discussed thus far, Balderjahn differentiates between four phases instead of three: the determination of the problem and requirements on the location, the search for the location, the evaluation and selection of locations, and the final location decision and implementation. The selection of production sites is made in two steps in the third phase (evaluation and selection of locations); a rough selection and a detailed selection. While the developed process model is similar to the ones discussed above, Balderjahn adds several interesting elements with regard to organizing the team, which is responsible for implementing the selection process, and with regard to the importance of gaining information on location factors. He states that five groups of actors are involved in location selection processes: important individuals, heads of departments and functions, other members of departments and functions, project teams, and consultants. In order to gain the necessary information for evaluating markets, Balderjahn suggests using secondary sources (e.g., the internet), primary sources (through research at the location), as well as through contacts with agencies, partners or suppliers. Balderjahn also points out that consultants collect part of the information. Moreover, he also emphasizes the relevance of a dynamic analysis of some location factors, as well as of taking uncertainty into account in the selection process.

Finally, Balderjahn suggests the use of a requirement-suitability matrix for aligning the firm's requirements on the location with the conditions at the locations reflected in the location factors (see Balderjahn, 2014, 67-68).

In summary, there are some aspects in the introduced selection process models developed in the field of marketing which are also relevant for developing a process model for selecting a production site. Despite their focus on selecting promising sales markets instead of a production site, and their mere national analysis which neglects all regional and local aspects, the inclusion of issues, such as market entry mode and market segmentation, which are not of major interest for selecting a production site, and their limitation to three-step process models, which are not enough for the more complex selection of a production site, the following aspects should be acknowledged with regard to developing a process model for selecting a production site. First, the available information is limited. Second, the time and resources that firms can allocate to selecting locations are constrained. Third, there are some requirements on the location, which are firm-specific or product-specific. Fourth, there are some location factors that must be evaluated in a dynamic analysis, given the highly dynamic and quickly changing environment on the one hand and the long-term decision on the other. Fifth, the selection process model should be structured so that, during the selection process, the number of countries (or generally, units of analysis) decreases as the information evaluated per country (or generally, unit of analysis) increases. Sixth, the selection process must be structured such that no 'promising markets' (or in the case of a selection process of a production site, no promising production sites) are excluded (Köhler and Hüttemann, 1989, 1434). Seventh, the selection of a location should start by considering the firm's strategies, guidelines, and requirements to determine the world region for the subsequent selection process. Eighth, feedback effects between the selected market and other markets (or in the case of a selection process of a production site, between the new production site and others) must be considered. Ninth, information about location factors must be gained through secondary and primary sources. Tenth, it is relevant who is involved in the selection process. Thus, even though the objective of selection process models developed in marketing (promising sales markets) is different from the objective of a process model for selecting a production site, there are still several noteworthy aspects that should be taken into account when developing a process model for selecting a production site.

2.4.2.2 Process Models Developed to Select a Production Site

In addition to the process models developed to select the most attractive sales markets, there are also selection process models which have been developed to select the most appropriate production site (or locations for any form of FDI, including production sites). In contrast to the process models developed in marketing, location in these process models refers to a specific production site, not an entire market. Even though none of them provide firms with all the tools, they need to identify the most appropriate production site for their specific production activity in practice, their analysis reveals many aspects, in addition to those learned from the process models developed in the field of marketing, which are important and ought to be considered when developing a process model for selecting a production site. This section briefly introduces the process models developed by Timmerman (1972), Lüder and Küpper (1983), Sabathil (1969), Goette (1994), Autschbach (1997), Eversheim (1999) as well as the BESTAND Project to highlight what can be adapted from their models for developing a process model for selecting a production site.

Timmermann, as well as Lüder and Küpper, were among the first to systematically approach the firms' selection process of production sites. While their selection process models do not start at a global level (see Autschbach, 1997, 136-137), their analysis still reveals some interesting aspects for a global selection process model. Timmermann formulated a stepwise process model for selecting a production site. He emphasizes that before the start of the selection process, the current and future requirements on the production site must be defined. In the course of Timmermann's selection process model, many possible and acceptable production sites are narrowed down to one production site that meets all requirements. As such, Timmermann's process model is composed of four sequential steps: first, from all possible and acceptable production sites the promising production sites are selected through a utility analysis. Second, among these promising production sites, profitable production sites are selected with a business case study. Third, the profitable production sites are evaluated with the help of a decision tree to identify those that are efficient, and, in the fourth step, the final production site is selected with a risk preference analysis (see Timmermann, 1972, 391). Timmermann pointed out several aspects that are relevant to the goal of this work. First, he discussed the relevance of a dynamic analysis of location factors, given the long-term nature of the investment in a production site and the quickly changing conditions at the production site. Second, he explained the necessity of analyzing the production site at different geographic levels ('region, city, community or neighborhoods as macro-location and certain land plots or locations as micro-location') (Timmermann, 1972, 391), however this is done without including this differentiation in the selection process model. Third, he acknowledges, like Schneider and Müller, in terms of the selection process of sales markets, that the number of production sites that are being analyzed must decrease as the amount of information that is evaluated about each production site increases in the course of the selection process. Fourth, he emphasizes the importance of the firm defining its requirements on the production site. Fifth, he explains the evaluation methods used in his selection process model.

Somewhat different to Timmermann's postulation, Lüder and Küpper started by surveying German firms about their practices of selecting their production sites and built their selection process model upon the findings of their surveys. However, their selection process model is very similar to that of Timmermann. The most relevant aspects of Lüder and Küpper's process model for this work is their differentiation between exclusion location factors (limitationale Standortfaktoren) and substitutable location factors (substitutionale Standortfaktoren).[33] Lüder and Küpper's substitutable location factors are further divided into financial and non-financial location factors. They describe that most firms follow a three-step process, of which the first step consists of a macro-location selection, the second of a preselection of micro-locations and the third of the final selection of the location. While they do not specify the evaluation methods for the macro-location selection, they do explain that in their preselection most firms applied checklists and utility analyses for evaluating exclusion location factors and non-financial substitutable location factors. In the final selection, firms mostly applied a utility analysis for evaluating non-financial substitutable location factors and capital budgeting for evaluating financial substitutable location factors (see Lüder and Küpper, 1983, 192-210). With regard to developing a process model for selecting a production site, it is important to acknowledge, first, the differentiation of different roles, which location factors can have in the selection process (e.g., exclusion location factors or substitutable location factors), second, the use of different evaluation methods, and third, the differentiation between the analysis on a macro-level and a micro-level of location factors.

Sabathil has developed a process model which is not exclusively for selecting a production

[33] Even though Lüder and Küpper differentiate between exclusion (limitationale) and substitutable (substitutionale) location factors, they further explain that the characteristic 'exclusion' or 'substitutable' indicate the role which the location factors have in the selection process, and refer to exclusion location factors also as must criteria (Lüder and Küpper, 1983, 192-194). Thus, they do not differentiate between the terms location factors and criteria. In this work, the location factors are clearly differentiated from criteria, as location factors reflect the conditions at the production sites, while criteria determine the role, which the requirements that the firm has on the production site play in the selection process.

site but rather for selecting a location for any form of a firm's foreign direct investment. Nevertheless, it still includes some noteworthy elements for developing a process model for selecting a production site. Sabathil's selection process model is divided into two parts—the first focuses on a theoretical approach for selecting a location and the second introduces other, particularly psychological factors, that affect the firm's location selection. The selection process model laid out in the first part consists of a preselection and a final selection. In the preselection location factors, such as the local market size, political stability, or economic policies, such as import taxes, are analyzed. The analysis in the final selection remains completely unspecified. Even though Sabathil's process model remains fairly vague, he recognizes some fundamental concerns that a selection process model needs to address: first, the depth of the analysis of potential production sites is limited by the resources available, second, the need for a dynamic analysis given the changing environment and the long-term investment, third, the need to deal with the variety of measurements of different location factors, fourth, the necessity to take uncertainty in assessing location factors into consideration, and fifth, the need to include interdependencies between different location factors in the analysis (see Sabathil, 1969, 249-257).

Goette's selection process model is similar to Seidel's (therefore, said process model is not laid out here) with the exception that Goette starts his process model with a concept phase, in which the firm's motives for pursuing the new production site, as well as the production site's 'strategic role', are specified (Goette, 1994, 106). Goette explains that the strategic role of the new production site depends on the following geostrategic requirements: direction of orientation in the firm's globalization process,[34] degree of globalization, technology of production, as well as the market in terms of its potential and barriers. It is noteworthy that Goette acknowledges that the quantitative impact of the selection of a production site on a firm's profitability can only be approximated, because assessing that impact on a firm's costs and revenues is very difficult and extremely complex. Furthermore, Goette considers the selection of a production site as a basic condition for a firm to meet its goals and not directly responsible for providing profits. Consequently, Goette suggests that a production site should not be selected based on its profitability, but instead based on whether the conditions at the production site meet the requirements which the firm has on that

[34] For Goette, a firm's direction of orientation in the process of globalization can be ethnocentric, polycentric, regional-centric or geocentric (see Goette, 1994, 113-124), while for Backhaus and Voeth the fundamental orientation of a firm with regard to the conduct of its international activities, thus, its internationalization strategy, can only be ethnocentric, polycentric or geocentric (see Backhaus and Voeth, 2010, 67).

specific production site. This requires the management to define the requirements on the production site in advance and to subsequently evaluate the match of these requirements with the conditions at each potential production site reflected in the location factors. Goette emphasizes that such a procedure is better than attempting to analyze the effect of location factors on costs and revenues of a firm (see Goette, 1994, 255-259).

There are several noteworthy ideas in Goette's work with regard to developing a process model for selecting a production site: first, the idea to prepend the selection process with a concept phase to determine the motives for and strategic role of the new production site, even though Goette does not explain how these motives and the strategic role impact the subsequent selection process, is of particular interest. Second, the realistic suggestion that the quantitative impact of selecting a production site on the firm's profitability can only be approximated, while the suggestion to consider selecting a production site as a basic condition for the firm's success, and not as an immediate means to make profits, is less realistic, because selecting a production site will always be made on the basis of costs and revenues and thus profits. However, Goette contends that the quantitative impact cannot and should not be the only relevant factor. Third, it is necessary for the firm to clearly define the requirements on the production site in advance to align them and the corresponding location factors in the selection process.

Autschbach has borrowed some ideas from the authors discussed above for developing a process model, which is not exclusively developed for selecting a production site, but for locations for any kind of a firm's FDI. The process model consists of three phases: the initiative, the concept, and the evaluation phases. In the initiative phase, management determines the goals that it pursues by conducting the FDI, such as accessing new markets, implementing its global corporate strategy, or taking advantage of low factor costs. In the concept phase, the strategic function of the new location is deduced from the motives identified in the initiative phase. In addition, the kind of FDI (such as representative and sales office, complete production or assembly) and the form of FDI (such as own foundation, acquisition or joint venture) are determined. Deciding the FDI specifies the firm's requirements on the new location, and the resources and the time that will be provided for the selection process. In regard to the evaluation phase, whose goal is to identify the location, at which conditions best match the firm's requirements, the suitability of identified locations is analyzed on the basis of relevant location factors. The evaluation phase consists of three selection steps: the country preselection, the rough selection (also referred to as rough screening) and the fine selection. Autschbach states that, for each of these selection steps, the relevant location factors must be specified (country-specific, industry-specific, and firm-specific location factors) and the source of information, as well as the evaluation methods, must be determined. In the decision phase, the decision-makers choose the most appropriate location among those left after all three selection steps of the evaluation phase (see Autschbach, 1997, 193-212).

Autschbach includes several relevant aspects in his work for developing a process model for selecting a production site. First, he constructed his process model with an awareness of the time and resource constraints under which the firm must make the location decision. Second, location factors are distinguished between country-specific, industry-specific, and firm-specific location factors. Third, even though the geographic granularity of analysis of location factors remains, in general, on a national level, Autschbach suggests that the investment climate, tax legislation, investment-related subsidies and public administration should also be analyzed on a regional and local level in the fine selection. Fourth, Autschbach explains that the selection process must be based on secondary research and primary research, which he refers to as 'desk research' and 'field research', respectively. Fifth, Autschbach differentiates between firm internal (e.g., experience of employees, or firm's documents and information) and firm external (e.g., public sources of the home or guest country, private sources, as well as international organizations) sources of information. Sixth, Autschbach points out that the quality of external sources and their usability for evaluating location factors depends on their availability, timeliness of data, comparability, and reliability. Seventh, Autschbach introduces several possible evaluation methods. Eighth, Autschbach's suggestion that the preferred form of FDI should be considered in the selection process acknowledges that the existence of potential partners for joint ventures or alliances at the production site might be a strategic requirement on the production site (see Autschbach, 1997, 193-212).

Furthermore, Eversheim formulated a detailed selection process model for selecting a production site. Like Autschbach, they applied Goette's idea that the goal of the selection process is to find a particular production site at which the location factors best match the firm's requirements. He suggests that it must be determined whether the requirements should play the role of exclusion criteria (which he refers to as fixed requirements), minimum criteria, or preferred criteria in the selection process. All requirements and their corresponding roles are summarized in a so-called Production Site Requirement Profile ('Standortanforderungsprofil') (Eversheim, 1999, 9-43). Eversheim's selection process model consists of a rough selection and a detailed selection. In the rough selection, the production site requirement profile is matched with the location factors of potential production sites, first at a global and regional level. If the location factors meet the requirements on a global and regional level, then the production sites are further analyzed on a local level. In the rough selection, the location factors are evaluated to ensure they meet the exclusion and minimum criteria. The detailed selection remains unspecified as Eversheim only introduces possible evaluation methods, which can be applied to the remaining production sites, such as utility, sensitivity, or cost-benefit analysis, as well as a transport costs optimization and weighting methods, like the pairwise comparison or the evaluation matrix (see Eversheim, 1999, 9/40-9/57).

Even though Eversheim's selection process model remains rather vague, it incorporates several interesting aspects for developing a process model for selecting a production site: first, Eversheim points out that location factors should be analyzed on a global, regional, and local level. Second, he suggests which location factors should be analyzed at which level of analysis by providing an overview and explanation of relevant location factors categorized in global, regional, and local location factors. Third, he analyzes the applicability of certain evaluation methods, but without determining which evaluation method should be applied for the analysis of which location factor and at which geographic level of analysis (global, regional, or local). Fourth, he defines the firm's requirements and strategic considerations in the form of a production site requirement profile, which he suggests aligning with the location factors at the production sites.

The BESTAND project is an approach for strategically evaluating production sites which was developed through a collaboration of 10 industry partners and 3 research institutes. The developed BESTAND approach for evaluating production sites is not a step-by-step selection process model which firms can use for selecting a production site, but instead suggests six tasks that firms should perform when evaluating production sites in the selection process. First, identify a list of 10 location factors which are relevant for implementing the firm's internationalization strategy (see Kinkel, 2009a, 65-66).[35] Second, analyze the firm's past selections of production sites aboard ('Historieninventur') to learn from the firm's experience with both selecting and constructing production sites in foreign locations. For this evaluation of experiences, the BESTAND project suggests creating a database that systematically captures these experiences,

[35] Kinkel composes lists of the 10 most relevant location factors to the four typical internationalization strategies, which are: market access, cost reduction, 'following customer' or access to technology and innovative know-how. Kinkel explains that empirical studies reveal that these four strategies are the most frequently pursued strategies by firms when they establish any kind of presence abroad (Kinkel, 2009a, 63-79).

both the successes and failures (see Erceg and Lay, 2009, 105-106). Third, assess the potential for optimizing domestic production sites[36] by benchmarking with the most efficient domestic competitors. This is especially important if the production site is offshored to reduce costs, and less important if the goal is to gain access to a market (see Erceg, 2009, 151-155, 167). Fourth, evaluate the production network, including external suppliers at well-functioning production sites (at home or abroad), in order to be able to adequately estimate the need for external suppliers and the required degree of integration in the internal (firm-owned) production network for successful operation of the new production site (see Richter and Buchner, 2009, 209, 224-227). Fifth, formulate dynamic future scenarios for the analysis of future developments at potential production sites over their planning horizon to address the uncertainty inherent to this assessment (see Buhmann and Schön, 2009, 279-282). Sixth, develop a strategic early warning system ('Location Control Scorecard') to systematically control the operations and monitor all important developments at the production site given that the conditions at the production site will change over the planning horizon (Kinkel, 2009b, 347).

The results from the BESTAND project point out several interesting aspects with regard to developing a process model for selecting a production site. However, the following five tasks are especially important. First, deduce the relevant location factors from the internationalization strategy to define strategy-specific location factors. Second, create a systematic database of the firm's experiences selecting production sites. This would be valuable for the selection process model, but its development cannot realistically be included in a selection process due to the time and resource constraints. However, the idea of incorporating lessons learned from experiences is an interesting feature. Third, analyze the potential for optimization at existing production sites for a more realistic and truthful benchmark, thus making firms less likely to systematically overestimate the potential savings at new production sites. Fourth, formulate dynamic future scenarios of uncertain developments at production sites for the planning horizon and, fifth, consider and determine the network requirements on the new production site based on the network available at other well-functioning production sites of the firm.

In summary, there are many interesting and important parts, aspects and ideas either

[36] Erceg suggests that firms should mainly analyze the field of technology, human resources, organization, and product design when assessing potential for optimization at domestic production sites, because, these, which he refers to as 'fields of modernization', offer the greatest potential for optimization at production sites in advanced countries (Erceg, 2009, 153-167).

incorporated in these process models or suggested by their authors that must not be neglected when developing a process model for selecting a production site. First, as already noted by Schneider and Müller, the selection process must be structured so that the number of production sites being evaluated decreases as the amount of information evaluated per production site increases throughout the course of the selection process. Second, the selection process of a production site is more complex than that of a sales market, which is reflected in the extra step of the process models (often four steps instead of three steps compared to the process models developed for selecting a sales market). Third, caution must be given to possible interdependencies between different location factors. Fourth, it is crucial to define the firm's strategic goals related to the new production site at the beginning of the selection process. Fifth, it is important to acknowledge that the impact of a production site cannot be captured entirely in terms of costs and revenues (or profit), but instead, that the impact of a selected production site on the firm's profit can only be approximated. Consequently, throughout the selection process it is better to align the firm's requirements on the production site with the conditions at potential production sites, reflected in the corresponding location factors, and to select the location with the best match. Sixth, this alignment of requirements with location factors makes the detailed definition of the firm's requirements on the production site necessary in advance. Seventh, in the analysis of location factors different geographic levels must be differentiated. Eighth, country-specific, industry-specific, and firm-specific location factors must be differentiated. Ninth, gaining information on location factors can be difficult and must be based on primary and secondary research and can stem from firm internal and firm external sources. Tenth, the quality of external sources and their usability for evaluating location factors depends on their availability, timeliness of data, comparability, and reliability. Eleventh, some requirements on the production site can be defined as exclusion criteria, others as substitutable criteria or preferred criteria. Twelfth, there are strategy-specific location factors which can be deduced from the firm's strategy. Thirteenth, it is necessary to take network-related aspects into account in the selection process and to determine the network requirements on the new production site based on the network available at well-functioning production sites of the firm. Fourteenth, overestimating potential savings at the new production site can be prevented by assessing the potential for optimizing existing production sites. Fifteenth, learning from the firm's experiences with searching for and constructing new production sites is valuable. Sixteenth, there is a large variety of evaluation methods that can be used in the selection process. Seventeenth, it is necessary to deal with uncertainty when selecting a production site (e.g., in the form of future scenarios). Lastly, eighteenth, the existence of potential partners for joint ventures or alliances at the production sites can be a strategic requirement on the production site.

2.4.2.3 Process Models Developed to Optimize Global Production Networks

A related branch of literature focuses on developing process models to plan or optimize a firm's entire production network. These process models aim to capture the complexity of production networks which arise from the many interdependencies between its individual parts, as well as from the interdependencies of the product design, the production process, and the production site (i.e., the location) (see Grauer, 2007, 2). Interdependencies between product design and production process arise because certain characteristics of a product require certain production processes, while limitations on the production process constrain the variety of product design or require it to adapt to the production process. The production process might require the product, for instance, to be more robust or less vulnerable to heat. Interdependencies between the production site and the production process can stem from technical and economic aspects, such as the relation between labor costs, degree of automation, quality requirements or the local availability of skills and the local climate. Interdependencies between the product design and the production site exist, for instance, with regard to transport and logistic requirements or the protection of intellectual property. Meyer emphasizes that interdependencies are especially significant in the production networks of firms that use serial production, such as those from the automotive industry, given the multitude of production processes that make up one production line, their mutual delivery relations, which must be reliable and flexible, the goal of sharing fixed costs, and the extensive flow of materials between different locations (see Meyer, 2006b, 111).

What these network-oriented process models aim to optimize is often referred to as the configuration of global production networks, instead of only the selection of a single production site. The configuration of a production network includes the physical set-up of individual production sites and of the production network as a whole, and determines the number of production sites, their location, their specialization, their technological equipment, the allocation of investments or distribution of resources among individual locations, as well as the design of the internal supply chain in terms of fragmentation, sourcing, and distribution (see Friedli et al., 2013, 46-50). Therefore, selecting a production site is part of configuring the entire production network, which is why, among the process models that have been formulated to plan or optimize a firm's production network are some that also include the selection of a production site.[37] This section introduces the process models developed by Herm (2006), Schnellberg (2002), Meyer and Jacob (2006) and Grauer (2007) to point out what can be learned from them when developing a process model for selecting a production site. Not all these process models include detailed parts for selecting production sites; however, they all contain some relevant ideas and aspects.

Herm configured a global value chain network model based on business capabilities. Herm splits the activities along the value chain into modules[38] and identifies related core capabilities of the firm, as well as main restrictions which constrain the configuration of the value chain network. Herm's goal is to configure the value chain network by aligning each module with the related core capabilities and restrictions (see Herm, 2006, 58-82). Herm does not develop a process model to identify the most appropriate production site for the firm, but instead asserts that to do so the firm must analyze its process-specific capabilities and find the production site at which the conditions best strengthen these capabilities. He also emphasizes that the production site must be identified based on firm- and process-specific requirements.

Schnellberg has formulated a process model to efficiently configure global production networks by addressing their complexity and, in particular, by supporting the capacity and investment planning of diversified production sites and their configuration to a production network (see Schnellberg, 2002, 3). As part of this approach, he defines a process model for selecting production sites which are considered in the configuration of the production network. These sites are selected from a predefined pool of production sites. The selection process model consists of four steps: the first step is determining the guidelines, product-specific and firm-specific goals, sources of information, available resources, or the different levels of analysis which should be included in the evaluation (e.g., country/regional, a local and a module level of analysis). The second step consists of determining the most important requirements on the production site which must be deduced from the firm's goals and strategies. Those requirements are, for instance, the volume of production that is planned to be produced or the unit costs. In the third step, the relevant location factors are selected and, if necessary, their interdependencies are identified. For the

[37] For a review of approaches to optimize production networks see Herm (Herm, 2006, 21-48). Likewise, the alignment of the product design and the production process for optimizing global production networks has been addressed in a variety of articles assembled in a book edited by Eversheim and Schuh (Eversheim and Schuh, 2005).

[38] Herm defines modules as parts of the value chain which can be assigned business capabilities, technologies, and resources (see Herm, 2006, 113). Grauer defines modules somewhat differently: as self-contained units of a product, which can be clearly separated from other modules of the product (see Grauer, 2009, 72).

relevant location factors, it is determined at which level they should be analyzed (e.g., country/regional, a local and a module level of analysis). In the fourth and final step, requirements are defined for each location factor, and all production sites at which the conditions reflected in location factors do not meet all of these requirements are eliminated. Key to Schnellberg's evaluation of production sites are operating figures that he summarizes in a table and categorizes depending on the strategy, guidance or project-related and firm-related goals, to which these location factors are relevant. Furthermore, he differentiates between location factors depending on whether their analysis is important for evaluating countries/regions, production sites or production modules. Moreover, he includes in the table for each of these figures some kind of measurement to enable the evaluation of these figures, as he emphasizes that the prerequisite for evaluating them is their measurability (see Schnellberg, 2002, 80-83, 177-186).

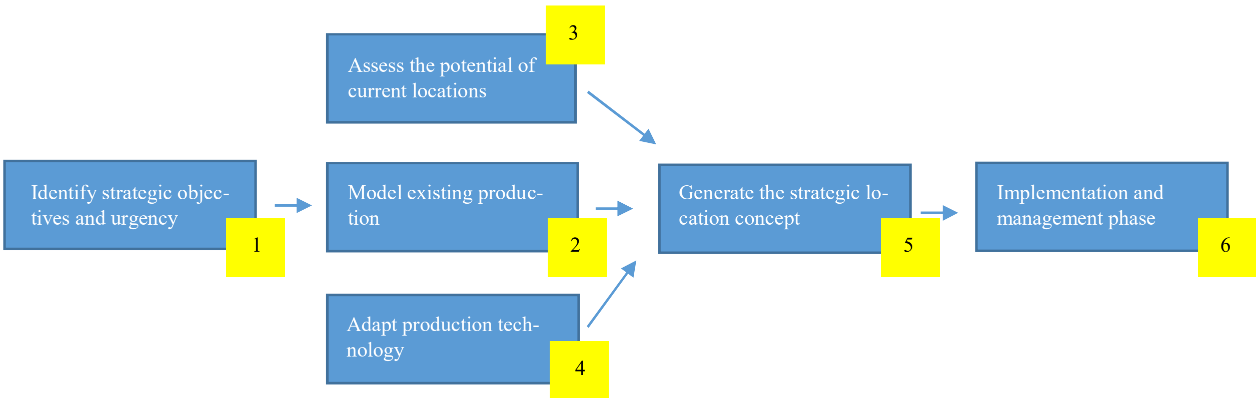
However, Schnellberg does not develop a step-by-step process model for selecting a production site but instead the selection of a production site remains a rather vague part of a larger process model to configure a global production network. Nevertheless, Schnellberg's process model contains several remarkable elements for developing a process model for selecting a production site: first, the comprehensive list of location factors. Second, the specification of the analysis of each location factor, whether it is important for evaluating countries/regions, production sites or production modules. This is, however, not necessarily the same as the geographic level of analysis at which each of these location factors should be evaluated. Third, the consideration of strategy, guidance or project-specific goals and firm-specific goals. Fourth, the particular emphasis on the relevance of measurability of location factors as prerequisite for their evaluation. Fifth, the focus on the capacity planning in the production network, and sixth, the need to choose the relevant location factors and to be careful of interdependencies between them.

Meyer and Jacob have developed an 'integrated globalization strategy' for coordinating global production networks.[39] They point out that selecting a production site must be part of a larger transformation of a firm's production network. The goal of this integrated approach is to take interdependencies between product design, production processes and production sites in a production network into consideration. This 'integrated globalization strategy' consists of the

[39] In the Book *Handbook Globale Produktion* Meyer, together with Jacob, Simon, Abele, and several others, developed a comprehensive analysis of global production in general. The chapter on 'Gestaltung Globaler Produktionsnetzwerke' written by Meyer and Jacob is of special interest for this work (see Abele et al., 2006). The English translation was published under the title *Global Production: A Handbook for Strategy and Implementation* in 2008 (see Abele et al., 2008).

following six steps (see Figure 3). In the first step, the strategic framework and goals are defined in terms of market developments, competitors' activities, industry trends, operational requirements, and opportunities, as well as risks. In the second step, the product and production process portfolios are segmented to construct a production process model.[40] In the third step, the potential of existing production sites and their network-related advantages, in particular, with regard to Research and Development (R&D) Departments, are analyzed and evaluated. In the fourth step, the production technique is analyzed and, if possible, alternative techniques are developed which allow for a successful adoption of the production technique to the conditions at the production sites (e.g., cost structure for inputs). The fifth step is the validation of the process model using simulation, the development of a 'target structure with minimum total landed costs', the planning of the migration and the optimization of the profitability. The sixth and final step, that of implementation and management, includes the selection of the final production site within a predefined region, the preparation of the investment, the detailed planning of the production site, the selection and development of suppliers and the start-up of the production site (Meyer and Jacob, 2008, 145; see Meyer and Jacob, 2006, 146-169).

Figure 3: 'Integrated Globalization Strategy' developed by Meyer and Jacob



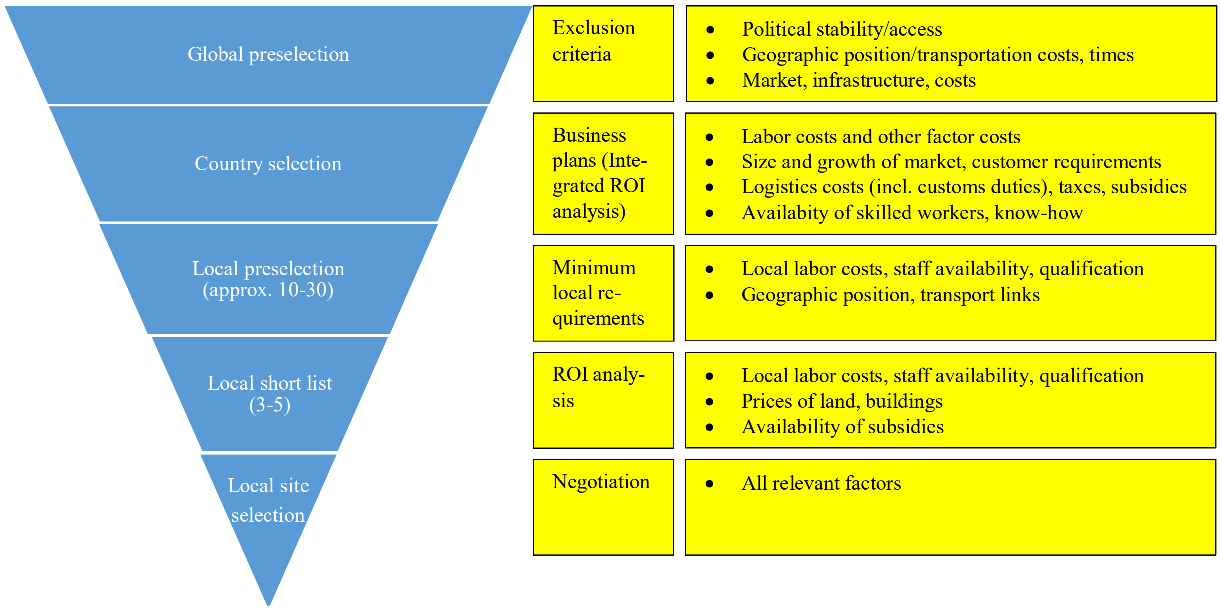
(Author illustration in reference to Meyer and Jacob, 2008, 145)

Hence, the process model for selecting a production site is only one part of the entire 'integrated globalization strategy'. This selection process developed by Meyer (2006b, 111, 129)

[40] This requires vertical (along product lines, products, and variants) and horizontal (along components, raw materials, and final products) segmentation of the product into modules and an assignment of the corresponding production processes. For each of these production processes, parameters, such as cycle times, costs for machinery and tools or required space for means of production, must be determined.

(see Figure 4) consists of five steps. The first is the global preselection of countries on the basis of political stability, access to markets, geographic location, and costs and time of transport, which are evaluated with the help of exclusion criteria. In the second step, the countries which have passed the first step are analyzed in terms of labor costs and other input costs, as well as on market size and growth, customer requirements, logistic costs, taxes or subsidies, all of which are evaluated with an integrated profitability analysis (business case study). In the third step, a local pre-selection is conducted based on an evaluation of local wages, availability of skills, geographic location, and logistic connection with minimum criteria, resulting in a long list of 10-30 production sites. In the fourth step, another local selection results in a short list of three to five production sites, based on the evaluation of skill and labor availability, prices for land plots and buildings, and available subsidies using a profitability analysis (business case). The fifth step is the selection of the final production site based on a comparative calculation, including all relevant factors with the help of negotiations (see Meyer, 2006b, 112, 129).

Figure 4: Selection Process Model Developed by Meyer



(Author illustration in reference to Meyer, 2008, 110-111, 126)

Clearly, Meyer and Jacob have developed an 'integrated globalization strategy'[41] of which the selection of a production site is only one part. There are several other aspects incorporated in this strategy which are relevant to developing a process model for selecting a production site: first, determining a strategic framework and goals, second, analyzing trends, which reveals an awareness of the necessity to take dynamic aspects into account, third, analyzing network-related aspects with a special focus on links between production and R&D, fourth, developing a production process model which raises the awareness of process-specific and product-specific requirements on the production site, fifth, adjusting the production technique to the conditions at the production site, sixth, considering aspects related to migrating to the new production site and to starting-up operations at the production site, and seventh, selecting and developing suppliers.

Moreover, even though the process model for selecting production sites, which Meyer has formulated as part of the 'integrated globalization strategy', has not been developed to be implemented in isolation, its isolated consideration is worthwhile. This fairly detailed step-by-step process model for selecting a production site, in which he determines the most important location factors and the method of evaluation for each step, incorporates several aspects which should be taken into consideration when developing a process model for selecting production sites. First, he differentiates between a global, country, and local level of analysis, which he assigns to the different steps of the process model. Second, it is interesting that he takes into account negotiations in the final step of the selection process model. Third, Meyer[42] dedicates an entire chapter to a comprehensive overview of location factors which are relevant to the selection of production sites. In this overview, Meyer differentiates location factors that are related to markets and the market development, factor costs, productivity and production techniques, logistics, external factors, and the migration of the production site. While Meyer explains the relevance of the included location factors for selecting a production site, he does not specify how to include the location factors in the selection process as he does not systematically determine an evaluation method for each location factor or the point in the selection process at which each location factor should be evaluated. Thus,

[41] Meyer and Jacob's 'integrated globalization strategy' (see Figure 3) and Meyer's process model for selecting a production site (see Figure 4) do not integrate smoothly: in the 'integrated globalization strategy' the final production site is selected (as part of step six) within a predefined country and region determined in the previous steps of the 'integrated globalization strategy'. However, the process model developed by Meyer for selecting a production site (see Figure 4) starts at the global level with the global preselection of countries.

[42] Meyer and Jacob developed the 'integrated globalization strategy' to optimize the 'global production footprint together' (see Meyer and Jacob, 2006, 149), while Meyer provided the overview of location factors (see Meyer, 2006a, 36-100).

he does not explain in detail the link between the overview of the location factors and the selection process. Fourth, Meyer suggests that, in general, some information must be collected at the production sites, as only part of the required information can be gained from public or private institutions. However, he does not go into more detail on this idea. Fifth, Meyer suggests units of measurements for some location factors, but he does not do so systematically for all location factors included in the overview.

Grauer developed another process model to optimize or plan a global production network, that aligns product design, production processes, and production sites. Grauer's process model consists of eight steps. In the first step, the technical elements of the product are derived from consumer requirements. In the second step, the concept of the product is defined in terms of its function, and, in the third step, the product concept is disaggregated in modules. In the fourth step, potential production sites are evaluated based on qualitative product module requirements (such as stability, potential, know-how, flexibility, and competencies) and those production sites which do not meet these product module requirements are eliminated. In the fifth step, production processes and required means of production are determined for each module. Furthermore, the means of production for each module and production process are quantitatively and qualitatively evaluated. In step six, all production processes are categorized into standard or core competencies depending on the ratio of both market and firm-specific know-how required for the production processes. In the seventh step, the production sites which meet the product- and process-specific requirements are assigned weights with the pairwise comparison method and evaluated using exclusion criteria with checklists. The remaining production sites are quantitatively evaluated with regard to their associated material unit, material common, production unit, production common, and quality costs. Moreover, Grauer suggests that the quantitative evaluation must also include attributable sales, and development and administration costs. After the qualitative and quantitative evaluation, the results from both evaluations are combined. In the last step, the global production network is built upon the production sites chosen for each module and within certain framework conditions (see Grauer, 2009, 62-108).

Overall, Grauer's[43] process model aligns product- and process-specific requirements with the production site. With regard to developing a process model for selecting a production site,

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[43] In an earlier paper, Grauer developed a process model to align the product design and the location, which consists of three phases: the checking of framework conditions, the construction of scenarios, and the evaluation of these scenarios. The checking of framework conditions is carried out by defining minimum criteria with which locations are

several aspects are noteworthy. First, the highlighted importance of the interdependencies in a production network between product design, production process, and production site. Second, the relevance of product-specific and process-specific requirements on the production site. Third, Grauer points out the complexity and variety of aspects which must be considered when selecting a production site for a specific product and production process and as part of a production network. Fourth, the necessity of considering local consumer requirements in the product design.

Overall, as selecting a production site is part of these process models for planning and optimizing global production networks, they incorporate several aspects and ideas which are also important for developing a process model for selecting a production site. The following aspects are the most relevant. First, potential production sites must also be evaluated based on the requirements of the product that will be produced, and the production process that will be implemented. Thus, the authors emphasize the relevance of product- and process-specific requirements on the production site due to significant interdependencies between different production processes, product design, and production sites in a production network. Second, the firm's process-specific competencies must be considered in the selection process, so that they may be strengthened by the conditions at the new production site. Third, a list or overview of location factors facilitates the selection for firms. Fourth, the measurability of location factors is a prerequisite for evaluating them in a selection process. Fifth, it is important to be cautious of interdependencies between location factors. Sixth, it is necessary to determine the geographic level of analysis for location factors. Seventh, negotiations should be considered in the selection process. Eighth, some information must be collected at the production sites, as only part of the required information can be gained from public or private institutions. Ninth, the new production site must be considered as part of the production network, and tenth, the strategy that the firm pursues with regard to the production site must be

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eliminated, such as risk to know-how or political uncertainty. For the specific locations that meet the minimum criteria, strengths and weaknesses portfolios are created or, if these locations are not yet identified, strengths and weaknesses portfolios are created for countries and regions. Furthermore, the first phase contains an identification of characteristics that motivate the consumer to buy the product, as well as the design of a production graph that depicts all the steps of the production process and their requirements. In the second phase, scenarios are created by joining location-process combinations which have a high degree of congruence (high correlation index), meaning that the conditions at the location mostly meet the requirements of the production process. In phase three, these scenarios are evaluated qualitatively, as well as quantitatively. The quantitative evaluation includes costs related to production and logistics, as well as sourced components. The qualitative evaluation occurs in the form of a utility analysis. At the end of the third phase, the final analysis is completed by depicting the qualitative and quantitative evaluation, as well as the correlation index in a coordinate plane. This illustration of results is planned to point out required adjustments in the global production network of firms in terms of product design, production process and location selection (see Grauer et al., 2007, 58-59).

taken into consideration in the selection process and the relevance of location factors depends on the pursued strategy.

2.4.2.4 Supply Chain Design

Another branch of literature which deals with selecting production sites is the literature on supply chain design, as the selection of a production site is part of the overall strategic supply chain design. However, many of the numerous models developed in the literature on supply chain design are based on mathematical programming techniques and optimization, do not capture the entire complexity of the supply chain, but instead focus on parts of the supply chain. The summary and assessment of this literature on supply chain design and the developed models therein is beyond the scope of this work. However, the literature on supply chain design deals with various aspects which are interesting for developing a process model for selecting a production site.

Supply chain design deals with the complex decisions required for setting up the supply chain[44] and addresses the firms' shift in focus from originally independent management of the different parts of the supply chain (namely, procurement, production, and distribution) to an integrated management of the total supply chain (see Korpela et al., 2001a, 193-195; Korpela et al., 2001b, 145-146). An integrated supply chain management requires a 'cross-functional integration' from an internal perspective and must include 'participating external suppliers' (Foerstl et al., 2017, 226). Hence, an integrated management aims, on the one hand, at improving the entire supply chain instead of improving individual parts and, on the other hand, at strengthening the cooperation between all partners working within the firm's supply chain (see Gharaei et al., 2017, 739-740; Korpela et al., 2001a, 193-195; Korpela et al., 2001b, 145-146). Hence, successful supply chain design must be cross-functional, including sourcing, production, and sales, as well as the necessary logistics connecting these functions (see Bogaschewsky et al., 2009, 215). Likewise, it must involve marketing (see da Silva Poberschnigg et al., 2020, 790; Ferreira et al., 2019, 1717) and must not only consider all functions individually, but instead manage their roles in the supply chain in an integrated manner (see Zhang et al., 2016, 39). Cross-functional supply chain design improves its overall effectiveness (see Franke and Foerstl, 2020, 6), and can lead to a competitive advantage for

[44] 'A supply chain is a network of suppliers, manufacturing plants, warehouses, and distribution channels organized to acquire raw materials, convert these raw materials to finished products, and distribute the products to customers' (Santoso et al., 2005, 96). Hence, the supply chain connects 'suppliers and customers, beginning with the production of raw materials by a supplier, and ending with the consumption of a product by the customer' (Sabri and Beamon, 2000, 581).

the firm (see Lambert and Enz, 2017, 3); in short, it is considered to enhance the supply chain resilience capabilities (see da Silva Poberschnigg et al., 2020, 791). Hence, cross-functional supply chain management, together with the integration of external partners thereof, constitute an integrated supply chain design, which is key for achieving a competitive advantage (see Gharaei et al., 2017, 739). The complexity of supply chain design arises from the 'overwhelming number of interactions and inter-dependencies among different entities, processes and resources' of supply chains (Surana et al., 2005, 4235). Supply chain design includes planning and coordinating the capacity at all individual production sites, their selection, and determining the total number thereof in the supply chain, as well as allocating customer demand, selecting entire sourcing markets or suppliers for components and materials[45], allocating suppliers to production sites and even to certain production processes, or deciding on materials and product flows (see Lambert and Enz, 2017, 8; Zhang et al., 2016, 39; Bogaschewsky et al., 2009, 215; Meixell and Gargeya, 2005, 532).

Supply chain design becomes even more complex if the supply chain operates globally. This type of supply chain design includes the selection of production sites abroad and addresses issues that arise for globally-producing firms (see Meixell and Gargeya, 2005, 533), including those related to tariffs, exchange rates, international logistics, local content regulations (see Bogaschewsky et al., 2009, 216), 'tax rates and where profits should be earned to legally minimize tax liability', as well as 'import and export regulations (see Lambert and Enz, 2017, 8). Moreover, global supply chains are characterized by larger geographic distances, which not only lead to higher transport costs and 'lead time in the supply chain', but also to cultural differences, in addition to different languages and working habits, which impede the 'effectiveness of business processes'. Global supply chains must also often cope with weaker infrastructure in developing countries compared to supply chains operating only in advanced countries. Moreover, in contrast to domestic supply

[45] Bogaschewsky developed a funnel model for selecting sourcing countries and regions which consists of four steps: a preselection, a utility-oriented prioritization, a cost-oriented prioritization, and a total prioritization. The funnel model starts with a consideration of the worldwide sourcing market, and hence includes all countries and regions. In the first step, all countries and regions which do not meet certain exclusion criteria are eliminated. In the second step, the remaining countries and regions are evaluated with a utility analysis with weights for partial utility values and countries and regions with relatively low utility are eliminated. The remaining countries and regions are evaluated in step 3 with the total cost of ownership method and those countries and regions found to be too expensive are eliminated. In step 4, the final selection of countries and regions is conducted with a utility analysis and the total cost of ownership method. Hence, the funnel model works with exclusion criteria, the utility analysis, and the total cost of ownership method, with the number of evaluated countries and regions decreasing from a worldwide consideration to finalists in the course of the selection process. Bogaschewsky also developed a similar funnel model for the selection of suppliers (see Bogaschewsky, 2007, 15, 17).

chains, global supply chains must deal with additional risks, such as exchange rate volatility or political instability (Meixell and Gargeya, 2005, 533).

The literature on supply chain design distinguishes strategic, tactical, and operational levels of decision-making. While strategic decisions are usually long-term and cannot be reversed or changed quickly at low costs, decisions on the tactical and operational level are mid-term or short-term and can be altered or reversed at lower costs more quickly (see Altmann and Bogaschewsky, 2014, 615; Chopra and Meindl, 2014, 30). The strategic level of supply chain design is also referred to as supply chain configuration. Strategic decisions on the design of a supply chain include selecting locations for any kind of facilities (e.g., production sites, distribution centers), the number of and capacity at the locations, the technology implemented and labor availability at the facilities, as well as modes of transportation (see Lambert and Enz, 2017, 8; Chopra and Meindl, 2014, 29-30; Surana et al., 2005, 4244). Moreover, decisions on 'demand planning, distribution channel planning, strategic alliances, new product development' (Surana et al., 2005, 4244), as well as on the production processes (see Altmann and Bogaschewsky, 2014, 615), are all part of strategic supply chain design. Tactical supply chain design includes decisions on the 'aggregate quantities and material flows for purchasing, processing and distributing of products' (Azaron et al., 2008, 129), as well as controlling inventory, coordinating production or distribution (see Surana et al., 2005, 4244) and choosing a delivery schedule (e.g., just-in-time or just-in-sequence) (see Fixson, 2005, 349). Meanwhile, operational supply chain design focuses on the 'day-to-day activities' of the supply chain (Lambert and Enz, 2017, 8) and consists of decisions on the required product-specific level of stock safety at each location, , the 'size and frequency of the product batches that are replenished and assembled', the 'replenishment transport and production lead times' or the 'customer service levels' (Sabri and Beamon, 2000, 582), as well as the scheduling of routing or workforce and packaging (see Surana et al., 2005, 4245). For an overview of 'process interfaces between the strategic and the operational level, see Lambert and Enz, 2017, 9.

Strategic supply chain design is not only very relevant because of the associated significant resources that must be committed, especially for the construction of new production sites or distribution centers, but also because it sets the framework for the tactical and operational supply chain design (see Azaron et al., 2008, 129). The selection of production sites is an especially important decision for the strategic supply chain design in terms of its efficiency, as problematic selections of production sites lead to inefficiencies in the supply chain regardless of the functioning of its other parts (see Shen, 2007, 1, 3). For a successful supply chain design, the selection of a production site cannot be made in isolation, but instead must be made with regard to other tasks that are part of the supply chain design on the strategic level, as well as on the tactical and operational level. Thus, 'the supply chain should be optimized as a whole' for a successful supply chain design (Shen, 2007, 2), as only such an integrated approach is able to create a sustained competitive advantage for the firm.

The following aspects dealt with by the supply chain design literature are especially important for developing a process model for selecting a production site. Arntzen et al. were already aware of the multifaceted problem of supply chain design in 1995 as they explained that 'firms need to consider many things when designing their supply chains: the location of customers and suppliers, the location and availability of inexpensive skilled labor, the length of the material pipeline in distance and time, the transit time and costs of various transportation modes, the significance and location of tax havens, offset trade (value of goods and services purchased in a country to balance the sales of products in that country) and local content targets (percentage of components, by value, for a product), and export regulations, duty rates, and drawback policies' (Arntzen et al., 1995, 71). Daskin et al. emphasize that, for the facility location decision in a supply chain, it is important to not only minimize costs that arise from the fixed costs at the location and the transport costs for goods to be shipped between the facility locations and the customer locations, but to at least also take into account inventory and routing (see Daskin et al., 2005, 40-41, 52-53). Zheng et al. stress the importance of optimizing the supply chain in terms of location, inventory, and routing in an integrated manner (see Zheng et al., 2019, 1-2). Additionally, Ozsen et al. point to the importance of considering the interdependency of capacity and inventory in designing a supply chain, as they show that capacity planning is different if inventory is taken into account (Ozsen et al., 2008). Further, Gharaei et al. highlight the important role of inventory in the set-up of a supply chain (see Gharaei et al., 2017, 742) and Diabat and Deskoores stress the link between the strategic selection of location and the tactical decision on inventory management (see Diabat and Deskoores, 2016, 172). Likewise, Diabat et al. also examine this link between location and inventory in the supply chain design, but with a special focus on uncertainty of demand and lead times (see Diabat et al. 2017, 139-140). Fixson developed a product architecture framework in which the 'decisions on design and operation of numerous processes in the three domains of product, [production] process, and supply chain' are linked, illustrating that it is important to analyze the linkages between the three 'domains' and the trade-offs in their coordination (see Fixson, 2005, 347). Fixson also emphasizes that part of the supply chain design involves choosing a delivery schedule (e.g., just-in-time or just-in-sequence) (see Fixson, 2005, 349). Similarly, Petersen et al. point out that selecting suppliers is a key component of the supply chain design and that their selection should not be exclusively based on evaluating their capabilities but also on how their culture affects the efficient interaction with the buying firm. Petersen et al. highlight the importance of the successful integration of suppliers in the design, production, and delivery of products (see Petersen et al., 2005, 372). Besides 'joint-product development', Foerstl et al. emphasize that integrating suppliers can include 'short-term working capital optimizations to leverage credit rating differentials' and 'long-term focused lending to suppliers' (Foerstl et al., 2017, 226). Lee and Kumara state that a successful supply chain design requires the cooperation between all participants, while special focus should be given to their cooperation with regard to information sharing (see Lee and Kumara, 2007, 4715-4716).

Another relevant aspect in supply chain design is flexibility, and thus the supply chain's capability to react, for instance, to changes in 'customer requirements' (Sabri and Beamon, 2000, 584). Lim et al. suggest considering the impact of proximity in terms of location on the agility of the supply chain (see Lim et al., 2016, 1026-1027). Chopra and Meindl emphasize the impact of selecting locations on the structure and hence the flexibility of the supply chain. They also note the trade-off in supply chain design between flexibility on one side and efficiency on the other (see Chopra and Meindl, 2014, 78-80). Supply chain risks are a related aspect. Various authors warn of external, as well as internal, supply chain risks, which, if they materialize, result in supply chain disruptions which can have serious consequences for a firm's success and competitiveness (see Craighead et al., 2007, 132-134; Shen, 2007, 23-24). In terms of external risks, Moradlou et al. analyze the impact of geopolitical disruptions, such as the Brexit, on the location of production sites and distribution centers (see Moradlou et al., 2021, 103). Given the variety of risks, the supply chain must be designed to strengthen its 'mitigation capabilities', namely its 'recovery capability' and 'warning capability' to cope successfully with any kind of supply chain disruption (Craighead et al., 2007, 144, 146). This requires building robustness and reliability into the supply chain design (see Daskin et al., 2005, 56-60; Shen, 2007, 23-24) and fostering resilience capabilities, such as 'visibility, agility and adaptability' (see da Silva Poberschnigg et al., 2020, 799). Zhao and You suggest, for instance, that supply chain resilience can be enhanced by proper 'facility location decisions and productions capacity decisions' (Zhao, S. and You, F., 2018, 1019). Moreover, the supply chain design must be embedded in the firm's strategies, especially the global sourcing, location, and sales strategy, in order to create a sustained competitive advantage for the firm (see

Bogaschewsky et al., 2009, 215). One further aspect that is very present in the literature on supply chain design is uncertainty. Given the multitude of sources of uncertainty in the supply chain (e.g., customer demands, 'suppliers, processing, transportation, shortage and capacity expansion costs' (Azaron et al., 2008, 130) combined with the long-term planning horizon, especially of strategic supply chain decisions, uncertainty must be taken into account when designing a supply chain (see Altmann and Bogaschewsky, 2014, 620-623; Pan and Nagi, 2010, 668-670; Azaron et al., 2008, 129-130; Santoso et al., 2005, 96-97; Sabri and Beamon, 2000, 528).

Overall, considering the literature on supply chain design is interesting for developing a process model for selecting a production site, as selecting a production site is part of the tasks included in supply chain design. Selecting a production site is an especially important strategic decision on the supply chain design, which sets the framework for the tactical and operational level of supply chain design, and hence requires taking other strategic, as well as tactical and operational, aspects into consideration in order to optimize the supply chain as a whole. Hence, in a production site selection, other strategic aspects of the supply chain design, such as the selection of suppliers, the location of distribution centers and customers, capacity consideration, and strategic goals must be taken into account. Moreover, the selection of a production site must include tactical aspects of supply chain design, such as determining inventory or material flows, coordinating production and distribution, and choosing delivery schedule(s), and operational aspects, such as determining the product-specific level of stock safety at each location or identifying customer demand requirements (see Sabri and Beamon, 2000, 578; Surana et al., 2005, 4244). Therefore, selecting a production site should ideally be such that it enhances the configuration of the supply chain on the strategic level while simultaneously contributing to an advantageous framework for the tactical and operational supply chain design. Overall, according to the literature on supply chain design, only such an integrated approach can create a sustained competitive advantage for the firm with regard to its supply chain.

2.5 Location Factors

2.5.1 Definition and Role of Location Factors

Location factors refer to specific factors which reflect the conditions at a location (see Goette, 1994, 255-259), and thus, are the determining factors in the decision on where firms locate their activities (see Rogalska, 2020, 601; Neumair et al., 2012, 233; Autschbach, 1997, 124). As location factors describe characteristics that are specific to individual locations, they vary by definition from location to location. As such, location factors reflect characteristics of locations that are not present to the same extent at each location, but instead vary across space in terms of quality and quantity (see Schöler, 2005, 23). Location factors are location-specific dimensions, which impact the achievement of corporate goals. With the help of location factors, firms can evaluate and compare different locations (see Balderjahn, 2014, 61). Though for Weber location factors are specific advantages which lead to cost savings from conducting an activity at a certain location at lower costs than elsewhere (see Weber, 1922, 18-20), location factors are not necessarily an advantage. Whether a location factor becomes an advantage for a firm depends on the quality (or quantity) of that location factor at the location under consideration.

There are some location factors which are relevant to any kind of location problem regardless of the industry the firm belongs to, the characteristics of the firm, the function that is performed at the location, or the relevant strategies. Examples of those location factors are security and political stability. However, the relevance of many location factors varies based on the firm, the industry to which it belongs, its strategy or the function that will be carried out at the location. In the case of a production site, the relevance of location factors also varies with the product that will be produced and the production process that will be used therein. This varying relevance of some location factors has been highlighted by many authors (see Schöllhammer, 1989, 1960-1965; Tesch, 1980, 521; Meyer, 2006a, 38; Grauer, 2009, 76-90). These location factors are referred to, respectively, as industry-, firm-, strategy-, function-, product- or process-specific location factors.

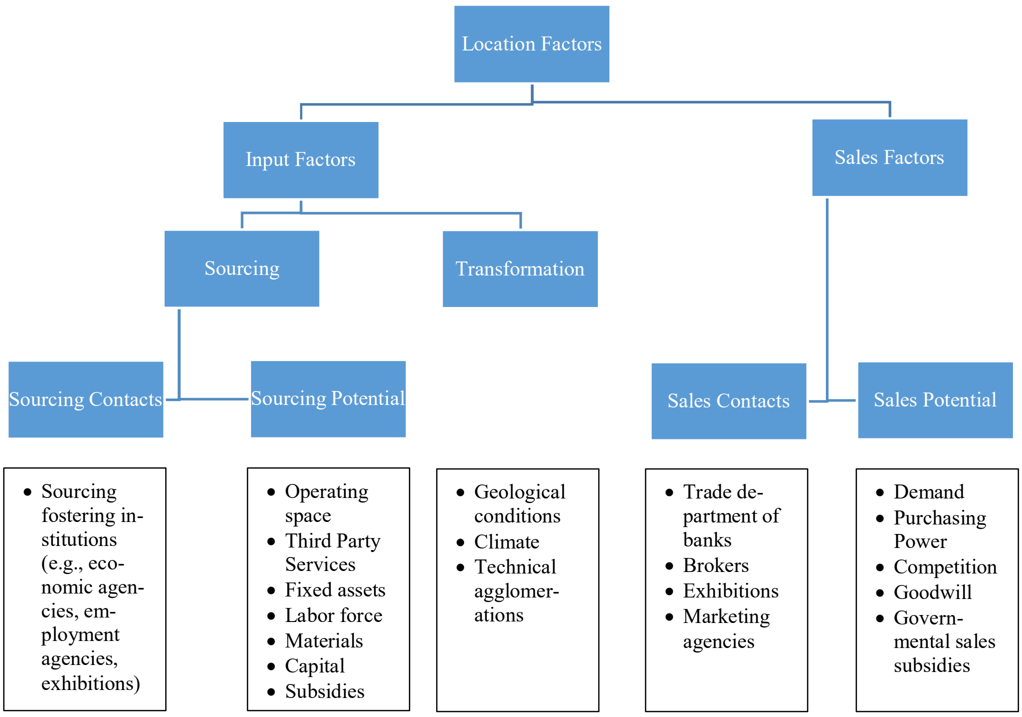
As mentioned in 2.4.1 Location Determining Theory, representatives of the empirical-realistic location determining theory have acknowledged the importance of location factors and their systematization for firms to solve their location problem. As a consequence, they have defined location factors and developed systematizations for them to facilitate solving the firm's location problem. As location factors reflect the conditions at locations, their analysis is necessary for the firm to be able to align its requirements on the location with its conditions. This alignment results in choosing the location, in general, or production site, in particular, whose conditions best meet the requirements, and must be based on a thorough analysis of location factors.

In the following sections, content-related systematizations of location factors, which have been developed to facilitate solving the firms' location problem, are introduced. Moreover, different forms of location factors are described, which is important for evaluating location factors. Lastly, industry-, firm-, function-, or strategy specific location factors, as well as product-specific and process-specific location factors, are discussed.

2.5.2 Content-related Systematizations of Location Factors

Several authors have developed a variety of content-related systematizations of location factors with the goal of facilitating the solution to the firm's location problem. The first comprehensive systematization of location factors was formulated by Behrens, who differentiates between input- and sales-related location factors. He further subdivides input-related location factors into transformation- and sourcing-related location factors, while sourcing consists of sourcing contacts and potential. Likewise, he also groups sales-related location factors into sales contacts and sales potential (see Figure 5) (see Behrens, 1971, 47-81; Kappler and Wegmann, 1985, 236; Kappler and Rehkugler, 1991, 222).

Figure 5: Systematization of Location Factors in reference to Behrens



(Author illustration in reference to Kappler and Wegmann, 1985, 236)

Tesch identifies three categories of location factors depending on their impact. The first category consists of location factors that impact all activities of a firm, such as rule of law, political stability, or competition policy. The second category is made up of location factors which exclusively impact the availability and costs of factors of production, such as legal regulations constraining production, availability, and costs of capital, real estate, buildings, labor, or raw materials. The third category contains location factors which impact sales, such as local demand, competition, or possibilities for exports (see Tesch, 1980, 364-365). Like Behrens' systematization, Tesch's systematization of location factors is also function-oriented. Similarly, Schöllhammer differentiates country-, firm- and product-specific location factors (see Schöllhammer, 1989, 1960-1965). Farhauer and Kröll distinguish between so-called natural location factors which reflect natural conditions at the location and those that do not. Natural location factors are not transferable to other locations, but instead are inextricably linked to the location. They include fertile soil for agricultural production or the availability of raw materials that can be used as inputs for production (see Farhauer and Kröll, 2014, 56-57).

Sabathil's systemization of location factors is somewhat more detailed as he formulates seven categories of location factors: those characterizing sales and production conditions, those determining the supply with components from production sites, taxes, exchange rate issues, internal factors, and the possibility of acquiring entire firms or parts of firms (see Sabathil, 1969, 50-226). Like Sabathil, Seidel (1977) and Goette (1994) have each developed systematizations of location factors, but it is worth mentioning their special features. Particular to Seidel's systematization is his analysis of location factors, which determine social and political-legal conditions. With regard to political-legal conditions, Seidel differentiates between those determined by indirect and direct intervention of the local government, with indirect interventions being governmental measures which impact the demand or supply of goods, or economic policy measures, while direct interventions are prohibitions and requirements, such as regulations on the use of local goods or raw materials, on the control of foreign firms or on the possibility to raise capital (see Seidel, 1977, 29-86). The noteworthy feature of Goette's categorization is its inclusion of cultural and geographic factors. While language, mentality, religion, or the level of acceptance of foreign firms are cultural factors, climate or weather conditions are geographic factors (see Goette, 1994, 175-254).

Autschbach formulates somewhat different categories of location factors as he differentiates between economic, governmental, or political, legal, technological, social, cultural, and natural location factors (see Autschbach, 1997, 205). More recently, Kinkel has developed a systematization of location factors in reference to Behrens. Kinkel adds to the production-related and sales-related location factors, performance and network-related location factors. Kinkel explains that these are especially important, as his systematization of location factors explicitly focuses on facilitating the selection of production sites. While network-related location factors reflect conditions relevant to the functioning of the production network at the production site, performance location factors reflect conditions at the production site which can be influenced by the firm once it has selected a production site (see Kinkel, 2009a, 59; Kinkel and Zanker, 2007, 153-157). Focusing rather on the geographical aspect, Rogalska differentiates between location factors that are 'associated with the geographical locations, such as temperature, precipitations, distance to the sea, presence of natural resources, availability of farmland' and those which are 'connected with human activities and economic incentives' (Rogalska, 2020, 601). Meanwhile, Dziemianowicz et al. divide location factors into three groups depending on the impact local authorities have on them: the first group accounts for 'factors that directly relate to actions (of lack thereof) on the part of local authorities', while the second only deals with 'factors indirectly dependent on local authorities', and the third with 'factors completely independent of local authorities, resulting from interventions from the central (or supra-regional) level, or from geographical location of the presence of specific natural resources' (Dziemianowicz et al., 2019, 1185). In contrast, Moradlou et al. see two groups of location factors: 'market-seeking' and efficiency-seeking' location factors. The former reflect conditions such as the access to large markets, while the latter include factors such as tariffs, non-tariff barriers, or efficiencies in ports (Moradlou et al., 2021, 103).

These systematizations of location factors reveal the variety of location factors that can be taken into consideration in a selection process and show that there are many ways to systematize location factors based on their content. Moreover, these systematizations illustrate the need to systematize location factors to facilitate the difficult but very important choice of location factors for solving the firm's location problem.

2.5.3 Different Forms of Location Factors

The differentiation between different forms of location factors is necessary for their evaluation. In this section, the differentiation between hard and soft, as well as between qualitative and quantitative, location factors, is explained first. Then, the differentiation of location factors depending on the geographic space that they characterize is introduced. Last, location factors which are considered as given are differentiated from those which are expected to change over time.

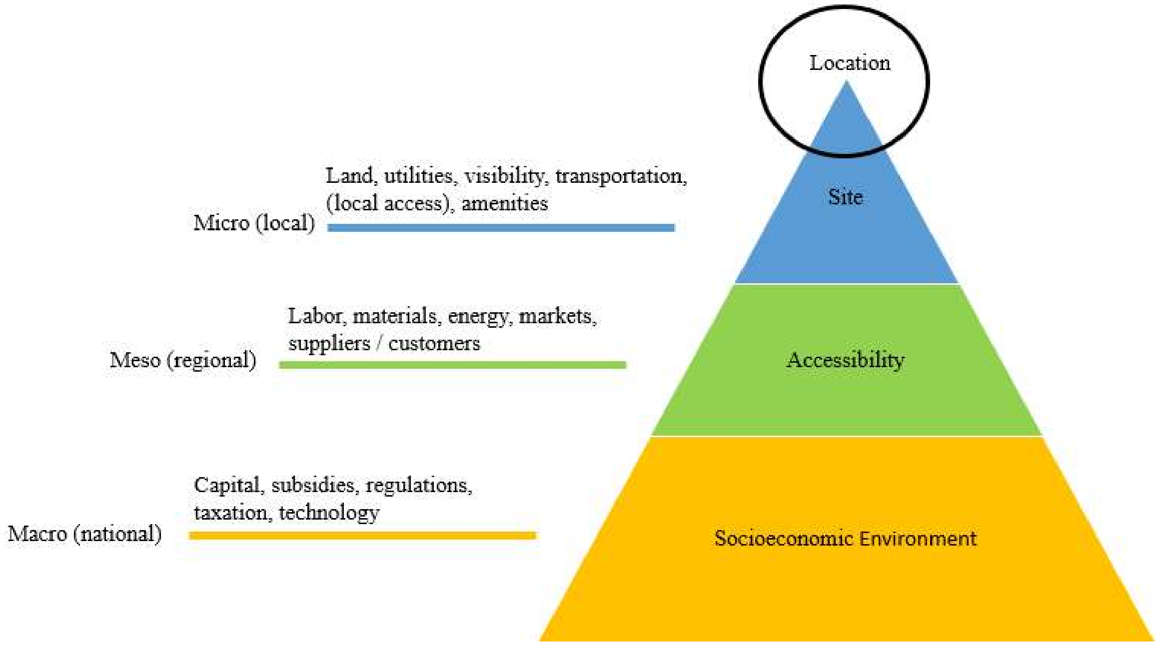
The difference between hard and soft location factors lies in the way they impact the activity that is planned to take place at the location; hard location factors have a direct, measurable effect on the costs or revenues of the activity located at the location and are normally economic in nature, while soft location factors impact the activity in an indirect, non-measurable way, and are difficult to quantify monetarily and, normally, not economic in nature. Hard location factors include transport costs or the local wage level, while political and legal framework conditions are examples of soft location factors (see Farhauer and Kröll, 2014, 57; Neumair et al., 2012, 234-325; Schöler, 2005, 24-25).

Location factors are further distinguished between quantitative and qualitative location factors. Qualitative location factors reflect some qualitative information about the conditions at the location, such as protection of intellectual property, rule of law, or risk of political unrest. Qualitative information is nonmetric information, as it is often based on subjective assessments or reflects fundamental relationships or developments. Qualitative information is either nominally or ordinally scaled information. Due to the partial uncertainty ('partielle Unbestimmtheit') of qualitative information, its formal analysis is not possible without its quantification (Klein and Scholl, 2011, 34). However, quantification is only possible for some qualitative location factors, such as political risk or social unrest. Once they are quantified, they can be treated like quantitative location factors, for instance, by approximating them in terms of costs of capital. The quantification of other qualitative location factors is only possible to a certain degree (e.g., rule of law) (see Meyer, 2006a, 39; Ottmann and Lifka, 2010, 2). Other non-quantifiable but very relevant qualitative location factors for selecting a production site include the availability of skills and community-related location factors, such as recreational facilities. Qualitative location factors cannot be simply aggregated into indexes as many of these factors do not outweigh each other and thus indexes would not portray the relevant information accurately. For example, a good protection of intellectual property does not compensate for a high risk of social or political unrest. Each of these qualitative location factors must be assessed independently. In contrast, quantitative information is metrically-scaled information; in particular, ratio-scaled or interval-scaled information. Quantitative location factors have the advantage that they can be subjected to mathematical calculations, processed using equations, and assessed through mathematical methods, as they can be formulated in mathematical relationships (see Klein and Scholl, 2011, 34; Adam, 1996, 81, 86). Advantages of using mathematical methods are their high degree of clarity, their intersubjective controllability, and the possibility to use mathematical laws and methods in their calculations (see Adam, 1996, 81, 86). Quantitative location factors can be distinguished into cost-related and non-cost-related quantitative location factors. Cost-related quantitative location factors can be measured in terms of costs—e.g., in EUR or US$—while non-cost-related quantitative location factors include all quantitative location factors, which cannot be measured in terms of costs, but instead in other units of measurement, e.g., meters, square meters, hours.

Location factors also vary with regard to the geographic space that they characterize (see Schöler, 2005, 24-25). While Autschbach states that location factors vary mainly across countries, but not significantly within a country (see Autschbach, 1997, 124), Nielsen et al. differentiate between macro-location and micro-location factors: macro-location factors vary across countries while micro-location factors vary within a certain country (see Nielsen et al., 2018, 191, 197-201). Tesch differentiates between national, regional, and local location factors, thus, between location factors that characterize the geographic space of a country, a region or a certain location (e.g., a production site). Accordingly, there are some location factors that are only relevant on the national, regional, or local level (see Schöler, 2005, 24-25; Tesch, 1980, 367). Likewise, Rodrigue subdivides location factors into three 'functional categories': 'site', 'accessibility' and 'socio-economic environment' (see Figure 6). The location factors in the category 'site' are referred to as micro-location factors since they reflect the 'micro-geographical (local) characteristics' (e.g., availability of plots of land), while those in the category 'accessibility' are referred to as meso-location factors since they reflect 'meso-geographical [(regional)] characteristics' (e.g., availability of skills). Additionally, the location factors in the category 'socioeconomic environment' are referred to as macro-location factors because they reflect the 'macro-geographical [(national)] characteristics' (e.g., regulations or taxation) (Rodrigue, 2020b, 75-76).[46] Overall, micro-, meso- and macro-location factors, or local, regional and national location factors are used interchangeably.

[46] For an overview of regional or meso-location factors see Eckey, 2008, 107.

Figure 6: Categorization of Location Factors in Micro-location Factors, Meso-location Factors and Macro-location Factors developed by Rodrigue



(Author illustration in reference to Rodrigue, 2020b, 76)

Moreover, location factors are differentiated between those which are considered as given, and those which are expected to change once the activity under consideration is situated at that location. These location factors that are expected to change once a firm is, for instance, constructing a production site at a location, are referred to as 'semi-external' location factors. With regard to production sites, Meyer explains that an example for a semi-external location factor is the local wage level, which increases as a reaction to a firm deciding to establish a production site at that location, given the expectation that the demand for labor will increase once the production site is in operation. The reaction of wages of highly skilled labor is even more extreme, since these workers are often scarce and might become even more so, and thus also more expensive, as the firm adds to the local demand for skilled workers (see Meyer, 2006a, 39-40). A special kind of semi-external location factors are performance location factors. Kinkel and Zanker define 'performance location factors' as ones that can be influenced by the firm once it has made the decision to locate an activity at that location. By influencing these location factors, firms can significantly increase the profitability of operating the activity (e.g., a production site). Examples of performance location factors are the productivity and quality of production or the local infrastructure, which can be improved through investments in training or infrastructure projects (Kinkel and Zanker, 2007, 153-

157).[47] While semi-external location factors include all location factors that (can) change in reaction to the firm locating the activity at the location, performance location factors are a specific kind of semi-external location factor, which the firm can actively influence to improve the conditions at the location.

Overall, differentiating between different forms of location factors is important for their evaluation. First, hard and soft location factors are differentiated based on their impact on the operations at the location. Second, qualitative and quantitative location factors are differentiated based on the information (metric or nonmetric) that they reflect, as their evaluation requires different methods. Third, location factors are distinguished based on the geographic space they characterize and fourth, semi-external and performance location factors are differentiated: semi-external location factors reflect conditions which are expected to change in reaction to a firm locating (or even announcing to locate) the activity at the location, while performance location factors are a specific kind of semi-external location factor which reflect conditions that the firm can improve.

2.5.4 Relevance of Location Factors

2.5.4.1 Industry-specific, Firm-specific or Function-specific Location Factors

Weber differentiates between 'general' location factors, which equally affect firms from all industries, and 'specific' location factors, which have varying relevance depending on the firm's industry (Weber, 1922, 18-20). Similarly, Sule points out that due to the differences between industries, the relevance of individual location factors varies from industry to industry (see Sule, 2008, 612) and Ottmann and Lifka state that the importance of individual location factors depends on the individual goals of the industries and firms (see Ottmann and Lifka, 2010, 8). Industry-specific location factors are those that vary with the industry to which the firm belongs: for instance, the availability of skills is less important for a firm from the textile industry searching for a production site than it is for a firm from the automotive industry, given the different skill requirements

[47] Kutschker and Schmid consider the micro-environment as a 'task-environment'. They differentiate between location factors, which define the macro-environment, and those which define the micro-environment. While the macro-environment consists of factors which are country-specific and are generally seen as given for a firm, the micro-environment is determined by market-specific and industry-specific factors, which can, to some extent, be influenced by the firm, which is why they refer to the micro-environment also as 'task-environment' (Kutschker and Schmid, 2011, 443). As this differentiation sets on one side those location factors that should be considered as given equally with those that determine the macro-environment and on the other side those that can be influenced by the firm with those that determine the micro-environment, this differentiation is not realistic mainly because there are also location factors that determine the micro-environment but cannot be influenced by the firm. The idea of a task-environment, while still interesting, is better reflected in the environment that is determined by those location factors that are referred to above as performance location factors.

in their production processes. Other industry-specific location factors are certain regulations or the availability of suppliers.[48]

Firm-specific location factors depend on the firm's characteristics. Hence, not all location factors are equally relevant for all firms (see Nielsen et al., 2018, 201). Firm-specific location factors can be determined by the size (see Shi, 2001) or the ownership structure (see Hong, 2007, 679-681) of a firm, as the relevance of specific location factors varies with the ownership structure and size of the firm; for example, between large corporations and family-owned firms (see Kahn and Henderson, 1992, 278-280). Besides the size and ownership structure, the firm's technologies, and human capital (see Shaver and Flyer, 2000, 1175-1177), or the experience of internationalization (see Chen and Yeh, 2012, 1176; Coeurderoy and Murray, 2008), can also determine firm-specific location factors. An example of a firm-specific location factor is the availability of infrastructure, as large corporations have more financial means to invest in the infrastructure at the location, while smaller firms with more limited financial resources must ensure that most infrastructure is readily available at the location (see Meyer, 2006a, 58). Another example of firm-specific location factors are agglomerations, as firms with a high level of technology sometimes prefer remote locations rather than agglomerations, given they do not benefit enough from joining a cluster due to the risk of spillover of their know-how (see Shaver and Flyer, 2000, 1177-1179, 1191).

The relevance of specific location factors varies not only depending on the industry or firm, but also on the business function, which will be at the location (e.g., Production, R&D, Human Resources, Sourcing, Logistics) (see Kimelberg and Williams, 2013, 93). Examples of function-specific location factors are the availability of skills or raw materials, as well as buildings or land. Kimelberg and Williams confirm the importance of a function-specific approach to the location problem in their empirical analysis, as they find that, for most location decisions, the relevance of location factors varies with the function (or facility type) (see Kimelberg and Williams, 2013, 93-94, 109). Sule, Kinkel, as well as Kinkel and Zanker, also emphasize the function-specific relevance of location factors and highlight the necessity to apply a function-specific perspective to the analysis of location factors. They point out that location factors, which are especially important for the function of production, hence production-specific location factors, include transportation facilities, labor supply, availability of land, proximity to sales markets or the availability of suitable

[48] Autschbach has assessed in a survey that the most relevant location factors to decision-makers in the automotive industry were the market potential and legal location factors, such as rule of law, foreign direct investment-related regulations, and branch-specific regulations (see Autschbach, 1997, 206).

utilities (see Sule, 2008, 612). As a production site must be integrated in a production network, especially in the automotive industry, network-related location factors are also relevant when selecting a production site. According to Kinkel, as well as Kinkel and Zanker, network-related location factors include the physical proximity to know-how-centers, innovative branch-specific clusters and suppliers, as well as the physical connection between production and R&D (see Kinkel, 2009a, 59; Kinkel and Zanker, 2007, 153-157).

Hence, the relevance of many location factors varies with the industry the firm belongs to, as well as with the firm and the function for which the firm is searching for a location. These location factors are referred to as industry-specific, firm-specific, or function-specific location factors.

2.5.4.2 Strategy-specific Location Factors

The firm's strategy in general and the specific strategic goals, which the firm pursues related to solving the location problem, have an important impact on the relevance of certain location factors. These location factors, which reflect conditions at the location that are relevant to the pursuit of certain strategies or related strategic goals, are referred to as strategy-specific location factors. Accordingly, Nachum and Wymbs find that the relevance firms attribute to agglomeration and industrial clusters (or proximity to related firms) vary with their strategy of product differentiation (see Nachum and Wymbs, 2005, 426-428). Accordingly, Kinkel explains that location factors, which are evaluated for selecting a production site, should be deduced from the firm's strategy (or strategic goals), to guarantee that the location factors taken into account in the selection conform to the firm's strategy and strategic goals, and that the selection process and the final selection of a production site meet the strategic significance of a production site selection for the firm (see Kinkel, 2009a, 57). As an example, Kinkel specifies, for each of the four typical internationalization strategies, the ten most relevant location factors based on survey results (see Kinkel, 2009a, 63-80). Like Kinkel, Schnellberg categorizes location factors according to their relevance for the pursuit of 26 possible goals which, according to Schnellberg, a firm can pursue by selecting a production site (see Schnellberg, 2002, 177-186). Hence, both Kinkel and Schnellberg acknowledge the importance of the firm's strategy and strategic goals for choosing relevant location factors in the selection process.

In short, the relevance of some location factors depends on the strategy or strategic goals the firm pursues with the new production site. A firm pursuing differentiation requires the availability of highly skilled workers at the production site to ensure the high quality of the product, while a firm pursuing cost leadership seeks a production site with the lowest wages possible. Hence, strategy-specific location factors reflect conditions at the location whose relevance varies with the strategies and strategic goals that the firm pursues with the new production site.

2.5.4.3 Product-specific and Process-specific Location Factors

To select a production site, there are also location factors whose relevance varies with the product that will be produced, and the production process that will be used at the production site. These location factors are referred to as product-specific and process-specific location factors, respectively. Meyer explains that a production site is not universally attractive for production, but instead is only appropriate for a certain production process and the production of a certain product (see Meyer, 2006a, 38-39). Grauer[49] points to the protection of intellectual property as an example of a product-specific location factor, as the level of know-how embedded in a product depends on the product, and thus the product determines the importance of protection of intellectual property at the production site. Other product-specific location factors include the availability of suppliers and the modes of transportation, as the number and kind of required components depends on the product, and the volume and weight of the product determine possible or profitable modes of transportation. Process-specific location factors are important to determine whether the conditions at a certain location are conducive for operating a certain production process. Process-specific location factors include the size and shape of the building, the availability of skills (see Grauer, 2009, 74), or the required energy or water supply. Meyer differentiates between quantitative process-specific location factors, which are input-related (e.g., required skills and working hours, capital requirements for the means of production or required energy, components or raw materials, and requirements for delivery times of input factors) and qualitative process-specific location factors (e.g., production process complexity, know-how, patents, or pollution) (see Meyer, 2006a, 38-39).

Hence, product-specific location factors are location factors, which reflect conditions at the production site whose relevance varies with the product which is to be produced at the location.

[49] Grauer formulates for each product module (product modules are self-contained units of a product, which can be clearly separated from other modules of that product) certain qualitative and quantitative requirements on the production site (see Grauer, 2009, 74), which must be met by the conditions at the production site, reflected in the corresponding location factors, in order to successfully produce that product module there.

Similarly, process-specific location factors are location factors which reflect conditions whose relevance varies with the production process planned to be implemented at the location.

2.6 Summary of Chapter 2

Chapter 2 defines key concepts for this work and introduces the relevant literature for developing a process model for selecting a production site. As the goal of this work is to develop a generic process model for selecting a production site, which is a specific kind of location, and the goal of location theory is to clarify the geographic dimension of firms' activities and thus solve the firm's location problem, location theory is the relevant theory for this work. Location theory analyzes where firms conduct their activities and thus always focuses on the behavior of firms. Chapter 2 classifies location theory, introduces relevant categories of thereof, and presents the theory on location factor.

The classification of location theory is not simple as it is traditionally part of Economic Geography (EG) and of Regional Economics (RE), but the literature on International Business (IB) and the New Economic Geography (NEG) also contributed to location theory. While in both, EG and RE location theory focus on the behavior of firms (see Lee and Wilhelm, 2010, 227-228), EG analyzes the location from a location perspective and RE from an economic perspective. Representatives from the field of IB contributed to location theory by addressing the issue of which locations firms select for particular activities and for which reason, while representatives from the field of the NEG attempted to give location theory an economic foundation and to integrate economic concepts therein. The classification of location theory illustrates that the problem lies between these fields of research and cannot be solved by only taking aspects from one field into consideration. Instead, all of them should be considered. Hence, analyzing a location as a potential production site requires the consideration of its geographic position with regard to other production sites, suppliers, clusters, natural resource deposits or transportation facilities, from a geographic perspective, as well as an economic perspective. Moreover, business-related aspects of production sites, such as labor costs, availability of skills, or functioning infrastructure must play a major role in selecting a production site, while economic concepts, such as economies of scale, imperfectly competitive markets, or external effects must also be taken into account when evaluating production sites.

Moreover, the various categories of location theory are introduced in Chapter 2, while only the relevant categories are dealt with in detail. The most relevant categories for developing a process model for selecting a production site are the location determining theory and the location planning theory, as they are both normative theories and address the firm's location problem. The objective of location determining theory is to identify the most appropriate location for a firm by identifying location factors that are relevant to firms' decision-making process in their search for locations and by developing models to evaluate these relevant location factors. Two of the three main subtheories of the location determining theory, the pure (exact) location determining theory, and the geometric location determining theory, are not relevant for developing a process model for selecting a production site since they formulate the firm's location problem in models that are unable to capture the complexity of the problem firms face when selecting a location, in general, or a production site, in particular, given their purely cost-focused or purely quantitative approach. Instead, representatives of the empirical-realistic location determining theory address the variety of location factors, acknowledge their importance, and provide systematizations thereof to facilitate the solution of firms' location problem, though none of them develop a process model that can be used for the successful selection of a production site in practice.

The other relevant category of location theory for developing a process model for selecting a production site is the location planning theory. The goal of the literature on location planning is to provide methodical support to help firms solve their location problem (see Friedli et al., 2013, 24) by systematically examining the different phases of firms' selection process and formulating models that help firms to find the most appropriate location. As part of location planning theory, many models have been developed to solve the firm's location problem by only taking cost-related quantitative aspects into account. However, the firm's location problem is too complex to be solved by a purely quantitative model. Thus, in Chapter 2 only non-purely quantitative models and approaches to the firm's location problem are introduced, systematized, and analyzed. They are separated into three groups: first, process models which are developed in the field of marketing to identify the most attractive sales markets, second, process models which are designed to select production sites, and third, process models which are designed to plan or optimize entire production networks. These process models are analyzed with regard to steps, aspects, and ideas which are useful for developing a process model for selecting a production site. Moreover, the literature on supply chain design is introduced and relevant aspects for developing a process model for selecting a production site are highlighted.

The selection process models which have been developed in the field of marketing by Seidel (1977), Henzler (1979), Stahr (1982), Schneider and Müller (1989), Köhler and Hüttemann (1989), Backhaus and Voeth (2010) and Balderjahn (2014) are introduced. As in the field of marketing, the goal of location selection is to identify the countries with the most attractive sales markets; in the marketing context, location refers to the entire market and not to a specific production site. Consequently, these selection process models remain on the national level of analysis and neglect all regional and local aspects which are of crucial importance for selecting a production site. Hence, these process models are not adequate to solve the more complex location problem of selecting a production site. Still, their analysis reveals several interesting aspects for developing a process model for selecting a production site, including the awareness of limited information and of constrained time and resources that firms can allocate to the selection of locations, the differentiation between firm-specific or product-specific requirements, or the necessity of a dynamic analysis of location factors. These aspects should be incorporated when developing a process model for selecting a production site.

Moreover, process models developed for selecting a production site are discussed. The goal of these selection process models is the same as that of the process model developed in this work. This chapter briefly introduces the process models developed by Timmermann (1972), Lüder and Küpper (1983), Sabathil (1969), Goette (1994), Autschbach (1997), Eversheim (1999), as well as in the BESTAND project to highlight aspects, either incorporated in these models or suggested by their authors, that must be taken into account when developing a process model for selecting a production site. These interesting aspects include the importance of thoroughly defining the requirements on the production site in advance, the need to differentiate between different geographic levels in the analysis of location factors, the existence of country-specific, industry-specific, and firm-specific location factors, the relevance of gaining information on location factors or the need to deal with uncertainty in assessing location factors. Despite these interesting aspects, it can be concluded that there is no selection process model which satisfies the requirements of a selection process model, and which OEMs can implement to select the most appropriate production site for their specific production activity in practice, as they are not detailed enough—for instance, in terms of assigning methods for evaluating particular location factors, in terms of the order to evaluate location factors in the selection process, or of the choice of location factors, or in terms of the possible measurements of location factors. Furthermore, these selection process models do not determine the geographic level of analysis or provide sources of information for the location factors.

A related branch of literature focuses on developing a process model to plan or optimize the firm's entire production network. These process models aim to capture the complexity of production networks which arise from the many interdependencies between its individual parts, as well as from the interdependencies of product design, the production process, and location in a production network. The process models developed by Herm (2006), Schnellberg (2002), Meyer and Jacob (2006), as well as Grauer (2007), are laid out. Not all these contain detailed process models for selecting production sites; however, they all contain some ideas and aspects which are relevant for developing a process model for selecting a production site. Overall, the analysis of these process models reveals that the significant interdependencies between different production processes, product designs, and locations must be considered during the selection process of a production site, and that the selection of a production site has a significant impact on other parts of the production network. Thus, they emphasize the relevance of network-related aspects for the selection process of a production site. Moreover, these process models reveal the helpfulness of a list or overview of location factors for the selection process, the measurability of location factors as prerequisite for their evaluation in a selection process, and negotiations as a means to impact the conditions at production sites. Despite these aspects, which are relevant for developing a process model for selecting a production site, none of these approaches provides OEMs with an instrument with which they can select the most appropriate production site for their specific production activity in practice.

In addition, the literature on supply chain design is also relevant to developing a process model for selecting a production site as selecting a production site is part of strategic supply chain design. Supply chain design deals with the complex decisions of setting up the supply chain and addresses the shift in focus of firms with regard to their supply chains from originally independent management of the different parts of the supply chain to an integrated management of the total supply chain. While a variety of models have been developed in the literature on supply chain design, many of these models are based on mathematical programming techniques and optimization and only focus on parts of the supply chain for modeling. Still, some of the issues, which these models deal with in regard to selecting production sites, are also relevant to developing a process model for selecting a production site. The literature on supply chain design acknowledges that selecting a production site, a strategic supply chain design decision should ideally enhance the strategic set up of the supply chain and simultaneously contribute to an advantageous framework for the tactical and operational supply chain design. Hence, the literature on supply chain design reveals that in order to successfully integrate the new production site into the supply chain and to enhance the supply chain design by selecting a new production site, aspects such as inventory, routing, capacity planning, flexibility, supplier selection, and their integration in the supply chain, delivery schedule(s), product design, as well as risks of supply chain disruptions must be considered in the selection process of a production site.

Furthermore, the theory on location factors, which is part of location theory, is introduced. Location factors vary by definition from location to location, as they describe characteristics that are specific to individual locations. Because representatives of the empirical-realistic location determining theory have acknowledged the importance of location factors and their systematization for firms to solve their location problem, they developed systematizations of location factors to facilitate solving the firm's location problem. Chapter 2 introduces the most relevant content-related systematizations of location factors. These systematizations of location factors reveal the variety of location factors that can be considered in the selection process and illustrate the need to systematize location factors to facilitate the difficult but very important choice of which location factors to analyze to solve the firm's location problem.

Moreover, different forms of location factors are differentiated, which is necessary for evaluating location factors in a selection process. First, hard and soft location factors are differentiated based on their impact on the operations at the production site: hard location factors have a direct impact while soft location factors have an indirect impact. Second, qualitative and quantitative location factors are differentiated based on the information that they reflect, as they require different methods of evaluation. Third, location factors are distinguished based on the geographic space they characterize and, fourth, semi-external and performance location factors are differentiated: semi-external location factors reflect conditions which are expected to change in reaction to the firm locating the activity at the location, while performance location factors are a specific type of semi-external location factors, which reflect conditions at the location that the firm can improve. Finally, it is explained how the relevance of many location factors varies depending on the industry of the firm which searches for a production site, on the firm itself, on the strategy that the firm pursues with regard to the location, as well as on the function that will be performed at the location, and, in the case of a production site, on the product that will be produced, and the production process that will be implemented at the new production site. Hence, the literature on location factors shows that location factors and their systematization are important for the selection of a production site in general and that the awareness of different forms of location factors is crucial for their successful evaluation in a selection process.

Overall, this general review of the relevant literature and, in particular, the included analysis of the literature on selection process models for a firm’s location, be it for sales markets, individual production sites or production sites as part of production networks, illustrate that no generic process model has been developed so far, which is both generic and at the same time detailed enough for firms and, in particular OEMs, to apply it in practice when selecting a production site.

3 The Selection Process Model

3.1 Structure and Scope of the Selection Process Model

In Chapter 3, a generic process model which OEMs can apply in practice to select the most appropriate production site for their specific production activity is developed. In order to satisfy the complexity of the production site selection of an OEM and the strategic importance for the OEM of the long-term, sizeable investment associated with a new production site, the selection process model is developed to ensure the selection of a production site as part of the OEM's global production network and supply chain and is meant to advance its strategic goals. Hence, the selection process model applies a strategic and network perspective and takes aspects into account which are relevant to the design of the supply chain. Furthermore, the selection process model is developed on the premise that a purely quantitative model cannot realistically solve the location problem of a firm in general and even less so the selection of a production site of an OEM given its great complexity and numerous qualitative aspects that must be taken into consideration. Additionally, the selection process model is based on the assumptions that the realistic analysis of the conditions at potential production sites requires evaluating the change of these conditions over the planning horizon and that, specifically, the future development of many of these conditions can only be assessed with uncertainty.

The process model for selecting a production site for OEMs is developed in Chapter 3 in four parts: first, the framework in which the selection process takes place in an OEM is described and the necessary preparation for successfully implementing the selection process is determined. Preparing the selection process mainly includes determining the OEM's requirements on the production site, as well as setting-up the project team and assigning responsibilities. This preparation must be completed before the selection process can start, as it serves as its starting point. Second, perspectives and basic assumptions upon which the selection process model is based for a successful selection are defined and it is explained how the perspectives are applied and the basic assumptions are considered in the selection process model. Third, necessary instructions for choosing location factors (from the discussion of location factors in Chapter 4) and evaluating them are provided in detail. The instructions for evaluating location factors include details on the geographic granularity of evaluating location factors, on sources of information on location factors, on measuring location factors and on methods for evaluating location factors. Fourth, the procedure of the selection process model is laid out and the tasks and characteristics of each phase of the procedure are specified on a generic level. Moreover, the discussion of location factors, which are relevant to selecting a production site for an OEM, is an integral part of the selection process model developed in Chapter 3, even though it is isolated in Chapter 4.

The selection process model is detailed enough to ensure its applicability for OEMs selecting a production site, while simultaneously providing sufficient flexibility to be adjusted to the needs of each OEM and the specific production activity incentivizing their search for a production site. This work guarantees the applicability of the selection process model, on the one hand, and its flexibility on the other, by providing a combination of detailed instructions for preparing and implementing the selection process, the generic definition of the procedure of the selection process model, and the discussion of location factors with all necessary specifications for choosing and evaluating the relevant location factors.

To ensure a successful selection of the most appropriate production site in practice, the selection process model is developed to pursue the following four goals:

- Identify the most strategically appropriate production site.
- Avoid selecting any but the most appropriate production site due to structural deficits of the selection process.
- Capture the conditions at potential production sites as realistically as possible.
- Consider the conditions under which OEMs implement the selection process in practice.

3.2 Organizational Framework and Preparation of the Selection Process

3.2.1 Organizational Framework of the Selection Process

This section briefly describes the organizational framework in which the selection process takes place in an OEM.[50] The OEM's selection process of a production site is, in many cases, initiated by the Strategy Department, in particular, by the part of the Strategy Department which is responsible for the production strategy by defining the strategic necessity of a new production site. The Strategy Department then presents this strategic necessity to the board of management, since in most OEMs the board of management must authorize the search for a new production site, thereby initiating the selection process. The timeframe for selecting a production site usually lasts

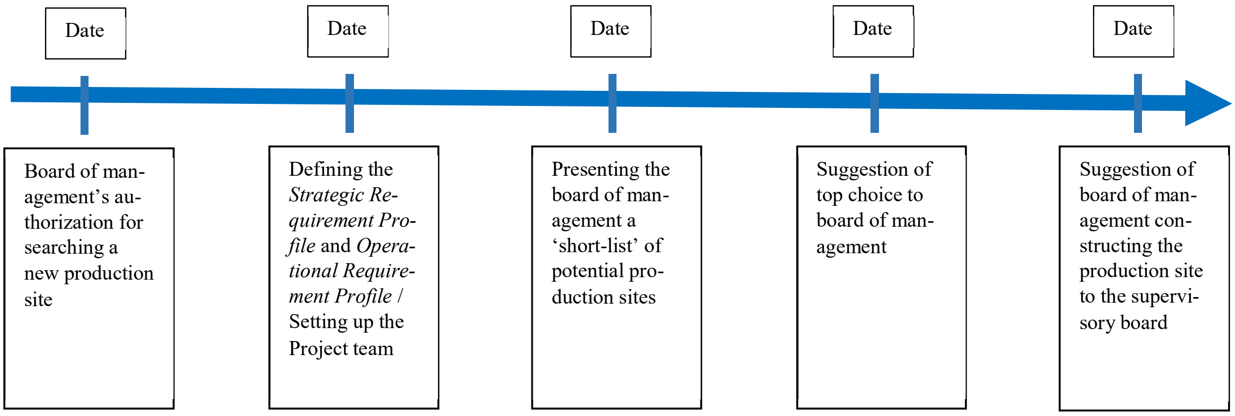
[50] This part is partly experience-based and partly conceptualized for the development of a successful selection process model. This is not a universal approach and the organizational framework is likely to vary from OEM to OEM. However, it may be as described here or similar in any OEM. Still, important for the approach of this work is that the various parts of this selection process model are developed to be consistent with each other and thus form an overall consistent selection process model with the goal of process optimization.

between 1 ½ to 2 years. This timeframe can be somewhat shorter (1 year), if finding the production site is urgent; for instance, due to an acute capacity constraint. In this timeframe, the selection process must be implemented.

Once the Strategy Department receives orders to select a production site, it starts by preparing the selection process. To begin, it finalizes what is in this work referred to as the *Strategic Requirement Profile* (see 3.2.2.2 Strategic Requirement Profile), which consist of the OEM's motive, and the strategic goals and corresponding strategic requirements related to the new production site. Moreover, the Strategy Department must ask the Factory Planning Department to define the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile). In this *Operational Requirement Profile*, the Factory Planning Department, in cooperation with other departments, such as the Production Planning Department and the Human Resources Department, defines all the OEM's operational requirements on the production site. Both the *Strategic* and *Operational Requirement Profile*, along with the *General Requirement Profile, constitute* the *Production Site Requirement Profile* containing all requirements which the OEM has on the production site. Then, the Strategy Department must set-up a project team with members from various business functions or departments and management levels, which will be responsible for selecting the production site (see 3.2.3 Setting-up the Project Team and Assigning Responsibilities). In the course of the selection process, external consultants often help the project team with certain tasks.

After the Strategy Department has finalized the *Strategic Requirement Profile*, asked the Factory Planning Department for the *Operational Requirement Profile* and set-up the project team, the project team continues preparing the selection process by defining a timeline, the budget, and the relevant reporting requirements for the selection process. Important milestones for defining the timeline include: first, the date on which the project team will present the board of management a 'short-list' of potential production sites. At this point, the project team receives the board of management's authorization to end the anonymity in its search and begin negotiating on specifics —such as subsidies or prices of buildings or land plots—as well as visiting the potential production sites under the OEM's name. The second milestone will be the date the project team will suggest the top production site to the board of management (see Figure 7). During the selection process, the project team uses this timeline for determining the individual steps in and contributions to the selection process. The budget must include all expenses to be incurred over the course of the selection process, including those for using commercial external sources, external consultants (man-days), expenses related to employees' visits to potential production sites, and for salaries of the employees involved in the selection process (man-days). Moreover, the project team must clarify the reporting requirements for the selection process to guarantee the required level of transparency, as well as the auditing acceptability of the project. Once this organizational framework has been set-up, the project team can start with the selection process.

Figure 7: Generic Timeline for a Selection Process



(Author illustration)

At the end of the selection process, the project team suggests its top choice to the board of management. In addition, one alternative is to be selected, which is important because the board of management makes the final decision and may not necessarily agree with the project team's top choice for some unanticipated reason. If the board of management agrees with the suggested production site, it approves the construction of the selected production site. Depending on the rules of the OEM, the board of management subsequently suggests constructing the production site to the supervisory board to seek its approval.[51] Once the supervisory board has also authorized the project, the construction of the new production site begins.

As just laid out, there are six inputs to the selection process. Determining these inputs or starting points forms the preparation of the selection process, which must be completed before the selection process can start. These inputs are the following:

[51] In OEMs, 'the Supervisory board must be involved in decisions of fundamental importance as promptly as possible to enable it to exercise due influence on such decisions' (Daimler Group, 2019, 9; see BMW Group, 2017, 11).

- The Strategic Requirement Profile
- The Operational Requirement Profile
- The project team that is responsible for implementing the selection process
- The timeline
- The reporting requirements for the selection process
- The budget required for the selection process.

In the following sections, the necessary details of the *Strategic* and *Operational Requirement Profile* are laid out, which together with the G*eneral Requirement Profile,* constitute the *Production Site Requirement Profile* containing all requirements which the OEM has on the production site. Moreover, it is explained what should be taken into consideration when setting-up the project team. It is worth noting this work does not delve deeper into the timeline, reporting requirements or the budget, as these tasks are regular business activities and not specific to the selection process of a production site. However, to meet the reporting requirements, the selection process model is formulated in a way that ensures a high level of transparency and documentation of the individual steps. Concerning the budget, the developed selection process model is supposed to be applicable for projects with a range of budgets, as the project team can adjust its choice of location factors and the type of evaluation depending on the available resources.

3.2.2 Production Site Requirement Profile[52]

3.2.2.1 Definition and Use of a Production Site Requirement Profile

In the selection process model developed in this work, the most appropriate production site is identified by determining the production site at which the conditions, reflected in location factors, best match the OEM's requirements. This approach is, on the one hand, in accordance with representatives of the empirical-realistic location determining theory (see 2.4.1 Location Determining Theory), who suggest solving the firm's location problem by aligning the firm's requirements with the conditions at the location, and, on the other hand, in accordance with representatives of the location planning theory, who aim to develop tools that firms can utilize to identify the location with the characteristics that best match the firm's requirements (see 2.4.2

[52] The idea for this expression is taken from Eversheim, who uses the expression of a 'Location Requirement Profile' ('Standortanforderungsprofil') (Eversheim, 1999, 9/43).

Location Planning Theory). Rüschenpöhler suggests relying on the alignment of location factors with requirements to determine a location, as he acknowledges that, in order to solve the firm's location problem, the firm's specific requirements on a location must be met by the conditions at the location as reflected in location factors (see Rüschenpöhler, 1958, 67). Goette confirms this approach, explaining that the impact of a location decision on the firm's costs and revenues is far too complex to be calculated, thus firms should not attempt to analyze the effect of location factors on its costs and revenues (thus, its profitability). Instead, Goette suggests firms select production sites based on whether the conditions at the production site, reflected in location factors, meet the requirements which the firm has on that specific production site. This alignment of requirements with location factors necessitates that the firm's management defines its requirements on the production site in advance (see Goette, 1994, 255-259). Consequently, Eversheim, who applied Goette's idea that the goal of the selection process is to find that production site at which the location factors best match the firm's requirements on the production site, suggest constructing so-called 'Location Requirement Profiles' ('Standortanforderungsprofil'), which contain all the requirements that the firm has on the production site (Eversheim, 1999, 9/40 – 9/57).

Following this discussion, the selection process model developed in this work is structured so that the most appropriate production site is identified by evaluating the potential production sites in terms of whether the conditions at these sites, reflected in the location factors, meet the OEM's requirements. Thus, the goal of this selection process model is to select the production site where the conditions best match the OEM's requirements. In accordance with many authors suggesting that management must define the requirements in advance (e.g., Timmermann, Goette, Eversheim, the publishers of the BESTAND project, Herm as well as Meyer and Jacob; see 2.4.2 Location Planning Theory), in this selection process model the OEM's requirements are defined before the selection process starts. In this work, the requirements are defined in a document, which is in accordance with Eversheim's 'Location Requirement Profile', referred to as the *Production Site Requirement Profile*. While Eversheim does not specify in detail what this profile contains, in this work the *Production Site Requirement Profile* consists of three parts: the so-called *Strategic Requirement Profile*, the *Operational Requirement Profile* and *General Requirement Profile*. The requirements defined therein are henceforth referred to as strategic, operational, and general requirements, respectively.[53] The location factors, which reflect the corresponding conditions at

[53] Similarly, Schneider and Müller differentiate in the process model they develop for the selection of sales markets between strategic-oriented and operative-oriented criteria (see Schneider and Müller, 1989, 23-27).

the production sites, are referred to as strategic, operational, or general location factors. In the following sections, the *Strategic, Operational* and *General Requirement Profiles* are explained in more detail, including who is responsible for their composition, and what they should contain.

3.2.2.2 Strategic Requirement Profile

As noted earlier, the Strategy Department defines the strategic necessity of a new production site and presents it to the board of management. This defined strategic necessity contains the underlying motive behind the decision to construct a new production site, and, ideally, also includes related strategic goals. These related strategic goals need to be considered in the selection process for the selection to be in line with the OEM's strategic orientation. Furthermore, to complete the *Strategic Requirement Profile*, the strategic requirements on the production site must be deduced from both the motive as well as the related strategic goals. Together, the motive, the related strategic goals, and the strategic requirements compose the *Strategic Requirement Profile*.

The motive underlying the decision to search for a new production site is most likely one of the following three:[54] Overcoming capacity constraints, overcoming market entry barriers or overcoming competitive disadvantages. Depending on the motive, the OEM establishes a new, additional production site or replaces an existing production site by a new one.[55] Furthermore, the OEM will search on a global scale or with a special focus on a certain country or region for the production site. Additionally, the OEM must decide whether to construct an entirely new production site or to expand an existing production site. The selection process model developed in this work exclusively deals with selecting a new production site. The motive that drives the construction of the new production site must be included in the *Strategic Requirement Profile*.

In addition to defining the motive for constructing a new production site, it is necessary to define the related strategic goals[56] thereof to successfully embed the new production site into the strategic orientation of the OEM. These strategic goals depend on the relevant strategies of the OEM, which include production, network, and competition strategies, the supply chain design, and,

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[54] This topic has been dealt with somewhat differently by Balderjahn (see Balderjahn, 2014, 45).

[55] The particular motive behind the decision to construct a new production site, and how that motive may influence the selection process, has, for example, been discussed by Eversheim, as well as Lüder and Küpper (see Eversheim, 1999, 9/40-9/41; Lüder and Küpper, 1983, 138-150).

[56] Strategic capabilities are certain capabilities related to, for instance, the production network or the supply chain. If the OEM defines in its strategies that it aims to pursue these capabilities, then these capabilities are a strategic goal for the OEM. Hence, strengthening the defined strategic capabilities is a strategic goal. In this work, enhancing strategic goals refers to strengthening strategic capabilities.

possibly, if existing independently, an internationalization strategy. Production strategy deals with the expansion of production activities domestically and internationally and defines strategic goals for which firms internationalize their production. The strategic goals of firms searching for a production site abroad include 'market access', 'cost reduction' or 'access to technology and to innovative know-how' (Kinkel, 2009b, 63).[57] Other strategic goals related to production are the minimization of exchange rate risks (see Goedhardt et al., 2015, 1, 4) or close-to-market production, and access to talent and 'proximity' to 'suppliers' or 'researcher' (Manyika et al., 2012, 4). Network strategy defines all network-related goals of a firm; for example, 'resource accessibility, thriftiness, mobility and learning' (Shi and Gregory, 1998, 202, 208-210), as well as access to information, markets, and technologies (see Gulati et al., 2000, 203), increased efficiency (see Friedli et al., 2013, 48), or diversification of risks (e.g., the goal of limiting dependence on one country). The goals of supply chain design include the optimal selection of sourcing markets or suppliers, the successful planning and coordination of capacity and inventory, optimizing the flow of material and products, as well as a high ability to react, and the efficiency of the supply chain (see Chopra and Meindl, 2014, 29-30, 53-55). Competition strategies traditionally aim at differentiation or cost leadership[58] (see Bloech et al., 2014, 128). From these strategies, the strategic goals which are relevant for the new production site must be deduced. Defining the related strategic goals from the relevant strategies of the OEM and ensuring that these goals are taken into consideration during the selection process guarantees that the selected production site aligns with the OEM's overall strategic orientation and ultimately advances the OEM's strategic goals.

Besides the motive and the related strategic goals, the *Strategic Requirement Profile* must also contain the specific requirements on the production site. These requirements must be deduced

[57] Ferdows lists 'access to low-cost production', 'access to skills and knowledge' and 'proximity to markets' as the main goals of firms searching for a production site abroad (Ferdows, 1997, 77). Bartlett and Ghoshal identify the main strategic goals of firms as follows: to internationalize their activities to be locally present, to have global cost advantages and to benefit from worldwide learning (see Bartlett and Ghoshal, 1990, 29-31). Vereecke and Van Dierdonck focus, like Ferdows, on the internationalization of production and identify the access to suppliers, access to labor, socio-political factors, positioning in regard to competitors, and access to resources as the main strategic advantages which firms pursue with the selection of production sites (see Vereecke and Van Dierdonck, 2002, 501-505). Besides these motives for which firms internationalize their production in practice, the traditional literature of International Business introduces numerous theoretical motives for firms to internationalize their production, including the regression of costs thanks to scale effects, cheaper costs of input factors, the product life cycle, theory of competitive advantage, but also ownership and monopolistic advantage, oligopolistic parallel behavior or trade restrictions (see Kutschker and Schmid, 2011, 403-437).

[58] A firm that pursues differentiation wants to be clearly distinct from competitors in terms of some properties of the firm's products, which are important for some consumers, while a firm that pursues cost leadership wants to offer its products at the lowest cost compared to its competitors (see Bloech et al., 2014, 128; Miltenburg, 2005, 18-21).

from both the motive and the related strategic goals of the OEM. Hence, these requirements define what is needed at the production site for the OEM to pursue its motive related to, as well as the strategic goals associated with, the new production site. These requirements ultimately determine the choice of strategic location factors, as well as the relevance given to individual location factors in the selection process, with regard to the motive and the strategic goals of the OEM (see 2.5.4.2 Strategy-specific Location Factors).

The Strategy Department, in general, or the Production Strategy Department, in particular, are responsible for composing the *Strategic Requirement Profile* as an input and starting point for the selection process. This means that the project team is not responsible for defining the *Strategic Requirement Profile*. Overall, the *Strategic Requirement Profile* contains the motive and related strategic goals for the new production site, as well as the OEM's corresponding strategic requirements. Going forward, the location factors that reflect the conditions at production sites, which are important for the production site to meet strategic requirements, are referred to as strategic location factors. With regard to the *Strategic Requirement Profile*, the goal of the selection process model is to select the production site at which the conditions, reflected in the strategic location factors, best match the strategic requirements outlined therein.

3.2.2.3 Operational Requirement Profile

As mentioned above, once the board of management has assigned the mandate to select a production site to the Strategy Department, the Strategy Department asks the Factory Planning Department to write the *Operational Requirement Profile*. In order for the Factory Planning Department to compose the *Operational Requirement Profile*, it is necessary to know the product that will be produced, and the production process that will be implemented at the new production site.[59] The Factory Planning Department works with other departments, such as Production Planning or Human Resources, to define the relevant requirements on the production site in the *Operational Requirement Profile* and thus ensure the successful operation of the production site. These requirements are here referred to as operational requirements, given they directly concern the operation of the production site.[60]

[59] At any production site the OEM can produce one product or several, and implement one production process or several. However, for reader-friendliness, only the singular forms will be used in this work.

[60] This definition is based on the understanding that 'operational' relates to specific measurements, which in this case are measurements that enable operations at the new production site. In contrast, the entire operational business refers to all activities of the firm which are part of the firm's core business.

These operational requirements depend on the product that will be produced, and the production process that will be used at the new production site. Hence, the operational requirements defined in the *Operational Requirement Profile* are product-specific, as well as process-specific, requirements (see 2.5.4.3 Product-specific and Process-specific Location Factors), which the OEM has on the production site. As the product- and process-specific requirements on the production site cover all technical requirements, they vary widely from product to product and production process to production process. For instance, product-specific requirements may include the required level of protection of intellectual property or the mode of transportation. Other aspects like the degree of customization or the maximum time from order to delivery, as well as the quality and quantity of components that are required to produce the product, all depend on the product as well. Similarly, process-specific requirements are numerous. Depending on the production process, production techniques with different degrees of automation may be utilized. These different production techniques normally require varying levels of both worker skills and capital-intensive machinery.[61] Thus, the *Operational Requirement Profile* must contain the detailed requirements on the production site in terms of skill for all feasible production techniques and degrees of automation, for which the production is profitable, and the required quality of production is guaranteed. These requirements of skill must be defined in terms of educational degrees, including technical degrees or managerial degrees, as well as in terms of experience. Furthermore, the level of knowledge of English or even German language required for each individual position, must be determined. All

[61] This is an idea picked up from Meyer and Jacob, who suggest in their 'integrated globalization strategy', that the production technique must be analyzed and alternative techniques can possibly be developed that allow an optimal adoption of the production technique to different locations (e.g., to their cost structure for inputs, as well as the amount of production output by reducing the capital intensity, the production complexity and the required fixed costs) (see Meyer and Jacob, 2006, 150). Automation refers to the practice of replacing labor with capital in the production process. Hence, the degree of automation of production is reflected in the labor or capital intensity of production processes. While the labor intensity of a production process refers to the share that labor is used as an input therein, the capital intensity reflects, analogically, the share of capital used as an input in the production process. Different degrees of automation require different production techniques or machinery. The feasible and profitable degrees of automation of a production process depend on the substitutability of the production factors, capital, and labor, as the degree of automation can only be increased as much as labor can be substituted by capital and decreased as much as capital can be substituted by labor. The implemented degree of automation tends to strongly influence the quality of production and in turn to decrease the required costs for quality control: a lower degree of automation and thus a higher level of labor input in the production increases the risk of quality loss and thus the need for quality control (see Liebeck et al., 2006, 208-210). However, in the selection process model developed in this work, with regard to the *Operational Requirement Profile* it is first only important for the project team to know which techniques and degrees of automation are possible options for the production of the product for which the production site is searched. The Production Planning Department should analyze, later on in the selection process, the production sites included on the short-list in terms of the best technology for the specific conditions at these production sites and possibly change the technology to take advantage of the conditions at these production sites.

requirements regarding skill are usually defined in internal job descriptions, which must be included in the *Operational Requirement Profile*. Further process-specific requirements on the production site, which must be defined in the *Operational Requirement Profile*, include the necessary supply of utilities, such as electricity, natural gas, and water, as well as the adequate removal of sewage water and disposal of solid waste. For instance, in terms of electricity, it must be clearly defined how much electricity is required per hour and for how many hours a day. With regard to waste, the kind and amount of waste that will be created at the new production site must be included in the *Operational Requirement Profile*. These considerations should also include estimates for a potential extension of the production capacity.[62]

Some of these product-specific or process-specific requirements also depend on the planned volume of production at the production site. The volume of production effects, for instance, process-specific requirements, such as the required capacity of the sewerage, supply of electricity or product-specific requirements, such as the quantity of required components. The volume of production at the new production site is added to the *Operational Requirement Profile* by the Sales Strategy Department. In cooperation with the Production Strategy Department, the Sales Strategy Department determines the required volume of production in the strategic planning process of the OEM in which the sales volume forecast is matched with the current production capacity. Including the volume of production in the *Operational Requirement Profile* ensures that the selected production site is the most appropriate for producing the required volume of production.

Moreover, the *Operational Requirement Profile* must define the operational requirements on the production site to ensure the successful operation thereof with regard to the OEM's production network in general and its supply chain in particular. First, the transportation requirements for components coming to the new production site from other production sites of the OEM, as well as from the production sites of suppliers, must be defined, including determining possible transport modes. Second, necessary suppliers must be identified and requirements on new suppliers must be

[62] In addition to product-specific and process-specific requirements on the production site, the *Operational Requirement Profile* can also contain requirements on the production site which are important to strengthen the process-specific capabilities of the OEM at the production site. Herm suggests firms analyze their process-specific capabilities and find the production site, at which the conditions best strengthen these capabilities. He formulates a configuration of a global value chain network based on business capabilities and splits the activities along the value chain into modules and identifies related core capabilities of the firm, as well as the main restrictions, which constrain the configuration of the value chain network. His goal is to configure the value chain network by aligning each module with the related core capabilities and restrictions (see Herm, 2006, 62-68) (see 2.4.2.3 Process Models Developed to Optimize Global Production Networks).

determined. Third, all tactical and operational aspects of the supply chain design which are necessary to successfully integrate the new production site into the supply chain must be included in the *Operational Requirement Profile*. Tactical aspects of the supply chain design that must be considered in the *Operational Requirement Profile* include inventory, material flows, and the coordination of production and distribution, as well as the choice of delivery schedule(s), while operational aspects include the product-specific level of stock safety at each location, the 'replenishment transport and production lead times', or customer demand requirements (Sabri and Beamon, 2000, 582; see Surana et al., 2005, 4245). This is especially important because the selection process model aims to select a new production site which not only enhances the strategic supply chain design of the OEM and contributes to the establishment of an advantageous framework for the tactical and operational supply chain design, but also because decisions on the tactical and operational aspects of the supply chain design can restrict the selection of a production site. For instance, the choice of a delivery schedule can significantly restrict the distance of the new production site from other production sites of the OEM (for instance, a just-in-sequence delivery schedule can limit the distance from the new production site to other production sites in terms of a maximum required number of hours of transport, as well as in terms of maximum kilometers). Hence, these operational requirements, which ensure the integration of the new production site into the production network and supply chain of the OEM must also be included in the *Operational Requirement Profile*.

Moreover, the *Operational Requirement Profile* specifies, in detail, the requirements on the production site in terms of the building and land plot needed for the production. The building's required size and form, as well as its utility requirements on heating and cooling, must be defined. With regard to the land the required size and shape of the land, the required topography, the groundwater level and slope must be defined. Another important aspect regarding the land is whether or not it should include options for sequential purchasing of neighboring land for a possible extension of the production site in the future. Furthermore, the relevant land zoning must also be included in the *Operational Requirement Profile*, since operating an OEMs' production site normally requires zoning for industrial use (or even heavy industrial use). For both land and building, it should be determined if single ownership, with the land, the building and even the neighboring land all under one owner, is preferred. Moreover, in the *Operational Requirement Profile,* the exact number of years of the planning horizon for the production site must be defined, which normally corresponds to the expected duration of the first lifecycle of the production series of the product.

These requirements are product-specific or process-specific, and thus must be defined for each production site individually. Still, the questions which the *Operational Requirement Profile* answers should always be the same. These questions include items such as the characteristics of the land plot and potential building, the required level of employees' skill, the number of employees needed, the planning horizon, the required land zoning, the required supplied components (normally in the form of a Bill of Materials), and the requirements with regard to the production network in general and the supply chain in particular, in order to ensure the successful operation of the new production site.[63]

Overall, the *Operational Requirement Profile* determines the operational requirements that must be met by the conditions at the production site for the production to operate successfully. The location factors that reflect conditions at the production site that meet operational requirements are referred to as operational location factors. The *Operational Requirement Profile,* along with the *Strategic Requirement Profile,* serve as an input and starting point for the selection process.

3.2.2.4 General Requirement Profile

The *General Requirement Profile* contains the general requirements, which neither depend on the specific product or production process nor on the motive or the strategic goals, which the OEM pursues with the new production site. These requirements must not be formulated for each production site individually but are instead, in general, valid for the OEM selecting any kind production site. Thus, they must only be formulated once and, if necessary, updated by the Strategy Department in cooperation with other departments (e.g., the Factory Planning Department). Examples of these general requirements could be a minimum level of political stability, a low level of corruption, a high level of security, reliable administrative procedures, the rule of law, the protection of property rights, or an overall level of infrastructure. Taking these general requirements into consideration in the selection process prevents the neglect of requirements which neither depend on the specific product or production process nor on the strategic goals in the selection process.

[63] If the Factory Planning Department's drafted *Operational Requirement Profile* does not sufficiently answer all questions in detail and the defined product-specific and process-specific requirements on the production site do not cover all technical requirements on the production site, the Strategy Department must go back to the Factory Planning Department and ask the relevant questions before the selection process starts. This can also be necessary at a later stage in the selection process, if other questions arise or the information contained in the *Operational Requirement Profile* needs to be updated, adjusted, or detailed. At a later stage in the selection process, the project team can ask the Factory Planning Department for an update of the *Operational Requirement Profile* and the Strategy Department for an update of the *Strategic Requirement Profile.*

Like the *Strategic* and *Operational Requirement Profile*, the *General Requirement Profile* must be defined before the selection process starts. The Strategy Department is also responsible for defining them. However, the project team is responsible for ensuring that the *General Requirement Profile* is updated and comprehensive, as well as for asking for updates in case of doubt.

3.2.3 Setting-up the Project Team and Assigning Responsibilities

Once the board of management gives the Strategy Department the mandate to select a production site, the Strategy Department is responsible for setting-up the project team which is subsequently responsible for implementing the selection process. In most firms, selecting production sites is not a permanent task and thus very few firms have positions that deal exclusively with selecting them. As such, selecting a production site is normally a task with a clearly defined start and end for which a project team must be set-up (see Ottmann and Lifka, 2010, 3; Balderjahn, 2014, 53-54).[64] The Strategy Department should consider the following aspects, when setting-up the project team to guarantee that all relevant business functions or departments are involved (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model), and that all required contributions and responsibilities are clarified early on:

- First, all business functions or departments that will be involved in the selection process must be identified.
- Second, the managers of these business functions or departments must be approached and informed about the project and must agree with the general responsibility of their departments for their contributions in the selection process.
- Third, it must be determined from which business functions or departments members must join the project team or which business functions or departments must only contribute some input at some point in the selection process.
- Fourth, those business functions or departments from which members must only contribute input to the selection process must be informed about their required input and the timing of that input.

[64] Balderjahn states that five groups of actors are involved in location selection processes in firms: important individuals, heads of departments and business functions, other members of departments and business functions, project teams and consultants (see Balderjahn, 2014, 53-54).

- Fifth, managers of business functions or departments that must assign members to the project team must choose those members.
- Sixth, it must be determined which responsibilities the individual team members have and, in particular, which individual contributions they must make at which point in the selection process.
- Seventh, with regard to the contributions, the required information—in particular, the exact granularity and other properties of that information—must be specified. To formalize the timing of the individual contributions, it is helpful to create a timeline that identifies when each member of the project team or other individuals involved in the selection process are required to deliver their contribution to the selection process.

This early clarification of contributions and responsibilities allows everyone involved in the selection process to plan ahead. Furthermore, it allows the project team to recognize, at an early stage of the selection process, which information is easily available from internal sources, which must be bought from commercial external sources, and which is not available from internal or external sources, but must instead be collected through visits to the production site either by external consultants or employees of the OEM. Then, once the project team is aware of which information must be provided by external consultants, it must identify external consultants who can provide this missing information.

3.3 Perspectives and Basic Assumptions of the Selection Process Model

The selection process model developed in this work is based on several perspectives and basic assumptions to fulfil its four goals, which have been introduced above (see 3.1 Structure and Scope of the Selection Process Model):

- Identify the most strategically appropriate production site.
- Avoid selecting any but the most appropriate production site due to structural deficits of the selection process.
- Capture the conditions at potential production sites as realistically as possible.
- Consider the conditions under which OEMs implement the selection process in practice.

The perspectives and basic assumptions of the selection process model are the following: first, to identify the most strategically appropriate production site requires the selection process to be guided by an inside-outside perspective, in general, and, in particular, to apply a strategic and network perspective and to take aspects which are important for the design of the supply chain of the OEM and related to the selection of a production site into account. Second, to avoid selecting any but the most appropriate production site due to structural deficits of the selection process requires the selection process to include all relevant business functions or departments, assume a realistic planning horizon and follow a top-down procedure. Moreover, all location factors must be defined without redundancy, and all interdependencies between location factors must be identified, and the selection process must be structured to avoid the problem of aggregation. Third, for the selection process to capture the conditions at potential production sites as realistically as possible, different forms of location factors must be taken into account. Fourth, to take the conditions under which OEMs implement the selection process in practice into consideration, the entire selection process model must be developed to be manageable, negotiations must play an important role in the selection process, and the selection process must be conducted anonymously at first. These perspectives and basic assumptions, which the selection process model is based on, are defined in this section. Likewise, it is explained how the perspectives are applied and the basic assumptions are considered in the selection process model.

Inside-Outside Perspective

First, the selection process model is characterized by an inside-outside perspective. The concept is borrowed from the literature on marketing, where it has been formulized for selecting markets, but it can also be used as a perspective for the selection process of a production site. A selection process that is characterized by an 'inside-outside perspective' starts with analyzing the firm's strategy, resources, and structure, and then, based on that analysis, searches for the production site (and in marketing for the market) that best matches the firm's requirements (Swoboda and Schwarz, 2004, 268). The opposite is an 'outside-inside perspective', which analyzes mainly, if not exclusively, production sites (or in marketing markets) and commonly omits any aspects related to the firm's strategy, resources, and structure. An inside-outside perspective is applied to the selection process model developed in this work based on the understanding that the selection of each individual production site must be conducted with regard to other parts of the OEM, such as other parts of the production network or supply chain, as well as under consideration of the OEM's strategies, structure, and resources, given the high degree of interdependency between the various stages of production and between various products and functions of the OEM and the relevance of the selection of a production site for the profitability and success of the OEM. For a project with long-term implications for the OEM, such as the selection of a production site, to be successful, a variety of aspects related to the structure, the resources, as well as the strategy of the OEM, must be considered. Thus, the selection process model developed in this work is characterized by an inside-outside perspective to ensure that the OEM's structure, resources, and strategy are taken into account. This selection process model is developed specifically for OEMs taking their structure and resources into account. The strategy is considered in the selection process model by way of its strategic perspective and network perspective (see below).

Strategic Perspective

Second, the selection process model is guided by a strategic perspective. The long-term investment that is required for a production site, as well as the impact of selecting a production site on the OEM's profitability and success, requires applying a strategic perspective to the selection process of a production site. The strategic perspective of the selection process model ensures that the production site is selected in accordance with the strategic orientation of the OEM. Such a strategic perspective is necessary in the selection process, as firms that see in their production sites abroad a possible 'source of competitive advantage' record higher profits and greater market shares (Ferdows, 1997, 74), while production sites can become a 'liability' (Skinner, 1969, 136) if they are selected without strategic considerations. Selecting a production site should be considered as a source of competitive advantage, given the increasingly competitive environment characterized by technological progress, rising ecological requirements, ever-higher consumer requirements of product quality and delivery flexibility, and new trends (e.g., autonomous driving or shared mobility) on the one hand, and the size of the associated investment on the other hand. In order to select a production site that becomes a competitive advantage for the OEM (see Hayes and Wheelwright, 1984, 32; Chen, 1999, 340), the selection process must be structured so that the production site which gets selected best enhances the strategic goals of the OEM and thus strengthens the capabilities that differentiate the OEM from its competitors (e.g., high efficiency, low costs (see Skinner, 1969, 140), high quality, speed, flexibility, or customer satisfaction (see Friedli et al., 2013, 45)).

Such a strategic perspective requires that all relevant strategies of the OEM are taken into account in the selection process. The most relevant strategies when selecting a production site are the production strategy, the network strategy, the competition strategy, and the general corporate strategy.[65] Taking all of them into account ensures that the production site is selected in accordance with the OEM's strategic orientation. This is in accordance with Chopra and Meindl, who emphasize that to ensure the firm's long-term success and competitiveness, the competition strategy and all other functional strategies of a firm cannot be considered in isolation (see Chopra and Meindl, 2014, 47). For example: the competition strategy should be taken into account in the selection process, as a firm with a competition strategy of differentiation through innovation and quality should not select the production site with the lowest possible production costs, regardless of quality (see Kinkel, 2009c, 6), but instead must ensure a high level of quality of production by focusing, during the selection process, on the availability of highly skilled labor and high-quality component suppliers. Hence, the selection process model developed in this work is characterized by a strategic perspective, which means that the OEM's overall strategic orientation is taken into consideration in the selection process and that the selection process model is developed to ultimately select a production site which enhances the OEM's strategic goals and, if possible, becomes a comparative advantage for the OEM.

This is ensured in the selection process model by using the *Strategic Requirement Profile* as a starting point of the selection process and by specifying for each location factor in Chapter 4 whether it is a strategic location factor and, thus, whether it is relevant to enhancing the OEM's strategic goals. Moreover, the consideration of the related strategic goals in the selection process is ensured by determining the world region(s) (or a limited number of countries) based on strategic considerations (see 3.5 Procedure of the Selection Process Model). At a later stage in the selection process, the SWOT analysis (Strength Weakness Opportunity and Threat analysis) is conducted for those production sites among the remaining options to ensure the inclusion of final strategic considerations.

Network Perspective

Third, the selection process model is guided by a network perspective. For the successful design and management of a production network, the single parts of the network, such as individual

[65] A firm's corporate strategy defines its general direction of development and is determined at the highest management level (see Bea and Haas, 2019, 188-189).

production sites, should not only be viewed from an isolated perspective, but must be analyzed from a holistic, integrated network perspective (see Friedli et al., 2013, 26) as part of a complex system with a high degree of interdependency between its units (see Friedli et al., 2013, 17-18; Rudberg and Olhager, 2003, 29). The network strategy defines strategic capabilities of the production network to create and sustain competitive advantages and is implemented through the network configuration, which is responsible for the structure and physical design of the production network, as well as through the network coordination, which is responsible for the organization and management of all units that are part of the network (see Friedli et al., 2013, 19; Porter, 1986, 17). Strategic network capabilities include 'resource accessibility', 'thriftiness', 'mobility' and 'learning' (Shi and Gregory, 1998, 202, 208-210), a high level of flexibility (see Friedli et al., 2013, 5) or the enhancement of the firm's process-specific capabilities (see Herm, 2006, 62-68).

A selection process, guided by a network perspective, requires a multiple-stage network analysis, which considers the production process that will take place at the new production site as part of the production network (see Meyer, 2006b, 114) and aims to successfully integrate the new production site therein. Such a multiple-stage analysis is in sharp contrast to a single-stage analysis, which only considers one stage or several disconnected stages of production. Such a single-stage analysis must be avoided, as it makes the long-term success of the new production site questionable by failing to select a production site that strengthens the OEM's production network (see Friedli et al., 2013, 5-6). Thus, as Backhaus and Voeth point out with regard to selecting sales markets when selecting a production site, feedback effects[66] between the new production site and all other parts of the production network must be taken into account in the selection process (see Backhaus and Voeth, 2010, 63-65). Likewise, authors (e.g., Grauer, 2007; Schnellberg, 2002; Meyer and Jacob, 2006) who developed process models to plan or optimize the entire production network of firms emphasize the impact that other parts of the production network have on the new production site, given significant interdependencies between different production processes, product design, and the production site in the production network (see Grauer, 2007, 2; 2.4.2.3 Process Models Developed to Optimize Global Production Networks).

[66] Furthermore, they point out that the attractiveness of markets cannot usually be evaluated in isolation, but interdependencies with other existing or new markets have to be taken into consideration. Backhaus and Voeth refer to these interdependencies as feedback effects and explain that there are demand-related, supply-related, as well as competition-related feedback effects. Feedback effects include all effects that the market selection has on the domestic market, as well as on all other markets, in which the firm is active. The intensity of feedback effects, as well as the need for coordination, depends on the number of already served markets, in addition to the number of markets that are supposed to be accessed (see Backhaus and Voeth, 2010, 63-66).

While Friedli et al. point out that, in practice, production networks emerge over time as a result of many often uncoordinated decisions and are not built in a systematic way based on a comprehensive analysis of a firm's global production network (see Friedli et al., 2013, 5-6), the goal of a process model for selecting a production site, especially in the automotive industry, must be to successfully integrate the new production site into the OEM's production network, not only to ensure the successful operation of the new production site but also to enhance the entire production network and the related strategic network capabilities. One practical way to ensure the required integration of the new production site in the production network is to follow the work of Richter and Buchner. They suggest firms estimate the need for external suppliers and the required degree of integration in the firm's production network for successful operation of the new production site based on an evaluation of the production network, including external suppliers, enhancing operations at existing production sites (see Richter and Buchner, 2009, 222-227). Hence, to understand the network-related requirements on a new production site, the production network, including external suppliers at existing production sites, must be thoroughly analyzed. The network perspective is especially important for the selection process of a production site in the automotive industry, given the exceptional degree of complexity and interdependencies of the production networks of that industry and the numerous components[67] that are integrated into the final product.

The selection process model in this work is developed to select a production site in accordance with its network strategy and to successfully integrate the new production site into the production network to ensure the successful operation of the new production site: the network-related strategic goals that are relevant to selecting a production site and the corresponding requirements are defined in the *Strategic Requirement Profile*, which serves as a starting point of the selection process, and, for each location factor in Chapter 4, it is specified whether it is relevant to the enhancement of the production network of the OEM and for the successful integration of the new production site into the production network, thereby ensuring the successful operation of the new production site. In short, the selection process developed in this work is guided by a network perspective.

[67] Klier and Rubenstein explain that about 15,000 parts are incorporated into the production of vehicles (see Klier and Rubenstein, 2010, 336).

Consideration of Relevant Aspects Related to the Design of the Supply Chain[68]

Fourth, relevant aspects to the design of the supply chain of the OEM are considered in the selection process model. This consideration acknowledges the relevance of the complex supply chain, which connects 'suppliers and customers, beginning with the production of raw materials by a supplier, and ending with the consumption of a product by the customer' (Sabri and Beamon, 2000, 581). Moreover, it means having an integrated approach to the supply chain, and hence not looking at the different parts of the supply chain independently but instead optimizing the supply chain 'as a whole' (Shen, 2007, 2) in a cross functional manner, including other functions, such as sales, in addition to sourcing, production and logistics (see Bogaschewsky et al., 2009, 215). Finally, it means not making isolated decisions on one level (strategic, tactical, or operational) of the supply chain design but instead taking into account other tasks that are part of the supply chain design on the strategic, and also the tactical and operational, level (see 2.4.2.4 Supply Chain Design). Only such an integrated approach can create a sustained competitive advantage for the OEM.

Such an integrated approach with regard to the supply chain is especially important when selecting a production site, not only because of the significant resources that must be committed to constructing new production sites and the difficulty and high costs associated with a failed selection, but also because selecting a production site sets the framework for the tactical and operational supply chain design (see Azaron et al., 2008, 129-130). The selection of production sites is an especially important strategic decision for the supply chain to work efficiently as problematic selections of production sites lead to inefficiencies in the supply chain regardless of the functioning of its other parts (see Shen, 2007, 1, 3).

In order to successfully integrate the new production site into the supply chain design of the OEM it is important to consider other supply chain design decisions which are also made on the strategic level, such as the selection of suppliers, the location of distribution centers and customers, or capacity considerations. Furthermore, tactical aspects of the supply chain design—such as inventory, material flows, and the coordination of production and distribution, as well as the choice of delivery schedule(s), and operational aspects, such as the product-specific level of safety stock at each location, the 'replenishment transport and production lead times' or 'customer service

[68] Even though this work considers the supply chain as part of the production network (see 2.1 Definitions) this part differentiates between the 'Network Perspective' and the 'Consideration of Relevant Aspects Related to the Design of the Supply Chain' due to the great importance of the supply chain for successfully operating a production site.

levels' (Sabri and Beamon, 2000, 582; see Surana et al., 2005, 4244-4245)—must not be neglected in the selection process.

The enhancement of the ability of the supply chain to react to changes in the environment when selecting production sites is crucial, due to unstable levels of production and sales, increasingly complex environments in the form of always intensifying competition, unstable macroeconomic conditions, which among others affect inputs as well as demand factors, and changes in consumer preferences (see Kogut, 1985, 27). Chopra and Meindl emphasize the relevance of the supply chain's ability to react, which they define as the ability to react to large fluctuations in the amount of demand, to ensure short delivery times, to offer a high variety of product, to produce highly innovative products, and to successfully face supply chain uncertainties and risks.[69] The ability of the supply chain to react is important as a supply chain must be able to successfully face and minimize various uncertainties and risks (see Chopra and Meindl, 2014, 53-55). The need for a high ability to react is reinforced by the inflexible nature of production sites, especially in the automotive industry, which makes the complete divestment of a production site or the establishment of new production sites, as a response to short-term developments in costs or demands, impossible. One way for OEMs to ensure flexibility is to enhance their capability to shift production capacities between their different production sites (see Fisch and Zschoche, 2012, 807) to react to 'divergent cost and market development(s)' (Belderbos and Zou, 2009, 600). Consequently, in the selection process of a production site, an OEM must aim for the supply chain to have a high ability to react to changes in the environment by adjusting, for example, the production capacity or the product produced at the production site.

Overall, the selection process model aims to select a new production site which should ideally enhance the strategic supply chain design and simultaneously contribute to the establishment of an advantageous framework for the tactical and operational supply chain design. In the selection process model, the consideration of relevant supply chain design related aspects is ensured by specifying strategic goals and the corresponding requirements on the production site, which are related to the supply chain design, in the *Strategic Requirement Profile*. Likewise, tactical and operational aspects and the corresponding requirements on the production site that must be

[69] Chopra and Meindl state that a firm must decide on the trade-off between its supply chain's ability to react and its efficiency, which is the minimization of the costs for the production of the products and their delivery to the customers. This must be taken into consideration when selecting production sites. However, this strategic choice must be made independent of the selection of an individual production site by the management of the OEM and be included in the *Strategic Requirement Profile* (see 3.2.2.2 Strategic Requirement Profile) (see Chopra and Meindl, 2014, 53-55, 192).

taken into account in the selection process to successfully integrate it into the supply chain and enhance the design of the entire supply chain are included in the *Operational Requirement Profile*. Moreover, for each location factor in Chapter 4, it is specified whether it is relevant to the integration of the new production site into the supply chain of the OEM and to the enhancement of the supply chain design of the OEM. As a result, aspects that are relevant to the design of the supply chain are considered in the selection process model.

Inclusion of all Relevant Business Functions or Departments

Fifth, all relevant business functions or departments are included in the selection process from its very beginning. For a successful selection, the business functions or departments that will be included in the selection process must be determined before the selection process starts. In the case of a selection process of a production site for an OEM, it is unrealistic and inefficient to create a 'total model'[70] that includes all business functions or departments of a firm (Adam, 1996, 93), due to the sheer size and complexity of such OEMs. Thus, the question is: which business functions or departments are relevant to selecting a production site and, hence, must be included in the selection process? Balderjahn suggests including actors from various business functions of a firm in the selection process (see Balderjahn, 2014, 53-54) to improve its quality and the available know-how. The business functions or departments that must be involved vary from OEM to OEM and from one selection to the next, depending on the product that will be produced, and the production process that will be implemented at the new production site, or the related strategic goals. With regard to the selection process, the business functions or departments can be separated into those directly related to production and those without direct relation to production, which must still provide services and information required during the selection process. The business functions or departments that must be involved in the selection process and are related to production are Human Resources, Sourcing, Logistics, Factory Planning and Production Planning. Business functions or departments which are not directly related to production but can provide services and information

[70] Adam differentiates between 'partial-models' and 'total-models' ('Partial- und Totalmodelle'). While 'total-models' attempt to include all business functions of a firm, their fields, and responsibilities into the model, 'partial-models' only include one or a few business functions, their fields, and responsibilities (Adam, 1996, 93). As the selection process model in this work only includes relevant business functions in the process and not all business functions of the firm, it reflects in this regard a 'partial-model' (Klein and Scholl, 2011, 39-40).

required in the course of the selection process are Real Estate, Legal, Political and Economic Department, IT, Finance and Controlling, Public Relations, Tax or Treasury.[71] With regard to these business functions or departments, it must be determined, before the selection process starts, at which point in the selection process they must be involved and for which contributions they are responsible. This selection process model ensures that all relevant business functions or departments are involved from the beginning of the selection process and that all contributions and responsibilities are clarified early in the selection process by setting-up the project team and assigning responsibilities before the selection process starts (see 3.2.3 Setting-up the Project Team and Assigning Responsibilities), as well as by specifying for each location factor in Chapter 4 which departments could serve as a source for the required information and determining for each phase in the procedure of the selection process which departments should be included (see 3.3 Procedure of The Selection Process Model).[72]

Determining the Planning Horizon

Sixth, the planning horizon of the production site must be determined before starting the selection process for a successful selection. The planning horizon is defined as the timespan, for which the planning is being done (see Klein and Scholl, 2011, 191). In the case of a production site, the planning horizon is normally determined by the motive for which a new production site is

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[71] Balderjahn suggests including actors from business functions, such as strategy, legal, finance, controlling, marketing and sales, in the selection process (see Balderjahn, 2014, 53-54).

[72] With regard to the information and other contributions from individual departments and business functions or employees of the OEM, the reliability, uptodateness and correctness of the information and contribution must be evaluated. Moreover, it is important to be aware that individual departments and business functions or employees have their own interests and their contributions are likely to be affected by, e.g., opportunism and dependencies. Hence, the objectives of individual departments and business functions or employees might deviate from the corporate objective of the OEM with regard to selecting a new production site (see Laux et al., 2012, 45-46). The situation in which the objectives of the firm on one side, and individual departments and business functions or employees on the other diverge, resulting in the firm's inability to control the individual contribution due to asymmetric information is referred to as a principal-agent-problem, where the individual departments and business functions or employees are agents and the firm is the principal: it is in the firm's best interest, and hence best for the selection process, if all individual departments and business functions or employees contribute all relevant information at the optimal point in the selection process. This might, though, not be in the best interest of the individual departments and business functions or employees (see Leach, 2004, 13, 341). Besides the diverging individual and corporate interest, employees carry emotions and individual motivation into the selection process as a decision-making process. While explicit motives are task oriented, verbal, social and absolute, employees also pursue implicit motives, which are rather automatic, nonverbal, and hedonistic in orientation (see Chlupsa, 2017. 4, 14-15). Moreover, as a decision-making process, the selection process is likely to also be affected by 'decision behavior phenomena', e.g., 'sunk costs', 'overconfidence bias' or 'anchoring and adjustment' (see Eisenführ et al., 2010, 381-387). The effect of such aspects and problems on the outcome of the selection process as a particular decision-making process and possibilities to mitigate their negative effects on this outcome are certainly interesting; however, this discussion is beyond the scope of this work.

being searched. Said motive is usually strategic, as the production site binds considerable resources of the OEM long-term and in the face of the significant impact the selected production site has on the success of the OEM. However, there are instances in which an OEM wants to react quickly to some kind of change or challenge by constructing a production site. This can be the case as a reaction to a competitor's move or an unanticipated demand hike. In these cases, the decision about a production site can be tactical, meaning it has a shorter planning horizon. However, with regard to production sites, tactical decisions are rather rare. Especially in the automotive industry, where constructing a production site requires a considerable investment and involves considerable sunk costs, the planning horizon of a production site is most often long-term.[73] In the automotive industry, the investments in a production site must be amortized in the first lifecycle of a production series,[74] which corresponds to a minimum time horizon of 10 years (see Kauder and Meyr, 2009, 508). As such, the planning horizon can correspond to the expected duration of the first lifecycle of the production series of the product.

Regardless of the length of the planning horizon or the basis on which the planning horizon is determined, it is important for the selection process that the planning horizon is determined before the selection process starts, as the planning horizon has an important effect on many location factors (e.g., subsidies, rent of land or buildings) that are evaluated in the selection process, on the dynamic evaluation of location factors, as well as on the conduct of negotiations with governments or firms. Hence, the exact number of years of the planning horizon of the production site must be determined before the selection process starts, which this selection process model ensures by requiring the determination of the planning horizon in the *Operational Requirement Profile*.

Top-Down Procedure

Seventh, this selection process model features a top-down procedure to identify the most appropriate production site. In a top-down procedure, potential production sites are narrowed down from a large number of options to a few or at the end only one final option by eliminating those

[73] In contrast, for instance, to the textile industry where production sites require far less machinery and infrastructure and are associated with considerable fewer sunk costs.
[74] The product life cycle describes the course of revenues that can be made with a certain product in one particular market over the lifespan of the product. This product life cycle consists of five phases: the phases of introduction, of growth, of maturity, of saturation, and of degeneration. At the latest, the product should be taken from the market after an entire life cycle (see Klein and Scholl, 2011, 69). From the producer's perspective, the product life cycle can also be regarded differently as consisting of three cycles; namely, the cycle of formation, of market and of aftercare ('Entstehungszyklus', Marktzyklus' and 'Nachsorgezyklus') (see Coenenberg et al., 2016, 615).

that do not meet the requirements. In turn, the number of options decreases during the course of the selection process. In contrast, a process with a bottom-up procedure starts by analyzing a few interesting production sites and continues from the analysis of these few options to search for other production sites with similar conditions. Hence, in a bottom-up procedure, the decision-maker expands the options from a few to more options (Swoboda and Schwarz, 2004, 271). With regard to the selection process of a production site, the choice between a top-down procedure or a bottom-up procedure depends on the firm's motive for deciding to construct a new production site. If the motive is to construct a production site under the same conditions as given at a different, already existing production site, it is reasonable to search for a production site with conditions that match those at this already existing production site and thus apply a bottom-up-procedure.

However, an OEM more often searches for a new production site without the goal of establishing it as similar as possible to an already existing production site somewhere else, but instead has somewhat different requirements on the new production site. Even though learning from other production sites should not be neglected, for instance, through the analysis of conditions that are beneficial for the cooperation with suppliers at other production sites (see Richter and Buchner, 2009, 222-227), it seems to be more promising to apply a top-down procedure in the selection process, as it allows for the inclusion of more production sites into the selection process from the start. Most importantly, a top-down procedure is a means to construct the selection process model so as to prevent missing potentially promising options,[75] as a top-down procedure includes all possible options at the beginning of the selection process. Hence, a top-down procedure which starts openly (in this case, with the entire world) prevents selecting a production site that is not the most appropriate production site, as it may have been excluded from the evaluation. Thus, the selection process model developed in this work is characterized by a top-down procedure.

Keeping the Selection Process Manageable

Eighth, to consider the conditions under which OEMs implement the selection process model in practice, this selection process model is formulated to be manageable by avoiding unnecessary complexity (see Neumair et al., 2012, 237) and being aware of the time and resource constraints under which decisions must be made in profit-oriented OEMs, the importance of which has been pointed out by Seidel (1977, 122-125), Stahr (1982, 60), Schneider and Müller (1989, 13),

[75] Köhler and Hüttemann stress the importance of selecting a new market 'without excluding any promising markets' (Köhler and Hüttemann, 1989, 1434).

Backhaus and Voeth (2010, 66-67), Sabathil (1969, 249) and Autschbach (1997, 200-202) (see 2.4.2 Location Planning Theory).

In the case of the selection process of a production site, resources must cover all expenditures; for instance, employees' salaries, visits to potential production sites, subscriptions to commercial external sources of information, or the costs of external consultants. Time affects the required resources given they tend to increase as the time required for conducting the selection process increases. However, time itself is also constrained, because, as explained above (see 3.2.1 Organizational Framework of the Selection Process), the timeframe for the selection process, from the mandate to the selection of the final production site, is normally between 1½ to 2 years. This timeframe might even be somewhat shorter (about 1 year), if finding the production site is urgent; for instance, due to an acute capacity constraint.

Notwithstanding the importance for applying the selection process in practice, the time and resource constraints are only considered in the selection process model to the extent to which they do not undermine the success of the selection process. This is especially important because even though the resources and time assigned to the selection of a production site are constrained, for a decision with such significant consequences on the profitability and success of an OEM, as in the case of selecting a production site, the project team has considerable resources and time at its disposal.

Keeping the selection process manageable requires not only an awareness of the time and resource constraints, but, even more important, an avoidance of unnecessary complexity, which can lead to an unfocused or misfocused analysis and increases the risk of incorrect evaluation and thus reduces the quality of the selection process. Evaluating, for instance, more than the relevant location factors in the selection process carries the risk of reducing the quality of the result of the selection process, particularly if it makes the process overly complex and the intermediate and final results more difficult to understand (see Neumair et al., 2012, 237). Unnecessary complexity can even lead to no result, especially in a predefined timeframe, in which the selection process should take place.

The goal of keeping the selection process manageable influences a variety of aspects of the selection process model. It has critical effects on the procedure of the selection process model: first, the world region(s) (or a limited number of countries) is determined in the first phase based on strategic considerations, and second, regions which can for some reason be ruled out are eliminated in the third phase of the selection process model (see 3.5 Procedure of the Selection Process

Model)). Moreover, the fact that the selection process model requires that the project team chooses the relevant location factors from the discussion of location factors in Chapter 4 which they want to evaluate in the selection process allows for adjusting the number and kind of location factors evaluated to the size and relevance of the production site (and associated investment), omitting all others. In addition, the selection process model requires the project team to choose only relevant location factors for evaluation in the selection process (see 3.4.1 Choosing Location Factors). Furthermore, it is suggested to limit the number of location factors that are evaluated in a dynamic or stochastic form in the selection process, as the effort required for collecting and evaluating information increases often disproportionately since the time for which the developments must be forecasted increases (see Klein and Scholl, 2011, 203-204), and the consideration of uncertainty increases the complexity of the evaluation. Thus, as it is necessary to include some location factors as dynamic or stochastic in the evaluation to realistically depict the conditions at potential production sites, only as many location factors as necessary and as few as possible are evaluated in a dynamic or stochastic form in the selection process model. Hence, in Chapter 4, it is suggested whether each location factor should be evaluated as a dynamic or stochastic location factor or if it can be considered as static or deterministic. These are, of course, only suggestions.

Overall, the selection process model is formulated in awareness of the time and resource constraints under which the OEM must implement the selection process in practice and to avoid unnecessary complexity to keep the selection process manageable. However, the time and resource constraints are only considered, and the complexity avoided, in the selection process model to the extent to which they do not undermine the success of the selection process.

Negotiations

Ninth, negotiations play an important role in the selection process. Negotiations are conducted through external consultants (see Phelps and Wood, 2018, 1027) anonymously or openly under the name of the OEM (see Anonymity below) or through the OEM itself. Once the OEM negotiates openly under its name, it can work with non-disclosure agreements or confidentiality arrangements with governments and other firms. Whether anonymously or under the name of the OEM, there are many aspects that should be negotiated in the selection process: prices of land plots and buildings must be negotiated with the owner(s) (see Meyer, 2006b, 107), the amount, time, and prices of the delivery of energy must be negotiated with energy providers, and the rates for transport, as well as potential investments in infrastructure, must be negotiated with railroad or harbor companies. Furthermore, Meyer suggests that firms should negotiate subsidies with local or central governments in the selection process of production sites (see Meyer, 2006a, 79). Subsidies for infrastructure projects, for training programs, or tax exemptions must be negotiated with national, regional, and local governments. In fact, Simon et al. suggest that firms should negotiate with local administrations to receive subsidies for schooling or tax exemptions. They also point out that, as leverage for these negotiations, it is helpful for the firm to still have a number of alternative production sites under consideration (see Simon et al., 2006, 244). For successful political negotiations and leveraging of the conditions at the production site, it is also important that the OEM knows which subsidies are negotiable, as well as all the requirements of the application processes for any kind of subsidy in the countries under consideration. The form in which possible subsidies are taken into consideration in the selection process, and thus impact the result of the selection process, must be documented in detail from the beginning of the selection process to meet the requirements of possible control systems of subsidies (see 4.2.2.4 Subsidies and State Aid).

In addition, the OEM also must conduct negotiations with suppliers. The supply of high-quality components is of utmost importance, especially in the automotive industry. As local suppliers are often unable to supply the high-quality components which the OEM needs for their production, the OEM must approach international high-quality suppliers through negotiations to convince them to move some of their production to the new location, if they are not already at the location. As international OEMs are usually a very important, if not the most important customer of individual international suppliers, they have considerable bargaining power to persuade their suppliers to follow them. This persuasion can be exercised by communicating that the suppliers will only receive the order for the new production site if they follow the OEM to the new location, or the OEM can increase pressure by communicating that it would reduce current orders for already existing production sites for these suppliers if they do not follow with a production site to the new location (Kinkel and Zanker, 2009, 96). Instead of coercion, in the negotiations with suppliers, the guaranteeing of a so-called ‘critical mass’ of orders for an extended period is helpful with regard to relocating suppliers to a new production site of the OEM. This guarantee of a ‘critical mass’ of orders is crucial for suppliers to ensure the profitability of their required investment (Kinkel and Zanker, 2009, 146). Normally, the international suppliers work in close cooperation with the OEM at many locations on the basis of a trustful partnership and are willing to follow them. With regard to suppliers, negotiations are very important during the selection process, as it is through negotiations the OEM must ensure that enough high-quality suppliers are at the new production site or in a close enough proximity.

Overall, negotiations play an important role in the selection process, most importantly with the owners of the land plot or buildings, owners of railroads or harbors, energy providers, local, regional and national governments, as well as with suppliers. For each phase of the procedure of the selection process model (see 3.5 Procedure of the Selection Process Model) it is determined whether the OEM should engage in negotiations either under its own name or anonymously. In addition, for every location factor in Chapter 4, it is determined whether the corresponding conditions at the production sites are negotiable.

Anonymity

Tenth, anonymity plays an important role for the success of the selection process. The decision whether the selection process or individual phases of the selection process should be conducted anonymously or openly under the name of the OEM has very relevant consequences for the selection process. Anonymity has not been dealt with in the literature with regard to the selection process of a production site. However, anonymity regarding the selection process has several advantages and disadvantages. For instance, an advantage of anonymity in the selection process is that the OEM does not have to deal with protest or critique about its decision to construct a new production site abroad. Given that the decision of an OEM to search for a new production site may evoke fears that an existing production site might be closed, or its volume of production reduced, the decision raises public interest and might lead to social or political moods which are unfavorable for the OEM at existing production sites or in its home country. Another advantage of anonymity in the selection process is that competitors do not know about the OEM’s plans to construct a new production site. Thus, competitors are provided no hint at the strategic orientation of the OEM and will not compete for the same production sites. A further advantage of anonymity is that it can be expected that the prices of land and buildings will be lower if the OEM negotiates anonymously, as landlords assume that an international OEM is willing to pay a high price and might, as a result, raise the price of the land (and building(s)), if the OEM negotiates under its name.

However, there are disadvantages of anonymity in the selection process, which include, in some cases, the best production sites being held back for large firms who are willing to make large investments and have a good image and from whose presence national, regional, or local governments expect a promotion of and advantages for their country, region or community and its overall attractiveness. Moreover, governments are interested in attracting large international firms and might be more willing to make larger commitments in the form of subsidies if the OEM negotiates under its name. Thus, anonymity in the selection process has advantages and disadvantages, which are relevant to the success of the selection process. In order to solve this conflict of interest for the OEM, the selection process is conducted anonymously at first and at a later stage of the selection process the OEM negotiates under its own name. For each phase of the procedure of the selection process model, it is suggested whether the selection process should be conducted anonymously or openly under the name of the OEM (see 3.5 Procedure of the Selection Process Model).

All Location Factors Must Be Defined Without Redundancy and Interdependencies Must Be Identified to Avoid Overlap Between Location Factors

Eleventh, this selection process model avoids overlap between location factors by defining them without redundancy and identifying all interdependencies between them. In theory, overlap can only be avoided if these two conditions are met (see Ottmann and Lifka, 2010, 37). Defining individual location factors within a certain set without redundancy means that they are defined so that they do not overlap in terms of their content. Eliminating redundancy is necessary to avoid any instances of double or multiple counting of some aspects of evaluated location factors and to address the problem of aggregation in the selection process (see *Awareness of the Problem of Aggregation* below). Location factors of a certain set are defined without interdependencies if changes in any factors of that set do not impact others within the same set (see Ottmann and Lifka, 2010, 37).

While defining location factors without any redundancy is possible, several authors suggest that interdependencies between location factors cannot be avoided (e.g., Sabathil 1969, 255; Schnellberg, 2002, 81) and acknowledge the need to clearly identify interdependencies between location factors. Sabathil suggests that interdependencies between location factors should be taken into account using simulation (see Sabathil, 1969, 255). A few examples highlight the interdependencies between location factors: A high level of corruption tends to have a negative effect on security, inflation affects the exchange rate, or infrastructure enhancing subsidies improve the infrastructure. Consequently, in this selection process model, it is assumed that defining location factors so that there are no interdependencies between them is impossible. Instead, all interdependencies between location factors are identified to take them adequately into account and to address the problem of aggregation in the selection process (see *Awareness of the Problem of Aggregation* below).

Hence, for successfully evaluating location factors, in particular, and selecting a production site, in general, it is necessary to define the location factors without any redundancy and to identify all interdependencies between them. Consequently, in the discussion of location factors in Chapter 4, the included location factors are defined without any redundancy and interdependencies between them are identified. To consider identified interdependencies between location factors as best as possible, the use of simulation is suggested (see 3.4.2.4 Methods for Evaluating Location Factors) for evaluating those factors between which relevant interdependencies are identified.

Awareness of the Problem of Aggregation

Twelfth, the selection process model is developed in awareness of the problem of aggregation. Neumair et al. refer to aggregation as the accumulation of several elements to an aggregated sum (see Neumair et al., 2012, 238). Put differently, aggregation is the combination of 'micro-elements' to 'macro-elements' (Klein and Scholl, 2011, 230). When selecting a production site, single elements are aggregated when location factors are considered in an aggregated way.

Correct aggregation requires consistency of measurement as micro-elements can only be added up to macro-elements if they all have the same unit of measurement (e.g., EUR) (see OECD, n.d.c). Hence, in the selection process only those location factors which have the same unit of measurement can be aggregated, and the resulting aggregate has the same unit of measurement as its elements. So, all cost-related quantitative location factors are measured in EUR and can thus be added up to an aggregate. Qualitative location factors are assessed in ratings—for instance, as very low, low, fairly high, high or very high—which are then expressed numerically as 1 through 5 (see 3.4.2.3 Measuring Location Factors). While the ratings can vary depending on the location factor, the ratings of all qualitative location factors have five entries, with 1 signifying the worst and 5 the best quality of the location factor, to ensure consistency in measurement. In contrast to cost-related location factors and qualitative location factors, non-cost-related location factors (e.g., size of the land plot, capacity of sewerage) cannot be aggregated in the selection process, as they have different measurements (hectare meters or square meters, and cubic meters per day or hour, respectively).

With regard to the problem of aggregation in the selection process, it must be differentiated between evaluating cost-related quantitative location factors on one side and qualitative and non-cost-related quantitative location factors on the other side. The aggregation of cost-related quantitative location factors does not lead to any problem, as long as all costs are added up and only counted once (this is ensured by defining all location factors without redundancy), and all cost-related quantitative location factors are independent from each other or, if there are interdependencies, those interdependencies are identified and their impact on costs is taken into consideration (see *All Location Factors Must Be Defined Without Redundancy and Interdependencies Must Be Identified to Avoid Overlap between Location Factors* above).

In contrast, the aggregation of non-cost-related quantitative and qualitative location factors in a selection process is more difficult. Qualitative location factors cannot be simply aggregated in indexes as many of these location factors do not outweigh each other and thus indexes would not portray the relevant information accurately. For example, a good protection of intellectual property does not compensate for a high risk of social or political unrest. The same holds for non-cost-related quantitative location factors. Hence, the high quality of one location factor compensating for the inadequate quality of another when evaluating location factors in an aggregated way, without control or awareness of possible compensation, must be prevented (see Ottmann and Lifka, 2010, 47).

The problem of aggregation of qualitative and non-cost-related quantitative location factors in this selection process model is addressed in three ways. First, like all cost-related quantitative location factors, all qualitative and non-cost-related quantitative location factors are defined without redundancy, and interdependencies between the location factors are identified. Second, qualitative, and non-cost-related quantitative location factors must be evaluated so that the high quality of one location factor does not compensate for the inadequate quality of another in the evaluation of production sites. Third, it must be ensured that each evaluated qualitative and non-cost-related quantitative location factor only enters the aggregation once.

When evaluating qualitative and non-cost-related quantitative location factors, the relevance of the problem of aggregation depends on the applied evaluation method: In particular, on whether the applied evaluation method is compensatory or non-compensatory. In general, using non-compensatory evaluation methods does not entail the problem of aggregation, as alternatives are evaluated without aggregating the quality of different location factors for a production site and the quality of each evaluated location factor is visible individually (see Ottmann and Lifka, 2010, 48). Instead, using compensatory evaluation methods entails the problem of aggregation, as alternatives are evaluated in terms of the aggregated quality of different location factors for a production site and the quality of each evaluated location factor is not visible individually in the aggregated result.

As explained under 3.4.2.4 Methods for Evaluating Location Factors when evaluating qualitative and non-cost-related quantitative location factors, the profile method and the utility analysis are applied and different kinds of criteria (exclusion, minimum, preferred and substitutable criteria) are used in the selection process model. While criteria and the profile method are non-compensatory evaluation methods, the utility analysis is a compensatory evaluation method. Hence, when using criteria to evaluate non-cost-related quantitative and qualitative location factors, no aggregation is taking place. Likewise, when evaluating non-cost-related quantitative and qualitative location factors in the profile method by topic, such as legal and political environment or labor market, without aggregating the individual topics, aggregation is not a problem as alternatives are evaluated without aggregating the quality of different location factors for a production site, and the quality of each evaluated location factor is visible individually. However, aggregation is a problem when analyzing the results of the profile methods by topic in an aggregated profile method, as then the individual location factors analyzed in the profile methods by topic are no longer visible individually in the aggregated result. To address this problem in the selection process model, it is suggested that three aspects are taken into consideration. First, never exclusively consider the result of the aggregated profile method, but always consider them in combination with the results of the profile methods by topic. Second, evaluate those qualitative and non-cost-related quantitative location factors reflecting conditions which may not be below a certain minimum threshold for a country, region, or production site to qualify as production site for the OEM, first as minimum criteria and, if the conditions at the evaluated production sites meet these minimum criteria, then, at a later phase in the selection process, they are evaluated in a profile method. This ensures the evaluation of only those production sites in the profile method at which the conditions meet the minimum requirements, and hence the high quality of some conditions cannot compensate for the inadequate quality of other conditions at a production site. Third, if the results of individual profile methods are aggregated in a profile method, it is important to make sure that each evaluated qualitative and non-cost-related quantitative location factor only enters the aggregated profile method once. This is ensured by analyzing location factors only according to the hierarchical structure of the discussion of location factors in Chapter 4.

When evaluating qualitative and non-cost-related quantitative location factors with the utility analysis, compensatory evaluation method, aggregation is more problematic, as the utility analysis leads to an aggregated result for a production site, which does not show the quality of each evaluated location factor individually. As in the case of the profile method, those qualitative and non-cost-related quantitative location factors reflecting conditions which may not be below a certain minimum threshold for a country, region, or production site to qualify as production site for the OEM, are evaluated first as minimum criteria and, if the conditions at the evaluated production sites meet these minimum criteria, then they are evaluated in a utility analysis. Hence, the high quality of some conditions cannot compensate for the inadequate quality of other conditions at a production site. In addition, the problem of aggregation with regard to the utility analysis is addressed by assigning weights to the location factors which are then evaluated in the utility analysis according to their importance for the selection depending on the OEM's goals. Assigning weights prevents that, when evaluating production sites in the utility analysis, the high quality of a less important location factor compensates for the low quality of a more important location factor. Moreover, if the results of individual utility analyses (for instance, by topic) are aggregated into an aggregated utility it is important to make sure that the utility related to each qualitative and non-cost-related quantitative location factor only enters the aggregated utility once. This is ensured by analyzing location factors only according to the hierarchical structure of the discussion of location factors in Chapter 4.

Hence, this selection process model is developed with an awareness of the problem of aggregation which arises in the selection process, especially when evaluating qualitative and non-cost-related quantitative location factors, and accordingly addresses this problem with the measures introduced above.

Consideration of Different Forms of Location Factors

Thirteenth, location factors are evaluated in the selection process model in different forms. To capture the conditions at potential production sites as realistically as possible, this selection process model evaluates qualitative and quantitative location factors and uses a dynamic analysis for relevant developments of the conditions at potential production sites over the planning horizon thereof. Furthermore, uncertainty in assessing conditions at potential production sites requires the selection process model to include not only deterministic, but also stochastic location factors. In addition, soft location factors that only have an indirect impact on constructing or operating the production site are differentiated from hard location factors, which have a direct impact on constructing and operating the production site. By differentiating between soft and hard location factors, the relevance which is given to location factors in the selection process can be determined. Moreover, location factors that reflect conditions at production sites that are considered as given are differentiated from those location factors reflecting conditions that are expected to change once an OEM begins constructing or announces the construction of a production site at a certain location (semi-external location factors). Hence, for each location factor, it must be determined if it is a quantitative (cost-related or non-cost-related) or qualitative location factor and whether it is considered in the selection process as static or dynamic, as deterministic or stochastic, as soft or hard, and whether it is considered as a semi-external location factor.

Quantitative and Qualitative Location Factors

As just stated, evaluating potential production sites requires not only considering quantitative, but also qualitative location factors. Quantitative location factors are distinguished into cost-related and non-cost-related quantitative location factors. Cost-related quantitative location factors are, for instance, the wage level (e.g., wage costs of engineers over the planning horizon of the production site), the required investment (e.g., costs for the required investment in energy supply facilities) or the transport costs for required components, while non-cost-related quantitative location factors include the size of the land plot, distance to suppliers, or the capacity of the sewerage. This selection process model is based on the assumption that, for the selection process to be successful, qualitative location factors cannot be omitted in the evaluation of production sites. These qualitative location factors include political stability, rule of law, or the protection of intellectual property rights. Moreover, while some qualitative location factors can be quantified, other qualitative location factors can only be quantified to a limited degree (see Meyer, 2006a, 39; Meyer, 2006b, 117-118; Ottmann and Lifka, 2010, 2). Differentiating between qualitative and quantitative location factors is crucial for their evaluation, as both require different evaluation methods (see 2.5.3 Different Forms of Location Factors; 3.4.2.4 Methods for Evaluating Location Factors).

Thus, this selection process model is based on the assumption that quantitative and qualitative location factors must be evaluated when analyzing production sites. For each location factor included in Chapter 4, it is determined whether it is a qualitative, cost-related quantitative or non-cost-related quantitative location factor. Moreover, for each phase of the selection process model, it is specified whether qualitative, cost-related quantitative or non-cost-related quantitative location factors are evaluated or several thereof.

Static and Dynamic Location Factors

Furthermore, to capture the conditions at potential production sites as realistically as possible, the dynamic analysis of some location factors in the selection process is necessary. The question at the core of the problem of whether to analyze location factors solely as static or also as dynamic is whether time plays a role in evaluating potential production sites; in other words, whether the conditions at potential production sites are considered subject to change over the planning horizon of the production site and, if so, whether these changes are considered significant for their evaluation. Given the quickly changing environment, including the macroeconomic and political conditions, the competitive situation (see Kogut, 1985, 27) and changes in input costs on the one hand and the long-term investment related to a production site on the other hand, there are some location factors whose changes over the planning horizon must be taken into account, which makes their dynamic evaluation necessary. The necessity of a dynamic analysis of location factors has already been suggested by Timmermann (1972, 390), Sabathil (1969, 151) or Balderjahn (2014, 62). Other authors have attempted to incorporate the dynamic analysis of location factors in their selection process models or suggested methods for a dynamic analysis: Henzler includes the analysis of economic trends by categorizing all countries under consideration, depending on their state of development, into countries in a preliminary phase, boom phase or saturation phase (see Henzler, 1979, 124). Similarly, Schneider and Müller analyze countries by their trend of development into current or potential core-markets, hope-markets, opportunity-markets, and abstinence-markets (see Schneider and Müller, 1989, 25, 51). Meyer and Jacob suggest firms, as part of their 'integrated globalization strategy', define market developments, competitors' activities, and industry trends (see Meyer and Jacob, 2006, 149-150) to understand the trends which these location factors follow (see Meyer, 2006a, 37). Stahr includes in his selection process model process-specific requirements on the production site which reflect market dynamics (see Stahr, 1982, 58, 61). Differently, Backhaus and Voeth suggest the assessment of dynamic conditions in the selection process in the form of a sensitivity analysis and simulation (see Backhaus and Voeth, 2010, 90). Buhmann and Schön explain that dynamic scenarios best capture the dynamic nature of the environment and, at the same time, enable the decision-maker to deal with uncertainty (see Buhmann and Schön, 2009, 279-280) (see 2.4.2 Location Planning Theory).

This selection process model is developed upon the assumption that the dynamic analysis of some location factors is necessary for a successful selection of a production site. As it is unrealistic that there are any conditions at the production site that do not change at all over the planning horizon of the production site, which would hence be static, all location factors are dynamic. However, the dynamic evaluation of location factors needs additional effort and time in the selection process for collecting and evaluating the required information: the effort required for collecting and evaluating information increases often disproportionately as the time for which the developments must be forecasted increases (see Klein and Scholl, 2011, 203-204). Thus, the decision for which location factors to include a dynamic evaluation in the selection process is a trade off between the goal of keeping the selection process manageable and capturing the conditions at potential production sites as realistically as possible. The extra time and effort required for a dynamic evaluation of location factors must be minimized while not foregoing significant information about the conditions at potential production sites over its planning horizon. Hence, it is suggested to limit the number of location factors that are evaluated in a dynamic form to those which reflect conditions whose change over the planning horizon of the production site is considered significant for the construction and operation thereof, thereby evaluating as many location factors as necessary and as few as possible in a dynamic form in the selection process. The selection process model suggests including only these location factors as dynamic, thus evaluating their change over time, and all other location factors as static. In this selection process model, the future development, if relevant, is captured as Buhmann and Schön suggest in scenarios (see Buhmann and Schön, 2009, 279-280) to assess the conditions at potential production sites over the planning horizon as realistically as possible. For the analysis of different scenarios, simulation is suggested (see 3.4.2.4 Methods for Evaluating Location Factors). For each location factor, Chapter 4 specifies whether it should be evaluated as static or dynamic.

Deterministic and Stochastic Location Factors

Closely related to the question of whether to analyze some location factors as dynamic is the question how uncertainty is dealt with in the selection process. The future development of conditions at potential production sites is subject to uncertainty. Given the long planning horizon of the investment decision associated with constructing and operating a production site, the uncertainty of forecasting the development of the conditions at potential production sites is highlighted by the consideration of a forecast horizon of one year as short-term, between one and three years as medium-term, and that of more than three years already as long-term (see Klein and Scholl, 2011, 264). From this statement, it can be inferred that, for any year in the future beyond three years from the current year, a reliable forecast is questionable. Hence, uncertainty is closely related to the decision of whether to consider location factors in the selection process as merely static or also as dynamic, as the uncertainty increases if factors are considered as dynamic.

For clarification, (business) decision theory differentiates between certainty, risk, and uncertainty. Certainty refers to a situation where the current state and development of a variable is known. Risk refers to a situation where all possible current and future states of the variable, as well as their probability of occurrence, are known; for instance, when rolling a fair dice. Uncertainty refers to a situation where all possible current and future states of the variable are known, but their probability of occurrence is unknown, such as exchange rate fluctuations (see Bamberg et al., 2019, 41, 67, 109; Laux et al., 2012, 81-82; Klein and Scholl, 2011, 40-41; Eisenführ et al., 2010, 23). Deterministic processes assume that all required information to assess the location factors' current and, if also considered, future state is known. Stochastic processes reflect the difficulty of forecasting and the lack of information about the future development and perhaps also about the current state of some location factors[76] (see Klein and Scholl, 2011, 35-36, 48-49). The level of uncertainty in assessing location factors depends on the level of information available in the selection process about the current, as well as future, conditions at potential production sites. If the assessment of all location factors evaluated in the selection process is not expected to be subject to uncertainty or that the uncertainty the evaluated location factors are subjected to is considered insignificant, then the process can be deterministic. However, if the assessment of location factors evaluated in the selection process is subject to uncertainty, and if it is expected that this uncertainty has a significant effect on the success of the selection process, then the process should account for this uncertainty when assessing these location factors and be stochastic.

As explained above, in today's dynamic and quickly changing world, it is not realistic to expect that the future development of all location factors that are included in the selection process

[76] The difference in terms of results between a deterministic and a stochastic process is that the outcome of a deterministic process is an optimal solution for the defined objective(s), given that the parameter values as assumed in the model will become true in reality. The outcome of a stochastic process, in contrast, is merely assigned probabilities for the quality of different outcomes (see Klein and Scholl, 2011, 35-36). As uncertainty in this process model is captured in the form of scenarios, there are no probabilities assigned to the different possible outcomes for each location factor, but instead the pessimistic and optimistic scenarios capture the span of possible future developments of location factors.

can be assessed without uncertainty. Accordingly, the selection process model must take uncertainty into account. Seidel identifies the uncertainty of the information required in the selection process as a fundamental problem that the decision-makers must deal with (see Seidel, 1977, 122) and Sabathil suggests that the uncertainty in assessing location factors must be taken into account, possibly with the help of a simulation model (see Sabathil, 1969, 255). Just as for the dynamic analysis of location factors, Buhmann and Schön's approach to deal with uncertainty proposes formulating dynamic scenarios of uncertain developments at production sites to realistically capture the uncertainty to which the assessment of future developments at the potential production sites over the planning horizon are subjected (see Buhmann and Schön, 2009, 282-292).

As with regard to static or dynamic and qualitative or quantitative, it must be determined whether each individual location factor is considered as deterministic or stochastic in the selection process. In this selection process model, the future development, as well as the uncertainty, if relevant, is captured, as Buhmann and Schön suggest, in scenarios to assess the conditions at potential production sites over the planning horizon as realistically as possible. In this selection process model, it is assumed that the assessment of the current state of location factors is normally not subject to considerable uncertainty, but that the assessment of the future development is always subject to uncertainty.[77] Thus, every dynamic evaluation of location factors must also be stochastic, which is why the dynamic and the stochastic evaluation of location factors is, as suggested by Buhmann and Schön, conducted together using scenarios in this selection process model (see Buhmann and Schön, 2009, 279-292). These scenarios are further analyzed with help of simulation (see 3.4.2.4 Methods of Evaluating Location Factors). Because it is assumed that assessing the current state of location factors is normally not subject to considerable uncertainty and the stochastic and dynamic evaluation of location factors is combined in scenarios, for each location factor, it is only specified in Chapter 4 whether it should be considered as static or dynamic and not, in addition, whether it should be analyzed as deterministic or stochastic.

[77] Still, if current conditions at a production site are considered subject to significant uncertainty, then the scenarios must be constructed to include that uncertainty in the starting year of the scenarios by having different scenarios for the starting point of the analysis (e.g., an optimistic scenario, a trend scenario, and a pessimistic scenario). This is different from the scenario analysis of location factors for which assessing the current state is not subject to considerable uncertainty, where the different scenarios have the same starting point.

Soft and Hard Location Factors

Furthermore, in the selection process model, soft location factors are differentiated from hard location factors (see 2.5.3 Different Forms of Location Factors), which helps to assign different relevance in the selection process to individual location factors according to the way they impact the construction and operation of the production site: hard location factors have a direct, measurable effect on the costs of constructing and operating the production site while soft location factors impact constructing and operating the production site in an indirect, non-measurable way, and are difficult to quantify monetarily (see Schöler, 2005, 24-25; Neumair et al., 2012, 234; Farhauer and Kröll, 2014, 57). In this selection process model, the greater importance of the direct impact of hard location factors compared to the indirect impact of soft location factors on constructing and operating the production site is captured by assigning hierarchical weights when evaluating qualitative and non-cost-related quantitative location factors (see 3.4.2.4 Methods for Evaluating Location Factors). Hence, for each location factor, it is specified in Chapter 4 whether it is a hard or soft location factor.

Semi-External and Performance Location Factors

Semi-external location factors are those which reflect conditions at production sites, and that are expected to change once an OEM begins constructing or announces the construction of a production site at a certain location. The local wage level is a typical semi-external location factor (see Meyer, 2006a, 39; 4.7.4 Wage Level). Similarly, performance location factors are a special kind of semi-external location factor which reflect conditions at the production site that can be influenced by the OEM once it has made the decision to construct a production site. Examples of performance location factors are the local productivity, the availability of skills, and the local infrastructure (see Kinkel and Zanker, 2007, 153-157) (see 2.5.3 Different Forms of Location Factors). In this selection process model, semi-external location factors are anticipated to change significantly in reaction to the construction and operation of the new production site or even only the announcement thereof. With regard to performance location factors, those which reflect conditions at the production sites for which it is expected to be worthwhile to influence by implementing measures, must be identified. To facilitate incorporating semi-external and performance location factors into the selection process, they are identified as such in Chapter 4, along with possible measures and their expected costs.

Summing up, in this part, the perspectives and basic assumptions upon which the selection process model is developed are defined, and it is explained how the perspectives are applied and the basic assumptions are considered in the selection process model. The selection process model is based on these perspectives and basic assumptions to pursue its four goals, which are: identify the most strategically appropriate production site, avoid selecting any but the most appropriate production site due to structural deficits of the selection process, capture the conditions at potential production sites as realistically as possible, and consider the conditions under which OEMs implement the selection process in practice. To identify the most strategically appropriate production site, the selection process model is guided by an inside-outside perspective, in general, and, in particular, the selection process model applies a strategic and network perspective and takes aspects into account which are relevant to the design of the supply chain. Given the inside-outside perspective of the selection process model, aspects related to the structure, resources, and strategy of the OEM are accounted for. The application of a strategic perspective in the selection process model means that the OEM's overall strategic orientation is taken into consideration in the selection process and that the selection process model is developed to ultimately select a production site, which advances the strategic goals of the OEM and, if possible, becomes a comparative advantage for the OEM. Furthermore, applying a network perspective means that the goal of the selection process model is to choose the production site in such a way that it strengthens the network capabilities targeted by the OEM, and that network requirements are sufficiently taken into account to ensure the successful operation of the production site, and to successfully embed the new production site into the OEM's production network. Moreover, considering aspects in the selection process model that are relevant to the supply chain design when selecting a production site ensures the successful integration of the new production site into the supply chain and the enhancement of the design of the supply chain by selecting the production site.

To avoid selecting any but the most appropriate production site due to structural deficits of the selection process, all relevant business functions or departments must be determined, along with the point at which these business functions or departments are responsible for their contribution, before the selection process starts. Moreover, the planning horizon of the production site must be determined before the selection process starts (in the *Operational Requirement Profile*) to ensure a realistic evaluation and the process follows a top-down procedure to be less likely to omit possibly promising options. Furthermore, all location factors must be defined without redundancy, interdependencies between location factors must be identified, and the selection process model must be structured to avoid the problem of aggregation, especially when evaluating qualitative and non-cost-related quantitative location factors.

To capture the conditions at potential production sites as realistically as possible, location factors are evaluated in different forms in the selection process model. The selection process model differentiates between quantitative and qualitative location factors. Moreover, scenarios are formulated for those location factors whose expected change over the planning horizon of the production site is considered significant for the selection to depict the expected future development and capture the uncertainty of that assessment. Furthermore, the selection process model assigns different weights to location factors based on whether they are considered as soft or hard location factors, anticipates the change of semi-external location factors as a reaction to the construction and operation of the production site under consideration, and considers the possibility of active improvement of conditions reflected by performance location factors.

To take into consideration the conditions under which the OEM implements the selection process in practice, the entire process model is developed to be manageable. Hence, it is constructed in awareness of the time and resource constraints under which the OEM must make the selection and to avoid unnecessary complexity for the sake of quality. Furthermore, negotiations play an important role in the selection process to ensure successful operations at the selected production site. These negotiations must be conducted during the selection process with the owners of the land lot or buildings, owners of railroads or harbors, energy providers, local, regional, and national governments, as well as with suppliers. Moreover, the selection process is conducted anonymously at first in awareness of the conditions under which the OEM implements the selection process in practice. For an overview of the goals, the corresponding perspectives, and basic assumptions of the selection process model, see Figure 8.

Figure 8: Goals and Corresponding Perspectives and Basic Assumptions of the Selection Process

1. Identify the most strategically appropriate production site
   - Inside-outside perspective
   - Strategic perspective
   - Network perspective
   - Consideration of relevant aspects related to the design of the supply chain

2. Avoid selecting any but the most appropriate production site due to structural deficits of the selection process
   - Including all relevant business functions or departments
   - Determining the planning horizon
   - Top-down procedure
   - All location factors must be defined without redundancy and all interdependencies between location factors must be identified
   - Awareness of the problem of aggregation

3. Capture the conditions at potential production sites as realistically as possible
   - Consideration of different forms of location factors
     - Quantitative (cost-related and non-cost-related) and qualitative
     - Static and dynamic
     - Deterministic and stochastic
     - Soft and hard
     - Semi-external and performance

4. Consider the conditions under which OEMs implement the selection process in practice
   - Keeping the selection process manageable
   - Negotiations
   - Anonymity

(Author illustration)

3.4 Choosing and Evaluating Location Factors

3.4.1 Choosing Location Factors

When selecting a production site, the choice of the location factors that are evaluated in the selection process is of utmost importance, since the selection of the production site is based on the location factors evaluated. Location factors reflect the conditions that determine the environment at a production site. (Location factors are discussed in more detail in 2.5 Location Factors.) As explained in 2.4.1 Location Determining Theory, representatives of the empirical-realistic location determining theory acknowledge the general importance of location factors for solving the firm's location problem and aim to facilitate solving the firm's location problem by identifying relevant location factors, developing systematizations of location factors, and raising awareness of the variety and complexity of location factors that firms should take into account when selecting locations (see Autschbach, 1997, 124). While there are some location factors of general importance independent of industry, firm, business function or strategy, such as security or political stability, it is important to understand that there is not one list of location factors that is valid for all firms regardless of industry, business function, or strategy. Instead, the choice of evaluated location factors and the relevance assigned to particular location factors in the selection process varies by industry, firm, business function, and strategy. In the particular case of a production site, the location factors which are relevant to the selection also vary greatly with the product that will be produced, and the production process that will be implemented at the new production site (see 2.5.4 Relevance of Location Factors).

While in the literature representatives of the empirical-realistic location determining theory have developed entire systematizations of location factors to facilitate solving the firm's location problem (see Behrens, 1971, 47-81, Seidel, 1977, 29-86; Sabathil, 1969, 50-226; Goette, 1994, 175-253; 2.5.2 Content-related Systematizations of Location Factors), they have not explained how a firm can choose those location factors from their systematizations which are relevant to their specific endeavor. Other authors have provided some suggestion of how the relevant location factors can be chosen: The results from the BESTAND project suggest firms apply a strategic approach to the choice of location factors by identifying the ten most relevant location factors for their internationalization strategy (see Kinkel, 2009a, 63-79). Similarly, Schnellberg assigns location factors ('operating figures') to certain strategies, as well as to firm-specific and project-specific goals, for which these location factors are relevant (Schnellberg, 2002, 177-186). A comprehensive overview of location factors, which are specifically relevant to the global selection of production sites, has been developed by Meyer. He differentiates location factors by topic: markets and the market development, factor costs, productivity and production techniques, logistics, external factors, and the migration of the production site (see Meyer, 2006a, 36-99) (see 2.5.4.2 Strategy-specific Location Factors). These systematizations of location factors provide some help for firms in choosing location factors, which they evaluate in the selection process, since they expose the variety of potentially relevant location factors, suggest choosing the location factors depending on the strategy and goals, or create categories of location factors. However, these systematizations are not specified to certain industries or certain business functions. Furthermore, they do not facilitate choosing relevant location factors for firms by identifying, for each location factor, whether it is strategic, operational (process-specific or product-specific), or general (see 2.5.4.2 Strategy-specific Location Factors; 2.5.4.3 Product-specific and Process-specific Location Factors). Overall, these systematizations of location factors do not enable the firm to choose the location factors, which are most relevant to the production site, for which they are searching.

In awareness of the significance of choosing the relevant location factors that are evaluated in the selection process, Chapter 4 of this work contains a discussion of location factors that are relevant to OEMs in their search for a production site. With Schöllhammer's recommendation in mind that it is better for firms to create their own list of relevant location factors for their specific endeavor (see Schöllhammer, 1989, 1963) on the one hand, and the usefulness of a list of possibly relevant location factors on the other hand, this discussion of location factors is developed to facilitate OEMs (or the corresponding project team) to choose those location factors that are specifically relevant to their search. To facilitate OEMs (or the corresponding project team) choosing those location factors that are relevant to their selection of a production site from this discussion of location factors (see Chapter 4), it:

- Includes location factors that are possibly relevant to selecting a production site for OEMs and is therefore specific to the automotive industry and production.
- Describes each location factor, provides a macroeconomic analysis, if relevant, and specifies the possible importance of each location factor for constructing and operating a production site.
- Provides additional information on each location factor, including whether the location factor is:
  - a strategic, operational, or general location factor (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).
  - a process-specific or product-specific location factor (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).
  - relevant to the enhancement of the production network of the OEM (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).
  - relevant to the enhancement of the supply chain design of the OEM (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).

The goal of this discussion of location factors is to create a tool for OEMs with which they can easily choose the location factors which are relevant to their endeavor. Overall, the discussion, as an integral part of the selection process model, is a means to facilitate the selection of a production site for OEMs. This discussion of location factors has been created with the goal of including all location factors that can be relevant to selecting a production site for an OEM. Thus, this discussion aims to meet the principles of completeness and substantiality by including only those location factors that are relevant to selecting a production site for an OEM, while omitting all others. Additionally, the selection process model requires the project team, which is responsible for its implementation, to choose the location factors from that discussion for evaluation in the selection process in such a way that their particular selection process also meets both the principles of completeness and substantiality (see Neumair et al., 2012, 237; Ottmann and Lifka, 2010, 35). On the one hand, when choosing location factors for evaluation in the selection process, it is important to not omit any significant location factors, thereby ensuring that all relevant information is considered. Omitting relevant information might lead to unexpected costs and a longer time to construct the production site or start operations, as well as reduced profitability of the production site. On the other hand, evaluating more location factors than those that are relevant (substantial) for the successful selection of a production site carries the risk of reducing the quality of the result of the selection process if it makes the process overly complex and the intermediate and final results more difficult to understand. Moreover, the time and resource constraints under which an OEM must select a production site, and the avoidance of unnecessary complexity require limiting the number of location factors in the analysis to those that are relevant to keep the selection process manageable (see Neumair et al., 2012, 237; 3.3 Perspectives and Basic Assumptions of the Selection Process Model). Therefore, the project team is responsible for choosing the location factors for evaluation in the selection process from the discussion of location factors such that as many location factors as necessary and as few as possible are included in the evaluation, driven by the goal of meeting both the principles of completeness and substantiality.

Hence, in this selection process model the important choice of location factors is facilitated by providing the discussion of location factors in Chapter 4, which includes only those location factors that are possibly relevant to the selection of a production site for an OEM. Choosing location factors from that discussion is facilitated by describing each location factor, giving a macroeconomic analysis if relevant, specifying the possible importance of each location factor for constructing and operating a production site, and by determining whether the location factor is strategic, operational or general and whether it is process- or product-specific, as well as whether it is relevant to the enhancement of the production network or the supply chain design of the OEM.

3.4.2 Evaluating Location Factors

3.4.2.1 Geographic Granularity of Evaluating Location Factors

The selection process must allow for differentiation between different levels of analysis with regard to the geographic level (e.g., supranational, national, regional, local) in the evaluation of each location factor (see 2.5.3 Different Forms of Location Factors). Given the significant difference between the quality of many location factors on a supranational, national, regional, or local level, differentiating the geographic level at which location factors are evaluated is necessary when selecting a production site. Only a few methods to solve this problem have been suggested or incorporated into process models that have been developed for selecting a production site (see Timmermann, 1972, 389; Lüder and Küpper, 1983, 200-209; Autschbach, 1997, 206-207; Eversheim, 1999, 9/43; Schnellberg, 2002, 83-84, 177-186; Meyer, 2006b, 104) (see 2.4.2 Location Planning Theory). However, these selection process models do not entirely solve the problem: while they include the analysis of different geographic levels in their process models, they do not determine the geographic level(s) of analysis for each location factor, but instead only provide some examples of location factors for each geographic level of analysis.

As defined in 2.1 Definitions, production site refers in this work to a clearly defined industrial location at which the OEM produces or processes its products. However, this production site is part of a region, country, and possibly even of supranational unions; therefore, the conditions at the production site are not only affected by local factors, but also by regional, national, and even supranational factors. On the basis of this understanding, the analysis applied in this work is a local analysis and factors that are considered at a supranational, national or regional level are only considered with regard to their effect on the production site. While the conditions at the production site are affected by local, regional, national, and supranational factors, the analysis in this selection process model only differentiates between the national, regional, and local level. Hence, the selection process model does not differentiate between the analysis on a national and supranational level. Location factors that could be evaluated on a supranational level, such as membership in a free trade agreement, are considered on the national level: for instance, Hungary and Poland are members of the European Union, while Turkey is not.

The necessity for differentiating between the national, regional, and local level when evaluating location factors in the selection process can be illustrated by the location factor 'wage level': The wage level in China, for instance, differs considerably across regions (also referred to as provincial-level divisions or traditional regions): the wage level in Shanghai in East China or in

Guangdong in Southcentral China is remarkably higher than in Qinghai in Northwest China. In general, differences in the wage level between agglomerations, urban areas or rural areas within countries are larger in emerging countries than in advanced countries (see Meyer, 2006a, 51-58). It is important, then, that OEMs are aware of this difference when searching for production sites in emerging countries. For the selection process of a production site, the local wage level at the production site matters, as may the wage level in the region of the production site, given people might be willing to commute from other parts of the region to work at the production site. However, the wage levels in other parts of the country do not matter. Given large differences in the wage level between different regions within many, especially large, countries, the national wage level is rather useless for selecting a production site there, as it does not reveal differences between regions. Instead, in smaller countries or in countries with rather homogeneous wage levels also due to collective agreements, interregional differences in wage levels are rather small, making the national wage level worth evaluating as well. Thus, while the national wage level is in many countries not very, if at all, relevant, the regional wage levels, and especially the local wage levels, are very important for selecting a production site. In contrast to the local wage levels, political stability must be considered on the national level, as the national political stability affects the construction and operation of the production site. In countries where the political stability varies significantly between the regions, political stability must also be analyzed on a regional level, as the regional political stability impacts the construction and operation of the production site as well. For these reasons, the relevant geographic level of analysis depends in some cases not only on the location factor, but also on the country in which the potential production site is located.

The geographic levels of analysis are also referred to in the literature as macro-level, meso-level and micro-level ('Makro-, Meso- und Mikroebene') (Ottmann and Lifka, 2010, 27-28), reflecting the national, regional, and local level of analysis. In this selection process model, the terms national, regional, and local level are used to indicate the level at which the individual location factors are supposed to be evaluated in the selection process. Hence, this selection process model solves the problem, explained above, by differentiating in the evaluation of location factors between the national, regional, and local levels of analysis with regard to the geographic granularity of evaluation. In Chapter 4, for each location factor the geographic level of analysis and, if necessary, multiple geographic levels of analysis at which the location factor is supposed to be evaluated in the selection process, are specified. In regard to those location factors which are supposed to be evaluated at more than one geographic level, the particular phase in the selection process model is identified for each geographic level of analysis.

3.4.2.2 Sources of Information on Location Factors

Finding adequate and reliable information for all relevant location factors at the relevant level of geographic granularity is very difficult. In general, there are four categories of sources of information on location factors for an OEM: public sources and databases, commercial external sources, internal know-how, and external consultants. Public sources and databases are, for instance, provided by governments, institutions such as the World Bank, the International Monetary Fund (IMF), the World Trade Organization (WTO), the World Economic Forum (WEF), the Organization for Economic Co-operation and Development (OECD), the U.S. Central Intelligence Agency (CIA), regional development banks, the European Central Bank (ECB) or national statistic bureaus. There is no cost for using public sources and databases.

Commercial external sources are provided by private firms and cost OEMs a considerable amount of money, mostly in the form of an annual subscription, which necessitates an intensive evaluation of their content, as well as a cost-benefit analysis of their subscription. These commercial external sources provide a wealth of information, most often, however, on a national level. Such commercial external sources include Oxford Economics, The Economist Intelligence Unit, IHS Markit or Consensus Economics. To evaluate the suitability of these sources for the selection process, it is important to determine in detail what information is required and at which level of geographic granularity. Furthermore, the project team must identify departments in the OEM which might already have access to one or more of these commercial external sources and find out if their subscriptions allow those departments to contribute the required information to the selection process. If other departments already have access to commercial external sources that provide information required in the selection process, these departments should be involved in the selection process (see 3.2.3 Setting-up the Project Team and Assigning Responsibilities).

Internal know-how[78] refers to the knowledge accumulated through experience and education of employees, as well as to information about potential production sites that they can gain through exchange with employees from other firms and personal visits to potential production sites.

[78] Autschbach differentiates between firm internal sources of information (e.g., experience of employees, or firm's documents and information) and firm external sources of information (e.g., public sources of the home or guest country, private sources, as well as international organizations) (see Autschbach, 1997, 157-165).

This has been alluded to by Simon et al. who realistically assume that some information must be collected at the production sites; however, they do not go into more detail on this idea (see Simon et al., 2006, 246). The know-how accumulated by employees of the OEM is very valuable; there are normally some employees in international OEMs who have experience with selecting production sites in general and with the construction and initial operation of offshore production sites in particular and who know about potential problems that in the past at other offshore production sites have led to higher than expected labor costs, delays in establishing the production site and additional costs in the initial phase of production (see Kinkel, 2009c, 4-8). Furthermore, international OEMs are likely to have employees with experience with other possible problems that can arise when constructing and operating a production site which should be prevented in the selection process, such as a loss of quality and flexibility, the scarcity of skilled labor, shortage of local high-quality suppliers, and insufficient local infrastructure (see Friedli et al., 2013, 17; Kinkel and Maloca, 2009, 31-32). In addition, the OEM's employees might have contact with employees from other firms which are already near potential production sites, for instance, suppliers, which work with the OEM and who are willing to share some information (e.g., on the local availability of skills or the relevant local wage level). This internal know-how must be taken advantage of by including the knowledgeable employees in some way into the selection process and thus allow for learning from their experiences both, with searching for production sites in general and with the requirements for a successful construction and start of operations at new production sites in particular.[79]

External consultants can be included in the selection process to take advantage of their experience and know-how (see Balderjahn, 2014, 58; Meyer, 2006a), either from international accounting firms, such as PricewaterhouseCoopers, Ernst & Young, KPMG or Deloitte, or from international management consulting firms, such as McKinsey or Roland Berger. Information can be gained through external consultants either because their consulting firms have offices in the countries where the potential production sites are or, if they as specialists, they focus on those countries

[79] Erceg and Lay explain that analyzing internationalization activities conducted by the firm in the past to learn from the firm's experience selecting locations abroad and constructing production sites is important for a successful selection process and suggest that this is easiest if the firm has a database that systematically captures these experiences, both successes and failures (see Erceg and Lay, 2009, 105-106). Even though a systematic database is certainly of value for a firm, given the time and resource constraints under which the production site must be selected, developing a database of the firm's past experiences with selecting production sites might not be a realistic part of a selection process. However, the goal to incorporate lessons learned from experiences is an interesting feature and is captured to some degree in this selection process model by attempting to include as much internal know-how as possible in the selection process.

and thus have the relevant information available or have contacts with people who have the relevant expertise. Consulting firms will send consultants to visit potential production sites on behalf of the OEM to research for information about production sites which they may not already have (see Phelps and Wood, 2018, 1027). With regard to choosing external consultants, it is important to follow all relevant procurement standards, meet all internal approval requirements, and sign non-disclosure agreements or confidentiality arrangements with all external consultants who are informed about the project.

These four categories of sources of information, namely public sources and databases, commercial external sources, internal know-how and external consultants, must be used as efficiently as possible in the selection process with an awareness of the time and resource constraints and to avoid unnecessary complexity. To facilitate evaluating location factors in the selection process, the category (or categories) of sources from which the information can be drawn for each location factor is (are) detailed in Chapter 4.

In addition to the four categories of sources of information, Autschbach differentiates secondary research from primary research, which he refers to as 'desk research' and 'field research', respectively (Autschbach, 1997, 157). Likewise, Balderjahn suggests secondary and 'on-site research' (Balderjahn, 2014, 58) while Phelps and Wood point to 'desk-based' assembled information versus information gained through 'site visits' or 'fieldwork' (see Phelps and Wood, 2018, 1027). All research based on public sources and databases, as well as commercial external sources on location factors, can be conducted as desk research. In addition, part of the information obtainable from internal know-how and external consultants is also gathered as desk research from secondary sources, while the part of information gained from internal know-how and external consultants which must be collected at the production sites or in the countries under consideration is referred to as field research in primary sources. Field research can be conducted by employees of the OEM or external consultants. The differentiation between desk research and field research is especially important with regard to the organization of the selection process and the assignment of responsibilities, given the greater effort required for field research than for desk research. The differentiation is also important with regard to whether the selection process is being conducted anonymously or openly under the name of the OEM, as field research can be conducted by OEM employees or by external consultants.

Autschbach postulates that the quality of sources of information and their usability for evaluating location factors depends on their availability, up-to datedness, comparability, and reliability (see Autschbach, 1997, 157-165). These important requirements are verified by suggesting only credible and up-to-date sources in Chapter 4. However, for general public sources and databases, such as national government databases, the project team must in addition check whether the indicated source meets the four requirements in their particular case (for the country under consideration).

Thus, in the discussion of location factors in Chapter 4, for each location factor, particular sources of information are identified that fall into one of the four categories introduced above. Moreover, it is specified for each phase of the selection process model (see 3.5 Procedure of the Selection Process Model) whether the required information can be gathered through desk research or must be collected through field research. This identification of one or multiple possible sources of information for each location factor in the discussion of location factors in Chapter 4, as well as the kind of research required in each phase of the selection process model, is a key means of facilitating the evaluation of the location factors and ensuring the applicability of the selection process model.

3.4.2.3 Measuring Location Factors

To evaluate location factors in the selection process, a form of measurement for each location factor must be determined. The measurability of location factors is a prerequisite for their evaluation in a selection process (see Schnellberg, 2002, 80-83). This section introduces how this selection process model meets the prerequisite of measurability of location factors for their evaluation. Measuring location factors refers to assessing their quality at the potential production sites in a common manner (see Ottmann and Lifka, 2010, 34-35). Quantitative location factors must be differentiated from qualitative location factors, as they must be evaluated separately (see 2.5.3 Different Forms of Location Factors). Moreover, cost-related quantitative location factors must be distinguished from non-cost-related quantitative location factors.

Cost-related quantitative location factors include wages, non-wage labor costs, transport costs or required investments in the local infrastructure. To evaluate these cost-related quantitative location factors in terms of money, the local costs, if expressed in different local currencies, must be expressed in terms of a common currency, which is the Euro in this selection process model. The conversion of local currencies into Euro requires a forecast of all relevant exchange rates versus the Euro for the entire planning horizon. Depending on the OEM's organization, its Treasury Department may be responsible for providing exchange rate forecasts. Thus, if the OEM's Treasury

Department provides exchange rate forecasts, these forecasts should be used in the selection process. If the OEM's Treasury Department does not provide the needed forecasts, public sources and databases or commercial external sources also provide exchange rate forecasts for a variety of countries (see 4.6.2 Exchange Rate). The evaluation of cost-related quantitative location factors must be made in awareness of Goette's realistic statement that the cost-related quantitative impact of the selection of a location on the firm's profitability can only be approximated, as assessing the impact of a location decision on costs and revenues of a firm is very difficult and extremely complex (see Goette, 1994, 255-259). Thus, it is unrealistic to expect to precisely measure all cost-related quantitative location factors in the selection process. As such, the goal is to approximate all cost-related quantitative location factors in Euro. In addition to evaluating these cost-related quantitative location factors, evaluating production sites also requires evaluating non-cost-related quantitative location factors: e.g., the distance which the produced product needs to be transported to its destination in terms of hours required for the transport, or the capacity of the sewerage, measured in terms of cubic meters per day/hour, or the size of the land and building, measured in terms of hectare or square meter. In Chapter 4, a measurement for each quantitative location factor is identified.

Qualitative location factors cannot be measured like quantitative location factors. In this selection process model, qualitative location factors are assessed through ratings (for instance, as very low, low, fairly high, high or very high). The goal of these ratings is not an exact measurement of the location factors, but instead a subjective assessment of the qualities of conditions at potential production sites as reflected by these qualitative location factors. Rating qualitative location factors on an ordinal scale is necessary as they can only be assessed imprecisely. By expressing the ratings (e.g., very low, low, fairly high, high or very high) numerically as 1 through 5, qualitative location factors are quantified. In the rating process of location factors, experts (project team members, other employees, or external consultants) must assess the location factors subjectively. For a successful assessment of qualitative location factors, it is necessary to ensure that the location factors are defined without redundancy (see Ottmann and Lifka, 2010, 32, 36-37; Adam, 1996, 409-410) and that interdependencies between the location factors are identified (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model). This is ensured by defining all qualitative location factors in Chapter 4 without any redundancy and by identifying interdependencies between them. Hence, in this selection process model, qualitative location factors are measured through ratings and for each location factor in the discussion in Chapter 4 rating options (e.g., very low, low, fairly high, high or very high) are suggested.

Overall, given the prerequisite of measurability of location factors for their evaluation, for each location factor included in Chapter 4, a measurement is identified. Quantitative location factors are either measured in Euro (EUR), if they are cost-related, or, if they are not cost-related, then they are measured in different units depending on the location factors being analyzed. Qualitative location factors are measured in terms of ratings—for instance, very low, low, fairly high, high or very high—which are expressed (or quantified) numerically as 1 through 5.

3.4.2.4 Methods for Evaluating Location Factors

To facilitate the application of the selection process model, it is necessary to determine the methods for evaluating location factors in the selection process. With regard to the evaluation methods that are suggested, it is important to emphasize that there is not one evaluation method which can be used to adequately evaluate all relevant location factors (see Kinkel and Buhmann, 2009, 35), but it is necessary to apply multiple evaluation methods in the course of the selection process. The evaluation method(s) used in each phase of the selection process depend on the location factors being evaluated, as well as the respective targeted depth of analysis. For each location factor, a method for its evaluation in each phase during which it is supposed to be evaluated is suggested in Chapter 4. It is important to acknowledge that the suggested method of evaluation, as well as the phase in the selection process model in which the location factors are suggested to be evaluated, are only recommendations and that both are likely to vary from selection to selection. In the selection process model, the following evaluation methods are suggested: different kinds of criteria, operating cost comparison, present value method, the profile method, the utility analysis, scenarios, simulation and the Economic Value Added method (EVA). A requirement-suitability matrix is suggested to depict the match between the requirements on the production site and the conditions there. Moreover, strategic considerations and the SWOT Analysis are used for strategic analysis while documentation is conducted using a decision tree, checklists, as well as strengths and weaknesses lists. Furthermore, it is explained which weighting method is suggested to assign weights to qualitative and non-cost-related quantitative location factors to quantify their relative importance for the selection of a production site, which is necessary when using the utility analysis.

Some location factors are evaluated using different kinds of criteria. The criteria used to evaluate location factors in the selection process can either be defined together with the requirements in the *Production Site Requirement Profile* (see 3.2.2 Production Site Requirement Profile) or specified in the course of the selection process. In reference to Eversheim, as well as to Lüder and Küpper, this selection process model uses exclusion criteria, minimum criteria, preferred criteria (see Eversheim, 1999, 9/43), and substitutable criteria (see Lüder and Küpper, 1983, 192-193). Exclusion criteria reflect requirements that must be met unconditionally at a production site for the production site to qualify as an alternative. Exclusion criteria are used to eliminate alternatives (see Ottmann and Lifka, 2010, 24) which can be ruled out for a certain reason. A possible example of an exclusion criterion in the selection process model is the risk of an earthquake or a volcanic eruption. Minimum criteria reflect certain minimum requirements, defined as thresholds (see Eversheim, 1999, 9/43). Thresholds normally define a minimum or maximum value for requirements on location factors. Minimum criteria for cost-related quantitative location factors can have a threshold of the maximum value for the operating costs (or operating expenditures) of a production site (e.g., per produced unit including its transport to its destination) or of the minimum present value of the production site. Using these minimum criteria only requires checking if the approximated operating costs do not exceed the defined threshold or, respectively, if the present value of the production site is above the defined threshold. The minimum size of the land plot is an example of a minimum criterion for a non-cost-related quantitative location factor, while the minimum level of political stability is an example of a minimum criterion for a qualitative location factor. All kinds of exclusion criteria and minimum criteria must be used with much caution, as too many exclusion criteria or overly demanding minimum criteria might lead to the elimination of otherwise promising alternatives. Thus, exclusion criteria and minimum or maximum values for the thresholds of minimum criteria must be formulated in such a way that they reflect only those requirements which are indeed absolutely necessary for the successful operation of a production site (see Ottmann and Lifka, 2010, 24-25).

Preferred criteria reflect desired requirements which do not have to be met by the conditions at a production site for it to remain an alternative (see Eversheim, 1999, 9/43), but are certainly beneficial for constructing and operating the production site. A possible example of a preferred criterion in a selection process is the possibility of sequential acquisition of neighboring land. Substitutable criteria reflect requirements of which the low quality of one location factor can be compensated for by the high quality of another (see Lüder and Küpper, 1983, 192-198). Examples of substitutable requirements are that the production site is located directly at an industrial harbor or, alternatively, that it is connected with railroads to an industrial harbor. This selection process model uses exclusion criteria, minimum criteria, preferred criteria, and substitutable criteria.

Besides minimum criteria for evaluating cost-related quantitative location factors, this selection process model also uses the present value method, a cost comparison, and the EVA method. As explained above, any kind of costs can only be approximated (see 3.4.2.3 Measuring Location Factors). For evaluating the costs of the investment (capital expenditures), the present value method is used as a dynamic capital budgeting method (see Kinkel and Zanker, 2007, 186-188). The present value method can be applied to compare alternatives for an investment in terms of its present value (see Perridon et al., 2017, 53-59). The long planning horizon of a production site makes a dynamic method necessary. The present value method accounts for the 'time value' of money by discounting all future cash flows (see Brealey et al., 2020, 20-24). Applying the present value method to the evaluation of different production sites requires calculating exclusively the costs that are expected to occur for constructing and operating each of the remaining production sites, while the revenues are considered as given. Hence, in this case, the present value method is only used to evaluate all investment costs (capital expenditures) and operating costs (operating expenditures) incurred over the planning horizon of potential production sites. Investment costs include costs for the land plot and buildings or investments in infrastructure on and off the production site (e.g., streets, tracks, waterways, waste, and sewerage facilities). Operating costs include costs for water, energy, sewerage, and waste disposal, maintaining machinery or wage costs. For the present value method, it is necessary to discount all approximated costs which are expected to arise at some point over the planning horizon of the production site. If the OEM commits in negotiations with the government, for instance, to invest in a training facility close to the production site, but to do so only five years after the start of operations at the production site, these costs for the investment must be discounted to approximate the total investment costs of the production site.

Furthermore, a cost comparison is suggested to evaluate operating costs (operating expenditures). The approximated total operating costs (also per produced unit, including the transport of the product to its destination) at the production site can either be expressed in absolute terms or in terms of savings compared to a benchmark production site of the OEM.[80] As for the present value

[80] This includes all costs which are incurred for producing and transporting the products, and therefore also the investment in the production site, all costs for its maintenance, and all costs that arise for the machinery. For a realistic assessment of the costs for the machinery, calculations must be made using the Total Cost of Ownership method, which

method, for the comparison of operating costs it is necessary to discount the approximated operating costs which are expected to arise at some point over the planning horizon of the production site. Hence, when comparing operating costs, it is necessary to calculate the present value of these costs. If one goal for offshoring a production site is cost savings, the additional comparison of the approximated costs per produced unit including its transport to its destination in terms of savings compared to a benchmark production site ensures that savings which result from offshoring the production site instead of constructing the production site in the OEM's home country meet the cost-savings target, which should be identified in the *Strategic Requirement Profile*.[81] Since the cost comparison is used to evaluate operating costs, it is henceforth referred to as operating cost comparison.

Moreover, the Economic Value Added (EVA) method is used for evaluating cost-related quantitative location factors. The EVA is a capital budgeting method applied to analyze whether a project creates more value than the cost of capital for the assets used in the project (see Schawel and Billinger, 2018, 113). Listed firms apply the EVA method to compare alternatives for an investment by answering the question: which alternative is most profitable and generates the highest net return to shareholders?[82] This method takes into consideration that shareholders not only want a 'return of their investment', but they also want a 'return on that investment', and thus that the cost of capital must also be covered by the returns of an investment (Brealey et al., 2020, 324). The EVA is the residual income of a period calculated by adjusting the operating profit for the cost of capital for the required capital (see Schawel and Billing, 2018, 113-114). Applying the EVA method to the evaluation of different production sites exclusively requires calculating the costs that are expected to occur for constructing and operating alternative production sites, with a given operating profit (net operating profit after taxes). The cost of capital required is calculated by multiplying the required capital for the investment by the weighted average cost of capital (WACC). As

takes all related costs into account and thus provides a more realistic assessment of the total costs which the OEM is expected to incur at the production site for machinery over the planning horizon. The Total Cost of Ownership is often significantly higher than the mere price of a product, in this case machinery (see Ellram, 2002, 661-662; Burt and Starling, 2002, 101-102), as it includes all costs related to a product - from its acquisition, to its use, and its disposal (see Geißdörfer, 2008, 14) (e.g., costs for acquiring, transporting, using, maintaining and disposing machinery, as well as administration or risk related costs) (see Ellram, 2002, 661-662; Burt and Starling, 2002, 101-102), and hence all direct and indirect costs related to the product (see Geißdörfer, 2008, 14; Ebel, 2009, 367).

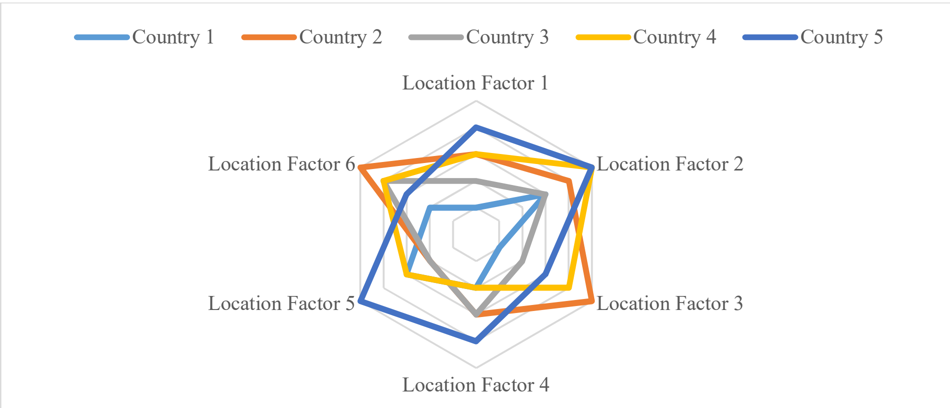
[81] Calculating the costs in terms of savings compared to a benchmark production site requires defining the costs of production at a benchmark production site.

[82] This is interesting as many OEMs are listed firms.

the WACC must be paid annually, the EVA must be calculated for each year of the planning horizon of the production site and then added up over the respective years. Taking the cost of capital into consideration ensures shareholders a return on their investment and is thus a valuable method to compare alternative production sites. The EVA method is used to compare potential production sites once all costs are approximated.

For evaluating qualitative and non-cost-related quantitative location factors, two rating methods are applied in the selection process model: the profile method and the utility analysis. In the profile method, the alternatives are evaluated without aggregating the total utility of an alternative (in this case a country, region, or production site). Each location factor included in the evaluation must be assessed on a rating scale and all evaluated location factors are depicted in the same graph, as well as assessed on the same scale (numerically as 1 through 5). The preferred graph depends on the number of production sites, regions, or countries and the location factors which are included: for the sake of clarity, it is advantageous to illustrate the result in a scatter plot, if the number of location factors is low (2 to 3) and the number of production sites, regions, or countries is high, and in a spider web if the number of location factors is between 4-10 and the number of production sites, regions, or countries is between 2-10. In a spider web, the best option is the one which covers the largest area (see Figure 9).

Figure 9: Example of a Spider Web



(Author illustration)

If, however, the number of production sites, regions, or countries is above ten and the number of location factors is high as well, then the result is depicted in a bar or line chart. The profile method has the advantage of providing a high level of information, as the quality of different location factors for each production site, region, or country is illustrated separately (see Ottmann and Lifka, 2010, 80-83). When evaluating a production site, region, or country in the profile method, it is advisable to conduct an analysis by topic (e.g., the legal, political, or economic environment, the labor market or infrastructure) and depict the results separately, as this allows for a systematization, differentiation, and consideration of the results by topic. This is especially important with regard to the problem of aggregation which arises when evaluating non-cost-related quantitative and qualitative location factors in the profile method. How this problem of aggregation is addressed in detail in this selection process model is explained in 3.3 Perspectives and Basic Assumptions of the Selection Process Model.

In contrast, the utility analysis leads to an aggregated result for each production site. Despite its aggregated result, the utility analysis is helpful for evaluating production sites, as it includes a large number of production sites and location factors and ranks the different production sites based on their aggregated utility. To conduct a utility analysis requires determining the requirements on the production site, assigning weights to these requirements, and evaluating the degree of fulfillment of these requirements by the conditions at potential production sites (see Eversheim, 1999, 9/46-9/52; Timmermann, 1972, 391). There are a variety of different utility analyses, but this selection process model uses the following kind: the so-called partial utility $u_i(x_i)$ of each individual location factor is multiplied with the weight (ω_i) that is assigned to this location factor and, at the end, all of these products are summed up in an aggregated utility (U_j) for each production site (j) of the n alternatives, expressed in a formal equation $\sum_{i=1}^{n} \omega_i \cdot u_i(x_{ij}) = U_j$ (see Ottmann and Lifka, 2010, 83; Adam, 1996, 412-421). It can also be conducted a multi-level utility analysis, which means that the utility values of individual criteria do not enter the total utility value directly, but that, first, the utility for individual groups of criteria (partial utility values)[83] are calculated with an independent assignment of weights and then they are condensed to a total utility value. The advantages of a multi-level utility analysis include a higher degree of clarity and the possibility to analyze and compare individual partial utilities (see Schütte and Vering, 2011, 112-113).

When evaluating a production site, and thus when evaluating various location factors for each production site, it is advisable to conduct a utility analysis of each production site by topic,

[83] In the formal equation above each u_i value can reflect, in a multi-level utility analysis, an individual group of criteria (partial utility value).

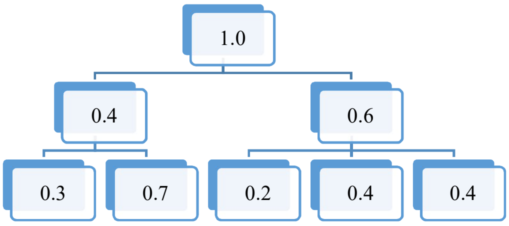
such as the legal, political, or economic environment, the labor market or infrastructure.[84] When evaluating qualitative and non-cost-related quantitative location factors in the utility analysis, the problem of aggregation arises. How this problem of aggregation is addressed in this selection process model is explained in 3.3 Perspectives and Basic Assumptions of the Selection Process Model.

As mentioned above, when assessing qualitative and non-cost-related quantitative location factors in the utility analysis, it is necessary to assign weights to each of them depending on their importance and thereby quantify their relative importance for selecting the production site. There is a large body of literature on various methods for assigning weights (see Bamberg et al., 2019, 57-62; Gabler and Ganninger, 2010, 143-164; Adam 1996, 127-139). For this selection process model, the direct rating method and the Analytical Hierarchy Process (AHP) are options. The direct rating method is a weighting method with which the relevance of individual criteria is rated on a rating scale for each element. The direct rating method is absolute as each element is rated independently of others (see Ottmann and Lifka, 2010, 63). The AHP uses paired comparisons for a relative assessment of the relevance of criteria for each element (see Bamberg et al., 2019, 60; Ottmann and Lifka, 2010, 108). The direct rating method is preferred for this selection process model as it is more easily applied, while the AHP method has the disadvantage of increasing complexity and required effort as the number of compared items (countries, regions, or production sites) or the number of location factors increases (see Ottmann and Lifka, 2010, 63-64,115). However, in some cases, it can be reasonable for the project team to prefer the AHP method as if, for example, only a very limited number of qualitative location factors are evaluated in the utility analysis. Furthermore, the weights are assigned to qualitative and non-cost-related quantitative location factors in a hierarchical weighting method, which means that all elements of one hierarchical group add up to 1 or 100% and all groups on one hierarchical level must add up to 1 or 100% (see Ottmann and Lifka, 2010, 60-72) (see Figure 10).[85]

[84] The results of a utility analysis can be depicted in a two-dimensional or three-dimensional portfolio analysis, which is useful for comparing the results of the utility analysis of many production sites based on two or three location factors or topics (dimensions). The production sites which are in the upper right-hand corner of the graphs score high on all dimensions depicted in each graph.

[85] This is in contrast to a non-hierarchical method in which all location factors are only assigned a weight on the lowest level and the weights assigned to all location factors have to add up to 1 or 100% (see Ottmann and Lifka, 2010, 60).

Figure 10: Example of a Hierarchical Weighting Method



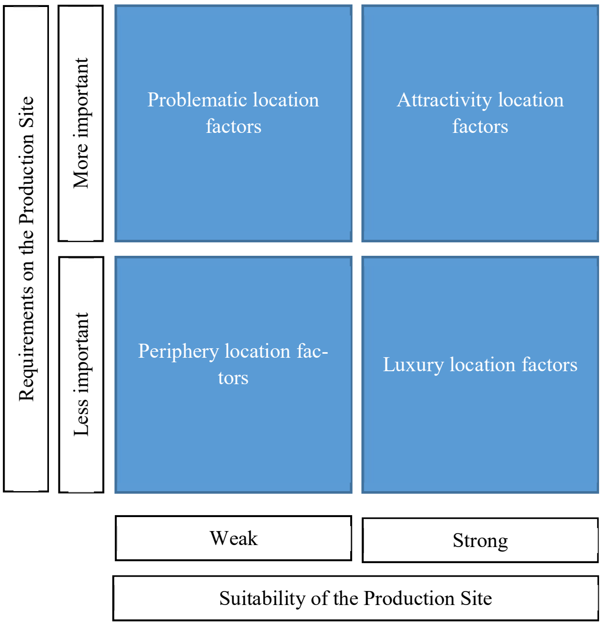
(Author illustration)

This hierarchical weighting offers the possibility of assigning different weights to different topics of location factors; for instance, to differentiate between the relevance assigned to economic versus political and legal location factors or previously determined hard and soft location factors (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model). Overall, the weights should be based on expertise, which can be a combination of the suggestions from external consultants who are involved in the selection process and the know-how of the OEM's employees, which can be collected through questionnaires or interviews. Assigning weights must be conducted case by case by the project team depending on the product that will be produced, the production process that will be implemented at the new production site, and the strategic goals that are pursued.

Assigning weights to qualitative and non-cost-related quantitative location factors is also necessary to depict them in a requirement-suitability matrix. Such a matrix can be used to depict the match between the OEM's requirements on the production site and those conditions at potential production sites which are reflected in qualitative and non-cost-related quantitative location factors. Using a requirement-suitability matrix identifies the problematic location factors, the periphery location factors, as well as the attractivity and luxury location factors, thus those that are more important but weak at the production site, less important but strong at the production site, more important and strong at the production site, or less important and strong at the production site, respectively (see Figure 11) (Balderjahn, 2014, 67). Hence, a requirement-suitability matrix depicts the match between the requirements on the production site and the conditions at potential production sites, reflected in qualitative and non-cost-related quantitative location factors according to their relevance.[86]

[86] This idea is taken from Balderjahn, who suggests using a requirement-suitability matrix to align the firm's requirements on the location and the conditions at the locations reflected in the location factors (see Balderjahn, 2014, 67-68).

Figure 11: Generic Example of a Requirement-Suitability Matrix for a Production Site



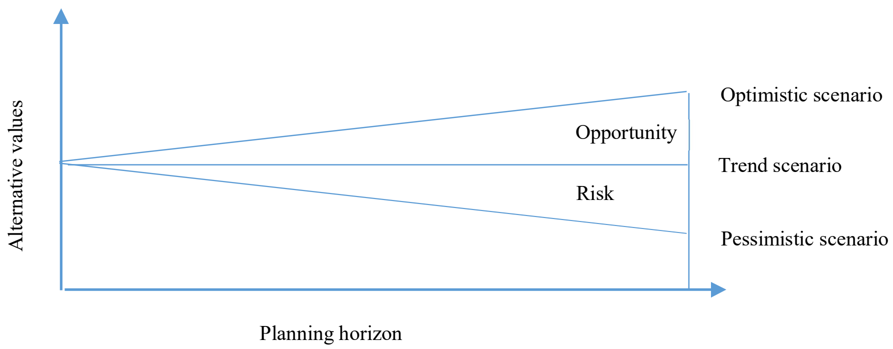
(Author illustration in reference to Balderjahn, 2014, 67)

As explained above (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model), the dynamic and stochastic evaluation of location factors is conducted together using scenarios in this selection process model. Location factors whose expected change over the planning horizon is considered significant for selecting a production site have their future development taken into account in this selection process model. Similarly, uncertainty is taken into account with regard to those location factors whose assessment is subject to significant uncertainty. As stated, for this selection process model it is assumed that the assessment of the current state of location factors is normally not subject to considerable uncertainty, but that the assessment of the future development is always subject to uncertainty. Thus, every dynamic evaluation is necessarily also stochastic. Hence, in this selection process model, scenarios are developed for the dynamic and stochastic analysis of location factors.

Even though Klein and Scholl suggest that the scenarios should, if possible, cover all imaginable cases (see Klein and Scholl, 2011, 10, 38), in this selection process model, in reference to Buhmann and Schön, the number of scenarios is limited to three, given the limited forecast accuracy, the time and resource constraints and the desire to avoid unnecessary complexity: a realistic scenario (‘realistic case’ or ‘trend scenario’ (‘Trendszenario’)), a ‘pessimistic scenario’ (‘pessimistisches Szenario’) and an ‘optimistic scenario’ (‘optimistisches Szenario’) (Buhmann and

Schön, 2009, 291). Together, these three scenarios create a span of possible future developments of the conditions at the production sites reflected in the location factors (see Ottmann and Lifka, 2010, 54-56). In formulating these scenarios, it is important, that there is no redundancy between them (see Klein and Scholl, 2011, 10, 38, 270). Furthermore, these scenarios are defined in the form of a discrete distribution of time,[87] as the future development of location factors is evaluated on the basis of annual data. The trend scenario indicates the most likely future development, while the extreme scenarios indicate the best and worst anticipated development. To formulate the optimistic and pessimistic scenarios, the best likely and worst likely value can be determined for the location factor under consideration. If future developments of various location factors are closely interdependent, then their best likely and worst likely values can be combined in a plausible way into consistent bundles of values of those location factors (see Ottmann and Lifka, 2010, 54-56). The difference between the optimistic and pessimistic scenario increases over the planning horizon, due to the increasing uncertainty of the assessment as the number of years of the forecast increases. As illustrated in Figure 12, the difference between the pessimistic scenario and the trend scenario indicates a risk, and the difference between the trend scenario and optimistic scenario indicates an opportunity. In formulating scenarios, it is advisable to formulate trends for the development of location factors and avoid attempting to forecast accurate future developments in the face of the aforementioned difficulty to forecast developments for more than three years in the future.

Figure 12: Span of Scenarios



(Author illustration in reference to Ottmann and Lifka, 2010, 55)

For the depiction and analysis of scenarios, as well as interdependencies between location

[87] A discrete distribution of time implies that elements change to discrete points in time (see Adams, 1996, 268-269).

factors, simulation is used in this selection process model as it enables a depiction of conditions (or of an environment), if the interdependencies between the different elements of the considered system are too complex to be captured by an analytical evaluation (see Klein and Scholl, 2011, 267). Simulation is especially useful to analyze complex systems with dynamic or stochastic elements (see Adam, 1996, 488). Various authors advise the use of simulation in a selection process to take into account uncertainty in assessing location factors (see Sabathil, 1969, 255), to assess dynamic conditions at production sites (see Backhaus and Voeth, 2010, 90) or to consider interdependencies between location factors (see Sabathil, 1969, 255). In this selection process model, simulation is used to depict and analyze scenarios and identified interdependencies between location factors (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model). The use of simulation requires software due to the high level of calculation required. There are a variety of software for simulation, e.g., AnyLogic Simulation Software.

Moreover, strategic considerations are used in the first phase of the selection process to determine the world region(s) (or a limited number of countries). This is in accordance with several authors who suggest strategic considerations at the beginning of the selection process based on the firm's strategies (see Seidel, 1977, 124; Backhaus and Voeth, 2010, 66-70; Köhler and Hüttemann, 1989, 1431; Goette, 1994, 105-174; Kinkel, 2009a, 65-79; Schnellberg, 2002, 80-81; Meyer and Jacob, 2006, 151-158). The use of strategic considerations in the first phase of the selection process (see 3.5 Procedure of the Selection Process Model) is a means to ensure that strategic considerations are given adequate importance in the selection process. These strategic considerations as a method of evaluation must be clearly distinguished from the use of criteria. The goal of using strategic considerations as a method of evaluation to determine the world region(s) (or a limited number of countries) is to prevent the omission of potentially promising production sites. By not defining hard exclusion criteria, such as security or political stability, but by exclusively considering strategic aspects that are relevant to successfully operating the production site, using strategic considerations in the first phase of the selection process prevents the omission of potentially promising production sites which are in line with the OEM's strategic goals. Strategic considerations consist of an extensive balancing of related strategic goals of the OEM associated with the new production site, which, in turn, depend on the OEM's motive for pursuing the new production site, the OEM's strategic goals, and also on the product, that will be produced and the production process that will be implemented at the new production site. Strategic considerations can include aspects such as sales markets, access to raw materials or rare earth materials and to skills, protection of intellectual property, capacity related issues, industrial policies, such as local content requirements or free trade agreements, and also production network and supply chain aspects, e.g., the logistic connectivity to suppliers, other production sites of the OEM and the sales markets.

At a later stage in the selection process, the SWOT analysis is conducted for those production sites, which are among the remaining options, to ensure the inclusion of final strategic considerations. The SWOT analysis is a way for the OEM to examine its strategic options by combining the analysis of external and internal characteristics (see Müller-Stewens and Lechner, 2016, 207-210). The SWOT analysis is based on the assumption that strengths and weaknesses depend on the capabilities of the firm, while opportunities and threats depend on the environment in which the firm acts. The goal of the SWOT analysis is to define strategies with which the firm can take advantage of opportunities using existing strengths and to successfully manage situations where threats encounter weaknesses (see Bea and Haas, 2019, 142). However, for the sake of selecting a production site, the SWOT analysis is used in a slightly different way, as a method to incorporate strategic considerations into the evaluation of production sites. The environment, hence, the conditions at potential production sites, determines the opportunities and threats for the OEM at those locations. Additionally, the SWOT analysis is used to assess how the strengths of the OEM would encounter opportunities or how its weaknesses would encounter threats at those potential production sites.

Moreover, checklists, as well as strengths and weaknesses lists, are used for systematizing information about evaluated location factors, as well as for documenting the results of the evaluation, while a decision tree is also used for documentation. Checklists document whether the evaluated production sites meet the requirements defined in criteria, though they are not a typical evaluation method; however, they can be used as an auxiliary instrument. Checklists are suggested to be used in the fundamental binary form with the possible values of yes and no (see Ottmann and Lifka, 2010, 74-75; Adam, 1996, 407-412). Moreover, part of the information, which project team members or external consultants gain when visiting the production sites, is systematized in strengths and weaknesses lists.[88] In the selection process, strengths and weaknesses lists are simply used as systematized lists of findings about production sites which the team members or external

[88] See footnote 43.

consultants make when visiting production sites to group strengths and weaknesses of the production sites based on the requirements on the production site as defined in the *Production Site Requirement Profile* (see 3.2.2 Production Site Requirement Profile). These findings include, for instance, information about the shape and size of the land, the possibility of a sequential acquisition thereof, as well as its topology and ground conditions, the existence of a natural reserve or archaeological findings in close proximity or the basic logistic connectivity (availability of roads, railroads, navigable river, sea harbor) of production sites. A decision tree retrospectively illustrates the individual steps of the selection process in terms of production sites, which have been eliminated during the selection process (see Ottmann and Lifka, 2010, 24, 29). The documentation of the selection process not only helps the project team to reconstruct the decisions made in previous steps of the selection process, but is also a means to meet the OEM's reporting requirements of a selection process.

Summing up, based on the understanding that there is not one method with which all relevant location factors can be adequately evaluated, but that multiple evaluation methods must be used in the selection process, the selection process model includes the use of strategic considerations, different kinds of criteria, the profile method, the utility analysis, operating cost comparison, the present value method, and the EVA method. Furthermore, to quantify the relative importance of individual location factors in the selection process, weights are assigned to qualitative and non-cost-related quantitative location factors which are evaluated in the utility analysis. These weights are assigned in a hierarchical form preferably with the direct rating method based on a combination of internal expertise and the suggestions of external consultants. A requirement-suitability matrix can be used to depict the match between the OEM's requirements on the production site and the conditions at potential production sites according to their relevance. The dynamic and stochastic evaluation of location factors is conducted using scenarios, while these, as well as interdependencies between location factors, are analyzed with the help of simulation. Moreover, the information gained by visiting the production sites is systematized in strengths and weaknesses lists and checklists. How the OEM's strengths would encounter opportunities, or how its weaknesses would encounter threats at the production sites is analyzed using the SWOT analysis. The selection process is documented using a decision tree, checklists, and strengths and weaknesses lists. To facilitate evaluating location factors, a method for its evaluation in each phase in which it is supposed to be evaluated is suggested in Chapter 4. The evaluation method(s) which should be used in each phase of the selection process depend on the location factors being evaluated, as well as the respective targeted depth of analysis. Moreover, for each phase of the procedure of the selection process model the evaluation methods and the form of documentation are assigned.

3.5 Procedure of the Selection Process Model

In this section, the generic procedure of the selection process model is laid out. The selection process model has a top-down procedure as explained above (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model). In such a procedure, the options are narrowed down step-by-step from numerous options, to fewer options, to one final option (see Meyer, 2006b, 115; Balderjahn and Specht, 2020, 151). A top-down procedure includes more production sites in the selection process from the start and is more likely to prevent the omission of potentially promising production sites. This kind of top-down procedure for the selection process of a production site has been formulated by several authors (see Timmermann, 1972, 391; Henzler, 1979, 122; Stahr, 1982, 59-61; Lüder and Küpper, 1983, 106; Köhler and Hüttemann, 1989, 1428-1430; Autschbach, 1997, 193-212; Meyer, 2006b, 106-108; for a summary see 2.4.2 Location Planning Theory). The procedure of the selection process model developed in this work consists of seven steps (see Figure 13), which is necessary given the complexity of evaluating production sites in the automotive industry and the variety of aspects that must be considered. This differs from existing process models developed for selecting sales markets, which consist mainly of two or three selection steps (see Seidel, 1977, 125; Henzler, 1979, 123-129; Stahr, 1982, 59-61; Köhler and Hüttemann, 1989, 1432; Schneider and Müller, 1989, 7-55; Backhaus and Voeth, 2010, 66, 70, 89; Balderjahn, 2014, 55) (see 2.4.2.1 Process Models Developed in the Field of Marketing), and from existing process models developed for selecting production sites (see Timmermann, 1972, 391-393; Lüder and Küpper, 1983, 200-209; Meyer, 2006a, 104), which have up to five selection steps (see 2.4.2.2 Process Models Developed to Select a Production Site).

While the individual steps of the procedure of the selection process model are explained below, the effect that the goal to keep the selection process manageable has on this procedure is explained first. As established above (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model), the entire selection process model is formulated in awareness of the time and resource constraints under which the OEM must make the selection, and to avoid unnecessary complexity and thus keep the selection process manageable. This has two especially crucial effects on the procedure of the selection process model: first, the world region(s) (or a limited number of countries) is (are) selected in the first phase of the procedure based on strategic considerations to ensure that the new production site enhances the strategic goals of the OEM and to avoid in-depth evaluation of production sites in subsequent phases which are unable to meet the relevant strategic goals of the OEM. This is in accordance with Backhaus and Voeth, who realistically assume that the firm's strategic orientation and goals confine the selection to a certain world region.[89] This strategic preselection increases the efficiency of the selection process (see Backhaus and Voeth, 2010, 66-67), as it constrains the potential countries, regions and production sites that must be evaluated subsequently to the selected world region(s) (or a limited number of countries). Starting the selection process with strategic considerations is important to keep the selection process manageable without eliminating any promising production sites and to ensure that the new production site is aligned with the strategic orientation of the OEM.

The second effect that the goal to keep the selection process manageable has on the procedure is to make the third step consist of selecting regions in the selected countries based on an evaluation on the regional level, eliminating those regions where constructing a production site must be ruled out. Even though it is generally more difficult to find information about location factors on the regional level than on the national level, this step can avoid unnecessary complexity without eliminating possibly promising production sites, if the location factors evaluated on the regional level in this phase are limited and wisely chosen. This regional evaluation prevents the project team from extensively analyzing production sites which are located in a region where an investment of such a large size[90] as is necessary for a production site is prohibitive or where the goals associated with the production site cannot be achieved. Eliminating certain regions in the previously selected countries is advisable in the selection process, in awareness of major differences within countries between different regions. Depending on the goals associated with the production site, there are several location factors whose evaluation on the regional level can help eliminate regions where the construction and operation of a production site is prohibitive (e.g., *Corruption*, *Security*, *Political Stability*, *Natural Hazards or Supply Chain Risks)* or where the goals associated with the production site cannot be achieved (e.g., *Transportation Facilities, Clusters, Access to Rare Earth Materials or Availability of Skills).*

Thus, to keep the selection process manageable, the selection process starts with selecting

[89] Some kind of strategic preselection at the beginning of the selection process involving taking the firm's strategy into consideration has also been suggested by Seidel (1977, 124), Backhaus and Voeth (2010, 66-70), Köhler and Hüttemann (1989, 1431), Goette (1994, 105-174), Kinkel (2009a, 66-68), Schnellberg (2002, 80-81), Meyer and Jacob (2006, 149).
[90] See footnote 1.

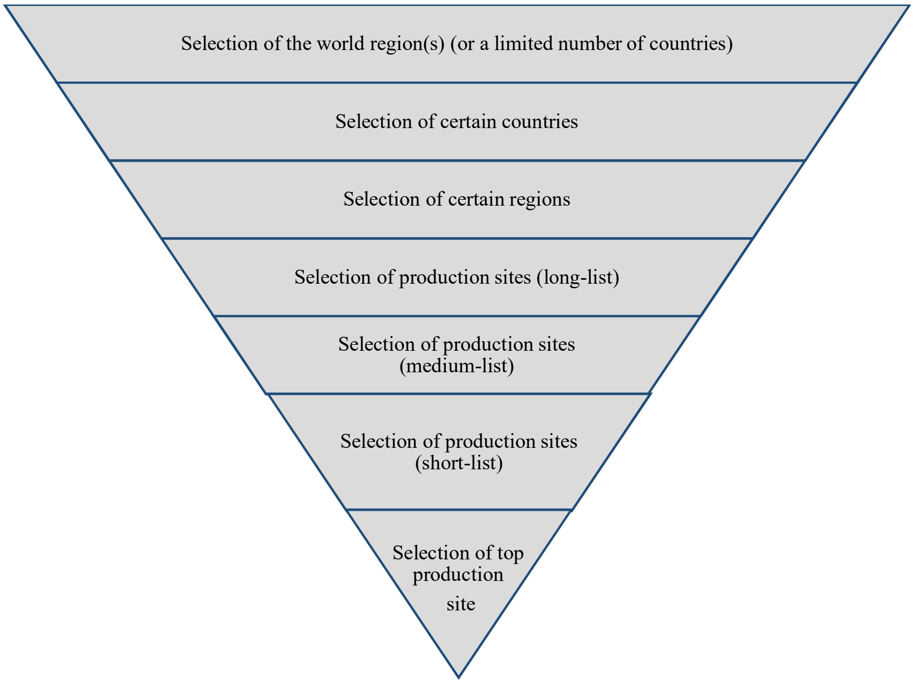
the world region(s) (or a limited number of countries) based on strategic considerations and includes, in the third step, the selection of regions. In total, the procedure of the selection process model consists of the following seven steps, which are illustrated in Figure 13 and explained below:

1. Selection of the world region(s) (or a limited number of countries).
2. Selection of certain countries in the world region(s) (or a limited number of countries) selected in Step 1.
3. Selection of certain regions in the countries selected in Step 2.
4. Selection of production sites (long-list of production sites) in remaining regions selected in Step 3.
5. Selection of production sites (medium-list of production sites) from the long-list.
6. Selection of production sites (short-list of production sites) from the medium-list.
7. Selection of top production site (and one alternative) from the short-list.

These seven steps are illustrated in a funnel form capturing the shrinking number of areas which are evaluated in order to find the best production site (Steps 1-3) and the decreasing number of production sites considered (Steps 4-7) in the course of the selection process (see Figure 13).[91]

[91] Bogaschewsky also developed a funnel model (see footnote 45), though his is developed to select sourcing markets and regions while the developed funnel model in this work aims at selecting production sites. This is also why this selection process model has 7 steps while Bogaschewsky's funnel model only needs 4 steps. However, the use of the funnel as a model is similar to Bogaschewsky's, particularly in steps 1-3, where the number of areas (countries and regions) shrinks during the course of the selection process (see Bogaschewsky, 2007, 15, 17).

Figure 13: Steps of the Procedure of the Selection Process Model

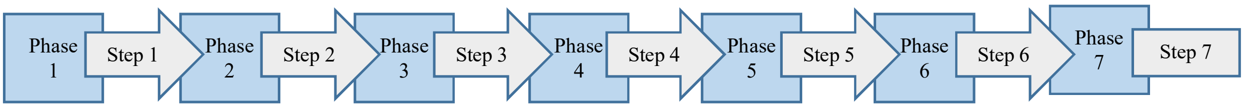


(Author illustration)

As illustrated above, the selection process starts with the selection of the world region(s) (or a limited number of countries) based on strategic considerations. In the second step, the countries within the selected world region(s) (or a limited number of countries) are selected by eliminating those countries where an investment of such a large size as is necessary for a production site is prohibitive (e.g., due to inadequate security) or where the goals associated with the production site cannot be achieved (e.g., due to an inadequate availability of skills). Likewise, in the third step, the regions where an investment of such a large size as is necessary for a production site is prohibitive (e.g., due to a high risk of natural hazards) or where the goals associated with the production site cannot be achieved (e.g., lack of an industrial cluster) are eliminated. In the fourth step, a long-list of production sites is selected from all potential candidates based on a first local evaluation. The goal of this step is to eliminate those production sites which can be ruled out because they do not meet some requirements which are closely related with the land plot and its surroundings (e.g., on the size of the land plot, its shape, its land zoning) and are rather simple to evaluate. In the fifth step, a medium-list of production sites is created based on a more detailed evaluation. The goal of this step is to eliminate those production sites that do not meet some requirements (e.g., on the availability of skills, the connectivity to firm-own production sites or to suppliers) which are harder to evaluate. In the sixth step, a short-list of production sites is composed based on a rough evaluation of costs. The goal of this step is to eliminate those production sites whose construction and operation cannot be profitable. In the seventh and final step, the project team selects the top production site based on a detailed analysis, which it subsequently presents to the board of management. In this step, the project team should also determine the best alternative in case the board of management does not agree with the selected production site, or the final acquisition of the selected production site fails for some unanticipated reason.

With each of these steps, either the production site search area (Steps 1-3) or the number of potential production sites (Steps 4-7) is reduced. Before each of these steps is a phase of information gathering, evaluating and decision-making, upon which the selection in each step is made or, put differently, each step is the result of the evaluation in the previous phase.[92] The phases of the procedure are correspondingly referred to as Phase 1 through Phase 7. Thus, in each phase, the evaluation is conducted of which the subsequent step is the result, while each step provides the starting point for the evaluation of the next phase. In this manner, the sequence of steps and phases of the procedure of the selection process model can be illustrated as in Figure 14.

Figure 14: Sequence of Phases and Steps of the Procedure of the Selection Process Model

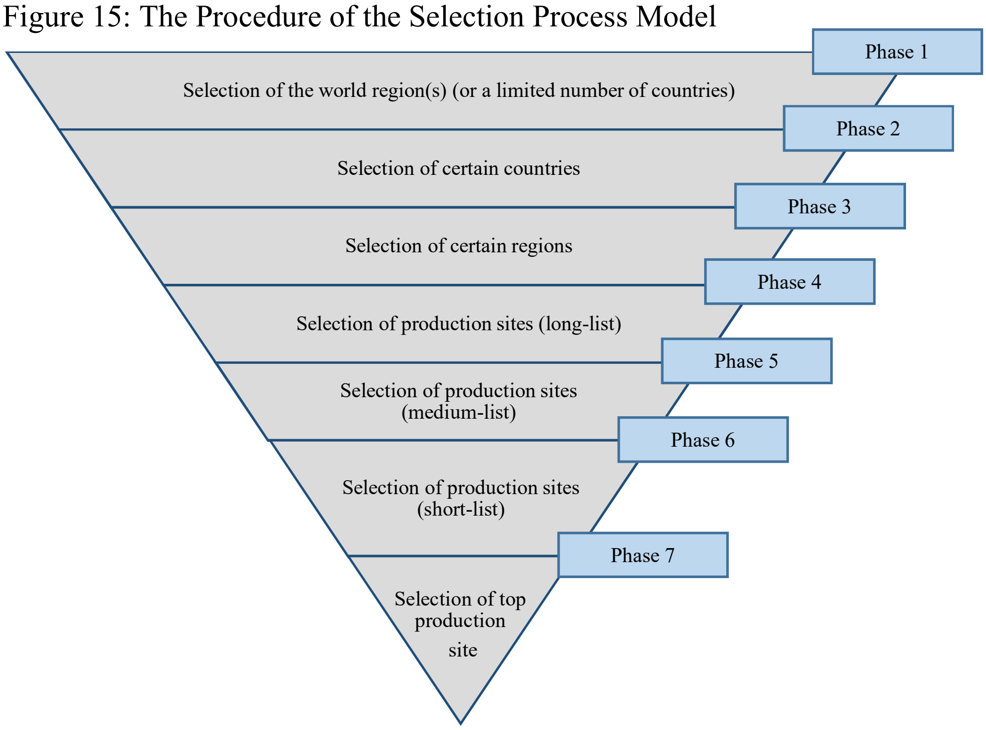


(Author illustration)

Figure 15 captures the entire procedure of the selection process model, as it combines the timing perspective of the different phases and steps (Figure 14) with its funnel form capturing the shrinking areas in which the production site is searched (Steps 1-3) and the decreasing number of production sites considered (Steps 4-7) in the course of the selection process (Figure 13).

[92] Schneider and Müller developed a process model for selecting the most attractive sales market and they acknowledged that in the face of firms' time and resource constraints, a systematic selection process must be structured so that during the selection process the number of evaluated countries decreases while the amount of information evaluated per country increases (see Schneider and Müller, 1989, 13).

Figure 15: The Procedure of the Selection Process Model



(Author illustration)

As the selection steps are defined above, next, the tasks and characteristics are specified on a generic level for each of the seven phases. While the first phase is briefly described as it is characterized by strategic considerations, for all other phases (2-7) the following tasks and characteristics are specified:

- The object that is evaluated—namely countries, regions, or production sites—and the geographic level of analysis, which is the national, regional, or local level (see 3.4.2.1 Geographic Granularity of Evaluating Location Factors).
- Some examples of location factors which could be evaluated.
- If qualitative location factors and/or cost-related quantitative location factors and/or non-cost-related quantitative location factors should be evaluated (see 2.5.3 Different Forms of Location Factors; 3.4.2.3 Measuring Location Factors).
- The method(s) that are suggested for evaluating location factors (see 3.4.2.4. Methods for Evaluating Location Factors).
- If the selection process is conducted anonymously or openly under the name of the OEM (see 3.3. Perspectives and Basic Assumptions of the Selection Process Model).

- If the OEM (or project team) should engage in negotiations (see 3.3. Perspectives and Basic Assumptions of the Selection Process Model).
- The category of sources of information and whether it is desk or field research (see 3.4.2.2. Sources of Information on Location Factors).
- The departments that should be included (see 3.3. Perspectives and Basic Assumptions of the Selection Process Model).
- The form of documentation (see 3.4.2.4. Methods for Evaluating Location Factors).

Hence, for each phase, the tasks and characteristics are only specified on a generic level, as the project team must choose the location factors for evaluation in the selection process from the discussion in Chapter 4 depending on the specific endeavor for which the production site is being searched. Defining the procedure of the selection process model on a generic level provides sufficient flexibility to adjust the selection process model to the particular endeavor of the OEM, while the detailed instructions for implementing the selection process and the discussion of location factors, with all necessary specifications for choosing and evaluating each location factor included therein, ensures the applicability of the developed selection process model. Depending on the product that will be produced and the production process that will be implemented at the new production site, as well as the strategic goals which the OEM pursues with the new production site, the tasks and characteristics in each phase might deviate from the ones suggested below: specifically, the location factors, but also the evaluation methods and the phases of their application, are likely to vary from selection to selection.

Phase 1:

Strategic considerations are used in this phase of the selection process as the evaluation method to determine the world region(s) (or a limited number of countries), in which the production site is searched in the subsequent phases of the selection process. This is necessary, as the selection process model applies a strategic perspective, which means that the strategic goals of the OEM are taken into consideration in the selection process and that the goal of the selection process model is to select a production site which enhances the strategic goals of the OEM. Starting by determining the world region(s) (or a limited number of countries) based on strategic considerations avoids the evaluation of production sites, in subsequent phases of the selection process, which are located in world regions or countries in which they are unable to meet and enhance the relevant strategic goals of the OEM. These strategic considerations start by considering the entire world, thus preventing the omission of any promising production site in the selection process or, put differently, excluding the possible existence of any production site outside of the determined world region(s) (or a limited number of countries) that is more appropriate (also in terms of being in line with the strategic goals of the OEM associated with the new production site) than the most appropriate production site inside this determined world region(s) (or a limited number of countries). The use of strategic considerations instead of exclusion criteria in the first phase of the selection process is due to the difficulty of defining criteria which rule out world regions or countries as locations for a production site, taking the entire set of strategic goals of the OEM into consideration.

Strategic considerations consist of an extensive balancing of relevant strategic aspects associated with the new production site which will depend on the OEM's relevant strategic goals and its motive for pursuing the site (see 3.2.2.2 Strategic Requirement Profile), but also on the product that will be produced and the production process that will be implemented at the new production site. Strategic considerations can include aspects like access to sales markets, free trade agreements, access to raw materials or even rare earth materials, protection of intellectual property, capacity related issues, but also production network and supply chain aspects, such as local content requirements or the logistic connectivity to suppliers, to other production sites of the OEM and to sales markets.

If, for instance, the motive for constructing a new production site is market access, then, to overcome market barriers, the new production site must either be located in this market or possibly, if the country under consideration is a member of a free trade agreement, in another member country. If, in contrast, an urgent capacity constraint is the motive for constructing a new production site, the world region(s) (or a limited number of countries) must be determined based on the current and future demand development and the possibility to profitably transport the produced product into the relevant markets. If the motive is relocating an existing production site to ensure the profitability and competitiveness of the OEM by reducing input costs (e.g., labor costs), a relocation only makes sense into countries where total costs are lower than in the country from which the production site is supposed to be relocated. Hence, the isolated evaluation of costs (e.g., labor costs) is not sufficient. Instead, total costs must be evaluated to avoid that higher costs (e.g., transportation costs) outweigh other lower costs (e.g., labor costs) at a production site compared to existing or alternative potential production sites). Moreover, other strategic goals, such as the protection of intellectual property, access to raw materials, a reduced reaction time, overcoming the liability of foreignness or access to know-how, skill or industrial clusters, might be included in the strategic considerations and impact the selection of the world region(s) (or a limited number of countries). If, for instance, the product that will be produced or the production process that will be implemented at the new production site contain very valuable know-how, such as in the case of designing or manufacturing an engine or its core parts, the protection of intellectual property is an important strategic consideration which may rule out certain world regions due to an inadequate protection of intellectual property. The access to raw materials, or especially, to rare earth materials is of importance in strategic considerations, if these materials are an important input to produce the product (e.g., batteries) at the new production site. Access to the relevant raw materials or rare earth materials is, especially in China, often restricted conditionally on their further processing in the country or on joint ventures. If a strategic goal is to produce in proximity to a major sales market, to reduce the reaction time, or to overcome the liability of foreignness, only countries which are close to this market, in the first case, or in the market, in the second case, are possible options for the new production site. Furthermore, if the access to certain know-how, skill or industrial clusters is a strategic goal which the OEM pursues by constructing the new production site, then only countries which have the relevant know-how, skill, or industrial cluster can be selected as candidates for a search of a production site in subsequent phases of the selection process.

Moreover, the integration of the new production site into the production network and the supply chain of the OEM is likely to be included in the strategic considerations to determine the world region(s) (or a limited number of countries). Depending on whether the product that will be produced at the new production site is a final product or a component, the logistic connectivity of production sites to suppliers, to other production sites of the OEM, or to the sales market, must be guaranteed. With regard to logistic connectivity, it is important to point out that this question must be approached completely openly at the beginning. Assuming, for instance, the unrealistic situation that the OEM could produce its product for free in a certain country at the required quality standard and transport the product large distances to the sales market or another production site for further processing, then it could be profitable to select a production site in that country, even if it is on the other side of the world from its destination. In any case, integrating the new production site into the production network and the supply chain of the OEM is necessary to successfully operate the new production site, as well as to enhance the OEM's production network and supply chain design. Hence, aspects such as capacity allocation, logistic connectivity, proximity to certain suppliers or the supply chain's ability to react must be taken into account. Furthermore, even though in this first phase of the selection process the world region(s) (or a limited number of countries) is determined based on strategic considerations, the integrated approach to the supply chain design requires including, as discussed above (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model), tactical and operational aspects of the design of the supply chain into those strategic considerations. An example might be the choice of the delivery schedule (e.g., just-in-time or just-in-sequence delivery), which is part of the operational supply chain design. Just-in-sequence delivery, in particular, can significantly limit the potential distance in terms of hours in transit between the new production site and other production sites of the OEM or suppliers.

These are only examples of possible aspects that can be included in the strategic considerations in the first phase of the selection process. It is neither possible to define these strategic considerations in detail because they vary from selection to selection with the OEM, the product, the production process, and the strategic goals of the OEM, nor to provide a complete list of all aspects that can be included in these strategic considerations. Moreover, it is important to acknowledge that, in this first phase, different strategic considerations must be balanced against each other. It might be that the OEM values the access to a large market more than the protection of its intellectual property. Therefore, these strategic considerations are likely to include trade-offs between the OEM's different strategic goals.

Hence, the world region(s) (or the limited number of countries) in which the production site is searched for in the subsequent phases of the selection process is determined based on strategic considerations which are, in turn, conducted anonymously and without any negotiations, while the source of information is internal know-how (if research is necessary, then only desk research in public sources and databases is performed and commercial external sources are used). Depending on the OEM's organization, the project team might not be responsible for determining the world region(s) (or a limited number of countries), as from a timing perspective determining the world region(s) (or a limited number of countries) can also occur at a high management level (most likely in the Strategy Department) before the project team is set-up.

Phase 2:

- Analysis of all countries in the predefined world region(s) (or a limited number of countries) determined in Step 1 on the national level.
- Evaluation of location factors such as *Exchange Rate, Gross Domestic Product,*

Inflation, Membership in Free Trade Agreements, Market Size and Market Share, Corruption, Rule of Law, Protection of Intellectual Property Rights, Capital Controls, Tariffs, Non-Tariff Barriers to Trade, Subsidies, Security, Infrastructure, Modes of Transportation, Labor Market Institutions and Regulations, Access to Rare Earth Materials, Availability of Component Suppliers, or Industrial Cluster.

- Evaluation of qualitative and non-cost-related quantitative location factors.
- Evaluation methods: Minimum criteria (e.g., to evaluate *Security* or *Corruption*), substitutable criteria (e.g., to evaluate *Modes of Transportation*), profile method (e.g., to evaluate the *Economic Environment, Economic Regulations and Policy*).
- The analysis is conducted anonymously.
- No negotiations take place.
- Sources of information: Public sources and databases, commercial external sources, internal know-how and external consultants. Kind of research: desk research.
- Included departments: Political and Economic Department, Treasury and Tax, Logistics, Human Resources, Sourcing, Strategy in particular Production Strategy, Production Planning.
- Documentation via checklists, strengths and weaknesses lists, and a decision tree (it is important to include any kind of state aid or subsidies which are considered in the selection process).

Phase 3:

- Analysis of all regions in countries selected in Step 2 on the regional level.
- Evaluation of location factors, such as *Political Stability, Corruption, Security, Contagion Effects, Industrial Clusters, Transportation Facilities, Modes of Transportation, Availability of Skills, Availability of Component Suppliers, Natural Hazards, Supply Chain Risks, Access to Rare Earth Materials, Connectivity to Other Firm-Owned Production Sites, Environmental Regulations and Policies, or Labor Market Institutions and Regulations*.
- Evaluation of qualitative and non-cost-related quantitative location factors.
- Evaluation methods: Minimum criteria (e.g., to evaluate *Security* or *Corruption*), preferable criteria or substitutable criteria (e.g., to evaluate *Transportation Facilities)*,

profile method (e.g., to evaluate *Supply Chain Risks* or *Administrative Procedures*).

- The analysis is conducted anonymously.
- No negotiations take place.
- Sources of information: Public sources and databases, internal know-how and external consultants. Kind of research: desk research.
- Included departments: Political and Economic Department, Human Resources, Logistics, Strategy in particular Production Strategy, Production Planning and Factory Planning.
- Documentation via checklists, strengths and weaknesses lists, and a decision tree (it is important to include any kind of state aid or subsidies which are considered in the selection process).

Phase 4:

- Analysis of potential production sites in the regions selected in Step 3 on the local level. These production sites are identified by asking external consultants to contact local administrations, investment agencies, and private owners for potential, suitable production sites.
- Evaluation of location factors, such as *Conditions at the Production Site* (e.g., *Size of Land*, *Shape of Land* and *Topography*), *Ease of Starting Operations at the Production Site and of its Extension* (e.g., N*umber of Owners of Land/Building)*, *Number of Land Plots*, *Consistency of Relevant Regulation*), *Transportation Facilities, Land Zoning, Building Codes, Natural Hazards* or *Community (e.g., Distance to Nearest International Airport)*.
- Evaluation of qualitative and non-cost-related quantitative location factors.
- Evaluation methods: minimum criteria (e.g., to evaluate *Conditions at the Production Site*, *Ease of Starting Operations at the Production Site and of its Extension*, *Land Zoning*, *Building Codes* or *Natural Hazards);* preferable criteria (e.g., to evaluate *Availability of Land for Future Extension of Production Site)*; substitutable criteria (e.g., to evaluate *Transportation Facilities, Community)*.
- The analysis is conducted anonymously.
- No negotiations take place.

- Sources of information: Public sources and databases, internal know-how and external consultants. Kind of research: desk and field research.
- Included departments: Factory Planning, Human Resources, Real Estate, Logistics, Legal and Production Planning.
- Documentation via using checklists, strengths and weaknesses lists, as well as a decision tree (it is important to include any kind of state aid or subsidies which are considered in the selection process).

Phase 5:

- Analysis of production sites included in the long-list of production sites selected in Step 4 on the local level.
- Evaluation of location factors, such as *Wage Level, Transportation Facilities, Water and Energy Supply, Waste Disposal and Sewerage Facilities, Information and Communication Technology Infrastructure, Transport and Logistic Costs, Availability of Logistics Service Providers, Availability of Skills, Labor Market Institutions and Regulations, Availability of Component Suppliers, Subsidies and State Aid, Environmental Regulations, Industrial Clusters, Supply Chain Risks, Access to Rare Earth Materials, Connectivity to Other Firm-Owned Production Sites* or *Taxes*.
- Evaluation of qualitative and non-cost-related quantitative location factors.
- Evaluation methods: minimum criteria, profile method or utility analysis[93] (to evaluate, e.g., *Availability of Skills, Transportation Facilities, Water and Energy Supply, Waste Disposal and Sewerage Facilities, Information and Communication Technology Infrastructure, Availability of Component Suppliers, Connectivity to Other Firm-Owned Production Sites*); requirement-suitability matrix (to depict the match between the requirements on the production site and the conditions at evaluated production sites).
- The analysis is conducted anonymously (negotiations are conducted anonymously through external consultants).
- External consultants start to conduct negotiations with national, regional, and local governments, as well as with local energy and transportation providers and landowners.

[93] Whether the profile method or the utility analysis should be used in Phase 5 must be determined by the project team depending on how many location factors are being evaluated for each production site: as the number of production sites increases, the better it is to use a utility analysis.

With energy providers, the prices of energy, the provided amount of energy, and the time schedule of the provision of that energy must be negotiated. With railroad or harbor companies, the rates for transport and potential investments must be negotiated. With the national, regional, and local government, possibilities for subsidies and other forms of incentives must be evaluated and negotiated. With the landowners, the price of the land and buildings, as well as the price of potential sequential acquisition of land, must be negotiated.

- Sources of information: Public sources and databases, commercial external sources, internal know-how and external consultants. Kind of research: desk and field research.
- Included departments: Factory Planning, Strategy, Human Resources, Real Estate, Political and Economic Department, Logistics, Legal and Production Planning.
- Documentation via the form of checklists, strengths and weaknesses lists, and a decision tree (it is important to include any kind of state aid or subsidies which are considered in the selection process).

Phase 6:

- Analysis of production sites included in the long-list of production sites selected in Step 5 on the local level.
- Evaluation of location factors, such as *Tariff Burden, Subsidy Amount, Costs Required for Preventative Measures due to Natural Hazards, Wage Costs, Additional Non-Wage Labor Costs, Additional Wage Labor Costs, Costs for the Required Investment in Transportation Facilities, in Water and Energy Facilities as well as in Waste and Sewerage Facilities, Costs for Using Water and Energy, Costs for Transporting Components, Costs for Transporting Produced Products to its Destination(s), Costs for Acquiring the Production Site, Costs for Constructing and Maintaining the Production Site*.
- Evaluation of cost-related quantitative location factors.
- Evaluation methods: minimum criteria (based on operating cost comparison and present value method); such minimum criteria have a threshold of the maximum value for the operating costs (also, per produced unit including its transport to its destination) or the minimum present value of the production site. Using minimum criteria to evaluate cost-

related quantitative location factors only requires checking if the approximated operating costs do not exceed the defined threshold or, respectively, if the present value of the production site is above the defined threshold.[94]

- The analysis is conducted anonymously (negotiations are conducted anonymously through external consultants).
- External consultants continue conducting negotiations with national, regional, and local governments, as well as with local energy and transportation providers and landowners. With energy providers, the prices of energy, the provided amount of energy, and the time schedule of the provision of that energy must be negotiated. With railroad or harbor companies, the rates for transport and potential investments must be negotiated. With the national, regional, and local government, possibilities for subsidies and other forms of incentives must be evaluated and negotiated. With the landowners, the price of the land and buildings, as well as the price of potential sequential acquisition of land, must be negotiated.
- Sources of information: Public sources and databases, commercial external sources, internal know-how and external consultants. Kind of research: desk and field research.
- Included departments: Factory Planning, Strategy, Human Resources, Real Estate, Political and Economic Department, Logistics, Legal and Production Planning.
- Documentation via the form of a decision tree (it is important to include any kind of state aid or subsidies which are considered in the selection process).

Phase 7:

- Analysis of short-list of production sites selected in Step 6 on the local level.
- Evaluation of location factors, such as *Wage Level, Transportation Facilities, Water and Energy Supply, Waste Disposal and Sewerage Facilities, Information and Communication Technology Infrastructure, Transport and Logistic Costs, Availability of Logistics Service Providers, Availability of Skills, Productivity, Labor Market Institutions and Regulations, Availability of Component Suppliers, Tariffs, Subsidies and State Aid, Non-Tariff Barriers to Trade or Environmental Regulations*.
- Evaluation of qualitative location factors, as well as of cost-related and non-cost-related

[94] Results can be depicted in a two-dimensional scatter graph (present value and operating costs on the axes).

quantitative location factors.

- Evaluation methods: utility analysis (to evaluate qualitative location factors and non-cost-related quantitative location factors, e.g., Availability of Skills, Transportation Facilities, Availability of Component Suppliers, Environmental Regulations, Non-Tariff Barriers to Trade); operating cost comparison (also, per produced unit including its transport to its destination), the present value method, as well as the EVA method (to evaluate cost-related quantitative location factors); SWOT analysis (to include final strategic considerations into the evaluation, e.g., supply chain design aspects or whether the OEM already has production sites in that region or country, which would increase the OEM's dependence on the country's or region's government).
- The selection is conducted openly under the name of the OEM.
- The OEM continues and concludes negotiations. To conduct negotiations, the OEM should sign non-disclosure agreements or confidentiality arrangements with the involved governments and public or private firms.
- Sources of information: Public sources and databases, commercial external sources, internal know-how and external consultants. Kind of research: desk and field research.
- Included departments: Factory Planning, Human Resources, Logistics, Corporate Finance, Real Estate, Political and Economic Department, Logistics, Legal, Communication and Production Planning.
- Documentation via through strengths and weaknesses lists, as well as a decision tree (it is important to include any kind of state aid or subsidies which are considered in the selection process).

Summing up, in this section, the generic procedure of the selection process model is laid out. The top-down procedure and the strategic considerations in Phase 1 are used to prevent missing any promising options in the selection process and to ensure the strategic perspective of the selection process. The procedure consists of seven steps in which either the area in which the production site is being searched (Step 1-3) or the number of potential production sites is reduced (Step 4-7). Before each of these steps lays a phase of information gathering, evaluation and decision-making, such that each step is based on the previous phase. The steps are illustrated in the form of a funnel. With regard to the phases, the first phase is differentiated from all subsequent phases. While the strategic considerations conducted in Phase 1 are briefly described, for all other phases all necessary tasks and characteristics are provided to facilitate evaluating location factors, in particular, and implementing the selection process, in general. Still, for each phase, the tasks and characteristics are only specified on a generic level as the project team must choose the relevant location factors for evaluation in the selection process from the discussion in Chapter 4 depending on the specific endeavor for which the production site is being searched. However, even though the specification of the procedure of the selection process model remains on a generic level, all necessary instructions for its implementation are explained in the previous parts of Chapter 3 (see 3.2 Organizational Framework and Preparation of the Selection Process; 3.3 Perspectives and Basic Assumptions of the Selection Process Model; 3.4 Choosing and Evaluating Location Factors), while the discussion of location factors in Chapter 4 (see 4 Discussion of Location Factors Relevant to Selecting Production Sites for OEMs) contains all necessary specifications for choosing and evaluating each location factor. This combination of defining the procedure of the selection process model on a generic level, the detailed instructions for implementing the selection process model, and the discussion of location factors with all necessary instructions for choosing and evaluating each location factor included therein, ensures the applicability of the developed selection process model for OEMs for their selection of production sites while simultaneously providing sufficient flexibility to adjust the selection process model to their particular endeavor.

3.6 Summary of Chapter 3

Chapter 3 lays out a generic process model which OEMs can apply in practice to select the most appropriate production site for their specific production activity, which satisfies the complexity of the production site selection of an OEM and the strategic importance for the OEM of the long-term, sizeable investment associated with a new production site. The selection process model is detailed enough to ensure its applicability for OEMs selecting a production site, while simultaneously providing sufficient flexibility to be adjusted to the needs of each OEM and the specific production activity for which they are searching for a production site. Providing detailed instructions for preparing and implementing the selection process model, the generic definition of the procedure of the selection process model, and the discussion of location factors with all necessary specifications for choosing and evaluating the relevant location factors guarantees the applicability of the selection process model on the one hand and its flexibility on the other hand. It is important to acknowledge that the discussion of location factors is an integral part of the selection process model developed in this chapter even though it is isolated in Chapter 4.

The process model for selecting a production site for OEMs is developed in Chapter 3 in four parts: first, the framework in which the selection process takes place in an OEM is described and the necessary preparation for successfully implementing the selection process is determined. Second, perspectives and basic assumptions upon which the selection process model is based for a successful selection are defined and it is explained how the perspectives are applied and the basic assumptions are considered in the selection process model. Third, necessary instructions for choosing location factors (from the discussion of location factors in Chapter 4) and evaluating them are provided in detail. Fourth, the procedure of the selection process model is laid out and the tasks and characteristics of each phase of the procedure are specified on a generic level.

The first part describes the general framework in which the OEMs selection process takes place and determines the necessary preparation for successfully implementing the selection process. This preparation includes determining all requirements which the OEM has on the new production site in a so-called *Production Site Requirement Profile* and setting up the project team, as well as assigning responsibilities. Determining all requirements before the selection process starts is of utmost importance, given that in the course of the selection process model the conditions at potential production sites, reflected in location factors, are evaluated in terms of their match with the requirements of the OEM. The *Production Site Requirement Profile* consists of three parts: The *Strategic Requirement Profile*, the *Operational Requirement Profile,* and the *General Requirement Profile,* which contain the strategic, operational, and general requirements, respectively. For all these parts, it is explained in detail who is responsible for their composition and what they should contain. Moreover, with regard to setting up the project team, this part explains aspects that should be considered to guarantee that all relevant business functions or departments are involved and that all required contributions and responsibilities are clarified early on in the selection process.

The second part defines all perspectives and basic assumptions on which the selection process model is based to pursue its four goals and explains how the perspectives are applied and the basic assumptions are considered in the selection process model: To identify the most strategically appropriate production site (first goal), the selection process model is guided by an inside-outside perspective, in general, and, in particular, the selection process model applies a strategic and network perspective and takes into account aspects which are relevant to the design of the supply chain. To avoid selecting any but the most appropriate production site due to structural deficits of the selection process (second goal), all relevant business functions or departments are determined, along with the point at which these business functions or departments are responsible for their contribution, before the selection process starts. Moreover, the planning horizon of the production site is specified before the selection process starts to ensure a realistic evaluation and the process follows a top-down procedure so as to be less likely to omit possibly promising options. Furthermore, all location factors are defined without redundancy, interdependencies between location factors are identified, and the selection process model is structured to avoid the problem of aggregation, especially when evaluating qualitative location factors. To capture the conditions at potential production sites as realistically as possible (third goal), location factors are evaluated in different forms in the selection process model. The selection process model differentiates between cost-related and non-cost-related quantitative location factors and qualitative location factors. Moreover, scenarios are formulated for those location factors whose expected change over the planning horizon is considered significant for the selection, and thus depict the expected future development and capture the uncertainty of that assessment. Furthermore, the selection process model assigns different weights to location factors based on whether they are considered soft or hard location factors, anticipates the change of semi-external location factors as a reaction to the construction and operation of the production site, and considers the possibility of active improvement of conditions reflected by performance location factors. To consider the conditions under which the OEM implements the selection process in practice (fourth goal), the entire process model is developed in awareness of the time and resource constraints under which the OEM must make the selection, and to avoid unnecessary complexity. Furthermore, negotiations play an important role in the selection process to ensure the successful operation at the selected production site. Moreover, the selection process is conducted anonymously at first.

Part three provides detailed instructions on choosing and evaluating location factors. Due to the structure of the selection process model, the OEM must choose the relevant location factors for the specific endeavor from the discussion of location factors in Chapter 4 and evaluate them. In the face of the utmost importance of the choice of relevant location factors for selecting a production site, this part explains how this choice is facilitated by providing the discussion of location factors in Chapter 4. This discussion facilitates the choice of relevant location factors for the specific selection by including only those location factors that are possibly relevant to selecting a production site for an OEM, by describing each location factor, giving a macroeconomic analysis if relevant, explaining the possible relevance of each location factor for constructing and operating a production site, and by determining whether the location factor is a strategic, operational or general location factor, whether it is a process-specific or product-specific location factor, as well as whether it is relevant to the enhancement of the production network or the supply chain design of the OEM.

Moreover, part three contains all necessary instructions on evaluating location factors, which are divided into four parts: geographic granularity of evaluating location factors, sources of information on location factors, measuring location factors and evaluation methods. Given the differences many location factors have between different geographical levels, the selection process model differentiates between the national, regional, and local level of analysis. It is explained that, for each location factor in Chapter 4, the relevant geographic level(s) of analysis is (are) determined. In the face of the difficulty of finding adequate and reliable information for all relevant location factors at the relevant level of geographic granularity, this part introduces four categories of sources of information on location factors (public sources and databases, commercial external sources, internal know-how and external consultants) and differentiates desk research from field research. Moreover, it explains that, in the discussion of location factors in Chapter 4, particular sources of information are identified for each location factor that fall in to one of the four categories.

Furthermore, given the prerequisite of measurability of location factors for their evaluation, the selection process model differentiates between cost-related and non-cost-related quantitative location factors and qualitative location factors in terms of their measurements. Quantitative location factors are either measured in Euro (EUR), if they are cost-related, or, if they are non-cost-related, then they are measured in the relevant unit. Qualitative location factors are quantified in terms of ratings—for instance, as very low, low, fairly high, high or very high—which are expressed numerically as 1 through 5. This part explains that, in Chapter 4, a measurement for each location factor is identified. Finally, in awareness that it is necessary to apply multiple evaluation methods in the course of the selection process, this part introduces all necessary evaluation methods to facilitate their application and explains that, in Chapter 4, for each location factor, one or multiple methods of evaluation are specified.

In the last part, the procedure of the selection process model is laid out and the tasks and characteristics of each phase of the procedure are specified on a generic level. The procedure consists of seven steps in which either the area in which the production site is being searched or the number of potential production sites is reduced. Before each of these steps is a phase of information gathering, evaluating and decision-making, such that each step is made based on the results of the previous phase. The steps are illustrated in the form of a funnel. While the strategic considerations which are conducted in the first phase are briefly described, for all subsequent phases all necessary tasks and characteristics are provided on a generic level (e.g., the geographic level of analysis, examples of location factors, evaluation methods, whether negotiations take place, whether the process is conducted anonymously, whether the required information can be gathered through desk research or must be collected through field research, categories of sources of information or the form or documentation).

Hence, in Chapter 3 the process model for selecting a production site for OEMs is developed. By providing detailed instructions for preparing the selection process, as well as for choosing and evaluating location factors, and by defining the procedure of the selection process model on a generic level in combination with the discussion of location factors in Chapter 4, including all necessary instructions for their choice and evaluation, the selection process model is, on the one hand, applicable and, on the other hand, sufficiently flexible to be adjusted to the needs of each OEM and the specific production activity for which it is searching for a production site.

4 Discussion of Location Factors Relevant to Selecting Production Sites for OEMs

4.1 Scope and Structure of the Discussion of Relevant Location Factors

This discussion of location factors includes all location factors which are possibly relevant for OEMs when selecting a production site. The scope of this discussion of relevant location factors is meant to facilitate the choice and evaluation thereof by thoroughly explaining their possible importance for constructing and operating a production site, and by providing additional information and instructions for their choice and evaluation in the selection process model developed in Chapter 3. Moreover, for reasons of clarity and user-friendliness, the location factors in this discussion are categorized by topic. This discussion of location factors is an integral part of the selection process model developed in Chapter 3, as the project team, which is responsible for selecting a production site, must choose those location factors from this discussion for evaluation in the selection process that are relevant for the specific production endeavor for which the OEM is searching a production site. This act of choosing the relevant location factors for the specific production site the OEM searches for is necessary, as this selection process model is constructed such that it can be implemented by any OEM in their search for any kind of production site. Hence, it cannot be determined which location factors are relevant independent of the production process that will be implemented, the product that will be produced, and the related strategic goals.

When selecting a production site, the choice of location factors that are evaluated in the selection process is of utmost importance, as the considered location factors which reflect the conditions at the production sites constitute the information upon which the selection of the production site is based. As explained in 2.4.1 Location Determining Theory, representatives of the empirical-realistic theory of determining a location have acknowledged the importance of location factors, their systematization, as well as the choice of relevant location factors, for firms to solve their location problem, in general, or select a production site, in particular. Consequently, they have created numerous lists of location factors to facilitate solving the firm's location problem (see Autschbach, 1997, 124) (see 2.5.2 Content-related Systematizations of Location Factors). However, the creation of a comprehensive list of location factors (see Kutschker and Schmid, 2011, 442), which any firm from any industry for any kind of endeavor could realistically use, would be inefficient: except for some location factors of general importance, such as security or political stability, the choice of location factors evaluated and the relevance assigned to particular location factors in the selection process must vary from industry to industry and from business function to business function. In the particular case of the selection of a production site, the relevance of location factors further varies with the strategic goals which the firm pursues by constructing a new production site, as well as with the product that will be produced, and the production process that will be implemented (see 2.5.4 Relevance of Location Factors). The inefficiency of creating a list of location factors which includes all location factors that could possibly be relevant for any kind of firm from any kind of industry and for any kind of business function has been acknowledged by Schöllhammer, who suggests each firm create their own list of location factors that are relevant for them and their specific endeavor (see Schöllhammer, 1989, 1963). Still, in practice, a list of possibly relevant location factors from which the project team can choose those location factors which are relevant for their specific endeavor facilitates choosing relevant location factors, in particular, and implementing the selection process model, in general. Thus, with Schöllhammer's statement on the one hand and the usefulness of a list of possibly relevant location factors on the other, the following discussion is not a comprehensive discussion of generally relevant location factors, but a discussion of only those location factors that are relevant to selecting production sites (business function: production) for OEMs (in the automotive industry). This allows the discussion to provide sufficiently detailed information on each location factor while simultaneously leaving enough flexibility of the selection process model to be used for the selection of a production site for any kind of production process, product, and strategy of OEMs.

To meet the principle of completeness, this discussion of location factors includes all location factors that can be relevant to selecting a production site for an OEM. Simultaneously, the discussion meets the principle of substantiality by including only the location factors that are relevant to selecting a production site for an OEM, omitting all others. However, even this discussion of location factors must be used with caution for evaluating production sites, as the relevance for the selection process of the individual location factors included in the discussion depends on the individual OEM, its strategy, the product that is to be produced, or the production process that is to be implemented at the production site. Hence, the selection process model developed in this work (see 3 The Selection Process Model) requires the project team to choose the location factors which are relevant to their specific search of a production site from this discussion for evaluation in the selection process. As the entire discussion of location factors must meet the principle of completeness and substantiality, the project team must choose the location factors from this discussion in such a way that its choice of location factors for evaluation in the selection process also meets both the principle of completeness and the principle of substantiality: the first, in order to include all significant location factors, thereby ensuring that all relevant information which is necessary for a successful selection is taken into account, and the second, mostly because the evaluation of more than those location factors that are relevant (substantial) to the successful selection of a production site carries the risk of reducing the quality of the result of the selection process, if it makes the process overly complex and the intermediate and final results more difficult to understand, but also due to the given time and resource constraints under which the selection must be made (see 3.4.1 Choosing Location Factors; 3.3 Perspectives and Basic Assumptions of the Selection Process Model). Thus, the goal of the project team when choosing location factors from this discussion for evaluation in the selection process is to include all relevant location factors, excluding all others, thereby ensuring that they evaluate as many location factors as necessary and as few as possible. This discussion facilitates the choice of relevant location factors for the particular selection of a production site:

- First, by including only those location factors that are possibly relevant for selecting a production site for OEMs.
- Second, by describing each location factor and specifying its possible importance for constructing and operating a production site.
- Third, by providing additional information on each location factor including whether the location factor is:
    - a strategic, operational, or general location factor (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).
    - a process- or product-specific location factor (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).
    - relevant to the enhancement of the production network of the OEM (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).
    - relevant to the enhancement of the supply chain design of the OEM (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).

Besides facilitating the choice of location factors, this discussion also facilitates the evaluation of included location factors by providing, for each, all information and instructions necessary for their evaluation in the selection process model developed in Chapter 3:

- For each location factor, it is determined whether the corresponding conditions at the production site are negotiable (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).
- For each location factor, it is specified whether it is a semi-external or even a performance location factor (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).
- For each location factor, it is specified whether it is a qualitative location factor or cost-related or non-cost-related quantitative location factor (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).
- For each location factor, it is specified whether it should be considered as hard or soft (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).
- For each location factor, it is specified whether it should be considered as static or dynamic[95] (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).
- For each location factor, the geographic level(s) of analysis (national, regional, or local level), at which the location factor should be evaluated, is (are) determined (see 3.4.2.1 Geographic Granularity of Evaluating Location Factors).
- For each location factor, a unit of measurement is determined (see 3.4.2.3 Measuring Location Factors).
- For each location factor for each phase in the selection process model in which it is supposed to be evaluated, an evaluation method is suggested (see 3.4.2.4 Methods for Evaluating Location Factors).
- For each location factor, the phase(s) in the selection process model in which the evaluation of the location factor should be conducted is (are) suggested (see 3.5 Procedure of the Selection Process Model).

[95] As explained in 3.3 Perspectives and Basic Assumptions of the Selection Process Model, in this selection process model, the future development, as well as the uncertainty, if relevant, is captured as Buhmann and Schön (2009) suggest in scenarios in order to assess the conditions at the production site over the planning horizon as realistically as possible. While the assessment of the current state is only uncertain for several location factors, the assessment of the future development is always subject to uncertainty. Thus, every dynamic evaluation of location factors must also be stochastic, which is why the evaluation of dynamic, as well as stochastic location factors is, as suggested by Buhmann and Schön, conducted together using scenarios in this selection process model (see Buhmann and Schön, 2009, 282-292). Thus, in the discussion of relevant location factors in Chapter 4 it is only specified whether the location factors should be considered as static or dynamic.

- For each location factor, those location factors with which it possibly has relevant interdependencies are identified (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).
- For each location factor, potential sources of information are identified. These potential sources of information are defined as specifically as possible and fall in the following four categories: public databases and information, commercial external sources, internal know-how, and external consultants (see 3.4.2.2 Sources of Information on Location Factors).

It must be noted that depending on the product that will be produced and the production process that will be implemented at the new production site, as well as the strategic goals, which the OEM pursues with the new production site, the instructions on the choice and evaluation of location factors might deviate from the ones suggested below: in particular, the evaluation methods with which the location factors are evaluated and the phase(s) of their evaluation are likely to vary from selection to selection.

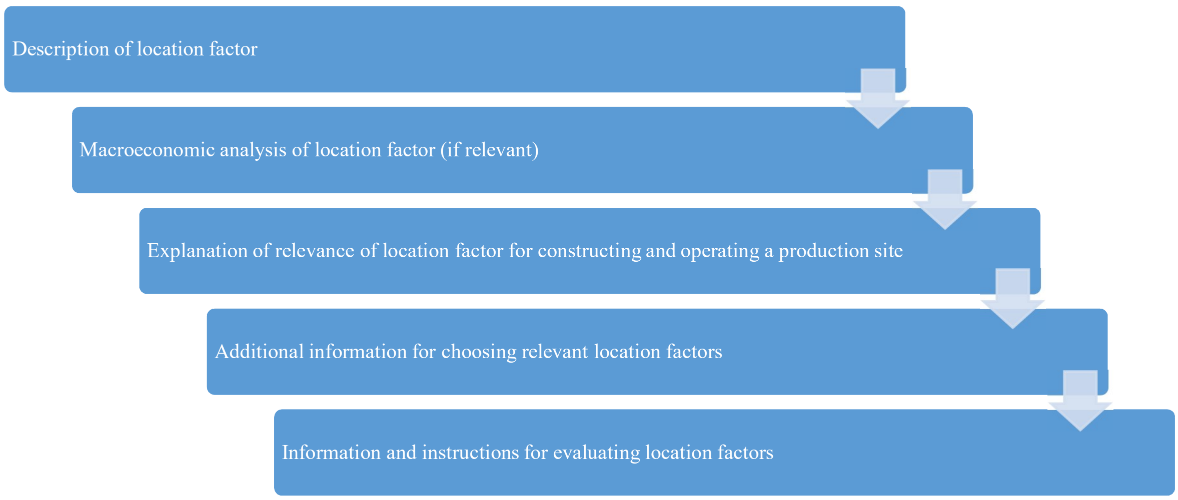
Moreover, this discussion has a special focus on macroeconomic aspects of the included location factors. Consequently, all location factors for which a macroeconomic analysis is relevant are explained from a macroeconomic perspective, which includes their macroeconomic description, an explanation of their macroeconomic driving forces, and their specific macroeconomic effect on constructing and operating a production site.[96] Macroeconomic location factors, such as the *Exchange Rate*, *Gross Domestic Product*, *Inflation*, *Fixed Investment (including Foreign Direct Investment)*, *Productivity* or *Wage Level,* are important in determining the general environment in which the production site must be constructed and operated, but they also have a direct effect on the construction and operation of the production site. These macroeconomic location factors are not only particularly important for the successful construction and operation of the production site, but they are also especially complex. As such, they must be evaluated in the selection process by the project team, which usually consists of business experts who do not necessarily have an Economics background. Hence, due to the particular importance of

[96] The goal of the macroeconomic description and the explanation of their macroeconomic driving forces is not a theoretical macroeconomic excurse or a review of the recent macroeconomic literature on these location factors, but instead a practical guide for business experts to choose and evaluate these very important and simultaneously very complex location factors, and to understand their most important driving forces and their relevance for constructing and operating a production site.

macroeconomic location factors for evaluating production sites on the one hand and the complexity of these location factors and their driving forces on the other hand, the special macroeconomic focus of this discussion of location factors is an additional means to facilitate the choice and evaluation of location factors, in particular, and to support OEMs in their selection of a production site, in general.

In summary, this discussion of location factors contains a description of each location factor and, if relevant, a macroeconomic analysis thereof, an explanation of their relevance for constructing and operating a production site, along with additional information for the choice of relevant location factors, and information, as well as instructions, on their evaluation in the selection process (see Figure 16).

Figure 16: The Five Elements Included in the Discussion of Each Location Factor



(Author illustration)

As explained in Chapter 3, this selection process model avoids overlap between location factors by defining them all without redundancy and identifying all interdependencies between them. Defining location factors without any redundancy is necessary to avoid any double or multiple counting of some aspects of evaluated location factors. Identifying all interdependencies between location factors is necessary to take these interdependencies adequately into account in their evaluation. Moreover, both defining location factors without any redundancy and identifying all interdependencies are important to address the problem of aggregation in the selection process (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model). Hence, to ensure the successful evaluation of the location factors in the selection process, all location factors included in this discussion are defined without redundancy and all relevant interdependencies between the included location factors are identified.

The location factors included in this discussion have been chosen based on the analysis of the relevant literature in Chapter 2 (see 2 Definitions and Literature Review), and depending on their relevance for selecting production sites for OEMs. In particular, representatives of the empirical-realistic location determining theory created various lists of location factors as a means to facilitate the firm's location problem (e.g., Tesch, 1980, 364-365; Behrens, 1971, 47-81; see 2.4.1 Location Determining Theory). Furthermore, representatives of the location planning theory have created lists of possibly relevant location factors (or given numerous examples of relevant location factors) for identifying sales markets (e.g., Seidel (1977, 29-86), Henzler (1979, 24), Stahr (1982, 60-61), Schneider and Müller (1989, 18-42), Köhler and Hüttemann (1989, 1432-1434), Backhaus and Voeth (2010, 85) and Balderjahn (2014, 46-54, 61-71)), for selecting a production site (e.g., Timmerman (1972, 390), Lüder and Küpper (1983, 192-205), Sabathil (1969, 50-226), Goette (1994, 175-254), Autschbach (1997, 143-157, 201-209), Eversheim (1999, 9-43), Kinkel as part of the BESTAND Project (2009, 57-79)) and for optimizing global production networks (e.g., Schnellberg (2002, 177-186), Meyer (2006a, 36-100) and Grauer (2010, 69-70)) (see 2.4.2 Location Planning Theory). Furthermore, many interesting aspects from which relevant location factors are deduced for this discussion have been revealed by fields of research which contributed to solving the firm's location problem (e.g., Economic Geography, Regional Economics, International Business and the New Economic Geography) and also by the literature on supply chain design (see 2.3 Classification of Location Theory; 2.4.2.4 Supply Chain Design). The included location factors have been defined in as much detail as possible to facilitate their choice and evaluation.

For reasons of clarity and user-friendliness (users are OEMs, in general, or the project team, in particular), the location factors in this discussion are categorized into the following different topics of location factors: *Regulations and Policies*, *Political and Legal Framework*, *Natural Hazards, Community*, *Economic Environment*, *Labor Market*, *Access to Raw Materials*, *Infrastructure*, *Production Network*, *Industrial Clusters*, *Market Size and Market Share*, *Production Site*, *Costs for Deploying Expatriates* and *Availability of Potential Partners for Strategic Alliances or Joint Ventures*.

4.2 Regulations and Policies

4.2.1 General Remarks on Regulations and Policies as Location Factors

Regulations and policies determine the operating environment in which the production site is constructed and operated. Such regulations and policies include economic (industrial) or environmental regulations. Economic regulations and policies have become increasingly important for international selling, as well as producing, firms and also in the face of a recent revival of protectionist trade policies. Economic regulations and policies are important for selecting a production site for OEMs, for instance, due to the great number of components which the OEM must import into the country for further processing at the new production site. Any regulation or policy which leads to interruptions of the OEM's global supply chain makes operating the production site unattractive or impossible due to missing or delayed components or the limited possibility to export the produced product to its final destination(s). This requires a detailed analysis of economic regulations and policies, which might hinder, limit, or even rule out the import of necessary components or make the export of the produced product difficult or expensive. However, the possibility of a detailed and exact assessment of their impact on the costs of operating a production site vary by regulation and policy. It also needs to be kept in mind that matters can be even further complicated if the political situation in the country under consideration is such that changes of government lead to major changes in economic policy. This changing environment makes a long-term optimization of the profitability of a production site or a production network, in terms of economic policies and regulations, difficult (see Meyer, 2006a, 79-80).

As economic policies and regulations have a direct effect on the costs and ease of operating a production site by facilitating, complicating, making costly or even denying access to markets for components, as well as final products,[97] they must be taken into consideration in the selection process. This section analyzes tariffs, non-tariff-barriers to trade, taxes, subsidies, and capital controls. In regard to the analysis of economic regulations and policies, it is interesting that the geographic level of analysis varies greatly between different economic policies and regulations, as some are part of the economic or industrial policy of a country (or, in the case of trade or economic unions, of a larger political body) and others are decided on a regional or even local level. Also,

[97] One theory on FDI (see Cokden, 1967, 210, 231) explains that firms conduct FDI as a means to overcome barriers to trade in order to gain or maintain market share. According to this theory, governments often establish barriers to trade to spur FDI by preventing or restricting firms from exporting their products into the market and thus forcing foreign firms to invest in their country in order to maintain or gain local market share (see Kutschker and Schmid, 2011, 440-445).

note (as mentioned above) that some of the relevant economic regulations and policies are negotiable with the national, regional, or local government while some must be taken as given in the selection process.

In addition to economic regulations and policies, the costs and feasibility of constructing and operating the production site can also be significantly affected by other regulations and policies which may impose requirements on operating a production site, making the operation either prohibitively expensive or not feasible for technical reasons. These regulations and policies include environmental regulations, land zoning, building codes or labor market institutions and regulations. While environmental regulations, land zoning and building codes are discussed in this section, labor market regulations are discussed in 4.7.3 Labor Market Institutions and Regulations. It is very important to consider these kinds of regulations in the selection process of a production site, as they cannot usually be negotiated and can have a significant effect on the costs and ease of constructing and operating a production site. Environmental regulations, as well as land zoning and building codes, must be evaluated in terms of whether they rule out constructing and operating the production site by forbidding a necessary aspect for constructing and operating the production site, or in terms of their effect on the costs and ease for constructing and operating the production site.

When analyzing environmental regulations, land zoning and building codes, it is important to be aware that some are determined on the national (or even on supranational levels, as in the case of the EU), while others are defined on the regional or even local level and must therefore be evaluated accordingly. Moreover, an OEM cannot impact some of these policies and regulations while some are negotiable.

In the following sections *Tariffs*, *Non-tariff Barriers to Trade*, *Taxes*, S*ubsidies and State Aid* and *Capital Controls* are locations factors analyzed under *Economic Policies and Regulations*, while *Environmental Regulations*, *Land Zoning* and *Building Codes* are locations factors analyzed under *Other Regulations and Policies*.

4.2.2 Economic Regulations and Policies

4.2.2.1 Tariffs

Tariffs are a form of trade barriers which a government implements to reduce the level of foreign trade below its optimum (from a macroeconomic theoretical perspective). Tariffs are usually in place to protect domestic industries, employees, or communities, and act as taxes on trade which effect the prices of imports or exports and, in turn, the quantity traded. Import tariffs are like a tax on imports and export tariffs are like a tax on exports (see Sauernheimer, 2004, 163). Thus, tariffs are customs duties on imports, giving a price advantage to locally-produced goods over similar imported goods, and raising government revenues (see World Trade Organization, n.d.j; Mankiw, 2013, 563). A related trade policy measure are tariff quotas which allow the import (or export) of goods at lower import (or export) tariff rates 'for quantities inside a [certain] quota' and impose a higher tariff rate on the import (or export) of any unit of imported (or exported) goods above that quota (World Trade Organization, n.d.g; see The World Bank, n.d.j).

One fundamental difference between tariffs is the basis upon which they are imposed. Most tariffs are ad valorem tariffs, implying that the tariff 'is calculated as a percentage of the value of the product'. If that is not the case, the tariff is a non ad valorem tariff, which is a specific tariff that is calculated based on 'the physical quantity of the good being imported' (examples are Australian tariffs on kilos of cheese coming from the US which are based on each goat that is alive in the US). There are also mixed tariffs, which are 'expressed as either a specific or an ad valorem rate, depending on which generates the most (or sometimes least) revenue'. Finally, compound tariffs 'include both ad valorem and a specific component' (The World Bank, n.d.j; see World Trade Organization, n.d.a).[98]

Moreover, it is important to know, that in the WTO framework, three types of tariffs exist for one commodity line. First, Most-Favored Nation Tariffs (MFN tariffs) are the maximum tariffs that WTO member countries may impose on imports from other WTO members according to WTO rules. Second, tariffs on imports of countries which are members of a preferential trade agreement under which they promise to give another country's products lower tariffs than their MFN tariff rate. These lower tariffs are referred to as preferential tariffs. The preferences provided are often defined as a percentage reduction from the MFN tariff and therefore vary between various partners and agreements. In addition to MFN tariffs and preferential tariffs, there are bound, which reflect the tariff rates the countries committed to when joining the WTO as the maximum MFN tariff level for a given commodity line. When countries join the WTO or when WTO members negotiate tariff levels with each other during trade rounds, they make agreements about bound tariff rates, rather than actually applied rates. Members may increase or decrease their tariffs (on a non-discriminatory basis) as long as they are not above their bound tariff rates. The difference between applied MFN

[98] Trade economists suggest that non ad valorem tariffs are less transparent and more distorting, as they lead to more significant differences between domestic and international prices (The World Bank, n.d.j; see World Trade Organization, n.d.a).

tariff rates and the bound tariff rates is referred to as the binding overhang. Since a large binding overhang provides some leeway to countries to change tariffs, trade policies of countries with a large binding overhang are considered to be less predictable. With regard to manufacturing products, WTO-bound tariff rates vary across countries. Until 1994, when the Uruguay Round of the GATT ended, countries agreed to bind tariffs on most manufactured products but not on all tariff lines on manufacturing products. Since many developing countries have not participated in previous trade rounds, many of them have bound tariff lines on fewer manufactured products than industrial countries. This variation of bound tariff rates can be seen between regions: in Latin America, all tariff lines of all countries are bound, while the so-called binding coverage differs considerably across Asian countries. Hence, for one product line in the WTO framework three types of tariffs exist: the bound rate is normally the highest, thus providing an upper limit for the tariff, followed by the MFN rate, while the preferential rate is the lowest rate (see The World Bank, n.d.f).

For the analysis of a tariff in the selection process, it is necessary to know what the effectively applied tariff is on the products (often components) which the OEM must import into the country under consideration. The tariff rate, which is actually applied to the products (often components), ultimately depends on the country's rules of origin, which are 'the criteria needed to determine the national source of a product' (World Trade Organization, n.d.i). Rules of origin are important with regard to tariffs as tariffs often depend on the source (source country) of imports. Whether the bound tariff rates, the MFN tariff, or a preferential tariff applies to particular products depends on whether the products meet the country's rules of origin. These rules of origin can vary from country to country (see World Trade Organization, n.d.i; World Trade Organization, n.d.e; The World Bank, n.d.f). Hence, for the OEM it is important to take the rules of origin on which the tariff rates are based into account in the selection process.

Overall, countries have increasingly reduced tariffs since the 1980s thanks to the widespread attempt to lower tariffs and non-tariff barriers to trade promoted by the WTO and realized in the form of many regional free trade agreements. However, tariffs have remained a significant location factor for internationally producing OEMs, as the tariff burden often accounts for a considerable share of total costs and since, in contrast to subsidies, tariffs are fixed taxes on the value or amount imported and cannot be negotiated. Moreover, most recently the implementation or raising of tariffs even to the extent of trade wars[99] has increased drastically. In addition to import tariffs, export tariffs are also relevant, unless the product that will be produced at the new production site is a final product that is only planned to be sold in the local market. The analysis of export tariffs is also important with regard to raw materials, and in particular, rare earth materials as some countries impose high tariffs or even prohibit the export of products which contain some kind of raw materials or rare earth materials from local deposits (see 4.8 Access to Raw Materials). This requires analyzing the production site from a network perspective, and in detail as part of a production line and sequence of assembly, to minimize the amount that must be paid in tariffs.

Tariff rates vary from country to country depending on trade relations between countries and are different depending on the category of traded product. The levels of tariffs vary, for instance, greatly between components and finished products, as well as between different kinds of products (relevant products in the automotive industry are, for instance, trucks, buses, personal vehicles, commercial vehicles, chassis with engine, engines, bodies (including cabs), parts and accessories) (see European Commission, n.d.c). The different categories of tariffs give some room for internationally producing firms to minimize their tariff burden. Thus, when selecting a production site, it is important to be aware of the variety of categories of tariffs (see Meyer, 2006a, 80-81; Pindyck and Rubinfeld, 2006, 321-326). In the face of the given complexity of tariffs, Meyer suggests it is necessary for many firms to seek advice from customs authorities to assess the tariff rates that are applicable for the specific country and the specific product (see Meyer, 2006a, 81). The complexity of tariffs for globally producing OEMs, the large number of components that OEMs need to import into a country to be processed at the new production site, the produced product that must be exported out of the country, and the size of the tariff burden as a share of total costs of production, require taking tariffs into consideration in the selection process.

Moreover, in the selection process, it must be taken into account that tariffs can be changed depending on the government in power in the short-term, while the production site is a long-term project. This makes the long-term assessment of the tariff burden especially difficult.

[99] A trade war occurs when countries impose, for instance, tariffs and tariff quotas on each others' products. Usually, a trade war starts when country A raises tariffs on the goods of country B or countries B, C and D, and as retaliation, country B or countries B, C and D raise tariffs on the products of country A (see BBC, 2019).

Table 2: Information and Instructions on the Choice and Evaluation of the Location Factor *Tariffs*

Location factor to be evaluated	**Tariff Rates**	**Tariff Complexity**	**Tariff Burden over the planning horizon of the production site**
Strategic, operational, or general	Operational	Operational	Operational
Process-specific / product-specific	Product-specific	Product-specific	Product-specific
Relevant for production network	+	+	+
Relevant for the design of the supply chain	+	+	+
Negotiable	-	-	-
Semi-external / even performance	-	-	-
Quantitative or qualitative	Non-cost-related quantitative	Qualitative	Cost-related quantitative
Hard or soft	Hard	Hard	Hard
Static or dynamic	Static (unless there is a specific reason for future change e.g., government announcement of changes in trade policy or plans to join FTAs).	Dynamic	Dynamic
Geographic level of analysis	National (including membership in FTAs).		
Unit of measurement	in %	Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).	Approximated in EUR.
Evaluation method(s)	o Strategic considerations o Profile method	o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method)	o Phase 2 (profile method) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	o Membership in Free Trade Agreements o Access to General Raw Materials o Access to Rare Earth Materials o Connectivity to other Firm-owned Production Sites o Availability of Component Suppliers		
Source of information: public databases and information	o European Commission: Market Access Database, Duties and Taxes (data on tariffs for all relevant products) o WTO: • Tariff Analysis Online • Tariff Download Facility (data on bound, applied and preferential tariffs detailed especially in terms of categories of products) • The World Tariff Profiles, annual report on tariffs for broader categories of products • Trade Monitoring Reports (biannually) • Trade Monitoring Database • Trade Policy Reports • Reports on Specific Trade Concerns and Disputes • Publication Requirements, Enquiry Points and Notifications • International Trade and Market Access Data	o The World Economic Forum: the Global Enabling Trade Index (ETI) for 138 countries (pillar: domestic market access)	o European Commission: Market Access Database, Duties and Taxes (data on tariffs for all relevant products) o WTO: • Tariff Analysis Online • Tariff Download Facility (data on bound, applied and preferential tariffs detailed especially in terms of categories of products) • The World Tariff Profiles, annual report on tariffs for broader categories of products • Trade Monitoring Reports (bi-annually) • Trade Monitoring Database • Trade Policy Reports • Reports on Specific Trade Concerns and Disputes • Publication Requirements, Enquiry Points and Notifications • International Trade and Market Access Data o Germany Trade & Invest website o UNECE: Vehicle Regulations

Location factor to be evaluated	Tariff Rates	Tariff Complexity	Tariff Burden over the planning horizon of the production site
	o Germany Trade & Invest website o UNECE: Vehicle Regulations		
Source of information: commercial external sources	-		
Source of information: internal know-how	o Tax and Customs Department o Industrial Policy Department		
Source of information: external consultants	+		

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.2.2.2 Non-Tariff Barriers to Trade

Non-tariff barriers to trade (NTBs) include all barriers to trade except tariffs. Like tariffs, governments impose NTBs to complicate or even deny the import (and, in few cases, the export; for instance, in that of rare earth materials) of goods. NTBs lead to a reduction in the level of foreign trade below its optimum (from a macroeconomic theoretical perspective) by reducing the quantity that can be imported or exported. While barriers restricting imports are usually in place to protect domestic industries, employees or communities, barriers restricting exports are generally motivated by concerns regarding foreign policy, the military (see Sauernheimer, 2004, 163), or raw materials. The WTO states that 'over the course of the past century, governments have expanded regulatory controls over economic activity, often in pursuit of social, public health, environmental, or other non-economic policy objectives'. The World Bank warns that NTBs will continue to gain relevance as a measure of economic policy in many countries (The World Bank, n.d.a).

The WTO distinguishes between technical NTBs and non-technical NTBs. Technical NTBs are based on 'specific characteristics of a product — such as its size, shape, design, functions and performance, or the way it is labeled or packaged before it is put on sale' (World Trade Organization, n.d.l). The primary goal of technical NTBs is related to public policy, such as the protection of health and safety or of the environment. Specific measures aim at the quality of food, national security or animal and plant health. These technical NTBs require certain standards regarding, for instance, the size, function, performance, labeling or packaging of a product. Non-technical NTBs do not impose product-specific requirements but general requirements on trade, for instance, in the form of shipping requirements, custom formalities, trade rules or taxation policies. NTBs are also categorized into import-related measures and export-related measures, depending on whether they are imposed by the importing or exporting country (see OECD, n.d.b; World Trade Organization, n.d.l). Another differentiation of NTBs is based on the way in which they reduce the quantity imported or exported: there are NTBs which directly limit the quantities imported or exported—for example, import or export quotas, import or export prohibitions or dual exchange rates—and there are NTBs, which affect the quantity imported or exported indirectly through their costs, such as import licensing procedures, country of origin regulations, norms or consumer protection (see Sauernheimer, 2004, 163-164).

As in the case of tariffs, governments attempt to protect or strengthen industries through NTBs, especially the automotive industry as it is considered as key industry in many countries, by encouraging international OEMs to produce some of their products in their country. NTBs significantly affect the costs and operations of internationally producing firms—especially OEMs as the production of their products normally requires a great number of components to be imported into the country for processing at the production site—to such an extent that they strategically adjust their production network to NTBs (see Autschbach, 1997, 85). Still, the significant variety of NTBs makes their analysis extremely difficult. Particularly interesting NTBs for selecting a production site for an OEM are import or export quotas or prohibitions, local content requirements, import licensing, certification requirements, or limitations of investment that foreigners can conduct or property that foreigners can hold. These NTBs and their effect on constructing and operating an OEM's production site are briefly described below.

Import and export quotas limit the quantity of a product that may be imported or exported into or out of a country, respectively.[100] Governments impose import quotas to ensure that the domestic price of the good is above its international price. The beneficiary of import quotas are domestic firms which have higher profits than they would enjoy if they had to compete internationally. Import quotas are very relevant to selecting a production site of an OEM, as the production of their products normally requires a great number of components to be imported into the country for processing at the production site. The number of imported components can be reduced to some extent by sourcing locally, but, nonetheless, due to quality requirements, a considerable number of components must be imported. Hence, it must be evaluated if a sufficient quantity of all required components can be imported to produce the product. Export quotas usually aim at limiting the export of products containing certain materials or are imposed for political reasons. With regard to export quotas, it is important for the selection of a production site to know if the produced product

[100] Import and export bans are the extreme case of import and export quotas. They reduce the quantity allowed to be imported or exported to zero.

contains any component on which an export quota is imposed, be it for components that have been imported and processed or components that have been sourced locally. Export quotas are often imposed (e.g., in China) on rare earth materials (see 4.8.3 Access to Rare Earth Materials). Thus, if, for instance, at the production site rare earth materials will be processed and the product produced at the production site will contain rare earth materials from local sources, then it is important to take any kind of export quotas on the relevant rare earth materials into consideration in the selection process. Hence, it must be evaluated if enough of the produced product can be exported. The insufficient consideration of export or import quotas in the selection process may have a significant effect on costs or even make the successful operation of the production site impossible.

Local content requirements are defined by the WTO as requirements for the investor to 'purchase a certain amount of local materials for incorporation in the investor's product' (World Trade Organization, n.d.d). Local content regulations require, for example, that a certain percentage of the product be produced in the country under consideration in order to sell that product in the local market or export it. The goal of local content regulations is to foster local production, as firms are forced to produce at least parts of the product locally to sell their goods in the local market or export them. In order to maximize profits in markets with local content regulations, firms establish different forms of production or assembly, such as 'semi-knocked-down (SKD)' or 'completely-knocked-down (CKD)'. The production modes SKD and CKD differ in terms of the extent to which products are put into its parts and then assembled at the production site, as well as in terms of the amount of local value added. CKD refers to a production mode in which the individual components of a product are produced in component factories in other countries and then transported to the country under consideration and assembled locally. SKD, instead, is a production mode in which some components are produced globally and then transported to the country under consideration while other components are produced locally and all components are assembled locally at a local assembly factory. OEMs often react to local content regulations by establishing SKD and CKD production or by entering into joint ventures with local firms. These joint ventures, which international OEMs have entered into to meet local content regulations thereby gaining access to the local market or being allowed to export the product produced at the production site, have been unprofitable in many cases. This is especially the case in China, which seeks, with its "Made in China 2025" strategy, to turn 'the country into a production hub for high-tech products within the next few decades' (Merics, 2016.). According to this strategy, China implements, among other industrial policies, local content regulations, especially in high-tech industries (Wübbeke et al., 2016, 20-21). Local content regulations must be closely analyzed in the selection process due to their impact on the cost and ease of operating a production site of an OEM. This requires the thorough analysis of the local content requirements on the produced product to be allowed to sell the product in the local market or to export it.

A closely related NTB are limitations of the investment which can be made by foreigners, or the property which can be held by foreigners. These kinds of limitations are very important for the selection of a production site as they limit or even rule out the possibility for the OEM to own the production site, depending on the limitations and the size of the investment. Thus, if this kind of NTB is in place, it is necessary to understand exactly what the allowed limits on foreign owned property and foreign investment are and the risk of any change to these limits in the future. If a NTB is in place, restricting the investment or property ownership of a foreigner, then it is necessary to analyze the option of a joint venture with a local partner, in general, and the availability of potential local partners, in particular (see 4.15 Potential Partners for Alliances and Joint Ventures). As in the case of local content regulations, limitations on investments and property ownership for foreigners can lead international firms to commit to unprofitable joint ventures with local firms. The significant risk associated with these limitations requires evaluating any kind of limitations on the ability to own property and make investments as a foreign OEM early in the selection process.

Import licensing is another NTB which is significant for selecting a production site. Import licensing occurs when governments require firms 'to obtain permits' in 'administrative procedures' to import certain products (World Trade Organization, n.d.c). Given the great number of components that the OEM must import into the country where the production site is located, import licensing can have a significant effect on the costs and ease of operating the production site by increasing the time needed to import components or the costs thereof. While the effect of import licensing on operating the production site also depends on the ease of receiving the required import licenses and hence on the administrative procedures (see 4.3.3.4 Administrative Procedures), the costs arising due to import licensing depend on the fees which the OEM must pay to receive the necessary licenses.

Another NTB which can significantly affect the operation of the production site are certification requirements. A government imposes certification requirements on imports by requiring the importing firm to turn in 'additional trade documents like Certificate of Origin' or 'Certificate of Authenticity' (tradebarriers.org, n.d.). These certification requirements are typical technical barriers to trade and are relevant when selling the produced product locally or internationally. Certification requirements are often in place to assess the conformity of a product with consumer protection standards; however, they often lead to inappropriate and unforeseeable costs and delays, as they are in many cases ‘duplicative, inefficient or applied in a discriminatory manner’ (World Trade Organization, 2012, 147). An example of a certification requirement in the automotive industry are certifications confirming certain properties of windshields. High certification requirements cannot only lead to additional costs, but also pose a significant risk to the ability to embed the new production site in the global production network of the OEM. They especially undermine the pursuit of network capabilities, such as speed and flexibility. For the OEM, it is very advantageous if the country under consideration and the countries in which the produced product is planned to be sold recognize the UNECE Standards and Certificates (see UNECE, n.d.a).

Given the effect that NTBs can have on the costs and ease of operating a production site, it is necessary to evaluate the NTBs which are imposed by the country under consideration, and to assess their potential impact on the costs and ease of operating the production site in the selection process. As NTBs are normally determined by national governments (in some cases by supranational entities, such as in the EU) and vary significantly from country to country, they must be analyzed on a national level. However, certification requirements on products might also vary across regions or even large cities. NTBs are normally not negotiable and, due to the great variety of NTBs, the information on NTBs must be collected from a variety of sources as each source only ‘sheds light on a small part of the universe’ of NTBs (World Trade Organization, 2012, 96). Moreover, in the analysis of NTBs’ effect, it must be distinguished between their effect on costs and their effect on the ease of constructing and operating a production site.

Table 3: Information and Instructions on the Choice and Evaluation of the Location Factor *Non-Tariff Barriers to Trade*

Location factor to be evaluated	**Costs due to Local Content Regulations over the planning horizon of the production site**	**Complexity due to Local Content Regulations**	**Costs due to Certifications Requirements over the planning horizon of the production site**	**Complexity due to Certification Requirements**	**Costs due to Import / Export Quotas over the planning horizon of the production site**	**Complexity due to Import / Export Quotas**	**Problems / Complexity due to Constraints on Foreign Investment / Property**	**Costs due import licensing over the planning horizon of the production site**	**Complexity due to import licensing**
Strategic, operational, or general	Strategic and operational								
Process-specific / product-specific	Process-specific and product-specific								
Relevant for production network	+	+	+	+	+	+	-	+	+
Relevant for the design of the supply chain	+	+	+	+	+	+	-	+	+
Negotiable	-	-	-	-	-	-	-	-	-
Semi-external / even performance	-	-	-	-	-	-	-	-	-
Quantitative or qualitative	Cost-related quantitative	Qualitative	Cost-related quantitative	Qualitative	Cost-related quantitative	Qualitative	Qualitative	Cost-related quantitative	Qualitative
Hard or soft	Hard	Hard	Hard	Hard	Hard	Hard	Hard	Hard	Hard
Static or dynamic	Dynamic	Local content regulations should be considered as static, unless there is a specific reason for future change e.g., government announcement of more restrictive trade policy or plans to join a free trade agreement.	Dynamic	Certification requirements should be considered as static, unless there is a specific reason for future change e.g., government announcement of more restrictive trade policy or plans to join a free trade agreement.	Dynamic	Import / Export Quotas should be considered as static, unless there is a specific reason for future change e.g., government announcement of more restrictive trade policy or plans to join a free trade agreement.	Constraints on Foreign Investment / Property should be considered as static, unless there is a specific reason for future change e.g., government announcement of more restrictive trade policy or plans to join a free trade agreement.	Dynamic	Import licensing should be considered as static, unless there is a specific reason for future change e.g., government announcement of more restrictive trade policy or plans to join a free trade agreement.
Geographic level of analysis	National	National	National / regional (city)	National / regional (city)	National	National	National	National	National

Location factor to be evaluated	Costs due to Local Content Regulations over the planning horizon of the production site	Complexity due to Local Content Regulations	Costs due to Certifications Requirements over the planning horizon of the production site	Complexity due to Certification Requirements	Costs due to Import / Export Quotas over the planning horizon of the production site	Complexity due to Import / Export Quotas	Problems / Complexity due to Constraints on Foreign Investment / Property	Costs due import licensing over the planning horizon of the production site	Complexity due to import licensing
Unit of measurement	Approximated in EUR.	Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).	Approximated in EUR.	Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).	Approximated in EUR.	Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).	Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).	Approximated in EUR.	Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).
Evaluation method(s)	o Minimum criteria o Operating cost comparison o Present value method	o Strategic considerations o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method	o Strategic considerations o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method	o Strategic considerations o Profile method o Utility analysis	o Strategic considerations o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method	o Strategic considerations o Profile method o Utility analysis
Phase(s) in the selection process	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 5 (profile method, utility analysis) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 5 (profile method, utility analysis) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 5 (profile method, utility analysis) o Phase 7 (utility analysis)	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 5 (utility analysis, profile method) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 5 (profile method, utility analysis) o Phase 7 (utility analysis)
Interdependencies with other location factors	o Membership in Free Trade Agreements o Environmental Regulations o Administrative Procedures o Potential Partners for Alliances or Joint Ventures	o Membership in Free Trade Agreements o Environmental Regulations o Administrative Procedures	o Membership in Free Trade Agreements o Environmental Regulations o Administrative Procedures o Access to	o Membership in Free Trade Agreements o Potential Partners for Alliances or Joint Ventures	o Membership in Free Trade Agreements o Environmental Regulations o Administrative Procedures	o Membership in Free Trade Agreements o Environmental Regulations o Administrative Procedures	o Membership in Free Trade Agreements o Environmental Regulations o Administrative Procedures	o Membership in Free Trade Agreements o Environmental Regulations o Administrative Procedures	o Membership in Free Trade Agreements o Environmental Regulations o Administrative Procedures

Location factor to be evaluated	Costs due to Local Content Regulations over the planning horizon of the production site	Complexity due to Local Content Regulations	Costs due to Certifications Requirements over the planning horizon of the production site	Complexity due to Certification Requirements	Costs due to Import / Export Quotas over the planning horizon of the production site	Complexity due to Import / Export Quotas	Problems / Complexity due to Constraints on Foreign Investment / Property	Costs due import licensing over the planning horizon of the production site	Complexity due to import licensing
	o Access to Raw Earth Materials		General Raw Materials o Potential Partners for Alliances or Joint Ventures o Access to Rare Earth Materials						
Source of information: public databases and information	o WTO: • Trade Monitoring Reports (bi-annually) • Trade Monitoring Database • Trade Policy Reports • Reports on specific trade concerns and disputes • International Trade and Market Access Data • Publication Requirements, Enquiry Points and Notifications o European Commission: Trade Market Access Database - Trade Barriers o Germany Trade & Invest website o United States Trade Representative's National Trade Estimate Report o World Bank: Temporary Trade Barriers Database (TTBD) o OECD: • Product Market Regulation Statistics – Economy-wide regulation (including Product Market Regulation (PMR) indicator, which covers domestic regulations in the manufacturing and service sectors) • OECD FDI Regulatory Restrictiveness Index o UNCTAD: Trade Analysis and Information System (TRAINS) o ACEA: Industrial Policy o VDA: Topics - Economic Policy and Infrastructure – Trade – International Trade and Investment								
Source of information: commercial external sources	o Industry-specific sources (VDA, ACEA) o ITC: Market Access Map (subscription required)								
Source of information: internal know-how	o Industrial Policy Department o Local Offices o Sourcing Department								
Source of information: external consultants	+								

(Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.2.2.3 Taxes

Taxes are dues which governments impose on individual persons or legal entities of the territory they govern. Particular to taxes are two aspects: that the government determines the taxes independently and that taxes must be paid without receiving any service in return. Hence, taxes are an important way for governments to raise revenues. The effective tax burden depends on the types of taxes, on the basis upon which the tax burden is calculated, and on the tax rates which are imposed. All three—tax types, tax bases, and tax rates—can vary on the national, regional (state) or local level, as national, regional, and local governments have the right to impose taxes in many countries (see Wöhe et al., 2020, 254; Perridon et al., 2017, 83). Tax types are differentiated into cost-related taxes and revenue-related or earnings-related taxes. Cost-related taxes include, for instance, property taxes or property and land transfer taxes, while revenue-related or earnings-related taxes are corporate (income) taxes, business taxes or income taxes (see Perridon et al., 2017, 83). There are a variety of types of taxes which are relevant for selecting a production site; among others, these include the corporate (income) tax, business or occupational tax, real estate or property tax and the sales or value added tax.

The corporate (income) tax is raised on the basis of the income of a firm. While almost all governments of the world raise corporate (income) taxes, the rules governing the application of the tax vary significantly among countries. With regard to corporate (income) taxes, it is important to note that the tax rate changes frequently with changes of governments. Corporate tax rates differ widely between countries: In Slovakia the corporate tax rate in 2020 was at 21%, while in Hungary, the corporate tax rate in 2020 was 9%. These two countries also show how corporate tax rates change differently: In Slovakia the corporate tax rate has been stable, around 22-21%, for years, while it fell significantly in Hungary, from 19% to 9%, in 2016 (see KPMG, n.d.). Besides the considerable difference between countries, the corporate (income) tax also varies between regions in some countries. Furthermore, there are a variety of provisions regulating the application of the tax rate to special activities, such as for manufacturing or R&D, which are in some countries lower, or in many countries for mining or oil and gas exploitation higher (see Deloitte, n.d.). Hence, the corporate (income) tax rate at the production site is an important factor that must be taken into consideration in the selection process of a production site as it varies significantly between countries, regions and activities, and has a considerable effect on the profitability of the production site.

In many countries, firms must pay a business or occupational tax to be allowed to conduct business. The tax burden is calculated based on real factors, such as the number of employees or the amount of revenues. Business or occupational taxes are normally community taxes and thus vary greatly on a local level. Many communities compete through low business or occupational taxes to incentivize firms to locate their operations in their communities. In countries which do not have such business or occupational taxes, such as Great Britain or the U.S., business licenses for which businesses must pay fixed fees are often required. These business licenses transfer the right to owners or operators of businesses to conduct a certain business activity at a certain location (see Blankart, 2008, 255; 4.3.3.4 Administrative Procedures). Thus, the OEM must evaluate whether constructing or operating a production site in the country, region or community under consideration requires paying a business or occupational tax and take it into account, if required, during the selection process (for licenses see 4.3.3.4 Administrative Procedures).

While the business or occupational tax is not imposed in the U.S. and other countries which have oriented their tax system on the British tradition, they do impose a real estate or property tax which is raised based on the value of the property (see Blankart, 2008, 259-260). As such, an investment on the production site should increase the taxable value (assessed property value) of the production site and thus the tax burden of the OEM, while a disinvestment should decrease the taxable value of the production site and thus the tax burden of the OEM. But public investments into the neighborhood, such as in schools, parks, or infrastructure, also increase the value of the property and thus the tax burden of the OEM (see Blankart, 2008, 260). Real estate or property tax is very relevant to selecting a production site, as the OEM must make considerable investments at the production site and public investments by the national, regional, and local government are likely in the neighborhood once the production site has been chosen.

Sales tax and value added tax are also of interest, as they decrease the revenue on locally sold products and increase the price of locally sourced components and services. The value added tax is a form of consumption tax that is imposed on every economic transaction in an economy, and in particular, on every stage in the production process of a product or service at which one firm sells a product for further processing to another, and on every stage in the distribution of a product or service. The tax burden for value added tax is calculated depending on the value added to the product or service (see Blankart, 2008, 299; Guay, 2014, 195). The value added tax affects the costs of constructing and operating the production site, as the firm must pay value added tax on locally sourced components and services. The sales tax is paid with the final sale of a product or service to the consumer. Increased sales tax decreases the firm's revenues if the product is supposed to be sold in the local market: either the consumer must pay the sales tax, and thus a higher total price for the product, which will decrease the total units the OEM sells in the local market, or the OEM reduces the price of the product in the local market to gain market share, which decreases the revenues per sold unit for the OEM (see European Commission, n.d.e).

In addition to corporate taxes, business taxes (occupational taxes), real estate or property taxes, value added taxes and sales taxes, other tax types can also be relevant to selecting a production site, such as taxes on unemployment compensation (see Sule, 2008, 614-615), investment taxes, payroll taxes, foreign taxes, or environmental taxes (environmental taxes are considered under the location factor *Environmental Regulations* (see 4.2.3.1 Environmental Regulations).

As taxes directly impact the cost of the production site and the tax burden constitutes a considerable share of total costs of constructing and operating a production site, taxes must be taken into account in the selection process. Meyer suggests firms thoroughly analyze taxes in the selection of a production site to take advantage of legal possibilities to reduce the effective tax burden (see Meyer, 2006a, 79). As the effective tax burden which the OEM must pay for constructing and operating the production site depends on the types of taxes it must pay, on the basis upon which the tax burden is calculated, and on the tax rates which are imposed, it is important to closely analyze the types, bases and rates of taxes on a national, regional and local level (see Wöhe et al., 2020, 254; Perridon et al., 2017, 83).

In the selection process of a production site, OEMs must not only analyze the expected tax burden for constructing and operating the production site, but also the time and effort required for the compliance with the tax system at the production site (the national, regional, and local tax system). The time and effort required for the compliance with the tax system depend, for instance, on the ease of collecting all necessary information and of completing and filling tax forms, as well as the frequency of tax payments or required postfiling of taxes, for instance, for corporate income tax audits (see The World Bank, n.d.d). Therefore, in the selection process, the tax burden must be assessed first, which requires evaluating all relevant tax types for constructing and operating the production site and the corresponding tax bases and rates, all on the national, regional, and local levels depending on the tax. Second, evaluating taxes also requires analyzing the complexity of the tax system and the effort and time required for complying with that tax system.

Another aspect which is important with regard to taxes in the selection process is that taxes are, in contrast to tariffs, not given, but can be negotiated with the national, regional, or local governments. Meyer suggests that firms should negotiate the tax basis and tax rates for all relevant tax types early in the selection process. Through negotiations with the national, regional, or local government, firms should try to maximize the profitability of the production site in the selection process (see Meyer, 2006a, 79) by receiving tax exemptions (see 4.2.2.4 Subsidies and State Aid).

The government budget can serve as an indicator for the future development of national taxes, as a large budget deficit might force the government to raise taxes in the future to reduce the deficit, while a large budget surplus provides the government scope to lower taxes or at least keep them stable in the near- to medium-term. Another indicator of planned government changes in taxes are budget plans. In addition, the country's sovereign debt (see 4.6.11 Debt, Debt Sustainability and Sovereign Credit Ratings) can be an indicator of the country's long-term leeway to spend without significantly raising taxes. If the government debt is high, the government must make payments to service this debt or is less likely to be able to borrow more money at international markets at feasible conditions. Besides the total sovereign debt, the country's sovereign credit rating gives a good indication of the country's possibility to raise money on international capital markets. Overall, regarding taxes in the selection process, it is important to get a thorough understanding of the tax system in place, all relevant provisions, and engage in negotiations about taxes and tax exemptions (a form of subsidy), with the national, regional, and local governments early in the selection process.

Table 4: Information and Instructions on the Choice and Evaluation of the Location Factor *Taxes*

Location Factor to be evaluated	**Tax Rate (Corporate Tax)**	**Tax Burden (Corporate Tax) over the planning horizon of the production site**	**Tax Burden (Business / Occupational Tax) over the planning horizon of the production site**	**Tax Burden (Sale Tax) over the planning horizon of the production site**	**Tax Burden (Real Estate / Property Tax) over the planning horizon of the production site**	**Tax Complexity (Corporate Tax)**
Strategic, operational, or general	General	General	General	General	General	General
Process-specific / product-specific	-	-	-	-	-	-
Relevant for production network	-	-	-	-	-	-
Relevant for the design of the supply chain	-	-	-	-	-	-
Negotiable	+	+	+	+	+	+
Semi-external / even performance	-	-	-	-	-	-
Quantitative or qualitative	Non-cost-related quantitative	Cost-related quantitative	Cost-related quantitative	Cost-related quantitative	Cost-related quantitative	Qualitative
Hard or soft	Hard	Hard	Hard	Hard	Hard	Hard
Static or dynamic	Static (unless there is a specific reason for change e.g., government announcement, analysis of budget).	Dynamic				
Geographic level of analysis	National, regional, and local	National, regional, and local	National, regional, and local	National, regional, and local	National, regional, and local	National, regional and local
Unit of measurement	Measured in %, and assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).	Approximated in EUR.	Approximated in EUR.	Approximated in EUR.	Approximated in EUR.	Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).
Evaluation method(s)	o Strategic considerations o Profile Method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method				o Strategic considerations o Profile method o Utility analysis
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 3 (profile method) o Phase 5 (profile method, utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)				o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 5 (profile method, utility analysis) o Phase 7 (utility analysis)
Interdependencies with other location factors	o Subsidies and State Aid o Political Stability					

Location Factor to be evaluated	Tax Rate (Corporate Tax)	Tax Burden (Corporate Tax) over the planning horizon of the production site	Tax Burden (Business / Occupational Tax) over the planning horizon of the production site	Tax Burden (Sale Tax) over the planning horizon of the production site	Tax Burden (Real Estate / Property Tax) over the planning horizon of the production site	Tax Complexity (Corporate Tax)
	o Administrative Procedures o Corruption					
Source of information: public databases and information	o PwC: • Paying Taxes (annual report) • Worldwide Tax Summary o EY: Worldwide Corporate Tax Guide (annual report) o Domestic Finance Department: Existing double tax agreements o Government websites o KPMG: Corporate Tax Rates Table (including provisions) o Deloitte: Corporate Tax Rates (annual report) (including provisions) o DLA PIPER REAL WORLD: Taxation of acquisition, Recurring Taxation o Asia Briefing: The 2018/2019 ASEAN Tax Comparator (annual report)		o PwC: • Paying Taxes (annual report) • Worldwide Tax Summary o Government websites o DLA PIPER REAL WORLD: Taxation of acquisition, Recurring Taxation o Asia Briefing: The 2018/2019 ASEAN Tax Comparator (annual report)	o PwC: • Paying Taxes (annual report) • Worldwide Tax Summary o EY: Worldwide Tax Worldwide VAT, GST and Sales Tax Guide (annual report) o Domestic Finance Department: Existing double tax agreements o Government web sites o DLA PIPER REAL WORLD: Taxation of acquisition, Recurring Taxation o Asia Briefing: The 2018/2019 ASEAN Tax Comparator o ACEA: ACEA Tax Guide (annual) (ACEA's Tax Guide provides an overview of specific taxes that are levied on motor vehicles in European countries and other key markets)	o PwC: • Paying Taxes (annual report) • Worldwide Tax Summary o EY: Worldwide Estate and Inheritance Tax Guide (annual report) o Domestic Finance Depart ment: Existing double tax agreements o Government websites o DLA PIPER REAL WORLD: Taxation of acquisition, Recurring Taxation o Asia Briefing: The 2018/2019 ASEAN Tax Comparator (annual report)	o World Bank: World Bank and PwC: Ease of Doing Business – Paying taxes o ACEA: ACEA Tax Guide (annual) (ACEA's Tax Guide provides an overview of specific taxes that are levied on motor vehicles in European countries and other key markets)
Source of information: commercial external sources	-	-	-	-	-	-
Source of information: internal know-how	o Tax Department o Treasury Department					
Source of information: external consultants	+					

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.2.2.4 Subsidies and State Aid

Governments support the activities of firms through a variety of subsidies. Subsidies are also referred to as state aid. In general, the terms can be 'used interchangeably'; however, the WTO predominantly uses the term subsidy, and the European Union uses the term state aid (OECD, 2010c, 17). From a micro-economic theory perspective, '[a] subsidy is the opposite of a tax' (Varian, 2006, 27). State aid or subsidies are ways for the government to grant funds (see OECD, 2010c, 9). The European Commission defines state aid 'as an advantage in any form whatsoever conferred on a selective basis to undertakings by national public authorities'. When a government provides subsidies, it does so by intervening in the market and providing state resources, for instance, in the form of grants, interest and tax exemptions, guarantees, government holdings of all or part of a firm, or providing goods and services on preferential terms. By providing subsidies the government gives 'the recipient', in this case a firm, 'an advantage on a selective basis'. Given that the advantage is given on a 'selective basis', subsidies usually distort competition (European Commission, n.d.d).[101]

The WTO distinguishes between two general types of subsidies, so-called export subsidies and domestic subsidies. 'An export subsidy is a benefit conferred on a firm by the government that is contingent on exports', while domestic subsidies are benefits that are 'not directly linked to exports' (World Trade Organization, n.d.f). Domestic subsidies are generally either in the form of cash payments or tax exemptions. Cash payments are, for instance, for investments or employment and are in the form of government investment in infrastructure or in training and schooling institutions, which governments provide to attract private investments into the country or certain regions (see Wöhe et al., 2020, 254; Sauernheimer, 2004, 176). Export subsidies are supportive measures for exports, such as export bonuses, dumping practices, or an undervalued currency (see Sauernheimer, 2004, 176). Subsidies are further differentiated into direct subsidies and indirect subsidies, while direct subsidies are in the form of cash payments, investments or tax exemptions, indirect subsidies are often in the form of a facilitation of procedures for firms. Like taxes, subsidies vary significantly across countries, but also within countries, across regions or even on the local level (see Wöhe et al., 2020, 254), as they can be provided by national, regional, and local governments.

[101] The economic impact of subsidies is hard to determine, as they are also used to avoid market failure and to provide goods with positive externalities, but subsidies also often lead to an inefficient allocation of resources and to market distortions (see OECD, 2010c, 9-11; Blankart, 2008, 51-75, 134).

There is a variety of subsidies, which can be provided to an OEM at the production site. These include direct subsidies, such as tax exemptions, cash payments for infrastructure investments in roads, harbors or railroads or in energy or waste disposal facilities and for training and educating employees. Tax exemptions, as well as tax abatements and tax credits, can significantly reduce the total tax burden the OEM must pay, for instance, in terms of payroll tax, taxes related to R&D, or corporate, real estate and personal property tax. Indirect subsidies can facilitate licensing and administrative procedures or help develop local suppliers or relocate other international suppliers close to the production site. Export-subsidies for the product produced in the country also affect the costs of the production site to the extent that the product produced is exported to other countries. The variety of subsidies which governments can grant OEMs to incentivize them to select a production site in a country, region or community, especially subsidies for infrastructure, employment, tax exemptions and exports, are important in the selection process.

Subsidies must be considered in the selection process, as they directly impact the cost for constructing and operating a production site. As for taxes, it is important to gain a thorough understanding of all available forms and amounts of subsidies, as well as the application processes which are necessary for obtaining them. This includes knowing all the documentation that is required and the timing of the application processes.

In particular, when various countries and regions compete for the long-term investment of large international OEMs, their governments are inclined to provide considerable subsidies. Meyer suggests that in selecting a production site firms should take advantage of legal possibilities to increase the total subsidies it receives for the investment and for operating the production site by trying to obtain subsidies from the national, regional, and local government, and negotiating them in advance (see Meyer, 2006a, 78-79). As subsidies are normally negotiable, the project team must draft an approach for these negotiations with the national, as well as regional or local, government. This might include summarizing all investments which the OEM plans to make at the new production site and an approximation of the number of local workers, which will be employed at the production site. In order to assess the availability of subsidies, it is helpful if the OEM already has experiences with the government or if other firms the OEM works with have experiences receiving subsidies in the country, region or even community.

However, with regard to subsidies, OEMs must be cautious about the period of time for which the government commits to provide these subsides and whether they can stop being provided due to a change of government within the planning horizon of the production site. For instance, the tax advantage for local production in India based on the Automotive Mission Plan 2026 (see Ernst & Young, 2016, 16) has been significantly reduced since the introduction of the Goods and Service Tax (GST) in July 2017. Likewise, the case of the Inovar-Auto incentive program in Brazil exemplifies the effect changes in subsidies can have given the Inovar-Auto incentive program had to end as it was not compatible with WTO rules, and the successor program (ROTA 2030) makes local production in Brazil less profitable.

Another aspect which is very important with regard to subsidies is the control system over subsidies. Control systems over subsidies vary significantly between different jurisdictions or between different countries. The control system is usually determined by the competition policy (anti-trust policy). The WTO and EU rules for subsidy control exemplify possible differences: the WTO rules only provide *ex post* controls and the possibility to member states to 'challenge the subsidy granted by another member state before the WTO settlement body'. In contrast, the EU rules on subsidy control require *ex ante* and *ex post* controls. *Ex ante*, all measures must be notified to the European Commission when they are planned by countries and the subsidy can only be granted after the clearance decision of the European Commission (OECD, 2010c, 9; see European Commission, n.d.d). *Ex post*, all subsidies must be reviewed by the European Commission and the European Commission can order the subsidy to be adjusted to meet changed market conditions (see OECD, 2010c, 21-23). Moreover, the European Commission may conduct inquiries if subsidy measures 'may distort competition in several Member States, or where existing aid measures are no longer compatible with the regulatory framework'. If the European Commission judges already granted subsidies incompatible with its competition law (or anti-trust law), it can recover these paid subsidies (European Commission, n.d.d). Moreover, the requirements to receive subsidies vary between countries. While in some countries competition policy is loose and subsides do not require specific reasons once they are granted by a government, in other countries they are only compatible with competition law (or anti-trust law) if they meet certain criteria. For instance, the European Union competition policy only allows for subsidies if it is beneficial for disadvantaged regions (e.g., due to deindustrialization, the rural and urban divide or high unemployment), for the environment, for restructuring a firm, for the assistance of disabled or disadvantaged workers (or other specific circumstances) or for certain industries (e.g., transport or media) (see Guay, 2014, 202). The example of the European Union shows the importance of understanding the rules which are in place in the country under consideration with regard to subsidies and the requirements for receiving subsidies in the country early in the selection process. Furthermore, it shows the necessity to document, in detail, at which point in the selection process subsidies are granted, the reason they are granted, and, possibly, to what extent they impact the selection. This documentation is, for instance, necessary to illustrate, during and after the selection process, that the subsidies in the European Union have been cleared by the European Commission before they were granted by a national, regional, or local government.

To assess the future development of available subsidies, the government budget can serve as an indicator, as a large budget deficit might force the government to cut subsidies in the future to reduce the deficit, while a large budget surplus provides the government with the ability to increase subsidies in the future. Another indicator of planned government expenditures are budget plans, which give an idea of what amount of money the government plans to spend and on what kinds of projects.

Table 5: Information and Instructions on the Choice and Evaluation of the Location Factor *Subsidies and State Aid*

Location factor to be evaluated	**Availability of Subsidies**	**Subsidy amount (Tax Exemptions) over the planning horizon of the production site**	**Subsidy Complexity (Tax Exemptions)**	**Subsidy Amount (Cash Payments) over the planning horizon of the production site**	**Subsidy Complexity (Cash Payments)**	**Subsidy Complexity / Benefit (Licensing & Administrative Procedures)**	**Subsidy Amount (for investment e.g., Production site, on- and offsite infrastructure)**
Strategic, operational, or general	Operational or general	Operational or general	Operational or general	Operational or general	Operational or general	Operational or general	General
Process-specific / product-specific	Process-specific and product-specific	Process-specific and product-specific	Process-specific and product-specific	Process-specific and product-specific	Process-specific and product-specific	Process-specific and product-specific	-
Relevant for production network	-	-	-	-	-	+	+
Relevant for the design of the supply chain	-	-	-	-	-	+	+
Negotiable	+	+	+	+	+	+	+
Semi-external / even performance	-	-	-	-	-	-	-
Quantitative or qualitative	Qualitative	Cost-related quantitative	Qualitative	Cost-related quantitative	Qualitative	Qualitative	Cost-related quantitative
Hard or soft		Hard	Hard	Hard	Hard	Hard	Hard
Static or dynamic	Subsidies and State Aid that are not in the form of an immediate investment by the government, but in the form of a continued payment or exemption must be evaluated as dynamic, as they are subject to changes in government or might be cut due to government budget issues.						
Geographic level of analysis	National, regional, and local						
Unit of measurement	Assessed as very low, low, fairly high, high or very high (or numerically as 1 through 5).	Approximated in EUR.	Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).	Approximated in EUR.	Assessed as very low, low, fairly high, high or very high (or numerically as 1 through 5).	Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).	Approximated in EUR.
Evaluation method(s)	o Strategic considerations o Minimum criteria o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method	o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method	o Profile method o Utility analysis	o Profile method o Utility analysis	o Minimum criteria o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 3 (profile method) o Phase 5 (profile method, utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)	o Phase 5 (profile method, utility analysis) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)	o Phase 5 (profile method, utility analysis) o Phase 7 (utility analysis)	o Phase 5 (profile method, utility analysis) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, present value method) o Phase 7 (present value method)

Location factor to be evaluated	Availability of Subsidies	Subsidy amount (Tax Exemptions) over the planning horizon of the production site	Subsidy Complexity (Tax Exemptions)	Subsidy Amount (Cash Payments) over the planning horizon of the production site	Subsidy Complexity (Cash Payments)	Subsidy Complexity / Benefit (Licensing & Administrative Procedures)	Subsidy Amount (for investment e.g., Production site, on- and offsite infrastructure)
Interdependencies with other location factors	o Political Stability	o Taxes o Political Stability	o Administrative Procedures o Corruption	o Availability of Skills o Infrastructure o Industrial Clusters o Political Stability	o Administrative Procedures o Corruption	o Administrative Procedures o Corruption	o Availability of Skills o Infrastructure o Political Stability
Source of information: public databases and information	o European Commission: Competition; State Aid; Data Analysis o IMF: the IMF Data give access to macroeconomic & financial data; under data by Country/Economy; Subsidies and Transfers o National governments: Data is also available in (finance) statistics yearbooks o OECD: Policy round tables: Competition, State Aids and Subsidies (Information on conditions, rules and trends on state aid and subsidies on a country basis)						
Source of information: commercial external sources	-						
Source of information: internal know-how	o Political Department o Economic Department o Production Strategy Department o Information gained in negotiations with governments & contacts with other firms with experience with negotiating subsidies in the country, region or community o Local Offices						
Source of information: external consultants	+						

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.2.2.5 Capital Controls

Governments can impose capital controls to regulate or administer any capital flows into the country from international markets and out of the country into international markets, and in particular, into and out of the country's capital account. In practice, capital controls limit the exchange of foreign currencies into the local currency (capital inflow controls) and the exchange of local currency into international currencies (capital outflow controls), simply by restricting the access to the relative currencies. The major goal of implementing capital controls is to protect the local exchange rate and the country's capital reserves from high volatility. There exists a variety of capital controls; for instance, 'controls on payments for imports and proceeds from exports', 'controls on capital transactions' and 'controls on FX [foreign exchange] transactions and other items that are not exclusively on trade or capital transaction'. A narrower concept of capital control only includes controls on capital transactions and on FX transactions (Wei and Zhang, 2007, 842).

Capital controls can be implemented by either prohibiting any import or export of financial instruments, such as money, by limiting import or export of financial instruments, by implementing a dual exchange market where the exchange market for commercial transfers is fixed and the exchange market for financial transactions is flexible, or by implementing the Tobin tax, a single, relatively low and flat tax on each transaction on the foreign exchange market (see Mankiw, 2013, 359-379; Burda and Wyplosz, 2013, 517-518). Controls on capital transactions affect all kinds of capital transactions, such as 'transactions of capital and money market instruments, derivatives, FDI, credit operations, real estates, and personal finance'. Controls on foreign exchange transactions impose taxes on exchange, prohibit currency derivatives, control bank accounts or current transfers. As such, countries which have capital controls imposed in one of these areas are more likely to have capital controls also imposed in the other areas (see Wei and Zhang, 2007, 843-844). Controls on payments for imports and proceeds from exports affect transactions which arise in the realm of international trade. Countries impose further controls on operations of institutional investors and commercial banks.

From a macroeconomic perspective (as also explained in more detail under 4.6.2 Exchange Rate), capital controls are an instrument of monetary policy. Those in favor of capital controls from a theoretical point of view argue that capital controls reduce the volatility of the exchange rate while simultaneously allowing a central bank to use monetary policy. This second aspect is captured by the economic concept of the so-called 'Impossible Trinity', which states that a country cannot pursue a fixed exchange rate, independent monetary policy, and free capital flows at the same time, but must give up one of these options. The US, for instance, allows free capital flows and has an independent monetary policy, but floating exchange rates, while China has capital controls in place, an independent monetary policy but fixed exchange rates, and Hong Kong has a fixed exchange rate and allows for a free flow of capital, but has no independent monetary policy (see Mankiw, 2013, 359-379; Burda and Wyplosz, 2013, 516-517). Thus, many countries which impose capital controls do so to protect their own currency from depreciation, as their currencies are overvalued.

Capital controls have a significant effect on the profitability of operating a production site in the country. Capital inflow controls limit the possibility for a foreign OEM to receive local currency in exchange for hard currencies (e.g., the US$) by limiting the exchange of foreign currencies into the local currency. This complicates operating the production site, as the international OEM needs local currency for payments for locally sourced products (components) and services, as well as for the wage payments of local employees. Capital outflow controls constrain the exchange of local currency into hard currencies, thereby impeding the operation of a production site in the country for an international OEM. Capital outflow controls make the conversion of any profits made in the local currency in hard currency difficult. This is a serious obstacle, especially if the produced product should be sold in the local market, as the conversion of profits into the reporting currency is necessary for international OEMs to repatriate their profits. The same holds true for the repatriation of the money the OEM receives for selling its property in local currency at the end of its time operating the production site.

In addition to these problems, capital controls often also impose bureaucratic obstacles for international OEMs operating a production site in the country by, for instance, requiring a foreign exchange budget for imports or 'documentation and financing requirements for import payments and export proceeds', which interrupt, prolong, complicate and might even rule out the import of required components and the export of the product produced at the production site (Wei and Zhang, 2007, 843). As capital controls pose a serious risk to the operation and profitability of a production site, it must be analyzed in detail whether capital controls are in place in the country under consideration and, if so, what kind of capital controls are in place and to what extent they would impact the operation and profitability of the production site. For analyzing changes in capital controls, the evaluation of the country's exchange rate (see 4.6.2 Exchange Rate) and its foreign reserves is necessary, particularly because the primary goal of implementing capital controls is to protect the local exchange rate or the country's capital reserves from high volatility. Moreover, it is interesting to consider the country's foreign denominated debt, as implementing or up-keeping capital controls might be a way to protect its foreign reserves needed to serve its foreign-denominated debt (see 4.6.11 Debt, Debt Sustainability and Sovereign Credit Ratings).

Table 6: Information and Instructions on the Choice and Evaluation of the Location Factor *Capital Controls*

Location factor to be evaluated	**Risks due to Capital Controls**
Strategic, operational, or general	General
Process-specific / product-specific	-
Relevant for production network	+
Relevant for the design of the supply chain	+
Negotiable	-
Semi-external / even performance	-
Quantitative or qualitative	Qualitative
Hard or soft	Hard
Static or dynamic	Static (unless there is a specific reason to expect them to be changed e.g., policy announcement, history of capital controls in recent past, high exchange rate volatility or high foreign-denominated debt).
Geographic level of analysis	National
Unit of measurement	Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).
Evaluation method(s)	o Strategic considerations o Minimum criteria o Profile method o Utility analysis
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 7 (utility analysis)
Interdependencies with other location factors	o Exchange Rate o Debt, Debt Sustainability and Sovereign Credit Ratings
Source of information: public databases and information	o IMF: Annual Report on Exchange Arrangements and Exchange Restrictions o Deutsche Bank: Risk and Capital Performance; Credit Risk Exposure o National governmental and central bank websites
Source of information: commercial external sources	o Capital Intelligence o Standard and Poor's o Moody's o Fitch o Business Environment Risk Intelligence S.A: BERI-index (R-Factor measures the risk of international firms to repatriate their foreign investments and profits).
Source of information: internal know-how	o Political Department o Economic Department o Treasury Department
Source of information: external consultants	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.2.3 Other Regulations and Policies

4.2.3.1 Environmental Regulations

Environmental regulations are measures aiming at safeguarding the natural environment. In theory, emission permits, subsidies, certificates, rules of liabilities, taxes or statutory requirements are possible instruments to implement environmental policy goals. However, in practice, statutory requirements and taxes are the most frequently used instruments in the realm of environmental policy. Statutory requirements can take the form of politically required parameters or prohibitions and allow private production only if the production does not have negative environmental effects[102] above a certain threshold. Likewise, they are categorized in three groups: restrictions regulating the emission, the imissions, and the inputs. Emission restrictions define certain maximum values for certain emissions (for instance: carbon dioxide, methane gas, chlorofluorocarbons, sulfur dioxide, or nitrogen oxide) which each firm is allowed to produce. Statutory requirements on inputs determine which input materials may be used and which production process may be applied. As imissions can be measured, but not attributed to who has caused them, they are normally restricted through statutory requirements on emissions (see Blankart, 2008, 500). Statutory requirements must be taken into account in the selection process, as they can have a very significant effect on the costs and ease of constructing and operating a production site.

In addition to statutory requirements, taxes are another frequently applied instrument of environmental policy. The application of taxes in environmental policy is based on the economic concept of external effects, which arise in situations in which the behavior of a firm or an individual affects the utility of at least one other firm or individual, which is not responsible for these effects, without that firm or individual being compensated for that effect on its utility. If the external effects are negative for the other individual or firm, they are referred to as negative external effects and, if they are positive, they are referred to as positive external effects. As external effects lead to market failure, they justify governmental intervention into the market from an economic perspective. Said intervention can be in the form of subsidies or taxes.[103] In the case of environmental policy, external effects are normally negative external effects. Governments intervene into the market to reduce these negative external effects, for instance, by implementing taxes (the so-called Pigou tax), which, in turn, incentivize the producer of negative external effects to internalize them (see Blankart, 2008, 496-498; Leach, 2004, 6-8, 99-102, 111). Besides the motivation for taxes based on economic considerations, environmental taxes are also imposed based on environment-related

[102] From an economic perspective, these negative effects of the production of a private firm on the environment are negative external effects.

[103] The market intervention that is implemented to correct market failure which arose due to external effects can, from a theoretical point of view, also be in the form of a better allocation of enforceable property rights. A clear allocation of property rights makes it possible to force the producer of external effects to compensate the individual or firm for the decline or increase in utility which the external effects have caused.

public policy goals; for instance, to ‘provide incentives for further efficiency gains, green investment and innovation and shifts in consumption patterns’ (OECD, n.d.a). Environmental taxes can, for instance, be imposed on emission of production sites. As environmental taxes directly affect the cost of constructing and operating the production site, they must be considered in the selection process.

Besides regulations in the form of statutory requirements and taxes, other environmental regulations which determine the use of water, or the protection of birds, forests, or ocean life may also be relevant for selecting a production site. Due to environmental regulations, the OEM might be required to implement, for instance, a costly pollution control system. Therefore, environmental regulations not only determine maximum emissions and the use of inputs, such as natural resources (e.g., energy, raw materials, water, or soil), but also determine energy prices. For instance, prices for electricity, oil, and gas are among other factors strongly influenced by environmental regulations in most countries (see Wöhe et al., 2020, 253), as the national, regional, or local government imposes taxes on their consumption. As production processes in the automotive industry require a lot of energy, the relevant environmental regulations and their effect on energy prices must be analyzed in the selection process. Moreover, environmental regulations also include regulations on sewerage or waste management, and compliance therewith might require considerable investments in sewerage and waste management facilities. These costs are considered under the location factor *Waste Disposal and Sewerage* (see 4.9.4 Waste Disposal and Sewerage).

Often, environmental regulations also determine some of the requirements products must meet in order to be sold in the local market. Environmental regulations regarding the product, such as emission requirements on cars, trucks, or buses, might make the production of the product for the local market more complicated and costly, which is important to know as early in the selection process as possible. Varying requirements on the product in different markets are especially difficult and challenging for the planning of the production process and optimizing the production network. Environmental requirements on cars or trucks differ greatly between countries, regions, or even large cities (like Beijing) and often make custom-made products necessary. Due to these varying requirements in different markets, the production process needs to be flexible enough to adjust the product to changing and varying product requirements. Hence, the environmental requirements on products implemented in the countries, regions, or cities which are the destined sales markets for the product produced at the production site must be evaluated. (This aspect related to environmental regulations is included under the location factor *Market Size and Market Share* (see 4.12 Market Size and Market Share).

In general, environmental regulations are looser in developing countries than in advanced countries regardless of the political tradition of environmental policy. One reason for this difference is that restrictions on emissions and inputs are defined based on the given state of technology. This is why restrictions on emissions are generally not the primary problem for international OEMs in less advanced countries. Still, environmental regulations which can cause the OEM considerable additional costs for constructing and operating the production site also exist in developing countries (see Wöhe et al., 2020, 253; Blankart, 2008, 501-503). Statutory requirements on inputs—such as the use of energy, water, or some raw materials—imposed in various developing countries can have a very significant effect. Even though environmental regulations in emerging countries are often still fairly loose, special attention should be paid to the possibility that requirements on more environmentally sound production might become stricter, as emerging countries increasingly experience consequences of environmental pollution (e.g., China).

Overall, the evaluation of the relevant environmental regulations is important for the selection of a production site, not only because compliance with environmental regulations can cause significant additional costs for constructing and operating a production site, but also because environmental regulations might even rule out constructing and operating a production site at the location under consideration. Overall, it is especially important when evaluating environmental regulations that they vary significantly between the national, regional, or local level, and that they might change considerably with a change in government.

Table 7: Information and Instructions on the Choice and Evaluation of the Location Factor *Environmental Regulations*

Location factor to be evaluated	**Costs due to Environmental Statutory Requirements**	**Strictness of Environmental Statutory Requirements**	**Environmental Taxes Rate**	**Tax Burden due to Environmental Taxes over the planning horizon of the production site**	**Complexity related to Environmental Taxes**
Strategic, operational, or general	Operational	Operational	Operational	Operational	Operational
Process-specific / product-specific	Process-specific and product-specific	Process-specific and product-specific	Process-specific	Process-specific	Process-specific
Relevant for production network	-	-	-	-	-
Relevant for the design of the supply chain	-	-	-	-	-

Location factor to be evaluated	**Costs due to Environmental Statutory Requirements**	**Strictness of Environmental Statutory Requirements**	**Environmental Taxes Rate**	**Tax Burden due to Environmental Taxes over the planning horizon of the production site**	**Complexity related to Environmental Taxes**
Negotiable	Negotiable in some cases	-	+	+	+
Semi-external / even performance	-	-	-	-	-
Quantitative or qualitative	Cost-related quantitative	Qualitative	Cost-related quantitative	Cost-related quantitative	Qualitative
Hard or soft	Hard	Hard	Hard	Hard	Hard
Static or dynamic	Dynamic (possible future change should be assessed from policy statements, regulation changes, budget).				
Geographic level of analysis	National and regional	National and regional	National, regional, and local	National, regional, and local	National, regional, and local
Unit of measurement	Approximated in EUR.	Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).	Measured in %, and assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).	Approximated in EUR.	Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).
Evaluation method(s)	o Minimum criteria o Operating cost comparison o Present value method	o Strategic considerations o Minimum criteria o Profile method o Utility analysis	o Strategic considerations o Profile Method o Utility Analysis	o Minimum criteria o Operating cost comparison o Present value method	o Minimum criteria o Profile method o Utility analysis
Phase(s) in the selection process	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method) o Phase 5 (profile method, utility analysis) o Phase 7 (utility analysis)	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 3 (profile method) o Phase 5 (profile method, utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)	o Phase 2 (minimum criteria, profile method) o Phase 5 (profile method, utility analysis) o Phase 7 (utility analysis)
Interdependencies with other location factors	o Building Codes o Waste Disposal and Sewerage o Water and Energy Supply		o Environmental Regulations o Subsidies and State Aid o Political Stability o Taxes		o Administrative Procedures o Corruption
Source of information: public databases and information	o RAND: Environmental legislation / Environmental Regulation o Government websites o Industry or trade associations o VDA: Topics - Environment & Climate o ACEA: Industry Topics: Environment and Sustainability Position Papers		o OECD: • Environmental taxation, compare your country, environmentally related tax revenue (trend and sector breakdown) • OECD.Stat: Environmental Policy Stringency Index o Eurostat: Report on Energy, Transport and Environment Indicators o ACEA: ACEA Tax Guide (annual) (ACEA's Tax Guide provides an overview of specific taxes that are levied on motor vehicles in European countries and other key markets o EY: Global Oil and Gas Tax Guide (annual report)		
Source of information: commercial external sources	-	-	-	-	-
Source of information: internal know-how	o Factory Planning Department o Production Planning Department o Political Department o Industrial Policy Department				
Source of information: external consultants	+	+	+	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.2.3.2 Land Zoning

A zoning scheme, also referred to as planning scheme, is a way to manage the use of land through legislation. A zoning scheme allocates the rights to develop the land that is part of the area under its control and to erect and use buildings within that area. Moreover, they are generally in the form of maps, which cover the entire area included in the scheme and break the area down to the individual building or land plot (see Cityscope, n.d.; The World Bank, n.d.i). Zoning categorizes land in various groups of possible usage, such as residential, commercial, industrial (or more detailed; for instance, into Single or General Residential Zones, Community Zones, Local Business Zones, General Business and Mixed-Use Zones, Industrial Zones, Utility, Transport and National Port Zones, Open Space Zones, Agricultural, Rural and Limited Use Zones). Industrial use is often further differentiated, for instance, into heavy industrial use, industrial use, and light industrial use. Normally, for an OEM's production process, a zoning of industrial use is sufficient, while heavy industrial use is, for instance, necessary for steel production.

Also, the variety of categories of zoning, which differ across countries, and even across regions and communities, require analyzing the zoning scheme with caution. In the Philippines, the industrial use of land is distinguished into three groups: an Industrial-1 Zone is 'an area within cities/municipalities intended for light manufacturing or production industries' (i.e., non-pollutive/non-hazardous industries, non-pollutive/hazardous industries); an Industrial-2 Zone is 'an area within cities or municipalities intended for medium intensity manufacturing or production industries' (i.e., pollutive/non-hazardous industries, pollutive/hazardous industries); and an Industrial-3 Zone is 'an area within cities or municipalities intended for heavy manufacturing or production industries' (i.e., highly pollutive/non-hazardous, highly pollutive/hazardous, highly pollutive/extremely hazardous, pollutive/extremely hazardous, non-pollutive/extremely hazardous) (Housing and Use Regulatory Board, 2014, 12). In this zoning scheme, '[m]anufacture or assembly of automobiles, cars, buses, trucks and trailers' fall in the category of pollutive/hazardous industries and thus in Industrial-2 Zone (Housing and Use Regulatory Board, 2014, 52).

Overall, land zoning ultimately regulates whether the specific land plot or the building existing on the land plot may be used for industrial production and for which kind of industrial production and, as such, must be evaluated in the selection process. For evaluating the land zoning scheme at the production site, it is important to know that, in most countries, municipalities are in control of the zoning process, while in some countries, the zoning scheme is controlled by the regional or national government. Moreover, it is interesting that land zoning is normally relatively permanent, as changes to the zoning scheme usually require complicated amendment processes (see The World Bank, n.d.i). However, in some countries, zoning schemes are not entirely developed (as is the case in India) and the zoning of certain land plots can be negotiated with local authorities. As the zoning for industrial use (or the corresponding zoning in the relevant scheme) is a necessary condition for any of the land plot to qualify as an OEM production site, evaluating the zoning of potential production sites in the selection process is absolutely necessary and all production sites which are not zoned for industrial use must be ruled out.

Table 8: Information and Instructions on the Choice and Evaluation of the Location Factor *Land Zoning*

Location factor to be evaluated	**Land Zoning**
Strategic, operational, or general	Operational
Process-specific / product-specific	Process-specific and product-specific
Relevant for production network	-
Relevant for the design of the supply chain	-
Negotiable	-
Semi-external / even performance	-
Quantitative or qualitative	Qualitative
Hard or soft	Hard
Static or dynamic	Static
Geographic level of analysis	Local
Unit of measurement	The required land zoning (e.g., Industrial Use) must be assessed as given (yes) or not (no).
Evaluation method(s)	Minimum criteria
Phase(s) in the selection process	Phase 4
Interdependencies with other location factors	-
Source of information: public databases and information	o National land zoning schemes are often made available on national government websites, as, in some countries, zoning schemes are not entirely developed (as is the case in India); one way to gain information is to contact authorities in ministries responsible for land or urban development or local law firms which specialize in zoning laws. o Land zoning is also often included in building codes o Regional or local government websites o DLA PIPER REAL WORLD: planning/zoning issues; Real estate and public law
Source of information: commercial external sources	-
Source of information: internal know-how	o Factory Planning Department o Real Estate Department
Source of information: external consultants	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.2.3.3 Building Codes

The primary goal of building codes is to ensure the safety and structure of buildings. As such, they define the minimum requirements for the construction of buildings. These requirements include stability concerns, such as structure (requires the building to withstand 'loads and physical conditions they are likely to experience during construction, alteration and throughout their lives', such as self-weight, temperature, water, earthquakes, snow or wind) or durability (requires that the building will satisfy the requirements throughout its life, for instance, by using materials which are expected to remain functional over that lifespan). Furthermore, building codes define the requirements for buildings to ensure the protection from fire (e.g., safeguarding people and property, facilitating firefighting or rescue operations, designing, and installing the building in a way which prevents fire from occurring or spreading, and ensure stability of the building even in case of fire). Building codes also define requirements to ensure a safe access and entry to and from the building and to guarantee that the building is not damaged by moisture (e.g., rain or internal moisture). Building codes determine requirements on safety provisions (demolition and construction hazards, warning systems) or on service and facility (natural or artificial light, ventilation, waste, and sewerage disposal) (see Building Performance, n.d.c). Thus, building codes also define the requirements for waste management, and hence for all activities related to waste, including the 'disposal, (which is both, permanent and temporary storage) and recovery of wastes', as well as its collection and transportation (OECD, 2007, 14-15).[104] This includes the requirements on waste management facilities. Likewise, the building codes also contain all requirements on the purification of 'wastewater, or sewage, before they reach aquifers or natural bodies of water such as rivers, lakes, estuaries, and oceans' (Archis and Nathanson, 2018). Building codes determine impurities and their allowed concentration in the water, as well as the mandatory sewerage systems to ensure that the 'buildings in which industrial liquid waste or foul water is collected, generated, treated or disposed of are provided with adequate spaces and facilities to do so safely, avoiding the likelihood of blockage, leakage or contamination' (Building Performance, n.d.a; see Building Performance, n.d.b).

The provisions of building codes can vary significantly between the national, state, or local level (see Sule, 2008, 613). Even though many requirements on fire protection or waste disposal are in many countries national (and in the case of the European Union, even a supranational institution determines how firms must dispose of their waste), these national requirements are normally further specified and can even vary between land plots.

In the selection of a production site, the relevant building codes must be taken into consideration, because they might have a considerable effect on the costs of constructing and operating the production site, and might even delay the start of construction or prolong the time between the

[104] From a business point of view, waste management is part of logistics, and hence also referred to as waste logistics or logistics of disposal. Waste logistics includes all activities related to environmentally sound avoidance, recycling, or disposal of waste. The object of waste logistics includes all waste created in the production and consumption process of products which lie within the responsibility of firms. Sub-processes of waste logistics are the collection, transport, turnover, treatment, and storage of waste (see Huber and Laverentz, 2019, 135).

start of construction and when operations may start at the production site. Especially important for a production site are the parts of building codes that determine the requirements on fire protection, safety, waste disposal, and sewerage. In order to prevent any additional unexpected costs, it is necessary to construct the production site, from the beginning, in compliance with the building code. Specifically, the compliance with requirements on fire protection and safety can lead to significant additional costs for constructing the production site, e.g., installing fire doors or using special construction materials. As strict regulations on waste disposal might require OEMs to construct waste disposal facilities, compliance with these regulations can also lead to considerable or even unreasonable costs, especially because the production of OEMs gives rise to many different kinds of waste: not only solid waste, but also gaseous and liquid waste. Furthermore, costs for the maintenance of waste disposal facilities must be assessed in the selection process. (In this selection process model, they are considered as individual location factor see 4.9.4 Waste Disposal and Sewerage.)

When evaluating the building codes, it is important to be aware that they are often subject to change (in contrast to land zoning), as they are frequently adjusted, driven by changes in government agendas, advances in technology or the availability of new construction materials (see International Code Council, n.d.). Furthermore, in addition to the costs which the compliance with the building code might entail, the way building codes are enforced may potentially lead to delays in the start of the construction or operation of the production site. Building codes are, in many cases, enforced by requiring a permit based on the proposed plans to receive permission to start constructing the production site and a code compliance certificate confirming that the requirements laid out in the building codes have been met by the constructed production site (see Building Performance, n.d.c). Thus, the start of construction and operation can be delayed due to slow administrative procedures regarding issuing building consents or code compliance certificates (see 4.3.3.4 Administrative Procedures).

Overall, it is necessary to assess three primary aspects with regard to building codes in the selection process: first, does the building code allow the construction and operation of the production site which is planned by the OEM? Second, how high are the additional costs which the compliance with the building code require for the construction and operation of the production site? Third, what is the overall complexity of complying with the building code? Fourth, what is the risk of possible delays?

Table 9: Information and Instructions on the Choice and Evaluation of the Location Factor *Building Codes*

Location factor to be evaluated	**Cost Burden due to Building Code**	**Possibility of Compliance with Building Code**	**Complexity due to the Building Code**
Strategic, operational, or general	Operational		
Process-specific / product-specific	Process-specific and product-specific		
Relevant for production network	-	-	-
Relevant for the design of the supply chain	-	-	-
Negotiable	-	-	-
Semi-external / even performance	-	-	-
Quantitative or qualitative	Cost-related quantitative	Qualitative	Qualitative
Hard or soft	Hard	Hard	Hard
Static or dynamic	Dynamic, as they are frequently updated, it must be assessed if any realistic change would have serious consequences.		
Geographic level of analysis	Local	Local	Local
Unit of measurement	Approximated in EUR.	Yes or no	Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).
Evaluation method(s)	o Minimum criteria o Operating cost comparison o Present value method	o Exclusion criteria	o Minimum criteria o Utility analysis
Phase(s) in the selection process	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)	o Phase 4	o Phase 4 (minimum criteria) o Phase 7 (utility analysis)
Interdependencies with other location factors	o Waste Disposal and Sewerage o Ease of Starting Operations at the Production Site and of its Extension o Cost of Constructing and Maintaining the Production Site		
Source of information: public databases and information	o FM Global (an U.S. industrial insurance company): International building codes o National and regional government websites		
Source of information: commercial external sources	-	-	-
Source of information: internal know-how	o Real Estate Department o Factory Planning Department o Visits to the sites		
Source of information: external consultants	+	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.3 Political and Legal Framework

4.3.1 General Remarks on the Political and Legal Framework as Location Factor

The political and legal framework determine the conditions under which economic activities take place, in general (see Goldstein and Pevehouse, 2006, 368), and the construction and operation of a production site, in particular. With regard to the selection process, both the political and legal environment determine the reliability and stability of the conditions at the production site. This reliability and stability are necessary as an OEM must make a considerable investment to construct and operate a production site. Both, the political and legal framework depend, to a large extent, on the functioning of institutions, which are the 'set of rules, compliance procedures, and moral and ethical behavioral norms designed to constrain the behavior of individuals' (North, 1981, 201-202). Institutions are critical to the political and legal environment as they determine how collective decisions are made on a national, regional, and local level, as well as the relationship between local institutions and the national government, and the distribution of power between these levels (see Acemoglu and Dell, 2010, 170). Furthermore, well-functioning institutions are considered to guarantee the efficient assignment, protection, and alternation of property rights and to secure contracts (Greif, 2006, 5). Institutions are an important instrument to enforce the rule of law through administration, police, and military forces, and to prevent any form of anarchy.[105] Overall, the quality of institutions is an important indicator for the stability of the political and legal environment in a country[106] (see North and Weingast, 1989, 803-808).

The political framework can include a variety of political properties of a country, a region, or a community, such as the political system or the political structure. However, in this work, the political framework is considered in more narrow terms. The most important for an OEM is that the political environment at the production site is stable and reliable, as this enables the successful construction and operation of the production site. In short, stable and reliable conditions are conditions which will either not change unexpectedly or, if they do change, as in the case of a change of government, this change does not significantly affect the operation of the production site and significant risks remain limited.[107] Stable means, furthermore, that the conditions are secure and safe, thus that there is no threat of extreme violence; for instance, in the form of terrorism, civil

[105] Moreover, institutions facilitate the use and exchange of rights by providing the currency system, the system of weights and measurement, technical standards, and public registers, such as commercial or land registers (see Blankart, 2008, 39). From a public policy point of view, functioning institutions are an important means to overcome market failures, such as imperfect information or the provision of public goods.

[106] Standard measures of the quality of institutions in the literature are the risk of expropriation, government effectiveness, and constraints of the executive (see Mokyr and Voth, 2010, 24), while Acemoglu et al. only use the protection against 'risks of expropriation' index as proxy for the quality of institutions (Acemoglu et al., 2001, 1370).

[107] Backhaus and Voeth refer to the kinds of risks which arise when firms conduct business activities abroad, but do not explicitly depend on the activity itself as country risks. Such country risks are, for instance, the risk of expropriation, transfer risks, such as illiquidity/insolvency risks, meaning that a country is not able or willing to fulfill its payment obligations, or disposition risks, which refer to risks for a firm's international activity that stem from government measures or political or social unrest (see Backhaus and Voeth, 2010, 77).

war, armed conflict, or violent social or political unrest. In this work, political stability, security, corruption, and relevant contagion effects are considered the most important aspects of the political environment for constructing and operating a production site.

The legal framework refers to the quality of government and institutions expressed in its capacity to protect intellectual property rights, to enforce contracts, to promote competition or to prosecute fraud (see Mankiw, 2013, 247). As mentioned above, functioning institutions are a necessary condition for a reliable legal framework in which investments and other kinds of property, such as intellectual property, are protected. A 'solid, consistently applied legal framework gives investors confidence in the security of their property, investments, and rights' (The World Bank, 2010, 3).[108] The reliability of the legal environment is a prerequisite for an OEM to conduct such a considerable investment as is associated with the successful construction and operation of a production site. An indicator for the overall level and quality of the legal environment and the ease for firms to conduct their activities in this environment is the Ease of Doing Business[109] indicator published by the World Bank (see The World Bank, n.d.c). Moreover, the 'Operating Environment'[110] indicator as a pillar of the Global Enabling Trade Index (ETI) published by the WEF can help to assess the overall legal framework in a country (see World Economic Forum, 2016, 44), as well as the country specific risk ratings, including specific risk assessments on government effectiveness or legal and regulatory issues published by The Economist Intelligence Unit (EIU) (see

[108] Autschbach explains that the investment climate is determined by the local protection of investment, insurance thereof, risk of expropriation, and approval and licensing procedures. He bases his definition of investment climate on various interviews with experts from the automotive industry and consultants (see Autschbach, 1997, 151).

[109] The Ease of Doing Business published by the World Bank is a project that aims to provide 'objective measures to evaluate business regulations'. The project covers 189 countries and some selected cities. The Ease of Doing Business is a ranking in which a high ranking implies that 'the regulatory environment is more conducive to the starting and operation of a local firm'. The ranking is based upon the evaluation of 10 different topics, namely starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts, and resolving insolvency. The indicators that determine each of these topics are available for each country with information and scores on the project's website (The World Bank, n.d.c).

[110] The WEF publishes the 'Operating Environment' indicator as a pillar of the Global Enabling trade index. 'Operating Environment' is composed of five indices: Protection of Property Rights index, which is again subdivided into property rights and intellectual property rights; Efficiency and Accountability of Public Institutions index, which is again subdivided into judicial efficiency & impartiality in commercial disputes, division of public funds and ease of compliance with government regulation; Access to Finance index, which is subdivided into affordability of financial services, availability of financial services, ease of access to loans, availability of trade finance; Openness to Foreign Participation index, which is subdivided into ease of hiring foreign labor, business impact of rules on FDI and Openness to multilateral trade rules; and index of Physical Security, which is again subdivided into reliability of police services, business costs of crime and violence, business costs of terrorism, homicide cases/100,000 pop and terrorism incidence. These sub-indices are individually composed for each country and available in the annual Global Enabling Trade Report (World Economic Forum, 2016, 44).

EIU, n.d.). Furthermore, given many governments (e.g., the German government) or international institutions also grant the protection of investments abroad (see Anderer, 1992, 351) as long as they consider the legal framework in the country stable enough, the withdrawal of these investment guarantees can be seen as an indicator for an insufficient quality of the legal environment in a country.

When selecting a production site, it is important to look at political, as well as legal, location factors, as the political and legal environment significantly influence the overall environment in which the OEM places its investment and constructs and operates the production site. While the political and legal framework are closely intertwined and the following location factors all affect and depend on each other, for the sake of evaluation they are considered separately in this selection process model. The following location factors are analyzed, as they are the most relevant when selecting a production site for the *Political Framework*: *Political Stability*, *Security*, *Corruption* and *Contagion Effects* and for the *Legal Framework*: *Rule of Law*, *Protection of Property Rights*, *Protection of Intellectual Property Rights* and *Administrative Procedures*.

4.3.2 Political Framework

4.3.2.1 Political Stability

The World Bank defines 'Political Stability and Absence of Violence/Terrorism' in its Worldwide Governance Indicators as 'the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence or terrorism (The World Bank, n.d.k). Though this definition is subject to considerable controversy (see Reynal-Querol, 2002; Dowding and Kimber, 1983; Ake, 1975), such a discussion is beyond the scope of this work. In this work, political stability refers to political conditions which are 'predictable' (Shepherd, 2010, 8) and thus reliable for the OEM. Therefore, political stability is given if a stable system of government secures a good business climate, promotes stability and continuity in its policies, prevents interruptions and creates conditions in which major political changes in the distribution of political power or even in the political system are highly unlikely (see Burda and Wyplosz, 2013, 102-103) (e.g., a coup d'état or a revolution). In addition, political conditions can be considered as stable if any changes due to politics (for instance, a change of government) do not significantly affect the activities of an OEM in the country. Hence, for the successful construction and operation of a production site, it is important that the political conditions are stable in terms of reliability and predictability and do not hinder, interrupt, or prevent the construction and operation of the production site.

Moreover, territorial integrity and political independence are closely related to political stability and are very important for selecting a production site. 'Territorial integrity guarantees the continuing existence of a state in its current borders' (Marxsen, 2015, 9-10) while political independence ensures that 'the territory is the exclusive zone in which the political independence of state can find its expression and where foreign governments may not – as a matter of principle – interfere' (Marxsen, 2015, 10). The territorial integrity and political independence in the country under consideration is important for selecting a production site as the production site must not be in a region wherein the state might lose its territorial integrity or political independence, given this would lead to significant changes in the political and legal framework and increase the uncertainty in which the production site would be operated to an unpredictable extent.

Moreover, the absence of internal conflict is fundamental to political stability. While peace, hence the 'absence of war', includes, according to The Global Peace Index (GPI), internal and external peace if it is 'not involved in violent conflicts with neighboring states or suffering internal wars' (Global Finance, 2018). External and internal conflict must be differentiated with regard to their effect on the construction and operation of a production site. External conflict is meant as any war or armed conflict with other nations or armed conflict spilling over into the country's territory. Internal conflict includes any kind of political, social, religious, or ethnic conflict or violence, but also terrorism, be it local, regional, national, or international. While internal conflicts can significantly threaten political stability (see The World Bank, n.d.g), external conflict is not necessarily linked with political stability. In other words, they do not need to have an effect on the political stability within a country. For instance, the U.S. having a military conflict with Syria tends not to risk the political stability in the US, while the conflict between Ukraine and Russia poses a significant risk to the political stability in Ukraine, especially in eastern Ukraine. As such, the risk of external conflict affecting the construction and operation of the production site is analyzed under the location factor *Contagion Effects* (see 4.3.2.4 Contagion Effects), in terms of the risk of external conflicts spilling over into the country or region in which the production site is being evaluated. The consequences of internal conflict on security are captured by the location factor *Security* (see 4.3.2.2 Security). Hence, this location factor *Political Stability* only includes internal conflict as a threat to political stability and thus to reliable and predictable political conditions.

The conditions for political stability are controversially discussed, especially with regard to the ability of different forms of government to provide political stability (see Filippaios et al., 2019, 1103-1104). While democratic governments are most inclined to meet the expectations of its people and are thus likely to establish economic and political stability, other forms of government also provide political stability. Democratic governments are, on the one hand, more likely to ensure rights, such as property rights in general and intellectual property rights in particular or invest in education and health (see Filippaios et al., 2019, 1104-1105; Burda and Wyplosz, 2013, 102-103), but, on the other hand, shifting parties and coalitions of democratic governments can lead to 'policy inconsistency' and hence uncertainty (Zhong et al., 2019, 1185), for instance, with regard to taxation or trade policies. Like the form of government, the effect of economic growth on political stability is also controversially discussed. While political stability certainly promotes economic growth and might be a necessary condition thereof, economic growth can, in turn, undermine the political system by empowering people (for instance, a rising middle class) who do not see their rights adequately represented, potentially causing social or political unrest (see Shepherd, 2010, 10). Alternatively, economic growth can also provide justification for the government to remain in power. In awareness of these controversial discussions, it is beyond the scope of this work to discuss which form of government is more conducive to political stability or the effect of economic growth therein.

Overall, a lack of political stability poses a serious risk to the construction and operation of the production site and to the total investment of the OEM. Low reliability and predictability of the political conditions at the production site include the risk of frequent changes to regulations and policies which can have a significant effect on the successful construction and operation of the production site. Besides changes to the overall regulations and policies, commitments of the national, regional, and local government (e.g., on subsidies) are not reliable without political stability. In extreme cases, lacking political stability might lead to changes in property rights which could even expropriate the OEM of the investment made in the production site (see 4.3.3.2 Protection of Property Rights). In summary, lacking political stability results in high levels of uncertainty, which is detrimental to the construction and operation of the production site, and puts the profitability of the production site, and even the investment, at risk. If the level of political stability significantly varies within the country, a regional analysis in the selection process is also necessary.[111]

[111] As a high level of inequality in a country reflected in the income distribution or lacking political and civil rights

Table 10: Information and Instructions on the Choice and Evaluation of the Location Factor *Political Stability*

Location factor to be evaluated	**Political Stability**
Strategic, operational, or general	General
Process-specific / product-specific	-
Relevant for production network	Insofar as the lack of Political Stability in any of the countries in which parts of the production network are located or products must pass through poses a serious threat to the successful operation of the production network.
Relevant for the design of the supply chain	Insofar as the lack of Political Stability in any of the countries in which parts of the production network are located or products must pass through pose a serious threat to the successful operation of the supply chain.
Negotiable	-
Semi-external / even performance	-
Quantitative or qualitative	Qualitative
Hard or soft	Soft
Static or dynamic	Static in countries/regions with very low risk of change to political stability but must be considered as dynamic in countries/regions with any risk of change to political stability.
Geographic level of analysis	National and regional, if the conditions vary on the regional level.
Unit of measurement	Assessed as very low, low, fairly high, high and very high (or numerically as 1 through 5).
Evaluation method(s)	o Strategic considerations o Minimum criteria o Profile method o Utility analysis
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method) o Phase 7 (utility analysis)
Interdependencies with other location factors	o Security o Rule of Law o Gross Domestic Product o Exchange Rate o Contagion Effect o Market Size and Market Share
Source of information: public databases and information	o The Fund for Peace and Foreign Policy: the Fragile State Index o World Bank: Ease of Doing Business o United States Department of State; Bureau of Diplomatic Security (OSAC): Crime and Safety o The Institute for Economics and Peace: The Global Peace Index and The Global Terrorism Index (annual reports) o Freedom House (ranks countries on Political Rights, Civil Liberties. Based on these rankings it ranks the countries' Freedom Status) o Uppsala University Department of Peace and Conflict Research; Uppsala Conflict Data Program (UCDP): Data on One-sided Violence, Non-State Conflict, Battle-Related Deaths o Business Environment Risk Intelligence S.A: BERI-index (ORI-Index, measures political risk)
Source of information: commercial external sources	o EIU: Political riks evaluates political stability and political effectiveness o IHS Markit: Economic & Country Risk
Source of information: internal know-how	o Political Department
Source of information: external consultants	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

can potentially lead to social or political unrest, the level of equality or political and civil rights can serve as indicators for political stability. Sources on Inequality and Civil Rights are the Gini-coefficient and the 'poverty headcount ratio at national poverty lines' published by the World Bank, or the indicator of political and civil rights published by Freedom House, while income distribution is available in the IHS Markit datatool.

4.3.2.2 Security

Security is understood as the absence of any considerable risk 'of potential danger to the life, health and freedom of employees of the firm and their relatives as well as of the physical demolition of the firm's assets' (Haas and Neumair, 2006, 721). Security is of utmost importance for the construction and operation of a production site. For the investment to be profitable, the production site must be constructed and operated without any serious interruption. Hence, it is mandatory that the region in which the production site is located is safe and secure in terms of serious criminal violence. Security of the production site and the employees working there may be threatened by any kind of crime, such as violent crime, kidnapping, highway robberies, gang violence, or security risks resulting from internal conflicts, such as political, social, religious, or ethnic conflict or violence, but also local, regional, national, or international terrorism. Hence, the consequences of internal conflict on the security conditions in the country and region are captured in the location factor *Security*, while the absence of internal peace as a threat to political stability is captured in the location factor *Political Stability* (see 4.3.2.1 Political Stability), while the risk of external conflicts spilling over into the country or region of the production site and thus affecting the construction and operation of the production site is analyzed under the location factor *Contagion Effects* (see 4.3.2.4 Contagion Effects).

In the case of internal conflict, it is likely to be too dangerous for the employees to operate the production site, the supply chain might be interrupted, and the local economy might stop functioning. In the past, violence against international property and production sites, in particular like that which took place in 2015 in Vietnam, seriously impacted several international factories, as they were burned down and machinery was stolen. This kind of violence must be considered as a serious security risk to the investment of the OEM and the employees working at the production site. Likewise, terrorism, as a form of internal conflict, is also a serious threat to the operation of a production site and could even pose a risk of a total loss of the investment. Production sites, as foreign property and the location where foreigners work, might be especially targeted by terrorists, as they might be considered symbols or representatives of western culture. Furthermore, in a region where violence and gang wars dominate the overall security situation, such as in parts of Colombia or Mexico, the employees and operation of the production site are at high risk. Another aspect of security for local employees and expatriates working at the production site is the threat of being kidnapped in the country or region. This is a serious problem in some regions of Mexico, among other places. Any risk of kidnapping of employees requires measures to ensure a high level of security for the employees. Further, kidnapping must be differentiated between the kidnapping of foreigners and the kidnapping of locals. Employees from western countries are more at risk of being kidnapped in many countries, particularly because some western governments are willing and able to pay ransoms. Moreover, in regard to any production site close to a border, it must be evaluated if there is any significant risk due to criminal activity, such as smuggling. Another aspect of personal security is whether the country or region experiences extraordinarily high gender, race, nationality or religious or disability-motivated violence. This might reduce the level of personal security for employees working at the production site.

Security is also crucial for the transportation of personnel and products or material. Secure and reliable transportation requires that the traffic is safe with regard to accidents (both on roads and railroads) and in terms of road quality. The aspect of road safety due to road conditions is captured in the location factor *Transportation Facilities* (see 4.9.2 Transportation Facilities). In addition, road safety is often undermined by highway robbery. In countries in which goods cannot be transported safely, the supply chain is unreliable, which leads to serious interruptions of the operation of the production site and the production network of the OEM.

These kinds of violence and other risks to security can make the operation of a production site impossible or extremely costly due to security requirements. Operations can, for instance, be disturbed when workers can only come to the production site under police protection or expatriates are not willing to relocate due to security concerns. As the police must enforce the security, the quality and reliability of the police is important. Thus, when evaluating the local security, the reliability of the police (or military personnel) is of utmost importance, as is whether or not they commit crimes themselves. It is important to know if the police are corrupt, a political tool of the governing party, or undermined by paramilitary forces, as well as whether crime is sufficiently investigated, or sufficient preventive measures are taken. It is also important that the military or police forces are sufficiently strong to safeguard internal security in case of social or political unrest (see OSAC, 2019). An indicator for a lack of security in a region is whether the region is declared by institutions, such as the U.S. State Department, to be off limits or whether, for instance, the U.S. State Department requires approval for any U.S. employees traveling outside the capital or into the region under consideration.

Overall, a certain minimum level of security for people, as well as for the physical capital invested at the production site, is a mandatory requirement for a location to qualify as a potential production site. Moreover, security aspects effecting the functioning of the OEM's supply chain, in particular, and its production network, in general, must also be considered. For the evaluation of the security at a production site, it is important to understand that the level of security varies significantly across regions within many countries. Especially in emerging countries, the level of security might vary greatly across regions, and thus a national, as well as regional, consideration is necessary. Moreover, all necessary expenditures in measures to provide security to the production site and its employees must be taken into consideration in the selection process.

Table 11: Information and Instructions on the Choice and Evaluation of the Location Factor *Security*

Location factor to be evaluated	**Security**	**Costs Related to Security**
Strategic, operational, or general	General	Operational
Process-specific / product-specific	-	-
Relevant for production network	Insofar as lacking security in any of the countries in which parts of the production network are located or products must pass through poses a serious threat to the successful operation of the production network.	-
Relevant for the design of the supply chain	Insofar as lacking security in any of the countries in which parts of the supply chain are located or products must pass through pose a serious threat to the successful operation of the supply chain.	-
Negotiable	Security is generally not negotiable. However, some additional investment by the national, regional, or local government, e.g., in the police forces can be negotiated.	Additional investment by the national, regional, or local government in the police forces can be negotiated and reduce costs for the OEM.
Semi-external / even performance	Security can be a semi-external location factor, if locating a production site induces crimes for instance due to anti-western sentiments; Security can also be a performance location factor, if the OEM decides to invest in local security at the production site for instance by having its own security forces, fences etc..	-
Quantitative or qualitative	Qualitative	Cost-related quantitative
Hard or soft	Soft	Hard
Static or dynamic	Static (unless there are specific reasons for concern such as increasing gang violence or border violence which could intensify and even escalate).	
Geographic level of analysis	National and regional level	National, regional, and local level
Unit of measurement	Assessed as very low, low, fairly high, high and very high (or numerically as 1 through 5).	Approximated in EUR.
Evaluation method(s)	o Strategic considerations o Minimum criteria o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	o Political Stability o Contagion Effects o Corruption	o Political Stability o Contagion Effects o Subsidies o Corruption
Source of information: public databases and information	o United States Department of State; Bureau of Diplomatic Security (OSAC): Crime and Safety o National and regional government websites	-

Location factor to be evaluated	Security	Costs Related to Security
	o The WEF: Operating Environment: the Index of Physical Security[112] o WHO: Global Status Report on Road Safety; including country profiles o Numbeo: Country Crime and Safety Index (by country) o Nationmaster: Economy, Population below poverty line: Countries Compared o OECD: OECD Better Life Index: Safety (Safety in Detail by Country) o Control Risks: RiskMap (The forecast of political and security risk for every country of the world); RiskMap Maritime (Risk ratings for piracy, criminality, conflict, territorial disputes, terrorism and militancy) and RiskMap Kidnap (The global kidnap picture by region, perpetrators and victims). o Knoema: World Data Atlas: Crime statistics: regional and country level data on a large variety of crime types	
Source of information: commercial external sources	o EIU: Political riks evaluates political stability and political effective ness o IHS Markit: Economic & Country Risk	-
Source of information: internal know-how	o Political Department o Local Liaison Offices	o Factory Security / Security Department o Local Liaison Offices
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.3.2.3 Corruption

Corruption is 'the single greatest obstacle to economic and social development around the world. It distorts markets, stifles economic growth, debases democracy and undermines the rule of law' (International Chamber of Commerce et al., 2008). Transparency International defines corruption as 'the abuse of entrusted power for private gain'. Corruption is differentiated into 'grand corruption', 'petty corruption' and 'political corruption'. Grand corruption refers to 'the abuse of high-level power that benefits the few at the expense of the many, and causes serious and widespread harm to individuals and society'. Petty corruption is defined as the 'everyday abuse of entrusted power by public officials in their interactions with ordinary citizens, who are trying to access basic goods or services in places like hospitals, schools, police departments and other agencies'. Political corruption is defined as 'the manipulation of policies, institutions and rules of procedures in the allocation of resources and financing by political decision-makers, who abuse their position to sustain their power, status and wealth' (Transparency International, n.d.).

[112] The WEF: 'Operating Environment' is a pillar of the Global Enabling Trade Index (ETI). Part of the 'Operating Environment' is the Index of Physical Security, which is again subdivided into reliability of police services, business costs of crime and violence, business costs of terrorism, homicide cases/100,000 pop., and incidence of terrorism. These sub-indices are all individually composed for each country and available in the annual Global Enabling Trade Report (World Economic Forum, 2016, 329).

When operating a production site, petty corruption is the most relevant form of corruption as it most impacts the day-to-day operations between the national, state, or local government and institutions, on the one hand, and the OEM, on the other. Petty corruption prolongs or impedes any kind of licensing or administrative procedures for which the OEM must apply; for instance, for a permit to start the construction of the production site or a code compliance certificate (see 4.2.3.3 Building Codes). Petty corruption makes the transport of people and goods less reliable, as officials might hinder people or goods from being transported by holding them back at checkpoints or at other roads or traffic controls, airports, or harbors, or might interrupt the supply of water and energy (see 4.9.3 Water and Energy Supply), as well as the functioning of sewerage and waste disposal (see 4.9.4 Waste Disposal and Sewerage), or the purchasing or renting of land. Another problem which is very prominent in countries or regions with high levels of corruption are corrupt policemen and security forces (see 4.3.2.2 Security).

OEMs not willing to engage in bribery—for instance, by using payoffs, gifts, or kickbacks— are especially disadvantaged when facing corrupt officials (see Rabbiosi and Santangelo, 2019, 112). In fact, many international OEMs have officially committed themselves to fight or at least not engage in any corrupt behavior, as specified in their codes of conduct (see Sartor and Beamish, 2020, 418). For instance, the Daimler Group states in its Integrity Code under 'We do not give or take bribes': 'The Daimler Group does not tolerate unethical or corrupt behavior by its employees or business partners and will take action against it'. This is, as the Daimler Group goes on to explain, in their own best interest as '[d]ecisions based on corruption are immoral, distort competition, harm the company's asset and reputation and go against the common good. We pay special attention to ethical behaviour in our contact with political parties, public authorities and their officials both at home and abroad. Under no conditions do we grant payments, favours or other monetary contributions to civil servants, public employees or employees of governmental organizations in order to win contracts or gain advantages for the Daimler Group or other individuals' (Daimler Group, 2012, 17). Table 12 lists the benefits which firms can gain from engaging in fighting corruption, as well as the risks which firms can incur from not engaging in fighting corruption.

Table 12: The Business Rationale for Fighting Corruption

	Benefits of Engaging in Fighting Corruption	Risks of Not Engaging in Fighting Corruption
Individual Company Action	• Reduce the cost of doing business • Attract investments from ethnically oriented investors • Attract and retain highly principled employees, improving employee morale • Obtain a competitive advantage by becoming the preferred choice for ethically concerned customers / consumers • Quality for reduced legal sanctions in jurisdictions like the US and Italy	Criminal prosecution, in some jurisdictions both at company and senior management levels which can lead to imprisonment • Exclusion from bidding processes, e.g., for international finance institutions and export credit agencies • 'Casino risk' – no legal remedies if a counterpart does not deliver as agreed and/or keeps increasing the price for doing so • Damage to reputation, brand and share price • Tougher fight for talent when hiring new employees • Regulatory censure • Cost of corrective actions and possible fines
Collective Action by Business	• Create a level playing field overcoming the 'prisoner's dilemma' • Improve public trust in business • Influence future laws and regulations	Missed business opportunities in distorted markets • Increased magnitude of corruption • Policymakers responding by adopting tougher and more rigid laws and regulations – internationally, regionally and nationally

(International Chamber of Commerce et al., 2008)

Assuming that international OEMs do not allow their employees to engage in any kind of corrupt behavior, the OEM can suffer significant disadvantages in a corrupt environment during the construction and operation of its production site (see Rabbiosi and Santangelo, 2019, 112). An elevated level of corruption is likely to distort any activity between the OEM and local officials and lead to unpredictable outcomes (see Sartor and Beamish, 2020, 414-415), e.g., in terms of delays or interruptions in the construction and operation of the production site, as well as in the functioning of the production network. Besides these direct negative implications, constructing and operating a production site in a corrupt environment carries the risk for the OEM that any potential involvement in corrupt behavior can lead to significant legal consequences and, especially, reputational damage for the OEM (see Sartor and Beamish, 2020, 416; Rabbiosi and Santangelo, 2019, 113). Hence, the level of corruption at a potential production site is an important location factor, while a high level of corruption might rule out production sites in the region or country under consideration.

For evaluating the level of corruption, it is important to consider that, depending on the country, the level of corruption might vary greatly across regions. Thus, if the level of corruption is considered to vary across regions in the country under consideration, a regional, as well as national, consideration is necessary. However, while information on the national level of corruption is generally available, information on the regional level of corruption is much harder to find. One way is to use internal know-how, thereby learning from the experience of the OEM's employees in the region, or to approach other international firms which are already at the location. Besides the information about the current level of corruption, the development of corruption at the location is also interesting, and can be assessed by analyzing, for example, government policy statements which credibly pledge to implement an anti-corruption campaign.

If the OEM considers local production in a country with a high level of corruption for some reason (for instance, strategic reasons (see Rabbiosi and Santangelo, 2019, 111) such as a large local market combined with significant protectionist policies) as important enough to still select a production site in that country, then the OEM can establish certain practices to construct and operate the production site there without engaging in corrupt behavior and still minimize 'the potential competitive disadvantage of abstaining from corrupt practices' vis-à-vis its competitors (Fox, 2010). In order to deal with the challenges, the OEM faces in countries with a high level of corruption, it can seek the support of global, multi-industry initiatives to establish channels in which it can operate as effectively as possible without engaging in any kind of corrupt behavior. These global, multi-industry initiatives include the International Chamber of Commerce (ICC), the United Nations Global Compact, Transparency International (TI), and the World Economic Forum Partnering Against Corruption Initiative (PACI) (see International Chamber of Commerce et al., 2008). In addition to these initiatives, Mullins identifies tactics a firm can use to conduct business without engaging in corrupt behavior in a corrupt environment[113]: they include the 'building of ethical teams' and addressing the behavior of the firm when 'dealing with governments', when 'dealing with locals' and when 'dealing with customs' (Mullins, 2012).[114] Moreover, Fox suggests firms follow four steps to work without engaging in corrupt behavior in a corrupt environment and still be as profitable as possible: '[s]elect [r]eliable [a]gents', '[d]evelop the [r]ight [r]eputation', '[u]se [g]overnments and [s]tatutes to [l]evel the [p]laying [f]ield' (Fox, 2010). Another strategy for operating in a corrupt environment is to 'expatriate staffing', meaning that more expatriates are sent to work at the production site under the assumption that they are 'easier to control' and more sensitive to the risk of involving themselves in corrupt behavior for the OEM (see Sartor and Beamish, 2020, 419). Hence, even though a corrupt environment undermines economic growth and generally hinders the OEM in the construction and operation of the production site, as well as in the operation of the production network, there are ways to deal with the challenges arising from a corrupt environment. Thus, an OEM does not need to rule out any production sites in countries or regions with

[113] The business development team at Celtel International developed these tactics (see Mullins, 2012).
[114] For more detailed information on the individual steps, see Mullins (2012).

a high level of corruption if there are significant reasons for selecting a production site there, rather it must be aware of the associated problems.

Table 13: Information and Instructions on the Choice and Evaluation of the Location Factor *Corruption*

Location factor to be evaluated	**Corruption**	**Costs Associated with Corruption**
Strategic, operational, or general	General	General
Process-specific / product-specific	-	-
Relevant for production network	+	+
Relevant for the design of the supply chain	+	+
Negotiable	-	-
Semi-external / even performance	-	-
Quantitative or qualitative	Qualitative	Cost-related quantitative
Hard or soft	Soft	Hard
Static or dynamic	Static, unless the level of corruption is likely to change (e.g., if a credible anti-corruption campaign is being implemented).	
Geographic level of analysis	National and regional (if necessary)	National and regional (if necessary)
Unit of measurement	Assessed as very high, high, fairly low, low and very low (or numerically as 1 through 5).	Approximated in EUR.
Evaluation method(s)	o Strategic considerations o Minimum criteria o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	o Political Stability o Rule of Law o Security	
Source of information: public databases and information	o Transparency International: Corruption Perception Index (168 countries and territories) o Institute for Economics and Peace: Peace and Corruption Report (annual report) o World Bank: Worldwide Governance Indicators (WGI) project: Control of Corruption	o International Chamber of Commerce (ICC) o United Nations Global Compact o Transparency International (TI) o World Economic Forum Partnering Against Corruption Initiative (PACI)
Source of information: commercial external sources	-	-
Source of information: internal know-how	o Political Department o Compliance Department o Production or Sales officers who have worked / still work in the country or region. o Local Liaison Offices	o Compliance Department
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.3.2.4 Contagion Effects

Contagion effects are a political risk factor which refers to risks that stem from a country's interdependencies with other countries or economies (see Backhaus and Voeth, 2010, 77, 84). In a globalized world, countries are highly connected with each other through trade, global supply chains, production networks, foreign direct investments, financial markets, or political and military alliances. The resulting interdependencies mean that occurrences in one country or regions often significantly affect other countries or regions. Due to these interdependencies, the thorough analysis of a country as a possible location for a production site requires analyzing risks arising from events that occur in other countries which impact the conditions in the country or region under consideration. These effects are summarized in the location factor *Contagion Effects*.

As explained under the location factor *Political Stability* (see 4.3.2.1 Political Stability) and the location factor *Security* (see 4.3.2.2 Security), the risk of external conflict affecting the construction and operation of the production site is analyzed under the location factor *Contagion Effects*. The risk of external conflicts spilling over into the country or region under consideration includes any war or armed conflict the country under consideration has with neighboring countries, and internal conflicts in neighboring countries. Besides war or armed conflict, other issues in neighboring countries, such as drug crimes, smuggling, human trafficking or kidnapping, can result in problems spilling-over into the country or region under consideration. Likewise, intensive migration from neighboring countries (e.g., due to conflict or economic crisis) can destabilize the country or region under consideration.

In economics or finance, a contagion effect occurs, for instance, if a shock or a crisis arises in one country and is transmitted into other countries. This transmission of shocks or crisis normally happens through price adjustments. The higher economic and financial interdependency between countries increases the risk of events occurring in the financial market or the goods market having contagion effects (see The Economic Times, n.d.). Contagion effects play a major role in currency crisis, financial crises, and debt crises. Currency crises remain normally contained to a certain region, which is assumed to be because currency crises are closely connected to trade patterns (see Glick and Rose, 1999, 615). Contagion effects also play a major role during debt crises, when one country might default, investors are more cautious towards other countries that have the same problems and stop lending them money, which might force them to default as well (having to pay higher interest rates, which makes it more expensive to pay back their debt) (see Thompson, 2010). The same holds true for a financial crisis: if one large financial institution defaults (like Lehman Brothers in the US), investors are skeptical and withdraw their funds, thus fueling a financial crisis (see The Economic Times, n.d.), which is usually not constrained to one country due to the high degree of interdependency between the national financial markets.

Besides the role of contagion effects in these crises, there are also other contagion effects which might be relevant for selecting a production site: for example, the economic dependence of countries on the conditions in other countries is exemplified by Hong Kong's economic dependence on inbound tourism from mainland China. Similarly, the raw material sectors in Indonesia, Malaysia or Australia that are dependent on exports to China are subdued if economic activities in China are weakened. Another example of a contagion effect is the dependence of many emerging countries' currencies on the monetary policy of the U.S. triggering considerable capital inflow or outflows, thereby effecting the exchange rate of these emerging countries. As a U.S. policy rate hike leads to capital leaving mainly emerging countries, their currency depreciates relative to the US$. This depreciation of the local currency brings another problem to many emerging countries, as a lower exchange rate increases their debt burden of US$ denominated debt, making it harder to service that debt. A further possible economic contagion effect can be a significant economic slowdown in a country triggering emigration to neighboring countries. These are just a few examples of possible contagion effects.

Overall, contagion effects should be analyzed in the selection process, as they can have significant effects on the conditions in the country or region under consideration, as well as on the reliability of the supply chain and production network of the OEM, and thus can impede the operation of the new production site. The risk of any contagion effect requires thoroughly analyzing relevant dependencies of the country or region under consideration on other countries and relevant developments in other countries that can spillover into the country or region under consideration.

Table 14: Information and Instructions on the Choice and Evaluation of the location factor *Contagion Effects*

Location factor to be evaluated	**Risk of Contagion Effects**	**Costs Required for Mitigating Contagion Effects over the planning horizon of the production site**
Strategic, operational, or general	General	General
Process-specific / product-specific	-	-
Relevant for production network	+	-
Relevant for the design of the supply chain	+	-
Negotiable	Generally, not negotiable. However, some additional investment by the national, regional, or local government in preventive measures can be negotiated to mitigate the associated risk.	
Semi-external / even performance	-	-
Quantitative or qualitative	Qualitative	Cost-related quantitative
Hard or soft	Soft	Hard
Static or dynamic	Dynamic (accounting for developments in other countries/regions which could spread into the country/region under consideration).	Dynamic, if the Risk of Contagion Effects is likely to change.

Location factor to be evaluated	Risk of Contagion Effects	Costs Required for Mitigating Contagion Effects over the planning horizon of the production site
Geographic level of analysis	National and regional (if the risk of relevant contagion effects differs significantly on a regional level).	Local or (regional and national, if necessary, for production network and supply chain).
Unit of measurement	Assessed as very high, high, fairly low, low and very low (or numerically as 1 through 5).	Approximated in EUR.
Evaluation method(s)	o Strategic considerations o Minimum criteria o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	o Security o Political Stability	o Costs Related to Security o Political Stability
Source of information: public databases and information	o ControlRisks: Riskmap (The forecast of political and security risk for every country of the world); Riskmap Maritime (Risk ratings for piracy, criminality, conflict, territorial disputes, terrorism, and militancy) and Risk Map Kidnap (The global kidnap picture by region, perpetrators, and victims). o See sources for location factor security on neighboring countries	-
Source of information: commercial external sources	o IHS Markit: Geopolitical Risk	-
Source of information: internal know-how	o Local Liaison Offices o Political Department o Economic Department	o Factory Planning Department
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.3.3 Legal Framework

4.3.3.1 Rule of Law

As explained above, a reliable legal environment is of utmost importance for the successful construction and operation of a production site. The reliability of a legal environment strongly depends on the rule of law, which is 'a principle of governance in which all persons, institutions and entities, public and private, including the state itself, are accountable to laws that are publicly promulgated, equally enforced and independently adjudicated' (United Nations and the Rule of Law, n.d.).[115] The rule of law makes the legal environment reliable by ensuring 'adherence to the

[115] In an alternative definition of the rule of law provided by the World Justice Project the rule of law, 'The rule of law is a durable system of laws, institutions, and community commitment that delivers' 'four universal principles': 'Accountability [means that] [t]he government as well as private actors are accountable under the law'. 'Just Law [captures that] [t]he law is clear, publicized, and stable and is applied evenly. It ensures human rights as well as contract and property rights.' 'Open Government [implies that] [t]he processes by which the law is adopted, administered, adjudi-

principles of supremacy of law, equality before the law, accountability to the law, fairness in the application of the law, separation of powers, participation in decision-making, legal certainty, avoidance of arbitrariness and procedural and legal transparency' (United Nations and the Rule of Law, n.d.). All these principles of the rule of law are important with regard to constructing and operating a production site. Though meaning of legal certainty requires more explanation as it is not as evident as that of other principles, it is especially important for constructing and operating a production site given its serious effect on the OEM's day-to-day business at the production site. Legal certainty guarantees: first, that all laws and decisions are made public, second, that all laws and decisions are 'definite and clear in their applicability', third, that decisions of courts are succinctly enforced, and all relevant information is provided, and fourth, that all persons responsible for the enforcement of laws are easily identifiable (Beauchard and Kodo, 2011, 7).

The rule of law, in general, and legal certainty, in particular, are especially important for constructing and operating a production site, as for firms it is easier to adapt their 'business model to a particular regulatory stance, even a restrictive one, […] than dealing with the risk created by regulatory uncertainty' (Shepherd, 2013, 36). Any kind of unreliability with regard to the legal environment can pose a threat to the successful construction and operation of the production site and thus it is best if the uncertainty related to the legal framework is as small as possible. The rule of law increases the planning reliability of the OEM with regard to the production site, which is, in turn, not only important due to the considerable investment the OEM must make at the production site, but also with regard to the high number of contracts which the OEM must enter with local firms, the national, regional, or local government, as well as local agencies, in order to construct and operate the production site. The rule of law is also important if the OEM's property or employees are impaired in any way and the OEM wants to sue the other party: The rule of law enables the OEM to sue local firms, agencies, or the government, if, for instance, electricity or water are not supplied in the contracted amount at the contracted times or if the infrastructure which has been agreed upon in contracts has not been provided (see Ottmann and Lifka, 2010, 75). Likewise, the rule of law is also very important for the OEM if it is being sued. Overall, the rule of law is an

cated, and enforced are accessible, fair, and efficient. Accessible and Impartial Justice [means that] [j]ustice is delivered timely by competent, ethical, and independent representatives and neutrals who are accessible, have adequate resources, and reflect the makeup of the communities they serve' (World Justice Project, n.d.).

important location factor in the selection process as it ensures the reliability of the legal environment, while an insufficient rule of law in a country might rule out the country under consideration as a location for a production site.

Table 15: Information and Instructions on the Choice and Evaluation of the Location Factor *Rule of Law*

Location factor to be evaluated	**Rule of Law**
Strategic, operational, or general	General
Process-specific / product-specific	-
Relevant for production network	+
Relevant for the design of the supply chain	+
Negotiable	-
Semi-external / even performance	-
Quantitative or qualitative	Qualitative
Hard or soft	Soft
Static or dynamic	Static unless there is a specific reason that suggests any risk of the rule of law being undermined in the future (e.g., government overriding court decisions).
Geographic level of analysis	National level and regional level, if the rule of law differs significantly across regions in the country under consideration.
Unit of measurement	Assessed as too weak, weak, strong enough, strong, and very strong (or numerically as 1 through 5).
Evaluation method(s)	o Strategic considerations o Minimum criteria o Profile method o Utility analysis
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method) o Phase 7 (utility analysis)
Interdependencies with other location factors	o Corruption o Political Stability o Administrative Procedures
Source of information: public databases and information	o The World of Justice Project: 'Rule of Law' on an annual basis for 102 countries o The Global Economy: Rule of Law - Country Rankings o World Bank: Worldwide Governance Indicators (WGI) project: Rule of Law o Freie Universität Berlin: Understandings of the Rule of Law in various Legal Orders of the World (Country Reports) o OECD: Data: FDI restrictiveness index: measures the degree of restrictiveness of a country's rules on FDI.
Source of information: commercial external sources	-
Source of information: internal know-how	o Local Liaison Offices o Political Department o Integrity Department
Source of information: external consultants	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.3.3.2 Protection of Property Rights

Property rights specify the 'sanctioned behavioral relations among men that arise from the existence of things and pertain to their use'. Hence, they determine 'the norms of behavior with respect to things that each and every person must observe in his interaction with other persons, or bear the cost for nonobservance' (Furubotn and Pejovich, 1972, 1139; see Prütting, 2017, 7-17). In practice, property rights ensure individuals the ability 'to accumulate private property, secured by clear laws that are fully enforced by the state' (The Heritage Foundation, n.d.). Property rights are distinguished between economic and legal property rights. The latter refer to those property rights which are 'recognized and enforced by the government' while the former refer to an individual's rights 'over a commodity or an asset', which include the 'individual's ability [..] to consume the good or the services of the asset directly or to consume it indirectly through exchange'. In other words, economic property rights 'include (1) the right to use an asset, (2) the right to earn income from an asset and contract over the terms with other individuals, and (3) the right to transfer ownership rights permanently to another party' (Benham, n.d.).

The protection of property rights is a necessary condition for investment in physical and human capital (see Burda and Wyplosz, 2013, 94) as it enables the 'predictable' 'allocation and use of resources' (Furubotn and Pejovich, 1972, 1139). The protection of property rights depends, in part, on 'the degree to which a country's laws protect private property rights' and, in part, on 'the degree to which its government enforces those laws' (The Heritage Foundation, n.d.). Hence, the quality of local institutions determines the level of protection of property rights (see Acemoglu and Dell, 2010, 170, 183, 187), as both the laws themselves and their enforcement depend on a high quality of local institutions.

In economic literature, the risk of expropriation is a proxy for the strength and quality of institutions, in general, and the level of protection of property rights, in particular (see Acemoglu et al., 2001, 1370), as it reflects the strength with which institutions protect property rights.[116] Expropriation is defined as the partial or complete seizure by the government of property or rights of firms with or without compensation, extreme forms of which are nationalization or confiscations (see Backhaus and Voeth, 2010, 77). Under international law, states are allowed 'to take property held by nationals of aliens through nationalization or expropriation for economic, political, social

[116] Economic historians have shown that the protection of property rights has been a driving force behind productivity growth thereby stimulating economic growth. For instance, thanks to secure property rights, farmers were willing to 'invest in agricultural innovation' as they were convinced that they would receive the returns on these investments (Dennison and Simpson, 2010, 159-161). Thus, by motivating investment in physical, as well as human capital, and thereby, for instance, stimulating productivity, the protection of property is an important condition for economic growth (see Guillaume et al., 2010, 8; Acemoglu and Dell, 2010, 170, 172, 187). The relevance of the protection of property rights for investment is illustrated by the fact that the lack of property rights leads to a risk premium on investments. However, this risk premium declines once property rights and limits to the executive power are in place and enforced. For property rights to have a positive effect on investment, trade, and growth, they must be succinctly enforced, and the government must not be able to arbitrarily change them (see North and Weingast, 1989, 803).

or other reasons.' For such measures to be lawful, the '[p]roperty has to be taken for a public purpose', '[o]n a non-discriminatory basis', '[i]n accordance with the due process of law' and '[a]ccompanied by compensation.' Hence, if one of these conditions is not met, the measure is an unlawful expropriation (UNCTAD, 2012, 1). Expropriation can be direct or indirect. Direct expropriation refers to the act by which a 'state exercises its sovereignty over a project either on an individual basis or as part of a wider scale nationalisation programme'. Direct expropriation is a distinct action of a government in which it transfers property to the state. As direct expropriation occurs in 'one act', it provides the basis of a claim of compensation. Indirect expropriation, instead, occurs in 'a series of regulatory actions' (Thomson Reuters, n.d.) and 'involves total or near-total deprivation of an investment but without a formal transfer of title or outright seizure' (UNCTAD, 2012, 7). Measures of indirect expropriations are 'attributable to the State', interfere 'with property rights or other protected legal interests' such 'that the relevant rights or interests lose all or most of their value or the owner is deprived of control over the investment' '[e]ven though the owner retains the legal title or remains in physical possession.' In contrast to direct expropriation, in the case of indirect expropriation the state typically 'refuse[s] to acknowledge the expropriatory nature of the measure and' does 'not offer compensation to the aggrieved investor'. Then, it is in the hands of the responsible 'tribunal' to decide whether the particular measures constitute an expropriation and hence must be compensated (UNCTAD, 2012, 12). This illustrates the legal uncertainty for firms stemming from lacking or weak protection of property rights.

Besides the positive effect on economic growth, in general, and investment, in particular, property rights and their enforcement are of utmost significance for the selection of a production site given the considerable investment therein associated. This considerable investment is only protected to the extent to which property rights are in place and enforced at the production site. The risk of expropriation in the case of a production site is the loss of the entire investment for the OEM without appropriate compensation. Hence, as the actual security of the investment depends on the protection of property rights, the reliable protection of property rights and their enforcement must be assessed when selecting a production site.

While property rights are principally protected by the national government, FDI is also protected by agreements of international organizations, such as the EU, the WTO or the OECD, by multi-lateral trade agreements, such as the NAFTA, ASEAN or MERCOSUR, or by bi-lateral (preferential) trade agreements[117] between any two countries. In turn, these often contain additional agreements on the protection of investments. Thus, if the country under consideration has signed international trade agreements, which contain additional agreements on the protection of investments, they then provide an additional protection for the investment of the OEM. Moreover, the protection of property rights likely has a significant effect on the costs required for the insurance of the production site over the planning horizon. These costs must be taken into account in the selection process.

Table 16: Information and Instructions on the Choice and Evaluation of the Location Factor *Protection of Property Rights*

Location factor to be evaluated	**Protection of Property Rights**	**Costs Related to the Protection of Property (including insurances) over the planning horizon of the production site**
Strategic, operational, or general	General	Operational
Process-specific / product-specific	-	-
Relevant for production network	-	-
Relevant for the design of the supply chain	-	-
Negotiable	-	-
Semi-external / even performance	-	-
Quantitative or qualitative	Qualitative	Cost-related quantitative
Hard or soft	Soft	Hard
Static or dynamic	Static unless there is a specific reason that suggests any risk of undermining the protection of property rights in the future (e.g., expected changes in legislation, signs of expropriation practices).	
Geographic level of analysis	National, and also on the regional level, if their enforcement varies across the regions in the country under consideration.	National, regional, and local level
Unit of measurement	Assessed as very weak, weak, strong enough, strong, and very strong (or numerically as 1 through 5).	Approximated in EUR.
Evaluation method(s)	o Strategic considerations o Minimum criteria o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	o Political Stability o Corruption o Rule of Law o Non-Tariff Barriers to Trade	
Source of information: public databases and information	o Credendo: Expropriation Risk o The Global Economy.com: Expropriation Risk Country Rating	
Source of information: commercial external sources	-	o Private insurance firms

[117] Preferential agreements are a form of agreement of cooperation in which states grant each other certain advantages which are exceptions to general regulations (see Kutschker and Schmid, 2011, 184-185), and which usually establish the following standards of protection: protection against expropriation without compensation, Fair and Equitable Treatment (FET), full protection and security, Most Favored Nation treatment (MFN), protection against discrimination, protection against the violation of governmental commitments (so-called ‘Umbrella-clause’) and unlimited transfer of capital and profits (Bundesministerium für Wirtschaft und Energie, n.d.).

Location factor to be evaluated	Protection of Property Rights	Costs Related to the Protection of Property (including insurances) over the planning horizon of the production site
Source of information: internal know-how	o Local Liaison Offices o Legal Department o Political Department	o Factory Planning Department o Local Liaison Offices
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.3.3.3 Protection of Intellectual Property Rights

Intellectual property is a specific kind of property[118] which 'refers to creations of the mind – everything from works of art to inventions, computer programs to trademarks and other commercial signs' (World Intellectual Property Organization, 2020, 1). Hence, intellectual property involves intangible assets, including 'creative and broadly innovative activities' (European Commission, n.d.b). There are two general categories of intellectual property: first, 'industrial property', which 'includes [..] inventions, industrial designs, trademarks and geographic indications'; and second, artistic work, which embraces 'literary, artistic and scientific works, including performances and broadcasts' (World Intellectual Property Organization, 2020, 3). While intangible assets already account for 'more than half the value of companies' in the European Union, this value is expected to continue to grow further (European Commission, n.d.b).

The protection of intellectual property is important for investment, in particular, and economic growth, in general, as firms have little incentive to invest in the creation of their intellectual property—for instance, in innovation—if they are not guaranteed the exclusive right to receive the revenues resulting from that innovation. From an economic point of view, external effects arise in the production of intellectual property, which, if they cannot be internalized by the producing firm, lead the firm to produce less than the economically optimal amount of the intellectual property under consideration. Intellectual property rights are established to internalize these external effects (Burda and Wyplosz, 2013, 100) and can be in the form of patents, industrial design rights, trademarks, geographical indications, and copyrights (World Intellectual Property Organization, 2020, 1-16). These instruments have been designed to encourage the private production of knowledge by protecting the exclusivity of the use of this knowledge for a certain time (Burda and Wyplosz,

[118] Intellectual property, specifically in the field of industry and production, also refers to 'industrial property', which are either 'distinctive signs, in particular trademarks […] and geographical indications'. Other types of industrial property are 'inventions [..], industrial designs and trade secrets' (World Trade Organization, n.d.k).

2013, 100). In particular, patents give their owner the exclusive right to use the knowledge commercially. Trademarks prohibit duplicating defined symbols or names that are used to distinguish firms or products for commercial purposes. Protection of geographical indications exclusively allow the use of the geographical indication 'by those who comply with defined standards' (in particular, by 'those whose products come from the area in question and meet all relevant standards'.). Copyrights prohibit others from duplicating artistic expressions (World Intellectual Property Organization, 2020, 1-16). If intellectual property rights are not seriously protected in practice, firms or individuals are incentivized to imitate and copy products or production processes. Infringements on intellectual property include, for instance, counterfeiting or piracy. Accordingly, Meyer points out that, in addition to the economic loss that results from reduced sales due to violations of intellectual property rights, such infringements also damage the image of firms as copied products rarely meet the same quality standards as original products (see Meyer, 2006a, 92).

Despite the importance of the protection of intellectual property for economic growth and investment, intellectual property in many countries is only protected to a limited extent. Specifically, it is not protected by general property rights (see 4.3.3.2 Protection of Property Rights). The WTO (in the TRIPS Agreement) has established minimum standards for the protection of intellectual property rights which the governments of member states are supposed to provide to protect 'the intellectual property of fellow WTO members' (World Trade Organization, n.d.h). However, the level of protection and enforcement of intellectual property rights varies significantly across countries. In advanced countries, the protection of intellectual property rights is crucial as their economies have become and continue to become more and more knowledge-based, and 'the protection of intellectual property is important for promoting innovation and creativity, developing employment, and improving competitiveness' (European Commission, n.d.b). Instead, governments of emerging countries might have an ambiguous attitude towards the protection of intellectual property rights (see Brandl et al., 2019, 826-827; Meyer, 2006a, 91-92), as local firms can, on the one hand, benefit from knowledge spillovers enhancing their productivity (see Xu and Sheng, 2012b, 72)[119] and an imitation of the intellectual property of technologically advanced international firms, while, on the other hand, a minimum protection of intellectual property rights increases the

[119] Xu and Sheng examine the effect of FDI spillovers on the productivity of local firms in China and find that FDI creates spillovers which enhance the productivity of local firms, but these productivity enhancing spillovers are generally limited to local firms from the same industry which are located in the same region ('spillovers are likely to be confined to regions') (Xu and Sheng, 2012a, 257).

willingness of international firms to make local investments. For developing countries to meet the required TRIPS standards, they were given the flexibility to 'modify' some of the 'TRIPS standards to make them more applicable to their own context, based on local regulatory needs' which led to heightened standards in many developing countries (Brandl et al., 2019, 827).

Protection of an international OEM's intellectual property must be a strategic goal of its global production network, given the relevance of intellectual property for its competitive advantage and the know-how embedded in its products and production processes. The required level of protection of intellectual property depends on the product that will be produced, and the production process that will be used at the production site. In countries in which intellectual property is at risk, firms prefer to produce only products with low technology content and to only implement production processes that are less technologically advanced. This is certainly relevant in the automotive industry with its advanced technology. Thus, OEMs would rather assemble cars, trucks, or buses in countries where intellectual property is less protected, and to produce engines in their home country or in countries with a similar level of protection of intellectual property rights.

In fact, Gupta and Wang suggest firms distribute their production, R&D, and assembly sites across various locations within a country and across different countries to protect their intellectual property (see Gupta and Wang, 2007), as this geographic distribution limits the risk that local firms can accumulate the entire knowledge required to copy a product (see Lee and Wilhelm, 2010, 238) or production processes. Moreover, the evaluation of intellectual property rights is also important with regard to deciding whether to join a cluster (see 4.11 Industrial Clusters). Loss of intellectual property is very likely for technological advanced international OEMs in clusters given their close proximity to and cooperation with other firms in the cluster, as well as the mobility of workers (see Inkpen at al., 2019, 252-253). For these reasons, firms tend to locate production processes which contain a high level of intellectual property outside of cities or industrial clusters in rather remote areas given their concerns over loss of know-how, as Goerzen et al. point out (see Goerzen et al., 2014, 166). When evaluating the advantages of joining a cluster by selecting a production site therein, it must be kept in mind that the fluctuation of labor is high in clusters compared with more remote regions (see Inkpen at al., 2019, 253-254), which requires a particularly thorough evaluation of intellectual property rights. If intellectual property rights are not at all, or only to a limited extent, protected in the cluster, then the OEM must weigh the risk of lost intellectual property against the benefits stemming from being part of a cluster. If the protection of intellectual property rights at the production site are insufficient, but the OEM still selects the production site for other reasons, the possibility and cost of cautionary measures, such as attempts to minimize the fluctuation or to limit the exchange with other firms at the location, must be assessed.

Moreover, when assessing intellectual property rights, it is necessary to thoroughly understand how difficult and expensive it is to apply for intellectual property rights in the country under consideration and how committed local authorities are to their enforcement. Usually, intellectual property must be registered in the country under consideration, so that the ‘protection is territorial’ (World Intellectual Property Organization, 2020, 15). However, the case of a patent shows that there are various ways for a registration, especially in the EU. Generally, ‘different countries have somewhat different laws’ regarding patents and the ‘protection is granted within a country under its national law.’ Hence, normally, a firm must register for a patent in each country where it wants protection. The costs and effort necessary for registration varies widely between countries. Still, there are ‘several groups of countries’ which have ‘regional patent systems’ where one registration can be for many or all countries in the group (World Intellectual Property Organization, 2020, 6-7). In the EU, a firm can apply for a national patent at a patent office in a specific EU member country if the firm only wants protection in one EU country. Otherwise, the firm can also apply for a European patent at the European Patent Office if it wants protection in multiple or all EU member countries. Such a European Patent must, however, be validated by the national patent office of each member country, which might lead to additional costs and take some time (see YourEurope, n.d.). For registering a trademark in the EU, the options are similar to those for registering a patent, but independent of the EU, there is also an international way to apply for a trademark via the Madrid System, which enables a firm to register ‘trademarks worldwide’ in ‘a single application’, paying ‘one set of fees to apply for protection in up to 123 countries’ (European Union Intellectual Property Office, n.d.b). For a ‘registered Community design’ in the EU, one single registration automatically provides protection for the intellectual property in all EU member countries (European Union Intellectual Property Office, n.d.c). Furthermore, the protection of intellectual property rights depends on the local authorities’ commitment to enforce these rights, ensuring the security of the OEM’s intellectual property in practice. For these reasons, it is necessary to understand the protection of intellectual property, the complexity of the application process for the required intellectual property right, and the enforcement of intellectual property rights in a country, as well as the possibility and costs of cautionary measures, when selecting a production site.

Table 17: Information and Instructions on the Choice and Evaluation of the Location Factor *Protection of Intellectual Property Rights*

Location factor to be evaluated	**Protection of Intellectual Property Rights**	**Costs Related to the Protection of Intellectual Property over the planning horizon of the production site**
Strategic, operational, or general	Strategic and operational	Strategic and operational
Process-specific / product-specific	Process-specific and product-specific	-
Relevant for production network	+	-
Relevant for the design of the supply chain	+	-
Negotiable	-	-
Semi-external / even performance	-	-
Quantitative or qualitative	Qualitative	Cost-related quantitative
Hard or soft	Soft	Hard
Static or dynamic	Static unless there is a specific reason that suggests any risk of undermining or improving the Protection of Intellectual Property Rights in the future (e.g., expected changes in legislation, political announcements pledging to strengthen the fight on infringements on intellectual property rights).	Dynamic
Geographic level of analysis	National level (and regional level, if their enforcement varies across the regions in the country under consideration)	National, regional, and local level
Unit of measurement	Assessed as too weak, weak, strong enough, strong, and very strong (or numerically as 1 through 5).	Approximated in EUR.
Evaluation method(s)	o Strategic considerations o Minimum criteria o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	o Rule of Law o Corruption o Non-tariffs Barrier to Trade	
Source of information: public databases and information	o The World Intellectual Property Organization (WIPO): World Intellectual Property Indicators (annual report) o European Commission, Taxation and Customs Union: Report on EU Customs Enforcement of Intellectual Property Rights o European Union Intellectual Property Office o Eurostat; Statistics explained: Intellectual property rights statistics o United States Department of Homeland Security: Intellectual Property Rights (annual Seizure Statistics prepared by the U.S. Customs and Border Protection Office of International Trade). o OECD: OECD Innovation Dataset (34 OECD countries and 10 non-OECD countries) analysis of number of patents. o EY: Worldwide R&D Incentives Reference Guide (annual report)	-
Source of information: commercial external sources	-	-
Source of information: internal know-how	o Patent Department o Local Liaison Offices o Legal Department o R&D Department o Strategy Department	o Production Planning Department o Factory Planning Department o Local Liaison Offices

Location factor to be evaluated	Protection of Intellectual Property Rights	Costs Related to the Protection of Intellectual Property over the planning horizon of the production site
		o Patent Department o Legal Department o R&D Department
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.3.3.4 Administrative Procedures

Registration, license, permit, and inspection procedures are, in this work, considered under the location factor *Administrative Procedures*. These can be differentiated based on the purpose, that they authorize, their jurisdiction, their frequency, and their timing in relation to the start-up of the business (see Table 18) (see The World Bank, 2006, 2). An important differentiation between registrations, licenses, and permits is what they authorize: a registration authorizes '[a] "generic" procedure that all businesses must complete', a license authorizes 'a core business activity', and a permit authorizes the completion of 'a single instance of an activity' related to the core business (The World Bank, 2006, 2). An important difference between registrations, licenses, and permits is the government level on which they are issued: registrations are usually issued on the national and/or local level, licenses on the national (or, in federal systems, on the state level), and permits on the local level. Moreover, the frequency of issuance is also different: registration occurs once, licenses need periodic renewal, and permits are valid only 'once per instance of activity'. Likewise, registration and licenses need to be issued before the business operation starts, while permits can be required for activities before and after the start of operations (The World Bank, 2006, 2). A related aspect are inspections, which occur *ex-ante*, prior to the start-up of the construction and operation of the production site for the issuance of licenses and permits, but also *ex-post*, during the operation of the production site. They consist of 'periodic visits by inspectors', are conducted by local or national authorities and occur regularly, though they are further supplemented with random visits (The World Bank, 2006, 2). In this work, procedures through which registrations, licenses, and permits are issued and inspections conducted are referred to as administrative procedures.

Table 18: Differentiating Registrations, Licenses, Permits and Inspections

Ideal Practice	Registrations	Licenses	Permits	Inspections
Purpose	To establish a business as a legal entity.	(1) To assure that operators have the qualifications necessary to carry out an activity in a way that safeguards public welfare, and/or (2) To allocate scarce resources.	To assure that structures and operations comply with standards that protect public health, safety, and the environment.	Ensure that compliance with public health, safety and environmental standards is maintained on an ongoing basis.
Distinguishing Characteristics	A "generic" procedure that all businesses must complete (procedure may vary by type of legal entity).	An authorization for a core business, continuous business activity.	An authorization to complete a single instance of an activity (e.g., building a warehouse).	Periodic visits by inspectors to verify that standards of construction or operation are being upheld.
Appropriate Jurisdiction	National and/or local (there should be a single "entry point").	National (or state in federal systems).	Local/municipal, (although state or national-level permits may be appropriate for specific sensitive activities).	Local/municipal or national.
Frequency	One time only.	Requires periodic renewal.	One per instance of activity.	Recur on regular schedule interspersed with random visits.
Relation to Start-up	Ex-ante	Ex-ante: issued prior to business operation. Issuance is the "next step" after business registration.	Ex-ante/ex-post: for activities that occur both prior to and after start-up.	Ex-post: periodic inspections after start –up (Ex-ante if linked to initial issuance of licenses/permits).

(Source: The World Bank, 2006, 2)

Complicated administrative procedures undermine the business climate of an economy—for instance, by discouraging firms from obtaining a registration which, in turn, prevents them from easily accessing credit—and restrain overall productivity in the economy (see The World Bank, 2013). An aspect closely related to registration, licenses, permits, and inspection procedures is the level of corruption in a country or a region, as they must be conducted by national, regional, or local authorities who can influence the length and outcome of these procedures. The reliability of administrative procedures and the time required for their conduct vary significantly across countries and, in some countries, across regions or communities. Similarly, the time required for starting a local business for an international firm varies greatly across countries: in some countries, time-intensive and complicated procedures are required to receive official approval for investments by foreign firms, while, in other countries, foreign firms can complete the procedures online in a few days (see The World Bank, 2010, 2-3, 12). The ease of receiving licenses or permits varies not only across countries but also significantly across regions in many countries (e.g., in China) (The World Bank, 2008, 3-4).

Furthermore, registration, licenses, permits, and inspection procedures have a significant effect on the costs and ease of constructing and operating a production site. For these endeavors, the OEM needs to receive registration, as well as a variety of licenses and permits, and must undergo numerous inspections. These, in turn, make the OEM dependent on the functioning of the bureaucratic procedures of the national, regional, or local authorities responsible for issuing registrations, licenses, and permits or for conducting inspections at the production site. The reliability of these procedures is crucial for the OEM's planning reliability with regard to the production site (see Ottmann and Lifka, 2010, 75). In many countries, manufacturing, in general, and industrial manufacturing, in particular, require specific licenses. These licenses might vary by industry, but also by the product and production process which are planned to be produced and implemented at the production site. Moreover, in many countries, as mentioned under the location factor *Building Codes* (see 4.2.3.3 Building Codes), the start of the construction of the production site requires a building consent, which is a kind of permit to start construction based on the proposed plans. In addition, once the production site is constructed, the start of the operation of the production site requires a code compliance certificate confirming that the requirements laid out in the building codes have been met (see Building Performance, n.d.c). Specific facilities, such as waste disposal or sewerage facilities, often require specific licenses for their construction, as well as operation, which can delay and impede the start of operations at the production site and lead to considerable additional costs. Moreover, the operation of the production site, as well as the maintenance of the production site, especially of waste disposal and sewerage facilities, are regularly under inspection.

Licensing procedures also play an important role with regard to the time products need to be exported out of or imported into a country, as this so-called 'trade time' consists of the transport time, and, additionally, the time required for 'document preparation, and customs and border formalities' (Shepherd, 2013, 23). As pointed out above under 4.2.2.2 Non-Tariff Barriers to Trade, some countries require documentation, certificates, or licenses to import products into the country or export products out of the country. The time and costs required for receiving these certificates, documentations, or licenses, or for getting them confirmed, depends significantly on the administrative procedures in the country under consideration. These export- and import-related procedures may determine the waiting time at the borders for the OEM's exports and imports (see The World Bank, n.d.e). Prolonged procedures lead to considerable delays in the importing of components or exporting of the products, which significantly reduces the profitability of the production site by interrupting its operation, making it unreliable, and reducing the speed and flexibility of the transportation of the produced product either to another production site for further processing or to the consumer. Thus, administrative procedures which affect the trade time are an important aspect for the evaluation of the production site as part of the OEM's production network and supply chain and for the enhancement of network capacities, such as speed or flexibility. The time and costs required for importing and exporting products related to administrative procedures also depends on the availability of information on the required licenses and permits, and on the requirements (e.g., documentation) to receive them.

When evaluating administrative procedures, it is important to understand how complicated the required processes are, how much documentation and how many different steps of approval are required, and how long it normally takes to receive registrations, licenses and permits or to undergo an inspection at the production site. The length and reliability of these procedures often depend on the functioning of institutions. If administrative processes in a country are very complicated and institutions do not work smoothly, these procedures can take a long time or have an uncertain outcome. In addition, the level of corruption in a country or a region (see 4.3.2.3 Corruption) also heavily affects the swiftness, processing, and costs of administrative procedures, as they must be issued by national, regional, or local authorities.[120] Furthermore, when evaluating the reliability and functioning of administrative procedures, it is important to assess whether the national, regional, or local institutions are responsible for issuing the relevant registrations, licenses, and permits, or conducting inspections. When evaluating the time that the issuing of registrations, licenses, and permits or conducting inspections can take, it can be helpful to find out whether the processes in the country under consideration have time limits and whether a non-observance of these time limits by the licensors is sanctioned. Moreover, it is of interest whether a 'silence is consent' principle is in place in the country under consideration. The principle establishes that 'government officials have to respond to the application of a […] entrepreneur in a fixed time period, otherwise the applying [..] entrepreneur is endowed with the right to the service (license) without a decision from the government official (i.e. tacit authorization)'. This principle prevents delays and unofficial payments in the procedures (International Finance Corporation, 2009, 69).

[120] The relevance to constructing and operating a production site of business license procedures has become, for instance, evident when high bureaucratic hurdles have led firms to shift their investments from India to China or to locate their investment in China instead of India. For example, this was the case when Motorola chose to construct new production sites in China instead of India, explaining its decision by pointing to high bureaucratic hurdles in India (see Gardan, 1992, 2).

Table 19: Information and Instructions on the Choice and Evaluation of the Location Factor *Administrative Procedures*

Location factor to be evaluated	**Complexity of Administrative Procedures**	**Costs Related to Administrative Procedures over the planning horizon of the production site**
Strategic, operational, or general	Operational or general	Operational or general
Process-specific / product-specific	In some cases, process-specific and product-specific	In some cases, process-specific and product-specific
Relevant for production network	+	+
Relevant for the design of the supply chain	+	+
Negotiable	+	+
Semi-external / even performance	-	-
Quantitative or qualitative	Qualitative	Cost-related quantitative
Hard or soft	Soft	Hard
Static or dynamic	Static, unless there is a specific announcement of increased complexity.	Dynamic
Geographic level of analysis	National (including trade-related issues), regional and local	National (including trade-related issues), regional and local
Unit of measurement	Assessed as too high, high, fairly low, low and very low (or numerically as 1 through 5).	Approximated in EUR.
Evaluation method(s)	o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 2 (profile method) o Phase 3 (profile method) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	o Corruption o Subsidies and State Aid o Taxes o Tariffs o Non-tariff Barriers to Trade o Capital Controls o Ease of Starting Operations at the Production Site and of its Extension o Costs for Acquiring the Production Site and Additional Costs o Costs of Constructing and Maintaining the Production Site	
Source of information: public databases and information	o The World Bank: • Investing Across Borders: Starting a Foreign Business indicator • Doing Business Database: Trading Across Borders report (Information on times and costs required for the export out of and import into a country due to documentary compliance, border compliance and domestic transport (excluding tariffs and sea transit) and a detailed summary of the documents required for imports into and exports out of each country.) This information is available for 211 countries and territories. o OECD: Complexity of regulatory procedures indicator as part of 'product market regulations'. This sub-indicator measures the licenses and permit system as well as the communication and simplification of rules and procedures and is available for 47 countries. o WEF: The Global Enabling Trade Index (ETI): pillar 'border administration' for 138 countries o The International Road Transport Union: information on wait times at borders, but only for a limited number of European and Asian countries. o National, regional, and local government websites.	
Source of information: commercial external sources	-	-
Source of information: internal know-how	o Factory Planning Department o Real Estate Department	
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.4 Natural Hazards

Extreme natural events, such as weather conditions that threaten or harm humans or any valuable object, are referred to as natural hazards. As natural hazards mainly pose a threat to 'human systems', the severity of the effect of natural hazards can be mitigated or intensified by human activities. Furthermore, 'A natural hazard' becomes 'a natural disaster when an extreme event causes harm in significant amounts and overwhelms the capability of people to cope and respond' (PennState, n.d.). Natural hazards include hurricanes, earthquakes, landslides, volcanic eruptions, floods, wildfires, and severe storms (see U.S. Geological Survey, n.d.a).

Natural hazards pose a variety of threats to the safety and operation of the production site, and, most importantly, to the safety of employees working therein. Natural hazards can interrupt operations and damage or even destroy the production site. Therefore, it is important to assess the risk exposure of potential production sites to natural hazards. For example, the risk of floods is very high in floodplains or low-lying areas. Coastal areas, in which the sea levels might rise, or the coast might break off, are also especially risky for production sites. Likewise, areas where landslides are likely, as well as those that are possibly hit by earthquakes, tsunamis, tornadoes or volcanic eruptions, are risky for production sites. Overall, natural hazards should be considered a serious threat, given the limited response capabilities to protect employees and the production site itself (see OSAC, 2019). To construct the production site in an area that is threatened by earthquakes, tsunamis, tornadoes, or volcanic eruptions would require it to be specially constructed so as to be resistant to earthquakes, tsunamis, or tornadoes to the extent that is possible. This, however, leads to considerable additional costs, while considerable risk to the investment and people nonetheless remains. However, other kinds of natural hazards (e.g., strong rains or landslides) which might not entirely destroy the production site can also interrupt the operations, damage the production site, or lead to considerable additional costs, either for repairs or preventive measures (such as investments in dams against floods or mudslides or take shelter in during tornadoes).

Besides their potential to directly harm the production site, natural hazards also affect the possibility and reliability of transporting goods, thereby affecting the production network and supply chain. In a land locked and mountainous country, such as Burundi, for instance, heavy rains make small, poorly constructed and maintained roads unusable. Under such conditions, the operation of the production site will be interrupted frequently as components will not arrive in time (see OSAC, 2019). The road conditions vary considerably in many emerging countries between national highways and the roads in the interior of the country. The effects of such conditions also depend on weather conditions, such as rainy seasons, which might make entire road systems unusable, or certain terrain which may make the transport of products by trucks impossible or dangerous. Moreover, weather conditions can also have a serious effect on the construction and maintenance costs of transportation facilities (see Rodrigue, 2020a, 15-16). In addition to the components, which must arrive in time and undamaged at the production site, employees must also get to and from the production site safely and timely. While the road conditions affect the impact that weather conditions can have on traffic safety, be it of people or goods, natural hazards impair the road safety regardless of road conditions. Hence, while security impairment due to poor road conditions is captured under the location factor *Transportation Facilities* (see 4.9.2 Transportation Facilities), risks to the transport of people or goods due to natural hazards or weather conditions are included in the location factor *Natural Hazards*.

Risks stemming from natural hazards must be carefully evaluated and assessed in the selection process. Some of the risks (e.g., risk of earthquakes, tsunamis, tornadoes, or volcanic eruptions) might even rule out any production site in the area under consideration, while others lead to considerable additional costs for the construction and operation of a production site. In addition to the direct impact of natural hazards on the production site, their impact on the production network and supply chain, as well as on the transport of employees, must also be taken into account.

Table 20: Information and Instructions on the Choice and Evaluation of the Location Factor *Natural Hazards*

Location factor to be evaluated	**Risks due to Natural Hazards**	**Costs Required for Preventative Measures or Additional Insurance Costs due to Natural Hazards over the planning horizon of the production site**
Strategic, operational, or general	General	General
Process-specific / product-specific	-	-
Relevant for production network	+	+
Relevant for the design of the supply chain	+	+
Negotiable	-	Preventive measures might be subsidized, and subsidies are negotiable.
Semi-external / even performance	A semi-external location factor if the construction and operation of the production site significantly affect the natural conditions and causes for example landslides or floods. A performance location factor if measures can be taken to prevent or mitigate the risks of natural hazards.	-
Quantitative or qualitative	Qualitative	Cost-related quantitative
Hard or soft	Soft	Hard
Static or dynamic	Dynamic, if any change to the risk stemming from them is realistic.	Dynamic

Location factor to be evaluated	Risks due to Natural Hazards	Costs Required for Preventative Measures or Additional Insurance Costs due to Natural Hazards over the planning horizon of the production site
Geographic level of analysis	National, regional, and local	
Unit of measurement	Assessed as yes or no (e.g., earthquakes, volcanic eruptions, tsunamis, temperature) or as very high, high, fairly low, low and very low (or numerically as 1 through 5) (for other risks, e.g., mud slide, heavy rains).	Approximated in EUR.
Evaluation method(s)	o Exclusion criteria (yes or no) (e.g., earthquakes, volcanic eruptions, tsunamis, temperature) o Minimum criteria (e.g., for mudslide)	o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 2 (exclusion criteria, minimum criteria) o Phase 3 (exclusion criteria, minimum criteria) o Phase 4 (exclusion criteria, minimum criteria)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	o Transportation Facilities o Water and Energy Supply o Connectivity to Other Firm-owned Production Sites o Availability of Component Suppliers o Modes of Transportation o Supply Chain Risks o Costs of Constructing and Maintaining the Production Site	
Source of information: public databases and information	o UNISDR: website for general information, reports and databases o UNEP in cooperation with UNISDR: Global Risk Data platform o UNISDR: Global Assessment Report on Disaster Risk Reduction: Risk Data Platform CAPRAViewer o CIA: The World Fact Book: Guide to country profiles: geography: terrain, climate, natural hazards, environmental issues o Center for Research on the Epidemiology of disasters: EM-DAT; The International Disaster Database: Country Profile o United States Department of State; Bureau of Diplomatic Security (OSAC): e.g., Crime and Safety Reports	-
Source of information: commercial external sources	+	-
Source of information: internal know-how	o Information gained by visiting the production site o Local Liaison Offices o Real Estate Department	o Real Estate Department o Factory Planning Department
Source of information: external consultants	o Information gained by visiting the production site o Already accumulated know-how	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.5 Community

Community-related location factors refer to those factors that determine the quality of life at the production site. The quality of life is one aspect that can help to attract skilled workers to work at the production site. In the face of a global 'competition for talent', firms have realized that attracting talent and retaining that talent, be it in advanced countries or emerging countries, is key to their long-term success (Morrison et al., 2013, 66). Sule splits community-related location factors into two categories. The first is related to public services, which are provided by the local government, such as police or fire protection, or services responsible for the maintenance of streets, basic infrastructure, or waste disposal. The second category of community-related location factors consists of social and cultural institutions (see Sule, 2008, 615). An important part of the first category is the local level of security, which is not only a necessary condition for the operation of a production site, but also for the quality of life nearby. While the security of employees at the production site is of utmost importance to their quality of life, all security related aspects are captured under the location factor *Security* (see 4.3.2.2 Security), while the risks for them to be impacted by natural hazards is captured under the location factor *Natural Hazards* (see 4.4 Natural Hazards).

Besides security related aspects, the quality of life at the production site is impacted by the availability of hospitals and doctors. For expatriates and local employees, it is important that the hospitals meet Western quality standards and that there are doctors who speak English. Furthermore, educational and child-care institutions are important for the quality of life of families. Part of the second category of community-related location factors that enrich the quality of life are the availability of leisure time facilities (see Simon et al., 2006, 247), such as restaurants, and cultural activities, such as operas, theaters, or museums, as well as recreational facilities, such as public parks, swimming pools or sport clubs. Sule's categories could be viewed as the first being a condition for the second, as security must be ensured, and basic public services provided in order for people to take advantage of cultural or recreational offers. While recreational facilities are important for local workers as well as for expatriates, they have different requirements on schools. While local workers need good local schools in close proximity (elementary through high schools), expatriates prefer international schools to ensure a western academic standard for their children. For expatriates, the proximity to an international airport is also an important issue, which significantly affects their quality of life, as it determines how long it takes for them to travel home and back to the production site. Another factor that might positively affect the quality of life of expatriates is the possibility for their partners to receive a work permit and to work somewhere close to the production site. A community-related aspect, which does not fit into Sule's categories, but which is relevant to both local labor as well as expatriates, is the availability, quality, and costs of housing (e.g., average rents and average purchasing price for apartments or houses). Furthermore, the public transportation system matters with regard to how easily people can reach public institutions, such as schools or shopping centers, as well as the production site with public transportation. Moreover, the proximity to the next bigger city, which offers a more extensive spectrum of cultural and recreational facilities, is an important factor for the quality of life at the production site.

The quality of life at the production site is important in attracting local skilled labor, which is scarce, as well as to make expatriates more inclined to move to the production site with their families and stay there for an extended period. Due to the lack of technical and managerial skills at many production sites, especially in emerging countries (see Chopra and Meindl, 2014, 178-179; Simon et al., 2006, 250), international OEMs must send expatriates to the production sites to ensure its efficient construction and operation, to teach local workers, and to guarantee the high-quality standards of production. In addition to taking care of the extra costs for expatriates and their families' relocation, their additional salaries, extra-pay, bonuses, and frequent travels (see Meyer, 2006a, 56, 97; 4.14 Costs for Deploying Expatriates), to motivate workers to move to the production site, the OEM must also ensure a certain quality of life in the surrounding area. While there are many community-related location factors, the following are the most relevant: distance to next larger city (e.g., city above 100,000 habitants), distance to nearest domestic and international airport, shopping opportunities, cultural and recreational facilities, hospitals with high standards, rental and purchase prices of apartments and houses, availability of childcare and (international) schools, as well as ease of receiving a work permit for life partners of expatriates.

Table 21: Information and Instructions on the Choice and Evaluation of the Location Factor *Community*

Location factor to be evaluated	**Distance to Nearest International Airport**	**Cultural and Recreational Facilities**	**Shopping Opportunities**	**Rents / Purchase Prices of Houses / Apartments**	**Availability of Schools and Childcare with International Standards**	**Availability of Hospitals with International Standards**	**Distance to Larger City (>100.000 inhabitants)**	**Ease of Receiving Work Permit for Life Partner of Expatriates**	**Required Investment for Community-related Location Factors over the planning horizon of the production site**
Strategic, operational, or general	General	General	General	General	General	General	General	General	General
Process-specific / product-specific	-	-	-	-	-	-	-	-	-
Relevant for production network	-	-	-	-	-	-	-	-	-
Relevant for the design of the supply chain	-	-	-	-	-	-	-	-	-
Negotiable	-	+	-	-	-	-	-	+	Required investment might be subsidized, and subsidies are negotiable
Semi-external / even performance	-	+	+	+	-	-	-	-	-
Quantitative or qualitative	Non-cost – related quantitative	Qualitative	Qualitative	Non-cost – related quantitative	Qualitative	Qualitative	Non-cost – related quantitative	Qualitative	Cost –related quantitative
Hard or soft	Soft	Soft	Soft	Soft	Soft	Soft	Soft	Soft	Hard
Static or dynamic	Static (taking all investments of the OEM into consideration (e.g., investment in recreational facilities, schools).								Dynamic
Geographic level of analysis	Local or regional	Regional and local	Local	Local	Local	Local	Regional and local	National	Local
Unit of measurement	Measured in kilometers. Assessed as very bad, bad, fairly good, good and very good (or numerically as 1 through 5).	Assessed as very bad, bad, fairly good, good and very good (or numerically as 1 through 5).		Approximated in EUR (monthly rent, purchase price) Assessed as very bad, bad, fairly good, good and very good (or numerically as 1 through 5).	Assessed as very bad, bad, fairly good, good and very good (or numerically as 1 through 5).		Measured in kilometers. Assessed as very bad, bad, fairly good, good and very good (or numerically as 1 through 5).	Assessed as very bad, bad, fairly good, good and very good (or numerically as 1 through 5).	Approximated in EUR.
Evaluation method(s)	o Minimum criteria, preferable criteria, substitutable criteria o Profile method o Utility analysis								o Minimum criteria o Present value me-thod)
Phase(s) in the selection process	o Phase 4 (minimum criteria, preferable criteria, substitutable criteria) o Phase 5 (profile method) o Phase 7 (utility analysis)								o Phase 6 (minimum criteria, present va-lue method)

Location factor to be evaluated	Distance to Nearest International Airport	Cultural and Recreational Facilities	Shopping Opportunities	Rents / Purchase Prices of Houses / Apartments	Availability of Schools and Childcare with International Standards	Availability of Hospitals with International Standards	Distance to Larger City (>100.000 inhabitants)	Ease of Receiving Work Permit for Life Partner of Expatriates	Required Investment for Community-related Location Factors over the planning horizon of the production site
									o Phase 7 (present value method)
Interdependencies with other location factors	o Transportation Facilities o Costs for Deploying Expatriates	o Availability of Skills o Costs for Deploying Expatriates			o Costs for Deploying Expatriates	o Availability of Skills o Costs for Deploying Expatriates		o Costs for Deploying Expatriates	o Availability of Skills o Costs for Deploying Expatriates o Subsidies and State Aid
Source of information: public databases and information	o Government websites o Operating agency website o Airlines' website o Public maps	o Government websites o Operating agency website o Operator's website o Public maps	o Government websites o Operating agency website o Operator's website o Public maps	o Government websites o Operating agency website	o Government websites o Operator's website o Public maps	o Government websites o Operator's website o Public maps	o Government websites o Public maps	o Government websites	-
Source of information: commercial external sources	-	-	-	-	-	o Commission International	-	-	-
Source of information: internal know-how	o Real Estate Department o Information gained through visits to the production site by firm employees. o Local Liaison Offices	o Strategy Department	-	-	-	-	-	-	-
Source of information: external consultants	o Information gained through visits to the production site o Already accumulated know-how								

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.6 Economic Environment

4.6.1 General Remarks on the Economic Environment as a Location Factor

The economic environment at the production site is very important for its successful construction and operation. The effects of the economic environment on constructing and operating the production site are numerous; they not only determine the level of productivity or the availability of skills, directly affecting the operation of the production site, but the economic environment itself also impacts the political stability via the employment rate, government debt, inflation or exchange rate, or the available infrastructure though investment. The political and legal framework are likewise important determinants of the economic environment, as any kind of economic activity depends on political stability and a stable and conducive legal framework (e.g., rule of law, the protection of property rights) (see 4.3.2.1 Political Stability; 4.3.3 Legal Framework). In particular, well-functioning institutions are considered to have a positive effect on economic growth, productivity, and the local market size, as they 'promote welfare-enhancing cooperation and action' and provide the basis for functioning markets by guaranteeing the efficient assignment, protection and alternation of property rights, securing contracts and encouraging specialization, exchange, saving, investment in human and physical capital, as well as the creation and 'adoption of useful knowledge'[121] (Greif, 2006, 5). Thus, the quality of institutions is important for economic growth, in general, and growth in investment, in particular (see Bogart et al., 2010, 71). Specifically, higher quality institutions tend to reduce 'operational costs' and raise the performance of FDI (Kawai, 2009, 118). Still, both economic growth and investment not only require institutions, but also the 'credible commitment' of the government to enforce the rules embedded in their institutions[122] (see North and Weingast, 1989, 803-808).

[121] Through the provision of public goods, such as education or infrastructure, local institutions directly impact local productivity (see Acemoglu and Dell, 2010, 170). Overall, higher quality institutions, better property rights, and fewer distortionary policy interventions incentivize investing more in physical, as well as human, capital, which leads to a higher productivity and income (Acemoglu et al. refer to North and Thomas (1973), Jones (1981) and North (1981) (see Acemoglu et al., 2001, 1369)). This influence of institutions on productivity is confirmed by Acemoglu and Dell, who found that local differences in productivity are highly affected by institutions. They point out that even differences in productivity within countries can be explained, among other things, by the quality of local institutions (see Acemoglu and Dell, 2010, 170, 187).

[122] North and Weingast confirm their argument by pointing out that the passing of the Bill of Rights in 1689's England restricted executive power by the greater power of the parliament and guaranteed that property rights were more consequently enforced. This led England to an acceleration of capital accumulation and an increase of profit from investments in new ideas and innovation (see North and Weingast, 1989, 804-812).

The economic environment is determined by economic location factors, of which those most relevant for the successful construction and operation of an OEM's production site are introduced and their significance for constructing and operating a production site is laid out in the following sections: *Exchange Rate*, *Inflation*, *Gross Domestic Product*, *Fixed Investment (including Foreign Direct Investment)*, *Productivity*, *Human Capital*, *Openness to Trade and Position in the Global Value Chain*, *Membership in Free Trade Agreements*, *Interest Rates*, as well as *Debt, Debt Sustainability and Sovereign Credit Ratings*. Another relevant economic location factor is the labor market with its wage level, availability of skills, labor force and labor market institutions and regulations. Even though the labor market is an economic location factor, due to its importance and the variety of aspects that must be evaluated in the selection process with regard to the labor market, it is analyzed separately in 4.7 Labor Market. Besides these economic location factors, the economic environment is further influenced by economic regulations and policies, which have been previously explained under 4.2.2 Economic Regulations and Policies.

As explained in 4.1 Scope and Structure of the Discussion of Relevant Location Factors, all location factors for which a macroeconomic analysis is relevant are explained from a macroeconomic perspective which includes their macroeconomic description, an explanation of their macroeconomic driving forces, and their specific macroeconomic effect on constructing and operating a production site. This macroeconomic analysis is, of course, especially relevant for the choice and evaluation of economic location factors.

4.6.2 Exchange Rate

The exchange rate is defined as the 'rate at which a country makes exchanges in world markets' (Mankiw, 2013, 601). The exchange rate can be expressed in nominal and real terms. The nominal exchange rate indicates at which relative prices two currencies can be compared or expresses the price in one currency of one unit of the other currency. The nominal exchange rate can be quoted in either one of the two corresponding currencies. Changes in the nominal exchange rate can either be in the form of a depreciation, which refers to a decrease in the value of the currency under consideration relative to the other currency, or in the form of an appreciation, which is an increase in the value of the currency under consideration relative to the other currency. The real exchange rate is more difficult to measure. The real exchange rate compares 'broad price level indices' representing 'the cost of a basket of goods' between countries and can be defined as the ratio of the consumer price indices of the two countries in one of the two currencies times the nominal exchange rate.[123] Similar to the changes in the nominal exchange rate, changes in the real exchange rate are also either a deprecation or an appreciation. The real exchange rate can either appreciate, if the nominal exchange rate appreciates and inflation in both countries remains constant, or if the nominal exchange rate remains unchanged (or, of course, also appreciates) and inflation in the other country increases. Hence, a change in the real exchange rate reflects either a change in the nominal exchange rate or in the 'inflation differential' thus in 'the difference between the domestic [..] and foreign […] inflation' (Burda and Wyplosz, 2013, 145-147). Normally, exchange rates are expressed in nominal terms. Hereafter, exchange rate refers to the nominal exchange rate in this section unless specified otherwise. As the real exchange rate is a function of the nominal exchange rate and inflation in the two countries, and inflation is discussed in 4.6.3 Inflation, only the drivers of changes in the nominal exchange rate are discussed here.

To analyze the exchange rate, it is necessary to understand the exchange rate regime—a political choice which determines how the currency of the country under consideration can be converted into other currencies—of a country. There are two kinds of exchange rate regimes: those with a floating exchange rate and those with a fixed exchange rate. Under a floating exchange rate regime, market forces determine the exchange rate, which is, in turn, allowed to fluctuate depending on changes in the equilibrium between the goods and the money market. In contrast, under a fixed exchange rate regime, the central bank announces a certain value for the exchange rate in terms of a foreign currency (e.g., the US$) and ensures that exchange rate by buying and selling as much of the domestic currency as necessary for the exchange rate to stay at the announced value. A currency which is fixed by defining its exchange rate with another currency is said to be pegged to that other currency. Thus, under a fixed exchange rate regime, the central bank cannot conduct any monetary policy other than to adjust the money supply such that the exchange rate remains fixed or change the announced exchange rate, thereby devaluing or revaluing the currency. The consequences of a floating or fixed exchange rate are theoretically captured in the concept of the so-called 'Impossible Trinity', which states that a country cannot pursue a fixed exchange rate, independent monetary policy, and free capital flows at the same time, but must instead give up one of these options. The US, for instance, allows free capital flows and has an independent monetary

[123] The external terms of trade are defined as the ratio between domestically produced exports and foreign produced imports, indicating how many exports a country receives for its imports. Internal terms of trade, which is the ratio of traded to nontraded goods, measures the price of traded goods relative to goods that are not traded (see Burda and Wyplosz, 2013, 149).

policy but floating exchange rates, while China has fixed exchange rates and an independent monetary policy but also capital controls in place, and Hong Kong has a fixed exchange rate and allows for a free flow of capital, but no independent monetary policy (see Mankiw, 2013, 359-379; Burda and Wyplosz, 2013, 516-518). Hence, to assess the exchange rate development, it is important to understand the exchange rate regime which is in place in the country under consideration. Under a fixed exchange rate regime, the exchange rate can be assessed as stable unless the central bank devalues or revalues its currency or if the exchange rate to which the currency is pegged appreciates or depreciates.[124] Hence, exchange rate related risks must be assessed with regard to a devaluation or revaluation of the currency or to movements in the currency to which the currency under consideration is pegged.

Under a floating exchange rate regime, the exchange rate is determined by market forces, given that the exchange rate, just as the price of the currency, fluctuates depending on changes in the equilibrium between the goods and the money market. Like the price for goods and services adjusts to the demand and supply thereof, the price of currencies adjusts according to the demand and supply of currencies. Movements in the exchange rate under a floating exchange rate regime can have a variety of drivers of which the most relevant are discussed briefly. One driver of a change in the exchange rate is a change in a central bank's key interest rate. If, for instance, a central bank raises its key interest rate, the demand for the country's government bonds increases which, in turn, leads to a higher demand of the country's currency as the government bonds must be paid in that currency. This higher demand for that currency leads to an appreciation of the exchange rate. For instance, a considerable rate hike by the U.S. Federal Reserve System (FED) is likely to lead to an appreciation of the US$.[125] The opposite is the case when the central bank cuts its key interest rate. Besides the key interest rate, the central bank can also impact the exchange rate by buying or selling domestic or foreign currency. By selling domestic currency, the central bank increases the supply of the currency, which leads to a depreciation, while the opposite is the case when the central bank buys domestic currency, thereby increasing the demand for the cur-

[124] A disadvantage with regard to economic growth under a fixed exchange rate that should not be underestimated is that monetary policy cannot be used as an instrument to stimulate the economy. In contrast, some central banks (e.g., the Hong Kong Monetary Authority (HKMA)) must follow the monetary policy of another central bank (e.g., the U.S. FED), because their currency is pegged against the US$ regardless of their domestic economic momentum or level of inflation.

[125] In addition, a considerable rate hike by the U.S. FED is likely lead to a depreciation of the currency of emerging countries, especially if their currencies have appreciated due to capital inflows in times of low U.S. FED rates.

rency, which leads to an appreciation. Instead, by selling foreign currency, the central bank increases the supply of the foreign currency and additionally increases the demand for domestic currency, if it sells the foreign currency for the domestic currency, thereby causing the domestic currency to appreciate and the foreign currency to depreciate. This also means that foreign central banks which hold considerable amounts of the domestic currency can cause the exchange rate to depreciate by selling the currency. The selling or buying of domestic currency for foreign currency in the foreign exchange market by central banks with the goal to affect the exchange rate is referred to as realignments.

Besides central banks, large corporations and private banks are other important actors in the foreign exchange market. An increase in foreign investments in the country under consideration leads to an appreciation of its currency as the investment must be made in local currency which, in turn, increases the demand thereof or, likewise, a decrease in foreign investment in the country under consideration leads to a depreciation. A further driver of exchange rate movements are changes in the demand for the country's products and services abroad. As the country's exports must be paid in the country's currency, rising exports lead to an appreciation of the currency.[126] This is why an increase in the international price of a certain raw material leads to an appreciation of the currency of countries for which this raw material is one important export. This is the connection between the exchange rate and market for goods and services. Moreover, expected exchange rates are another force that affects the exchange rate. If the exchange rate is expected to depreciate, investors holding the currency are likely to sell the currency which increases the supply of the currency, thus leading to a depreciation of the exchange rate. All the aspects which drive exchange rate movements—namely changes in the key interest rates, realignments, changes in foreign investments in the country under consideration, changes in the demand for exports or changes in expected exchange rates—affect the exchange rate through the demand and supply of the currency.[127]

Movements in the exchange rate have a variety of effects on the economy, of which the most relevant for selecting an OEM's production site are introduced briefly. Overall, high exchange

[126] Due to the impact of the demand of a country's exports on its currency, the implementation of trade restrictions (see 4.2.2 Economic Regulations and Policies) also affects the exchange rate but only under a floating exchange rate regime: for instance, a decrease in import quotas reduces the demand for the currency and thus leads to a depreciation in a floating exchange rate regime. In a fixed exchange rate regime, a decrease in import quotas does not lead to a change in the exchange rate, but to an increase in money supply.
[127] There are a variety of other economic theories on exchange rate movements (e.g., the portfolio balance approach, balance of payments approach, asset approach) but their discussion is beyond the scope of this work.

rate volatility, i.e., 'large, discrete changes in currency value' (Clark et al., 2004, 6), induces general uncertainty in the economy, which always weighs on economic growth. Moreover, movements in the real exchange rate indicate changes in the economy's competitiveness relative to another by expressing how expensive a country's goods and services are relative to those of another. The Purchasing Power Parity (PPP) approach explains that the real exchange rate is, in the long-term, determined by the competitiveness of the country.[128] Likewise, the PPP approach is based on the assumption of monetary neutrality. Given the neutrality of money, the nominal exchange rate between two countries and their price levels do not affect any real variables in the long-term and hence do not affect the real exchange rate, as inflation will adjust to changes in the money supply. Therefor, an increase in money supply leads to an increase in inflation and hence to a depreciation in the real exchange rate unless the nominal exchange rate adjusts. At the given nominal exchange rate, domestic goods and services are less expensive abroad and more competitive, and thus the nominal exchange rate will eventually appreciate to adjust to the level of competitiveness. Therefore, in the long-term, the real exchange rate is determined by the competitiveness of the country (see Burda and Wyplosz, 2013, 149). Thus, a real appreciation implies a gain in competitiveness, while in turn, a real depreciation implies its loss. As such, the level of competitiveness in a country is of interest in selecting a production site, since a more competitive local economy suggests higher productivity of the economy. This does not necessarily mean that the automotive sector is competitive, but that parts of the economy function well relative to other economies, which requires a certain level of infrastructure and productivity. Another aspect that is especially important for the stability of emerging countries is the risk of a sharp depreciation of the local currency if the country is highly indebted abroad. For instance, some emerging countries, whose debt is denominated in US$ are seriously challenged if their currency sharply depreciates, increasing their debt burden and the amount of debt service payments in terms of local currencies. Thus, a sharp depreciation may pose a significant threat to the debt sustainability of a country that is indebted in a foreign currency (see 4.6.11 Debt, Debt Sustainability and Sovereign Credit Ratings). Moreover, the exchange rate affects inflation in the country under consideration by affecting the costs of imported goods: a depreciation increases the costs for imports thus exerting upward pressure on inflation.

[128] In order to be precise, the above-mentioned PPP approach is the relative PPP approach, while the absolute PPP approach is based on the law of one price, which assumes that 'the same good should trade everywhere at the same price, when prices are expressed in the same currency'. Thus, if prices differ across countries, arbitrage leads to the elimination of any difference (Burda and Wyplosz, 2013, 150).

Besides these general effects of the exchange rate on the overall economy of a country, movements in the exchange rate also directly affect the profitability of the production site and the value of the investment made in the production site (see Papaioannou, 2006, 4). According to Papaioannou, the most relevant 'types of exchange rate risk' for firms which operate internationally are transaction, translation, and economic risks. Transaction risks refer to the impact movements in the exchange rate can have 'on transactional accounts exposure related to receivables (export contracts), payables (import contracts) or repatriation of dividends'. Translation risks arise due to the effect of exchange rate movements on 'the valuation of a foreign subsidiary and […] the consolidation of a foreign subsidiary to the parent company's balance sheet.' The economic risks include the impact that exchange rate movements can have on 'revenues (domestic sales and exports) and operating expenses (cost of domestic inputs and imports)' (Papaioannou, 2006, 4).

Transaction risks with regard to the local currency at the production site are, for the most part, mitigated as large international OEMs source most of the components and raw materials they need as inputs for their production globally.[129] While transaction risks do not directly affect the profitability of the production site, transaction risks do exist for local suppliers of the OEM: a depreciation of the local currency makes all components and raw materials, which they must import, more expensive, and an appreciation makes their products abroad more expensive and less competitive, thereby possibly undermining their exports. While local suppliers must likely pass these higher costs for their imports on to the OEM by increasing prices of their goods and services, this should not have a major effect on the costs of the production site in terms of the reporting currency as the OEM pays in the depreciated local currency. However, the success of the OEM's local suppliers is of utmost importance for the successful operation of the production site, and transactional risks are significant for local suppliers and their profitability. The importance of that aspect for the OEM is highlighted by the fact that insolvency of suppliers is among the chief supply chain risks of internationally producing firms—this risk is captured by the location factor *Supply Chain Risks* (see 4.10.4.5 Supply Chain Risks). Overall, in the case of exchange rate movements, transaction risks are relatively small for the profitability of the production site.[130] Translation risks

[129] From an organizational point of view, the department of global sourcing is responsible for the sourcing of all required components and raw materials and for the minimization of negative effects of exchange rate volatility on total costs.

[130] Kinkel suggests creating exchange rate advantages through local sourcing strategies: By creating a so-called currency scale ('Währungswaage'), a firm can compensate disadvantages due to an appreciated home currency by lower import prices (Kinkel, 2009a, 68). However, as described above, the minimization of exchange rate risks related to the sourcing of components is not part of this selection process model, as according to the practice of most international

with regard to the local currency exist for the production site of the OEM because a depreciation of the local currency devalues the investment the OEM made in the production site. As the investment is made in local currency and can only be disinvested in the local currency, a depreciation of the local currency versus the reporting currency decreases the value of the investment in terms of the reporting currency. This risk must be taken into consideration, especially when calculating the total costs of the production site in the event the production site is meant to be sold after its planning horizon or if the production site is unprofitable and must be sold off for other reasons before the end of the planning horizon.

Economic risks are the most relevant in relation to exchange rate movements for the profitability of the production site. They arise for the OEM with regard to operating costs and revenues. An appreciation of the local currency affects operating costs by making all locally sourced products and services that the OEM must pay for in local currency more expensive (see Meyer, 2006a, 87), thus increasing the costs for constructing and operating the production site. This includes the costs of all components and raw materials sourced from local suppliers paid in local currency and all services which are provided by local firms, and which must be paid in local currency. Besides goods and services which the OEM must pay for in local currency, it must also pay the wages of local workers in local currency. Overall, an appreciation of the local currency increases operating costs in the reporting currency and thus carries a significant risk for the profitability of the production site. Moreover, an appreciation of the local currency makes the repayment of loans taken up in the local currency more expensive. However, economic risks with regard to revenues only arise if the OEM produces a final product at the new production which it wants to sell in the local market. Then, a depreciation of the local currency decreases the revenues made in the local market in terms of the reporting currency. This decreases the profits in the reporting currency (see Goldstein and Pevehouse, 2006, 505) unless local product prices in the local currency are increased accordingly which, however, might lead to market share losses in the local market, though this normally leads to lower revenues in a market. This happened, for instance, in Russia, when the Ruble depreciated

OEMs, it is assumed in this selection process model that the OEM has an international sourcing strategy, and that any kind of sourcing of components and related risks are not part of the selection process. Furthermore, the sourcing scheme of an international OEM is so large and includes components from so many currency areas that a thorough analysis of all exchange rate related risks seems to be rather unrealistic.

considerably in 2014 and foreign firms which sold their products in Russia made less profits as they could not adjust their prices sufficiently without losing considerable market share.[131]

Thus, transaction risks are rather negligible when selecting a production site given the global sourcing of international OEMs, while translation risks exist, especially with regard to the value of the investment made in the production site. When selecting a production site, economic risks with regard to the exchange rate must be analyzed with regard to both operating costs and revenues if the product is supposed to be sold in the local market. For assessing the exchange rate development and associated risks, it is, first, necessary to understand the exchange rate regime, and second, to analyze the relevant drivers of exchange rate movements.

Table 22: Information and Instructions on the Choice and Evaluation of the Location Factor *Exchange Rate*

Location factor to be evaluated	**Risk Associated with Exchange Rate**	**Hedging Costs (Hedging via Foreign-Exchange Swaps or Cross-currency Basis Swaps) over the planning horizon of the production site**
Strategic, operational, or general	Strategic, operational, and general	Strategic, operational, and general
Process-specific / product-specific	-	-
Relevant for production network	+	+
Relevant for the design of the supply chain	+	+
Negotiable	-	+
Semi-external / even performance	-	-
Quantitative or qualitative	Qualitative	Cost-related quantitative
Hard or soft	Soft	Hard
Static or dynamic	Dynamic	Dynamic
Geographic level of analysis	National	National
Unit of measurement	Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).	Approximated in EUR.
Evaluation method(s)	o Strategic considerations o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)

[131] Movement in the exchange rate can also impact local revenues by affecting the disposable income of the local population: A depreciation increases the costs of imports for the local population. Assuming that the local population still buys some imports regardless of the higher import prices, depreciation decreases the income that remains for the consumption of domestic goods.

Location factor to be evaluated	Risk Associated with Exchange Rate	Hedging Costs (Hedging via Foreign-Exchange Swaps or Cross-currency Basis Swaps) over the planning horizon of the production site
Interdependencies with other location factors	o Political Stability o Gross Domestic Product o Inflation o Debt, Debt Sustainability and Sovereign Credit Ratings	
Source of information: public databases and information	o IMF: • Data and Statistics, Query tools: IMF exchange rates • Representative Exchange Rates for Selected Currencies o Eurostat o Bank for International Settlements (BIS)	-
Source of information: commercial external sources	o Consensus Economics: Report: Foreign Exchange Consensus Forecasts; foreign exchange rates forecasts, cross rate forecasts, purchasing power parity, risk analysis, monetary policy o EIU: CountryData: exchange rate, real effective exchange rate, terms of trade, money supply o Oxford Economics: data tool: exchange rate, purchasing power parity, current account, total external debt, foreign exchange reserves, money supply o IHS Markit: Global Economic Data: finance and financial markets, government finance, national accounts o Deutsche Bank Research: exchange rate forecasts	o Consensus Economics: Report: Foreign Exchange Consensus Forecasts on Hedging Markets o Bloomberg and international private banks
Source of information: internal know-how	o Economic Department o Treasury Department	o Treasury Department
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.6.3 Inflation

Inflation is defined as 'an increase in the overall level of prices' (Mankiw, 2013, 603) which decreases the amount one can buy with one unit of money (see Burda and Wyplosz, 2013, 146). Inflation is usually quoted in terms of the rate of inflation, which is defined as 'the percentage change in the overall price level' (Mankiw, 2013, 99). The most used measure of the rate of inflation is the change in the Consumer Price Index (CPI)[132], which reflects the weighted prices of 'a basket of goods consumed by a representative or average individual' (Burda and Wyplosz, 2013, 30). Another relevant price index is the index of core inflation, which is calculated similarly to the CPI, but with the exclusion of food and energy from the basket of goods. Core inflation fluctuates less because it excludes prices for food and energy, which often fluctuate more than other consumption goods given they depend on supply side factors, such as droughts or OPEC production cuts. By excluding food and energy goods from the basket, core inflation can provide a better indication of the price level of other, less volatile, consumption goods. While inflation is one of the

[132] A price index is an 'average of prices with fixed weights', which is composed by selecting a basket of goods and using the amount of each good in the basket as weights for the corresponding goods (Burda and Wyplosz, 2013, 30).

key indicators of the well-being of an economy, the desirable level of inflation has been and still is a topic of intense controversy in economic theory, which is, of course, beyond the scope of this work. However, it is beyond dispute that very high inflation (and very high deflation, which is a decrease in the overall price level) is destructive for economic activities.

Economic theory differentiates what determines short-term inflation versus long-term inflation. Inflation in the long-term is determined by the money supply. If the money supply does not change proportionally to output (Gross Domestic Product), then the price level adjusts either in the form of deflation or inflation to the change in output by a change in wages and prices (see Mankiw, 2013, 404-410). In the short-term, wages and prices are sticky and thus changes in the money supply do not directly impact inflation. Short-term variation in inflation is, according to the Phillip's curve,[133] determined by three factors: expected inflation, cyclical unemployment, and supply shocks. Expected inflation determines inflation based on the concept of adaptive expectation, assuming that people base their expectations of future inflation on their experience of past inflation. This adaptive inflation causes people to set prices and wages based on experienced inflation, which then indeed leads to a certain inflation inertia, a 'continued increase in the price level' without either accelerating or decelerating. Cyclical unemployment, a derivation of unemployment from its natural rate, leads to a decrease in price level if unemployment is above its natural rate, and to an increase in price level if unemployment is below its natural rate. This inverse relationship between unemployment and inflation is based on the link between unemployment, aggregate demand and inflation, as lower unemployment increases aggregate demand,[134] which, in turn, increases inflation and is thus referred to as demand-pull inflation. Besides expected inflation and cyclical unemployment, inflation is further influenced in the short-term by supply shocks, which can lead to an increase in inflation (adverse supply shocks), for instance, through an interruption of global supply chains due to armed conflict or pandemics; or to a decrease in inflation (beneficial supply shocks), for example, through a decrease in global oil prices due to the fracking industry becoming more profitable. As supply shocks usually have a major impact on the costs of production, their effect on inflation is referred to as cost-push inflation. Thus, inflation expectations, the unemployment rate, and supply shocks are important drivers of inflation in the short-term.

[133] The Phillips curve is defined as $\pi = E\pi - ß(u-u^n) + v$, where π=inflation, $E\pi$=expected inflation, ß=parameter measuring how inflation responses to cyclical unemployment, $(u-u^n)$=cyclical unemployment and v=supply shock (Mankiw, 2013, 404-405).

[134] Okun's law describes that the relationship between output and unemployment is inverse, thus if economic output decreases, unemployment increases (see Mankiw, 2013, 275-276).

As mentioned above, in the long-term, the level of inflation is determined by the money supply. As the money supply is determined by monetary policy, and in most countries central banks are responsible for monetary policy, the money supply is normally determined by central banks. Monetary policy can either target price stability or an expansion of output and employment as its primary goal. However, the goals of monetary policy are often conflicting as an expansionary monetary policy stimulates output and employment in the short-term but leads to higher inflation in the long-term. The different effect of changes in the money supply in the short-term versus the long-term can be explained by the classical dichotomy, the theoretical separation of real and nominal variables, according to which money has no effect on real variables, such as output and employment, and is thus considered as neutral. The neutrality of money, however, only holds in the long-term; in the short-term, wages and prices are sticky and do not adjust to changes in the money supply. The aforementioned Phillips curve illustrates that real and nominal variables (in this case, unemployment and inflation) are linked in the short-term, thus disproving the classical dichotomy in the short-term. So, while so-called ‘monetary neutrality’ implies that the effect monetary policy has on output and employment is not lasting, in the short-term tighter monetary policy can constrain output and employment, and expansionary monetary policy can stimulate output and employment (see Mankiw, 2013, 404-410). These different effects monetary policy has in the short-term versus the long-term lead to the conflict of interest between long-term price stability and short-term stimulation of employment and output. As such, monetary policy in most countries is not in the hands of elected politicians, who might be tempted to use monetary policy to obtain a short-term improvement of output and employment at the expense of long-term price stability. Instead, the conflict of interest is addressed by the establishment of an independent central bank in most countries, which are normally given a defined task: in most cases, they must guarantee price stability in the long-term as its primary goal, and support growth and employment in the short-term as its secondary goal.

Central Banks have several instruments to influence inflation. To control inflation, most central banks pursue inflation targeting, thus they determine an inflation target (or an inflation target range), forecast the rate of inflation, and set the interest rate such that the corresponding money demand causes the rate of inflation to be at the inflation target (or in the target range) (see Burda and Wyplosz, 2013, 223-224). Besides setting the interest rates, central banks also impact the money supply directly through so-called ‘Open Market Operations’ (OMOs). These OMOs are transactions in which, by the ‘purchase and sale of securities in the open market’, central banks supply reserves to or withdraw reserves from the banking system. These OMOs are a key tool used by central banks to implement monetary policy and hence determine the money supply (Board of Governors of the Federal Reserve System, n.d.; see Burda and Wyplosz, 2013, 558). Through asset purchase programs, main refinancing operations, or longer-term refinancing operations central banks can also increase the money supply (see The European Central Bank, n.d.b). Likewise, by changing the minimum reserves requirements[135] and other liquidity conditions central banks may impact the money supply. Through these instruments, central banks determine the money supply thereby impacting inflation. To assess the development of inflation in a country, it is important to consider the factors that have a short-term effect on inflation, such as the rate of unemployment, supply shocks or inflation expectations, and the factor that determines inflation in the long-term, monetary policy.

As mentioned above, inflation is one of the key indicators of the well-being of an economy, which is mainly because of the disruption of economic activities and the uncertainty that very high inflation (as well as very high deflation) can lead to. While history has shown that high inflation disturbs and very high inflation (or even hyperinflation) disrupts the functioning of an economy, the actual costs of high inflation are hard to identify, not to mention quantify (see Burda and Wyplosz, 2013, 407). In general, inflation has a direct effect on consumption, as inflation decreases real wages in the short-term (as wages are sticky in the short-term) and hence weighs on consumption.[136] Inflation also has an important effect on a country's real exchange rate as this rate is a function of the nominal exchange rate of two countries and their price levels: higher inflation in a country leads to an appreciation of its real exchange rate as long as the nominal exchange rate and the price level in the other country remain constant.

Besides its general effects, inflation has several costs, which differ depending on whether inflation was expected or unexpected. Costs caused by expected inflation are mainly related to the distortion caused by inflation: as inflation acts like a tax on holding money, it forces people to spend their money as soon as possible ('shoeleather cost'). As inflation lowers firms' revenues given fixed prices, inflation forces firms to change prices more often (menu costs). Inflation also

[135] Eurozone banks are required to hold minimum reserves in their current accounts at their national central bank. A bank's minimum reserve requirement is set for six-week maintenance periods. The level of reserves is calculated based on the bank's balance sheet before the start of the maintenance period (see The European Central Bank, Minimum Reserves, n.d.a).

[136] Moreover, inflation has an important effect on the nominal interest rate: according to the Fisher equation a change in inflation leads to a one-to-one change in the nominal interest rate (see Mankiw, 2013, 108-109).

changes the effect of taxes and leads to the overall inconvenience of living and doing business in an economy wherein prices change frequently. In contrast, unexpected inflation hurts people on fixed pensions and changes the creditor-debtor relationship as, when inflation is higher than expected, the creditor loses and the debtor wins. Overall, unexpected inflation leads to an arbitrary and extensive redistribution of wealth (Mankiw, 2013, 116-118; see Burda and Wyplosz, 2013, 408). Thus, both expected and unexpected inflation distort the functioning of an economy. Overall, the costs of inflation can be summarized in an arbitrary redistribution of wealth, the malfunctioning of prices as signals, as well as the costs associated with holding money as its value declines. All these costs lead to uncertainty in the business environment and disturb the functioning of the economy.

Importantly, inflation is a significant location factor for the selection of a production site, as high inflation disturbs the overall stability of an economy and induces uncertainty in the business environment in which the production site must be constructed and operated. Besides the higher overall uncertainty, there are specific aspects which make the operation of a production site in a country with high inflation difficult. The variety of prices for products in the economy that stem from firms having to adjust their prices frequently makes working on long-term contracts between OEMs and their local suppliers of components and providers of services difficult. In addition, significant unexpected inflation requires the OEMs adjust their (nominal) wages often to avoid their workers being hurt by reduced real wages. High inflation is also relevant with regard to local sales, as it requires the OEM adjust its prices frequently to maintain profits, which is inconvenient. Moreover, as inflation leads to a general decrease in real wages in the short term due to a certain stickiness of nominal wages, inflation decreases the purchasing power of the local population. This is likely to negatively affect an OEM's local sales, which is relevant if the OEM wants to sell its product in the local market, unless the OEM lowers its prices which, in turn, reduces the profit margin. Hence, inflation should certainly be considered in the selection process of a production site. Understanding inflation and assessing its development is also important for the assessment of other macroeconomic location factors in real terms (e.g., *Gross Domestic Product*, *Fixed Investment (including Foreign Direct Investment)*, *Consumption*, *Business Fixed Investment* or *Wage Level*).

Table 23: Information and Instructions on the Choice and Evaluation of the Location Factor *Inflation*

Location factor to be evaluated	**Risk Associated with Inflation**
Strategic, operational, or general	General
Process-specific / product-specific	-
Relevant for production network	-
Relevant for the design of the supply chain	-
Negotiable	-
Semi-external / even performance	-
Quantitative or qualitative	Qualitative
Hard or soft	Soft
Static or dynamic	Dynamic (for an assessment of the future development, it is important to analyze monetary policy)
Geographic level of analysis	National
Unit of measurement	Assessed as very high, high, fairly low, low and very low (or numerically as 1 through 5).
Evaluation method(s)	o Strategic considerations o Profile method o Utility analysis
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 7 (utility analysis)
Interdependencies with other location factors	o Exchange Rate o Political Stability o Gross Domestic Product o Fixed Investment (including Foreign Direct Investment) o Consumption o Business Fixed Investment o Wage Level o Debt, Debt Sustainability and Sovereign Credit Ratings
Source of information: public databases and information	o World Bank: DataBank (only past) o European Commission: Economic Performance and Forecast o IMF: World Economic Outlook (annual report containing past and forecasts of annual inflation rates) o National Central Banks websites o Central Banks websites (for additional information on Interest Rates and Monetary Policy)
Source of information: commercial external sources	o Consensus Economics: Consensus forecast on consumer price inflation (G7&Western Europe, Latin America, Asia Pacific, Eastern Europe) o EIU: CountryData: consumer prices o IHS Markit: Global Economic Data: prices, finance and financial markets o Deutsche Bank Research: Macro forecasts: inflation rate o Oxford Economics: data tool: consumer price index Information on money supply: o EIU: CountryData: money supply, lending, deposit and money supply, interest rate, bond yields o IHS Markit: Global Economic Data: prices, finance and financial markets o Oxford Economics: data tool: prices, finance and financial markets
Source of information: internal know-how	o Economic Department
Source of information: external consultants	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.6.4 Gross Domestic Product

Gross Domestic Product (GDP) is generally considered the best or the 'most comprehensive' measure of the overall performance of an economy (Yamarone, 2012, 11) and the 'best overall barometer of the economy's ups and downs' (Baumohl, 2013, 130). GDP is defined as the 'total income earned domestically, including the income earned by foreign-owned factors of production' or as ‘the total expenditure on domestically produced goods and services’[137] (Mankiw, 2013, 602). Thus, GDP can either be defined as the ‘total expenditure on the economy’s output of goods and services’ or as the ‘total income of everyone in the economy’; this is because total expenditure must equal total income for the economy in sum (Mankiw, 2013, 16). According to the national income accounts identity, GDP is the sum of consumption, investment, government purchases, and net exports (see Mankiw, 2013, 25). A slightly different definition of GDP points to a different aspect of the concept: GDP is defined as ‘the final value of all goods and services produced in’ an economy. This definition highlights that the value of intermediate products or services produced in the country and used as inputs for the production of other products and services is only counted once in the composition of GDP.

GDP is normally calculated in nominal and real terms. Nominal GDP is the value of all goods and services produced (or consumed), measured at current prices. That is why nominal GDP is also referred to as current GDP.[138] Absolute GDP, also referred to as GDP volume, provides a good indication of the strength and size of the economy, and, if converted in the same currency, enables an easy ranking or comparison of the overall size and strength of different economies. However, to assess the economic strength of an economy, it is not enough to consider nominal GDP, because a change in nominal GDP might be caused by a change in the quantity produced or by a change in the prices of the products and services produced. Given this ambiguity of nominal GDP, it is important to analyze the change in GDP in real terms. The comparison between Vietnam and China exemplifies the importance of analyzing not only the change in real GDP but of also taking the GDP volume into consideration when assessing the strength of an economy. While Vietnam’s real growth rate (2015: 6.7%, 2016: 6.2% and 2017: 6.8%) has been very close to that of China (2015: 6.9%, 2016: 6.7% and 2017: 6.9%) between 2015 and 2017, the overall difference in strength between the two economies only becomes evident when taking their nominal GDP volume into consideration: The nominal GDP of China in 2016 (11,221.836 billion US$) was almost 51 times that of Vietnam (220.408 billion US$) (see International Monetary Fund, 2018). This shows that GDP must be assessed in terms of its volume and growth.

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[137] Gross National Income (GNI) is an alternative measure of economic activity. GNI measures the income of all ‘residents of an economy in a given period’ (Eurostat, n.d.d).

[138] Real GDP is the value of all goods and services produced (or consumed) at constant prices (or chained prices) (see Baumohl, 2013, 133). In order to compute real GDP a chain-weighted measurement is often used, in which the base-year for prices of goods and services changes continuously over time and the single growth rates are ‘put together to form a “chain”’ (Mankiw, 2013, 24). Nominal GDP and real GDP is identical for the base year, meaning that real GDP measured, for instance, at 2016 prices is equal to nominal GDP of 2016.

As mentioned above, according to the national income accounts identity, GDP is the sum of consumption, investment, government purchases, and net exports (see Mankiw, 2013, 25). Hence, the analysis of GDP growth requires understanding the contribution of each of these four components. Consumption means all 'personal consumption expenditures' and thus everything 'consumers spend'. Consumers spend their money on durable goods, which are goods that last at least three years, such as TVs or cars, on nondurable goods, which last less than three years, such as food or clothes, and on miscellaneous services, such as medical or legal assistance (see 4.12.2 Consumption). Investment in the income account identity refers to business investment, which is 'what businesses invest in plants, equipment, and construction' (see 4.12.3 Business Fixed Investment). A large share of business investment is fixed investment, while the other major part is the change of inventory. Government purchases include both government consumption expenditures and government investments (see 4.12.4 Government Spending). Net exports of goods and services is the value of all exports minus the value of all imports (Baumohl, 2013, 133-136). Thus, in order to analyze the volume and change of GDP, it is necessary to analyze the four components of GDP, which are all positively related to economic growth. Nevertheless, the discussion of determinants of economic growth is beyond the scope of this work. The effect of investment, productivity, human capital, and trade on economic growth are briefly discussed in 4.6.5 Fixed Investment (including Foreign Direct Investment), 4.6.6 Productivity, 4.6.7 Human Capital and 4.6.8 Openness to Trade and Position in the Global Value Chain.

In the selection process, GDP serves as an indicator for the overall size (volume of GDP) and performance (change in real GDP) of an economy. While GDP volume and growth are important indicators of the market size, this aspect is captured in the location factors *Market Size and Market Share* (see 4.12.1 General Remarks on Market Size and Market Share as Location Factor). In the location factor *Gross Domestic Product,* GDP growth and volume are considered as indicators of a functioning infrastructure, a minimum level of political stability and security, or an intact labor market. Considerable GDP growth also tends to benefit the government budget (thanks to higher tax revenues), allowing for more government investments, for instance, in infrastructure or education, for an increase in subsidies (or the continuation of existing subsidies) or for a reduction of taxes, and tends to lower the sovereign credit risk and improve the country's debt sustainability (see 4.6.11 Debt, Debt Sustainability and Sovereign Credit Ratings). These aspects all benefit the OEM in constructing and operating the production site, as investments in infrastructure and education improve the productivity of the production site or reduce the investments, which the OEM must make on its own, while higher subsidies or lower taxes reduce the costs of constructing and operating the production site. Furthermore, higher government revenues ensure that the government can continue to provide relevant public services, such as those related to police, hospitals, traffic, and administration procedures. Considerable GDP growth also tends to indicate that the local suppliers of components and services the OEM works with are less likely to go bankrupt or be insolvent and are thus more reliable partners.

To analyze GDP growth and volume in the selection process, it is important to be aware that both differ greatly across regions in many countries. Hence, it is important that the selection process includes not only a national but also a regional analysis of GDP. Given considerable regional differences, the regional analysis of GDP growth and volume is important, particularly because in regions with high GDP volume and growth, local production is higher, thus more skilled labor, better infrastructure, as well as public services, are likely to be available. Whether the OEM prefers a production site in an economically weak or strong region of a country is a strategic decision. Some arguments for and against selecting a production site in an economically strong or weak region are included under the location factor *Industrial Clusters* (see 4.11 Industrial Clusters). While the information on GDP on the national level is available at a number of public and private sources, information on the regional level is harder to obtain.

Overall, GDP growth and volume are a very relevant location factor for the selection process of a production site as they provide the best indication of the overall well-being of the economy. Specifically, the economic well–being at the production site has several affects that are relevant for its construction and operation. Besides the effect on the market size, which is captured in the Location Factors under *Market Size and Market Share* (see 4.12 Market Size and Market Share), GDP volume and growth are an important location factor, especially with regard to government investments and subsidies, provision of public services, availability of infrastructure, and the reliability of local suppliers.

Table 24: Information and Instructions on the Choice and Evaluation of the Location Factor *Gross Domestic Product*

Location factor to be evaluated	**Gross Domestic Product**
Strategic, operational, or general	Strategic or general
Process-specific / product-specific	-
Relevant for production network	+
Relevant for the design of the supply chain	+
Negotiable	-
Semi-external / even performance	-
Quantitative or qualitative	Non-cost-related quantitative
Hard or soft	Soft
Static or dynamic	Dynamic
Geographic level of analysis	National and, if necessary, on the regional level
Unit of measurement	GDP volume measured in absolute terms (e.g., in US$) and GDP growth rate in percentage change of real GDP. Based on this information GDP should be assessed as very stable, unstable, fairly stable, stable and very stable (or numerically as 1 through 5).
Evaluation method(s)	o Strategic considerations o Profile method o Utility analysis
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 7 (utility analysis)
Interdependencies with other location factors	o Fixed Investment (including Foreign Direct Investment) o Consumption o Business Fixed Investment o Government Spending o Debt, Debt Sustainability and Sovereign Credit Ratings
Source of information: public databases and information	o World Bank: Databank (only past) o European Commission: Economic Performance and forecast o IMF: World Economic Outlook (annual report containing past and forecasted GDP growth rates) o National or regional web sites (e.g., Department of Commerce)
Source of information: commercial external sources	o Consensus Economics: Consensus forecasts of GDP growth (G7&Western Europe, Latin America, Asia Pacific, Eastern Europe) o EIU: CountryData:GDP and GDP growth o IHS Markit: Global Economic Data: cyclical indicators o Oxford Economics: data tool: nominal and real GDP o Deutsche Bank Research: Macro forecasts o Research institutes: e.g., China Briefing
Source of information: internal know-how	o Economic Department o Treasury Department
Source of information: external consultants	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.6.5 Fixed Investment (including Foreign Direct Investment)

Fixed investment, also referred to as Gross Fixed Capital Formation (GFCF), is the sum of all investments in fixed assets made by 'resident producers' minus disposals (Eurostat, n.d.c). Fixed assets include both tangible (e.g., machinery, buildings, equipment) and intangible assets ('intellectual property products'), which have been produced and acquired to be 'used repeatedly, or continuously, for more than one year' (Eurostat, n.d.c; see Eurostat, n.d.a; Eurostat, n.d.b). The total value of fixed assets 'available for production […] at a given point in time' constitutes the fixed capital (Eurostat, n.d.b). Gross fixed investment, in contrast to net fixed investment, means that all 'money spent on new [fixed] capital' is included regardless of whether the new fixed capital constitutes an increase in the fixed capital stock or a replacement of depreciated fixed capital (Burda and Wyplosz, 2013, 62).

An aspect that must be differentiated with regard to fixed investment are the actors which conduct the investment. Total fixed investment refers to the fixed investment conducted by 'the entire economy, including expenditures by the general government, non-financial corporations, financial corporations, households and non-profit institutions' (OECD, 2013a, 80). Business fixed investment includes new plants, equipment, buildings, and other fixed capital which are acquired by firms for their production. Residential fixed investment refers to the buying of new housing by households or landlords (see Mankiw, 2013, 25; Baumohl, 2013, 133-136). Government fixed investment includes all direct investments the government makes, in contrast to capital transfers, which are indirect government investments. Direct government investments are investments in infrastructure, such as roads, schools, or hospitals (see OECD, 2013a, 80). Fixed investment by the government, by firms, or by households falls under domestic fixed investment, while fixed investments conducted by foreigners are foreign fixed investments which only include foreign direct investments (FDI)[139] but not foreign portfolio investments (and other investments) (see Swanson, 2007, 345). FDI is usually in the form of 'building a factory, owning a company, or buying real estate in a foreign country, while indirect portfolio investment occurs in the form of buying stocks or bonds or making a loan to a foreign company' (Goldstein and Pevehouse, 2006, 353). Thus, in contrast to a portfolio investment, FDI is not only associated with a capital transfer, but also with a real transfer, for instance, of management service, equipment or know-how (see Autschbach, 1997, 11), and requires 'the acquisition of at least ten percent of the ordinary shares or voting power in a public or private enterprise' by foreign investors (International Monetary Fund, 2006a). FDIs are conducted based on the long-term strategic planning of a firm (see Autschbach, 1997, 11), involve 'a lasting interest in the management of an enterprise and include the reinvestment of profits' (International Monetary Fund, 2006a).[140] Hence, to consider fixed investment in a country, it is necessary to look at domestic fixed investment as well as FDI.

[139] With regard to the national income accounts identity, FDI is part of net trade.

[140] In the national income accounts identity, private investment by households and businesses, government investment, and investments by foreigners are separated into investment, government expenditures, and net exports, respectively.

In terms of the national income accounts, identity growth in investment as a component of GDP contributes to economic growth. However, investment in the national income accounts identity refers exclusively to business investment, while government investment falls under government expenditures and FDI under net exports. The chief intention of governments to conduct investments, for instance, in infrastructure is to enhance economic growth. That is why governments often increase their investment expenditures in times of economic slowdowns (countercyclical expenditures) (see OECD, 2013a, 80). That investment, be it by the government or firms, has a significant positive effect on growth (see Mankiw, 2013, 239-241; Hall and Jones, 1999, 83-116; Klenow and Rodrigues-Clare, 1997, 73-103) and could be observed in the BRIICS (Brazil, the Russian Federation, India, Indonesia, China, and South Africa) countries where investment has been the most significant growth driver (see OECD, 2014, 222, 227). Investment, be it in the form of fixed business investment, government investment or FDI, tends to enhance productivity as it is considered a necessary condition for technological change and progress (see Carreras and Josephson, 2010, 53-55). The government invests in infrastructure (see 4.9.1 General Remarks on Infrastructure as Location Factor) in the form of railroads, streets, and harbors, as well as electricity and the provision of public goods, such as healthcare, education, and sanitation. These government investments enhance the environment in which businesses operate thereby improving their productivity. Business investment in new plants and equipment, but also in R&D, enhances technological change, innovation and, eventually, productivity making businesses more profitable. While the total effect of FDI on economic growth is controversially discussed in economic literature (see Xu and Sheng, 2012b; Jeon et al., 2013; Newman et al., 2015), FDI is also considered to enhance productivity as it encourages competition (see Nabar and N'Diaye, 2013, 13), the process of industrialization (see Nguyen, 2013, 2-3), as well as the adoption of new technologies, by providing local firms and workers the possibility to tap into the know-how and knowledge of international firms (see Jin at al., 2018; 848; OECD, 2014, 80). As such, higher contestability of a market, thus a high share of FDI of total fixed (asset) investment, is considered a sign of higher productivity growth (see Nabar and N'Diaye, 2013, 13). While an increase in investment tends to enhance productivity, it does not necessarily lead to productivity growth. The rapid increase in capital accumulation in China across all provinces between 2000-2010 has not led to a convergence in the level of output per worker. This implies that an increase in investment is not enough for an increase in productivity (see 4.6.6 Productivity) (see Nabar and N'Diaye, 2013, 12).[141]

Fixed investment depends on the interest rate, as the interest rate is the cost of borrowing money and the opportunity cost of investing money in any fixed investment. Businesses, households, and governments must finance their investments. However, businesses have two ways to finance their investments: first, they can receive financial resources in the capital market via stocks, bonds or by borrowing from banks, or second, they can use their own resources in the form of retained earnings (see Burda and Wyplosz, 2013, 161-163). The government can use its wealth or its revenues (e.g., tax revenues) or borrow from banks to finance investments. The cost of investment, thus the cost of capital, is determined by the interest rate. In the firm's decision whether to invest its own resources (retained earnings) in new productive capital or alternatively lend the money to the capital market, 'the real interest rate measures the opportunity cost of the resources used for the investment' (Burda and Wyplosz, 2013, 162-163). Thus, the higher the real interest rate is, the higher the opportunity cost of the investment, thus the less likely the firm is to make an investment in productive capital. If the firm must borrow money in order to make the investment, the real interest rate measures the cost of borrowing the capital for the investment. The same holds for the government. Thus, a higher interest rate has a negative effect on the investment in fixed capital (see Burda and Wyplosz, 2013, 163). Hence, the interest rate is an important indicator of fixed investment as it represents the cost of borrowing or the opportunity cost for investing money in fixed investment.

The total volume of fixed investment, in general, or of FDI, in particular, can be measured in real or nominal terms, as well as by the percentage change of real fixed investment over time. A country's investment can be measured by its investment ratio, which is the investment as a share of GDP.

In the selection process, fixed investment is relevant as an important driver of productivity and economic growth. Furthermore, with regard to constructing and operating a production site, government fixed investments are significant as they are often investments in infrastructure, which has an important effect on the business environment in which the OEM must construct and operate

[141] The discussion of the conditions under which an increase in investment enhances productivity growth is beyond the scope of this work. With regard to the positive effect of investment on productivity, it must be kept in mind (as discussed under productivity) that investment only increases (labor) productivity until investment equals the amount of depreciation, which occurs at the steady state, the long-term equilibrium of an economy. Hence, investment is not the long-term driver of productivity but is necessary to bring the capital stock to or keep it at the steady state.

the production site. This overall business environment at the production site is also important as local suppliers benefit from public fixed investments in the local infrastructure and, consequently, investment in infrastructure tends to increase the number of suppliers of intermediate inputs that produce locally (see Egger and Falkinger, 2003, 25). The level of public fixed investment provides an initial indication of availability and quality of infrastructure. The level of business fixed investment is important, as it is not only relevant for assessing overall economic growth and productivity, but it also provides an insight about the local business climate. This is because private firms tend to invest more when they are optimistic about the future and hold their investments back when they are uncertain or even pessimistic about the future. With regard to the market potential, business fixed investment can serve as an indicator for the sales of trucks as they are a typical fixed asset in which business invest (see 4.12.3 Business Fixed Investment). Furthermore, the share of FDI of total fixed investment, hence the contestability of the economy, hinges on the local level of productivity and competitiveness. Furthermore, sector specific data of inward FDI shows 'which sectors of the economy are of interest to foreign competitors and where long-term growth is expected to be' (Office for National Statistics, n.d.). Thus, FDI should be analyzed to assess the contestability of an economy, in general, or, if data is available on the sector-specific FDI, then the contestability of certain sectors.[142]

Overall, fixed investment is a very relevant location factor for the selection process of a production site. Public investment is especially interesting with regard to the available infrastructure at the production site and the business fixed investment with regard to the business climate. Business fixed investment as an indicator for the market size of investment goods, such as trucks, is considered under the location factor *Business Fixed Investment* (see 4.12.3 Business Fixed Investment). Moreover, the contestability of the economy helps in assessing the level of productivity and competitiveness in the economy.

Table 25: Information and Instructions on the Choice and Evaluation of the Location Factor *Fixed Investment (including Foreign Direct Investment)*

Location factor to be evaluated	**Fixed Investment**	**Foreign Direct Investment (FDI)**
Strategic, operational, or general	Strategic or general	Strategic or general

[142] Data on FDI is often split into FDI flowing into the agricultural sector, the manufacturing sector, or the service sector.

Location factor to be evaluated	**Fixed Investment**	**Foreign Direct Investment (FDI)**
Process-specific / product-specific	-	-
Relevant for production network	+	+
Relevant for the design of the supply chain	+	+
Negotiable	- (The negotiable part of investment falls under subsidy)	-
Semi-external / even performance	-	-
Quantitative or qualitative	Non-cost-related quantitative	Non-cost-related quantitative
Hard or soft	Soft	Soft
Static or dynamic	Dynamic (indicators for future public investment are government announcements or long-term budget plans).	Dynamic
Geographic level of analysis	National and, if necessary, on the regional level	
Unit of measurement	Measurements for a country's investment are its investment ratio (investment as a share of GDP), Investment volume measured in absolute terms (e.g., in US$) and investment growth rate in percentage change of real investment. Based on this information it must be assessed as very low, low, fairly high, high or very high (or numerically as 1 through 5).	Measurements for a country's FDI are its total level of FDI (the volume), as a share of GDP as well as the percentage change. Furthermore, the share of FDI of total fixed investment. Volume of business and government Investment and FDI should be measured in real US$ and the percentage change units in real terms on an annual basis and as a share of GDP. Based on this information it must be assessed as very low, low, fairly high, high or very high (or numerically as 1 through 5).
Evaluation method(s)	o Profile method o Utility analysis	
Phase(s) in the selection process	o Phase 2 (profile method) o Phase 7 (utility analysis)	
Interdependencies with other location factors	o Gross Domestic Product o Political Stability o Productivity o Security o Infrastructure	o Gross Domestic Product o Political Stability o Productivity o Security o Infrastructure o Exchange Rate
Source of information: public databases and information	o European Commission: Economic Performance and Forecast: gross fixed capital formation o IMF: • World Economic Outlook (annual report containing past and forecasted growth rates for gross fixed capital formation) • Data: total investment o World Bank: Data tables: inward direct investment positions by country o National or regional web sites (e.g., Department of Commerce)	o World Bank: Databank: foreign direct investment net inflows (as % of GDP) and total) (only past) o IMF: • Data tables: inward direct investment positions by country • Data: gross domestic product and components: gross fixed capital formation o OECD: • Foreign Direct Investment Statistics: Data, Analysis and Forecasts; in OECD.Stat: FDI positions and FDI financial flows (main aggregates, by partner country, by industry) and FDI income (by partner country, by industry) • Data: FDI flows (inward and outward) and FDI stocks o National or regional web sites (e.g., Department of Commerce) o Research Institutes: e.g., China Briefing o A.T. Kearney: A.T. Kearney Foreign Direct Investment Confidence Index (annual report)
Source of information: commercial external sources	o EIU: CountryData: real gross fixed investment, real stock building, growth of capital stock o IHS Markit: Global Economic Data: cyclical indicators o Oxford Economics: data tool: real fixed investment	o EIU: CountryData: inward foreign direct investment, stock of inward foreign direct investment o Oxford Economics: data tool: total foreign direct investment

Location factor to be evaluated	Fixed Investment	Foreign Direct Investment (FDI)
Source of information: internal know-how	o Economic Department	o Economic Department
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important
(Author illustration)

4.6.6 Productivity

An economy's productivity measures its efficiency to create wealth (see Acemoglu and Dell, 2010, 170) and is 'the most important determinant of the long-run health and prosperity of an economy' (Baumohl, 2013, 335).[143] Productivity growth leads to economic growth, while a lack of productivity growth leads to economic stagnation. Productivity provides an indication of how efficiently firms use 'their employees and their physical capital' (Baumohl, 2013, 335) by measuring the output of production of any unit of input (labor, capital, land) and thus the efficiency of production. A rise in productivity means a higher 'output from a given set of inputs' (Schmenner, 2015, 341). The neoclassical economic theory derives productivity from the production function. This theory differentiates between the productivity of labor, capital, and total factor productivity. Labor productivity is defined as the 'value-added per employee' (OECD, 2014, 35) and measures the efficiency of labor (the output per worker). Capital productivity is the efficiency of capital or the output per unit of capital. Total factor productivity (TFP) is defined as 'the residual explaining value-added after accounting for labor and capital' (OECD, 2014, 35) and determined by the state of technology. An increase in TFP increases output if capital and labor are held constant and thus reflects how efficient labor and capital are combined in the generation of output (see Burda and Wyplosz, 2013, 72-73).

An indicator of productivity is the unit labor costs, which is the cost of labor necessary to produce one unit of product or, in other words, it is how much workers are paid to produce one unit (see Baumohl, 2013, 338). Unit labor costs reflect the output relative to wage or the labor cost per output unit. Hence, the unit labor costs can be affected by both changes in wages, as well as changes in productivity (see OECD, 2002, 27-28). Productivity is also measured in output per hour worked, which is different from the unit labor costs, as it measures how much output one worker produces

[143] Krugman notes '[p]roductivity isn't everything, but in the long-run it is almost everything'. He goes on to explain that '[a] country's ability to improve its standard of living over time depends almost entirely on its ability to raise its output per worker' (Krugman, 1994, 11).

in one hour and is thus not expressed in terms of costs but in terms of output. The assessment of the related costs for the output per hour worked requires information about the relevant wage level.

The output per worker (in one hour) is often difficult to measure. Therefore, in economic theory per-capita income is often used as a proxy for labor productivity. In traditional economic growth theory, the increase in per-capita income is explained by increasing employment and saving rates. However, cross-country differences in employment and saving rates are not enough to explain the sustained increase in per-capita income in industrial economies (see Mankiw, 2013, 236-240; Doppelhofer et al., 2000, 813)) and the significant differences in productivity levels between emerging and advanced countries which remain even after adjusting for differences in purchasing power. These cross-country differences in per-capita income have been addressed by an extensive body of literature, which is beyond the scope of this work. Still, a few aspects are briefly illustrated to create an understanding of some drivers of productivity growth.

Increasing the capital stock makes labor more productive. Hence, investment that leads to a rise in capital stock increases labor productivity. Put differently, the output per worker increases as the capital stock increases. However, not all investment adds to the capital stock, rather part of the investment is needed to replace depreciated capital and thus compensate depreciation. The higher the capital stock, the higher the amount of depreciation, which implies that the higher the capital stock the greater, the share of new investment that must be used for replacing depreciated capital, and the smaller the share that adds to the capital stock. Hence, investment increases labor productivity until investment equals the amount of depreciation, which occurs at the steady state, the long-term equilibrium of an economy. Hence, from an economic theory point of view, investment cannot be the long-term driver of productivity (or as mentioned above of differences in per-capita income) (see Mankiw, 2013, 239-240; Hall and Jones, 1999, 83-116; Klenow and Rodrigues-Clare, 1997, 73-103). Still, the importance of investment as a driver of productivity can be observed in the BRIICS (Brazil, Russia, India, Indonesia, China, and South Africa), where capital accumulation has been the most important driver of productivity and growth (see OECD, 2014, 222, 227). The contrary can be observed in advanced economies: the decrease in growth of capital per worker, be it human or physical capital, since the 1990s, contributed significantly to the decrease in labor productivity in advanced economies (see Dabla-Norris et al., 2015, 7-8).[144] However, as mentioned above, sustained productivity growth must have a different source. The Solow

[144] However, with regard to total investment, Nabar and N'Diaye find that the rapid increase in capital accumulation across all provinces of China in recent years has not led to a convergence in the level of output per worker. This implies

growth model (the neoclassical growth model) assumes that sustained productivity gains and sustained economic growth (or sustained growth in per-capita income) can only stem from technological progress, which leads to increases in the productivity of labor and capital ('labor-augmenting technical change' and 'capital-augmenting technical change') (Acemoglu, 2010, 5). However, while the Solow model suggests that the driving force of productivity is technology, it does not explain from where these differences in technology stem[145] (see Mankiw, 2013, 236-240). In contrast, the first endogenous growth models[146] explain technological change by focusing on human capital as an endogenous source of sustained growth (see Doppelhofer et al., 2000, 813) (see 4.6.7 Human Capital). Hence, these models point to differences in human capital as a source of differences in per-capita income. Thus, investment in both factors of production, physical and human capital, enhances productivity growth. Their relative significance for explaining differences in per-capita income is controversially discussed in economic literature.

Besides these factors, the quality of institutions has a significant effect on differences in sustained growth and per-capita income and thus productivity across countries. The quality of local institutions can even explain differences in per-capita income and productivity within countries (see Acemoglu and Dell, 2010, 170-172).[147] A related aspect also impacts productivity growth: competition and the allocation of resources. Competition and policy measures promoting competition enhance productivity. In contrast, a lack of competition and the resulting misallocation of resources constrain productivity. In China and India, the misallocation of resources significantly constrains productivity compared to the U.S. (see Hsieh and Klenow, 2009, 1421-1424, 1431-1434). According to economic theory, the more productive firms are, the greater their incentive to innovate is, making them more attractive for labor and capital, which forces less productive firms out of the market over time. However, governmental intervention, such as regulations, taxes, subsidies, and state ownership, lead to imperfect competition (see Dabla-Norris et al., 2015, 9, 16). In

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that the factor (capital) accumulation is not enough for an increase in total factor productivity (see Nabar and N'Diaye, 2013, 12).

[145] The Solow growth model considers technology exogenously given, which implies that the model does not explicitly explain what determines the level of technology (see Mankiw, 2013, 236-240).

[146] Endogenous growth models, in which technology is an endogenous variable, have been formulated by Romer (1990a) and Lucas (1988) to determine the source of sustained economic growth (see Barro and Sala-i-Martin, 2003, 63, 213, 239).

[147] In addition to the available factors of production and the available level of technology, the use of technologies, meaning the efficiency in the usage of technologies, especially new technologies, is another source of cross-country differences in per-capita income. Even if the same technology is available in both advanced and less developed countries, the technology is used more efficiently in advanced countries (see Clark and Feenstra, 2001, 1-2), resulting in a higher level of productivity.

China, for instance, the lack of competition has led to a misallocation of resources, as state and state partner monopolies dominate the economy without having to compete in the market as they are protected by regulations or have preferential access to state resources (see Ahuja, 2012, 7-8). A lack of competition leads to a misallocation of resources and overcapacity of production and thus lower productivity levels. These factors, together with the quality of institutions, are not only important for investments in the factors of production, but especially for productivity which, in turn, depends on the ability of firms to create innovation and on how much the environment in which they operate promotes high-quality infrastructure, enhances competition, provides well-functioning administrative procedures and access to credit (see Dabla-Norris et al., 2015, 9, 16). Another important driver of productivity growth are agglomeration effects, which are discussed in more detail under the location factor *Industrial Clusters* (see 4.11 Industrial Clusters). Hu et al. estimate the contribution of agglomeration on productivity growth in the industrial sector in China in the years between 2000 and 2007 to have been 14% (see Hu et al., 2015, 64).

This brief overview of approaches to explain differences in productivity (and per–capita income) has shown that investment in physical, as well as human capital, the quality of institutions, and the level of competition, as well as the allocation of resources, all affect productivity growth. Notwithstanding the controversial literature on sources of sustained productivity growth, there is no controversy about productivity enhancing economic growth.

Besides the relevance of productivity for the economic development of the country under consideration, the level of local productivity also directly affects the construction and operation of the production site. As the local level of productivity depends on the operating environment, which is determined by local factors—such as the quality of institutions, political stability, security, education (human capital), infrastructure (such as streets, railways, waterways, reliable electricity, or water supply), or functioning administration and police—a high level of productivity portends a good operating environment which also benefits the OEM. Higher productivity also suggests the availability of skilled workers, which is especially important in the automotive industry, where skilled workers are required to operate or repair the necessary machines. The OEM needs an operating environment in which it can construct and operate the production site with sufficient productivity. If the OEM cannot reach a sufficient level of productivity at the production site (see Meyer, 2006a, 61), potential gains from low costs of labor or other inputs will be reduced. Moreover, the local level of productivity also reflects how productive local suppliers and service providers are.

This is relevant to constructing and operating the production site with regard to locally sourced components and services.

The local level of productivity is very important in the selection process, even though the productivity at the production site will certainly be enhanced by the technology, machinery, and know-how the OEM brings. Some even claim that low levels of productivity in emerging countries are less of a problem for experienced international firms, as they can ensure high-quality and productivity at their production sites in emerging countries thanks to their management methods and modern production techniques, if they successfully implement their experience and technical know-how. This argument is based on the assumption that output per worker not only depends on the initial local productivity level but is strongly influenced by the international firm (see Meyer, 2006a, 57-58). This is without doubt true to a certain degree, as the international OEM can develop local suppliers to improve their productivity and spend on local infrastructure and education (be it vocational training, dual education, or on-the-job training) to increase the productivity at the production site. However, increasing local productivity by these kinds of measures requires time and money. Furthermore, it must be noted that a minimum initial productivity is required at the production site for the OEM to reach sufficient productivity for the successful construction and operation of the production site.

Moreover, in order to best take advantage of low labor costs, the local productivity of labor and capital must be analyzed for an optimal adjustment of the degree of automation. By adjusting the degree of automation, the substitution of labor and capital can be regulated depending on the ratio between capital and labor productivity at the production site. As labor and capital are partial substitutes in the production, the local productivity of both must be carefully analyzed and the degree of automation optimally adjusted (see Meyer, 2006a, 61-62). (The possible degrees of automation for the production of the particular product, which are efficient and guarantee the required quality of production, must be specified in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile).)

Hence, the level of productivity at a production site is an indicator of the quality of the operating environment, the productivity of local suppliers and service providers, as well as the availability of skilled workers. Thorough analysis of the local productivity in the selection process is necessary to assess the possibility of reaching the required minimum level of productivity at the production site and whether that minimum level of productivity can be reach at reasonable costs and in reasonable time. Furthermore, assessing the level of productivity in combination with the labor costs is necessary for deciding the optimal degree of automation which should be implemented at the production site.

When evaluating the level of local productivity, it is important to be aware that productivity varies significantly not only across countries, but also across regions and industries. Thus, in order to get an overall understanding of productivity in the country, the productivity for the entire economy should be taken into consideration; additionally, industry- and region-specific productivity must be assessed as well. Assessing region- and industry-specific productivity, which in the case of an OEM is normally the entire manufacturing sector, is more difficult due to data availability issues. Following the discussion, productivity can be measured as unit labor costs (as well as output per hour worked, which is though difficult to measure) or approximated as per-capita income (volume and growth). Some institutes also compose a productivity indicator (e.g., Oxford Economics). Any of them can be used to gain a better understanding of productivity.

Table 26: Information and Instructions on the Choice and Evaluation of the Location Factor *Productivity*

Location factor to be evaluated	**Productivity**
Strategic, operational, or general	Strategic
Process-specific / product-specific	Process-specific
Relevant for production network	-
Relevant for the design of the supply chain	-
Negotiable	-
Semi-external / even performance	Semi-external and performance
Quantitative or qualitative	Non-cost-related quantitative
Hard or soft	Soft
Static or dynamic	Dynamic
Geographic level of analysis	National and regional
Unit of measurement	Measured as an annual percentage change, unit labor costs and per-capita income (in real US$). Productivity should be assessed as very low, low, fairly high, high or very high (or numerical as 1 through 5).
Evaluation method(s)	o Strategic considerations o Profile method o Utility analysis
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 7 (utility analysis)
Interdependencies with other location factors	o Availability of Skills o Wage Level o Gross Domestic Product o Openness to Trade and Position in the Global Value Chain
Source of information: public databases and information	o World Bank: Databank: GDP per person employed o OECD: OECD.Stat: Productivity and ULC: income per-capita and GDP per hour worked (for total industry and by main economic activity, e.g., manufacturing), unit labor costs o European Commission: Economic Performance and Forecast: unit labor costs (whole economy) o Websites of national or regional statistics institutes, governments (e.g., Department of Commerce) and national statistical yearbooks
Source of information: commercial external sources	o EIU: CountryData: unit labor costs, labor cost per hour, GDP per head, labor productivity growth, total factor productivity growth o IHS Markit: Global Economic Data: labor market o Oxford Economics: data tool: unit wage cost, GDP per-capita

Source of information: internal know-how	o Economic Department o Employees working in the country o Other departments with experience with the country and region under consideration and through exchange with other firms, which have experience with the country and region under consideration
Source of information: external consultants	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.6.7 Human Capital

Human capital is the 'intrinsic productive capabilities' of people and reflects capabilities, which can produce goods and services and impact personal income (Eide and Showalter, 2010, 27). In contrast to 'human knowledge', which is 'just human' and belongs to everyone, 'human capital' is 'the knowledge of particular people' and thus personal to individuals and impossible to alienate from them (Lucas, 1988, 15). Human capital is people's 'knowledge and skills' enabling 'them to create value in the global economic system' (World Economic Forum, 2017, vii). Further, it consists of 'the knowledge and skills that workers acquire through education, from early-childhood programs […] to on-the-job training for adults' (Mankiw, 2013, 244). Broader concepts of human capital also include people's health, social status, and their attitude towards work (see Bröckling, 2003, 18).

Human capital is usually measured in years of schooling or on-the-job training. The human capital theory explains differences in income with differences in education activities or investment in human capital as they lead to differences in productivity, which, in turn, are reflected in different income levels. In terms of growth, according to human capital theory, higher levels of human capital increase the productivity of labor and capital and thus have an endogenous effect on growth (see Romer, 1990a and 1990b).[148] Moreover, growth in human capital enhances the adoption of technology that increases the productivity of skilled-labor and leads to productivity growth in skill-intensive industries (see Ciccone and Papaioannou, 2009, 66-67). Furthermore, human capital not only increases the productivity of the individual, who embodies that level of human capital, but also raises the productivity of other production factors by improving production processes, by better managing other workers, or by better operating complex machines (see Burda and Wyplosz, 2013, 86-87). As the capabilities of a person can be increased through education, investments in

[148] Uzawa had already developed a model in 1965, in which the sustained per-capita income growth exclusively depends on endogenous human capital accumulation, claiming, that 'no external engine of growth is required' (Lucas, 1988, 19).

education lead to a higher level of human capital, which results in a higher quality of labor and productivity (see Eide and Showalter, 2010, 27-32; Gunderson and Oreopoulos, 2010, 37-43) and, in turn, in higher wage levels. Therefore, an important driver of human capital is investment in education (or educational activities), such as in schools, other educational institutions, or teachers. Based on the broader concept of human capital, investments in the health care system also promote human capital by enhancing the health of the population. Hence, human capital enhances productivity and growth, while human capital depends on the investment people make in their capabilities, firm's make in their employees' capabilities, or the government makes in people's education (and health). When assessing human capital, the Global Human Capital Index is of special interest as it analyzes the level of human capital using four dimensions to rank 130 countries. The four dimensions are capacity, deployment, development, and know-how. The capacity sub-index captures 'the existing stock of education across generations', the deployment sub-index quantifies 'skills application and accumulation of skills through work', the development index covers 'current efforts to educate, skill and upskill the student body and the working age population' while the know-how index reflects the breadth and depth of specialized skills used at work' (World Economic Forum, 2017, vii).

When selecting a production site, it is important to consider the stock of human capital in the country under consideration, not only because human capital is an important driver of productivity and growth, but because it also provides an indication of the overall level of available skills and education of the population. While the level of human capital on the national level does not help precisely illustrate the availability of skills at the production site required for its operation, the level of human capital is especially important as an indicator of the long-term path of the accumulation of skills and the level of education of the population. When selecting a production site, the broader concept of human capital, including other aspects, such as health and life expectancy, are also of interest as the successful operation of the production site benefits from a well-educated and healthy work force. Hence, human capital should be analyzed in the narrower concept in terms of education (e.g., years of schooling (in primary, secondary or tertiary schools), literacy rate, or the related public investment in education). Still, human capital should also be analyzed in the broader concept, including health (e.g., public health expenditure) and life expectance (e.g., life expectancy at birth).

Overall, the level of human capital is important as an indicator of the long-term path of the accumulation of skills and the level of education of the population and, in its broader concept, also serves as an indicator of the health of a population. Human capital in both the narrow concept and the broad concept is a driver of productivity and growth in the overall economy but also benefits the operation of the production site. Especially for an OEM, where skills are particularly important, the development of human capital should be considered given the long planning horizon of a production site and in the face of the global competition for talent.

Table 27: Information and Instructions on the Choice and Evaluation of the Location Factor *Human Capital*

Location factor to be evaluated	**Human Capital**
Strategic, operational, or general	Strategic
Process-specific / product-specific	-
Relevant for production network	+
Relevant for the design of the supply chain	+
Negotiable	-
Semi-external / even performance	-
Quantitative or qualitative	Non-cost-related quantitative
Hard or soft	Soft
Static or dynamic	Dynamic
Geographic level of analysis	National
Unit of measurement	Measured in terms of government expenditure per student; government expenditure on education as a percentage of GDP; mean years of schooling; literacy rate or by using the ranking from the WEF report. Based on this information it should be assessed as very low, low, fairly high, high or very high (or numerically as 1 through 5).
Evaluation method(s)	o Strategic considerations o Profile method o Utility analysis
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 7 (utility analysis)
Interdependencies with other location factors	o Availability of Skills o Gross Domestic Product o Productivity
Source of information: public databases and information	o UNESCO: UIS Statistics – UNESCO; Database: possible indicators: e.g., government expenditure per student; expenditure on education as % of GDP; mean years of schooling; literacy rate. o HDX: mean years of schooling (of adults) o United Nations Development Programme: Human Development Reports: • International Human development indicators: country profile (see health and education subsections) • Expected years of schooling (of children) o World Economic Forum: 'The Human Capital Report. Annual report with an analysis of general global trends and developments in human capital and a human capital ranking of 130 countries (including ranking by age groups). o World Bank: • Databank: possible indicators: literacy rate (adult and youth), government expenditure on education, total (as % of GDP and as % of total government expenditure), government expenditure per student on education (primary, secondary, tertiary) (as % of government expenditure on education), duration of compulsory education, education attainment (primary, secondary, tertiary) health expenditure, public (as % of total health expenditures), health expenditure, public, (as % of GDP), health expenditure per-capita, life expectancy at birth (female, male and total). • DATA:EDSTATS; The State of Education: ample data on country level on education by quality, access, pre-primary, primary, secondary, tertiary, literacy rate, expenditure, equality and gender. o Wittgenstein Centre for Demography and Global Human Capital: Wittgenstein Centre DataExplorer: Data on Population & Human Capital Stocks.

Location factor to be evaluated	Human Capital
Source of information: commercial external sources	-
Source of information: internal know-how	o Economic Department o Local Liaison Offices
Source of information: external consultants	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.6.8 Openness to Trade and Position in the Global Value Chain

A country's trade of goods and services indicates its 'integration into the world economy'. The importance of trade for an economy is reflected in the county's total trade as a share of total GDP. This ratio is referred to as 'trade openness' (OECD, 2010b, 58b) or openness to trade (see World Integrated Trade Solutions (n.d.), and is an indicator of the competitiveness of an economy and of how well an economy is integrated into the global value chain. Growth and openness to trade are considered to be positively correlated, as countries with a greater openness to trade tend to grow at faster rates. Traditional economic theory assumes that trade enhances growth: while Smith (1776) argued that trade enhances growth based on absolute advantage and specialization, Ricardo (1817) developed the concept of comparative advantage that postulates that all countries participating in trade benefit from it. The trade theory built on these concepts assumes that countries which participate in trade are more competitive and produce more efficiently, which enhances growth and ultimately leads to a higher standard of living. This theory has been controversially discussed in economic literature, but by and large research has shown that openness to trade enhances growth and the standard of living (see Mankiw, 2013, 240-241). One of the reasons for this positive correlation is that trade intensifies competition, as trade forces domestic firms to compete not only with domestic but also with international firms and hence to innovate and produce efficiently (see Burda and Wyplosz, 2013, 101-102). Trade also enhances growth by spreading knowledge, innovation, and technologies across borders[149] (see Gylfason, 1999, 35). As countries are only able to export goods which they produce at a globally competitive level, the analysis of

[149] Trade strengthens competition, which, in turn, enhances efficiency and thus growth. It does so mainly through reallocation and reorganization. Reallocation of resources occurs due to the clearing of existing price distortions that have kept resources inefficiently employed in protected sectors, where, under (free) trade, domestic producers must compete at world prices. This reallocation of production factors to where they are applied more efficiently, enforced by international competition, increases the efficiency of production, which in turn increases overall output, holding inputs constant, and thus economic growth. In addition to the reallocation of resources trade due to the enhanced competitive pressure also induces a reorganization of production by adopting new technologies and more efficient production techniques, which also leads to an increase in output holding inputs constant (see Gylfason, 1999, 83-86).

the products that a country exports provides information about the most competitive sectors of an economy (unless the sector is heavily subsidized or its competitive advantage is mainly based on endowments of, for instance, natural resources). Moreover, based on the link between export and competitiveness, the trade balance of a country is an indicator, even if it is a very general indicator, of the competitiveness of a country or a sector. The trade balance reflects net exports, thus a country's exports minus imports. A trade surplus usually reflects a relatively high competitiveness of a country or a sector[150] (see OECD, 2010b, 60).[151]

The level of competitiveness and the performance of exports of a country or a sector within a country are closely connected to the country's 'integration into global production chains' (OECDiLibrary, n.d.) such that 'the ability of countries to prosper depends on their participation in the global economy' and thus in Global Value Chains (GVCs) (Gereffi, 2020, 130). GVCs, also referred to as global production chains or global supply chains, are the 'proliferation of internationally joined-up production arrangements' (Fung, 2013, xix). GVCs have become increasingly important since the 1970s and '80s due to fundamental economic changes driven by 'advances in information, communication and transport technologies' (Fung, 2013, xix). The rising production in GVCs implies an increasing international fragmentation of production, which 'challenges the conventional perception and interpretation of trade statistics' (OECD, 2013b, 54): traditional trade measures count the 'gross flows of goods and services every time they cross borders'; however, trade along GVCs can no longer be counted like that, as it results in a '"multiple" counting of trade' (OECD, 2013b, 53), as intermediate goods comprise a large 'share of local production and exports' (Fung, 2013, xix). Thus, analyzing total exports exclusively does not provide a good indication of the share of the content of exports that has been produced in the country, hence the domestic value added[152] of exports. Instead, it is also necessary to assess the 'import content' of exports (Fung, 2013, xix-xx). Thus, exports must be broken down 'into their domestic value-added (DVA) content

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150 Here, it must be noted that the competitiveness of an economy or a sector does not exclusively determine the trade balance. Unbalanced growth between the domestic and the export markets and the terms of trade, thus the ratio between the price of imported and exported goods, also affect the trade balance (see OECD, 2010b, 60).

151 A related aspect is foreign direct investment (FDI) (see 4.6.5 Fixed Investment (including Foreign Direct Investment)), which is considered to enhance local competitiveness by strengthening competition (see Nabar and N'Diaye, 2013, 13) and by facilitating the introduction and the adaption of new technology and know-how (see OECD, 2014, 154). This is why the contestability of an economy, which is foreign direct investment as a share of total fixed (asset) investment, can serve as an indicator of the level of competitiveness of an economy (see Nabar and N'Diaye, 2013, 13).

152 Value added is defined as the amount by which 'the market value of a product at a particular stage of production' increases, thus value added is the difference between 'the value of all inputs bought from other firms' and 'the value of the firm's output' (Burda and Wyplosz, 2013, 563).

and their foreign value-added (FVA) content'. The DVA content of exports has three parts. First, DVA 'sent to consumer economy' is DVA 'embodied either in final or intermediate goods or services that is directly consumed by the importing economy'. Second, DVA 'sent to third economies' is the DVA embodied 'in intermediates (goods and services) exported to an economy that re-exports them to a third economy as embodied in other goods and services'. Third, the DVA 're-imported in the economy' hence the DVA contained in 'exported intermediates […] that is sent back to the economy of origin as embodied in other intermediates and used to produce exports'. The FVA content of exports 'corresponds to the value added of inputs that were imported in order to produce intermediate or final goods/services to be exported' (World Trade Organization, n.d.b).

Based on the analysis of the DVA and FVA content of exports, it is possible to assess the upstream and downstream links through which a country participates in GVCs. The upstream links of an economy are those through which it imports foreign inputs and processes them to produce the goods and services it exports. The participation in the GVC through upstream links is referred to as backward GVC participation. The downstream links of an economy are those through which it exports domestically produced inputs to other economies where these inputs are processed in production stages that are further downstream. The participation in the GVC through downstream links is referred to as forward GVC participation. The GVC participation is captured in the GVC participation index which consequently has two parts: one reflects the upstream links of a country in the GVC, and the other reflects its downstream links in the GVC. Forward participation in the GVC is reflected by the indicator 'Domestic value-added sent to third economies' as it 'captures the domestic value-added contained in inputs sent to third economies for further processing and export through the value chain'. Backward participation in the GVC is reflected by the indicator 'foreign value-added content of exports' as it captures the intermediates an economy imports to produce exports'[153] (World Trade Organization, n.d.b).

Emerging Market Economies (EMEs) generally have a large amount of imported content, thus FVA share in their exports relative to advanced economies and their share of indirect exports that is sent to third countries is relatively small. As such, many sectors in EMEs have a further downstream position in the GVC, meaning that a relatively large share of the DVA of their exports

[153] Another widely used indicator to measure the export competitiveness of a country is the Export Similarity Index (ESI), which measures the degree of export similarity between countries (see Riad et al., 2012, 27-30).

are produced in lower value-added production processes in which final products are often assembled from imported components (see Riad et al., 2012, 16). Exports can be categorized into 'primary products', resource-based manufactured products, or low-, medium- and high-tech manufactured products (Gereffi, 2020, 143). The analysis of exports over time can reveal significant changes of a country's position in the GVC: Chinese exports show how changes in the composition of a country's or a sector's exports can provide insight about its position in the global value chain: the share of Chinese DVA in German, Japanese and U.S. manufacturing exports has significantly increased in the decade after 1995 with a concentration on high and medium-high technology goods (see Riad et al., 2012, 19). This change occurred at the same time that the share of labor-intensive consumption goods in total exports has decreased by more than 20%, while the share of capital goods and components in total exports has increased from 10-15% to over 40% (see Cui and Syed, 2007, 7). Both changes in China's production structure reflect an upstream move in the GVC.

When selecting a production site for an OEM, the trade openness of a country can serve as an indicator for the overall competitiveness of a country and its integration into the GVC. However, when analyzing exports, it is necessary to differentiate between the DVA and FVA content of exports given the increasing fragmentation of production in GVCs. The analysis of the export content is relevant to the selection of a production site, as a higher share of DVA content of exports, thus a more upstream position in the GVC, usually requires a higher level of technological content in exports. The production of products with a higher level of technological content is only possible if the country has workers who possess a certain minimum level of skills, a favorable business environment (see Riad et al., 2012, 24), and a relatively high level of competitiveness. Moreover, a higher position at the GVC hints to the availability of infrastructure, a skilled workforce, and standards or certifications (Gereffi, 2020, 148-150). The evaluation of the DVA versus the FVA content of exports of a certain sector of an economy is also helpful when selecting a production site since it provides a hint as to the position of the sector in the GVC and on the sector-specific competitiveness. This is not only important with regard to the operation of the production site itself, but also as an indicator of the quality of local suppliers, and whether they produce competitively and have highly skilled labor at their disposal in a functioning business environment.

Table 28: Information and Instructions on the Choice and Evaluation of the Location Factor *Openness to Trade and Position in the Global Value Chain*

Location factor to be evaluated	**Openness to Trade**	**Position in the Global Value Chain**
Strategic, operational, or general	Strategic	Strategic
Process-specific / product-specific	-	Process-specific and product-specific
Relevant for production network	+	+
Relevant for the design of the supply chain	+	+
Negotiable	-	-
Semi-external / even performance	-	-
Quantitative or qualitative	Non-cost-related quantitative	Non-cost-related quantitative
Hard or soft	Soft	Soft
Static or dynamic	Dynamic	Dynamic
Geographic level of analysis	National level (if possible is the regional analysis interesting)	
Unit of measurement	Measured as total trade exposure as a percentage of total GDP. Assessed as very low, low, fairly high, high and very high (or numerically as 1 through 5).	Measured in terms of goods and services a country exports and imports and the value added in a country. Assessed as very low, low, fairly high, high and very high (or numerically as 1 through 5).
Evaluation method(s)	o Strategic considerations o Profile method	
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method)	
Interdependencies with other location factors	o Gross Domestic Product o Availability of Skills o Productivity	
Source of information: public databases and information	o WTO: Resources, Statistics, Statistics database: trade profiles: detailed information about merchandise trade broken down by main commodities, main destination and main origin. o World Bank: • Databank: exports of goods and services (total and as % of GDP); trade as % of GDP. • World Integrated Trade Solution • Trade Stats: by country (detailed sector-specific trade information, openness to trade). o OECD: OECD Data: trade in goods (exports, imports and net trade (trade balance)). o DHL: Global Connectedness Index (GCI) (global connectedness, measured by cross-border flows of trade, capital, information and people).	o WTO: Resources; Statistics; • Statistics database: trade profiles: detailed information about merchandise trade broken down by main commodities, main destination and main origin. • GVCs: profiles: detailed country profiles on trade in value added and Global Value Chains. o World Bank: • World Integrated Trade Solution • Databank: manufacturing exports (as % of merchandise exports) • Trade Stats: by country (detailed sector-specific trade information). • Analytical database; Export of value added: by country (detailed sector specific information). o UN Industrial Development Organization: the Competitive Industrial Performance index (CIP) sub-indices: manufacturing value added per-capita, Manufacturing export per-capita, Industrial intensity, Export quality, Impact of a country on world manufacturing value added and Impact of a country on world manufacturing trade. o OECD: • OECD-WTO: Statistics on trade in value added (TiVA): OECD.Stat: domestic/foreign value added share of gross exports; Industry domestic/foreign value added contribution to gross exports. • OECD.Stat: OECD Global Value Chains indicators: Index of the number of production states (total, domestic and international), participation index (total, backward and forward). • OECD Data: trade in goods (exports, imports and net trade (trade balance)); domestic value added in gross exports and import content of exports.

Location factor to be evaluated	Openness to Trade	Position in the Global Value Chain
Source of information: commercial external sources	o EIU: CountryData: trade balance, exports and imports (goods and services), main export and import markets, principal exports and imports o IHS Markit:Global Economic Data: merchandise trade, national accounts o Consensus Economic: current account balances o Oxford Economics: data tool: exports of goods and services, imports of goods and services, total trade balance	-
Source of information: internal know-how	o Economic Department	o Economic Department
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.6.9 Membership in Free Trade Agreements

A considerable part of total global trade occurs between countries that are members of formal Free Trade Agreements (FTAs). Through these FTAs, countries grant each other trade policy related preferences. The largest regional FTAs are the EU, NAFTA, ASEAN, and MERCOSUR (see Walter, 2004, 33). Agreements that aim to enhance and facilitate trade come in the form of cooperation and integration agreements. Cooperation agreements include general cooperation agreements which countries sign to cooperate in a clearly defined field or project, preferential agreements which countries sign to provide each other preferential status compared to third countries, and association agreements which countries sign to express the mutual intention of future integration between them. As such, integration agreements are differentiated depending on their degree of integration into a free trade zone, a tariff union, a common market, an economic union, and a political union: while in a free trade zone all tariffs and NTBs are abolished to facilitate trade within the zone, a tariff union is a free trade zone that additionally has a common trade policy with third countries. A further step in terms of integration is the common market, which is a free trade zone with a common trade policy, that additionally requires its members to create common economic conditions, including the free movement of factors. The most integrated are the economic unions and political unions. Economic unions have, along with the common market, a common system of economic policies and measurements. Likewise, they can also be currency unions if they introduce a common currency. Political union is given when an economic union also has a common legislative, executive, and judicial system (see Kutschker and Schmid, 2011, 182-187).

Besides the general relevance of a country's membership in FTAs for trade and growth, membership in FTAs of the country under consideration is significant in several respects when evaluating production sites for an OEM. First, it suggests that the competitive pressure in the country has most likely increased due to the membership, increasing efficiency through reallocation and reorganization of resources towards the most efficient sectors of the economy, thereby strengthening specialization and competition. Second, membership in FTAs usually enhances integration into GVCs (see OECD, 2014, 28; 4.6.8 Openness to Trade and Position in the Global Value Chain), which also strengthens specialization of and competition within sectors. Third, the membership in a FTA grants that goods and services can be traded within the trade zone at lower or even no tariffs, and possibly with having to overcome fewer or no NTBs. This is important, as the OEM must import many components for operating the production site and will likely export the products produced therein, whether they are components or final products. Hence, with regard to components that must be imported into the country in which the production site is located, existing and planned FTAs must be analyzed to facilitate that import with regard to tariffs and NTBs. If the product is a component, then FTAs should facilitate its export to all production sites of the OEM at which the component is further processed. If the product is a finished product, FTAs should facilitate its export into sales markets. For instance, producing in Mexico allows an OEM to sell the product in the U.S. and Canada without having to pay tariffs thanks to NAFTA. Likewise, producing in Hungary allows the OEM to sell its product in the EU without having to pay tariffs thanks to the EU. Such a membership in FTAs can make small markets attractive for production sites (e.g., eastern European countries) given the ease of exporting products from there into larger markets of countries which are also members of the FTA (e.g., Germany in the case of the European Union) (see Bilbao-Ubillos and Camino-Beldarrain, 2008, 150). Hence, if the product is a final product, the market size for the product, hence the area in which the product can be sold profitably, depends on the FTAs which the country under consideration has signed. Thus, membership in FTAs determines the geographic market size, hence the geographic region, in which the product can be sold, increasing it from only the domestic market to all markets included in the FTA. Clearly, reduced tariffs and NTBs in FTAs have a direct effect on costs and the complexity of operating the production site. Fourth, FTAs often contain special agreements regarding the protection of investments, property rights or intellectual property rights, and offer dispute settlement procedures which are beneficial for operating a production site. Moreover, membership in FTAs makes member countries more inclined to be committed to standards and, depending on the FTA, there are appellant bodies and enforcement mechanisms in place which also benefit the operation of the production site.

When evaluating FTAs in the selection process, it is important to consider not only their current state, but to also take ongoing negotiations and developments into account. This includes negotiations over new FTAs (e.g., EU and Canada Comprehensive Economic and Trade Agreement (CETA)) but also over changes of existing FTAs (e.g., NAFTA negotiations) or the exit of members from FTAs (e.g., Brexit). Moreover, it is necessary to thoroughly analyze the links between different FTAs and the effect the membership of countries in several FTAs has on constructing and operating a production site in the country under consideration. Especially relevant for evaluating FTAs when selecting a production site is analyzing if the automotive industry and its components and products are included in those FTAs, and how the tariffs are reduced for trade in the signatory countries of the FTAs for the relevant components and products. For the analysis of relevant local content regulations, one key question with regard to FTAs is how much regional content, hence content from signatory countries of the FTAs, components or products must have to qualify for the preferential trade in the signatory countries of the FTAs.

Table 29: Information and Instructions on the Choice and Evaluation of the Location Factor *Membership in Free Trade Agreements*

Location factor to be evaluated	**Membership in Free Trade Agreements**
Strategic, operational, or general	Strategic, operational, and general
Process-specific / product-specific	-
Relevant for production network	+
Relevant for the design of the supply chain	+
Negotiable	Not in the short-term but the membership of certain countries in certain FTAs can be lobbied for.
Semi-external / even performance	-
Quantitative or qualitative	Qualitative
Hard or soft	Soft
Static or dynamic	Dynamic (e.g., government announcements, ongoing negotiations)
Geographic level of analysis	National
Unit of measurement	Assessed as not integrated, slightly integrated, fairly integrated, integrated and very integrated in relevant FTAs (or numerically 1 through 5).
Evaluation method(s)	o Strategic considerations o Minimum Criteria o Profile method o Utility analysis
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 7 (utility analysis)
Interdependencies with other location factors	o Tariffs o Non-Tariff Barriers to Trade o Connectivity to Component Suppliers o Connectivity to Other Firm-owned Production Sites o Market Size and Market Share
Source of information: public databases and information	o WTO: • Participation in Regional Trade Agreement; by country analysis of ‘Participation in Goods & Services RTAs’. • Bi-annual reports on: ‘Recent RTA Development’ o European Commission: Countries & Regions o ACEA: International Trade o VDA: Topics - Economic Policy and Infrastructure – Trade – Global Trade Agreements o Country websites, e.g., in the United States: International Trade Administration or the Office of the United States Trade Representatives (Free Trade Agreements). o bilaterals.org: information on the membership in trade agreements and negotiations
Source of information: commercial external sources	-
Source of information: internal know-how	o Industrial Policy Department o Political Department
Source of information: external consultants	+

Key: ‘+’: yes / relevant / important; ‘-‘: no / irrelevant / not important

(Author illustration)

4.6.10 Interest Rates

The interest rate is the ‘return to saving’ and the ‘cost of borrowing’ or, put differently, the ‘market price at which resources are transferred between the present and the future’ (Mankiw, 2013, 603). On the one hand, the interest rate is the ‘cost of borrowing’ money and thus the cost of capital. Hence, when interest rates are low, people and firms are more likely to borrow capital, holding all else constant, and, when interest rates are high, they are less likely to borrow capital, holding all else constant: as the interest rate increases, the cost of borrowing and the yields from saving rise, and firms reduce their fixed investments and consumers spend less on investment goods. Thus, an increase of the interest rate reduces fixed investment and consumption and thus the demand for goods and services. Hence, a change in the interest rate changes the demand for goods and services (consumption and investment). While the interest rate also effects consumption, as consumers borrow money to buy consumer durables, such as cars, this section focuses on the effect the interest rate has on firms' fixed investment. Firms have two ways to finance their investments: first, they can receive financial resources in the capital market via stocks, bonds or by borrowing from banks, or second, they can use their own resources in the form of retained earnings. When borrowing from banks, firms must pay interest. Therefore, if the firm must borrow money to make a fixed investment,[154] the interest rate measures the cost of borrowing the capital for the fixed investment, thus the cost of capital, and, consequently, a higher interest rate, has a negative effect on fixed investment (see Burda and Wyplosz, 2013, 161-163).[155] Hence, fixed investment depends on the interest rate, which is the cost of borrowing capital.

On the other hand, the interest rate is the return one receives for investing money in interest-bearing bank deposits or bonds, and thus, the interest rate is also what people forgo for holding their money or using it for fixed investments. Hence, the interest rate is the opportunity cost of holding money or using it for fixed investments. The theory of liquidity preference postulates that 'the interest rate adjusts to equilibrate the money market'. Hence, the interest rate changes in response to changes in the supply and demand for real money balances: if the money market is not in equilibrium, people adjust their portfolios (thereby changing the interest rate) until the money market is in equilibrium (Mankiw, 2013, 316).[156]

With regard to the interest rate, it is important to differentiate between the nominal and the real interest rate. The nominal interest rate is the stated or actual interest rate (see Varian, 2006, 191, 200), whereas the real interest rate is the nominal interest rate corrected for inflation. 'The

[154] In the firm's decision whether to invest its own resources (retained earnings) in new productive capital or alternatively lend the money to the capital market, 'the real interest rate measures the opportunity cost of the resources used for the investment' (Burda and Wyplosz, 2013, 162-163) in productive capital. Thus, the higher the real interest rate is, the higher the opportunity cost of the investment in productive capital, thus the less likely the firm is to make an investment in productive capital.

[155] This inverse relationship between fixed investment and the interest rate is captured in the IS curve of the IS-LM model.

[156] This is captured in the LM curve of the IS-LM model (see Mankiw, 2013, 316).

nominal interest rate is the interest rate […] that investors pay to borrow money' and thus 'measures the true cost of borrowing' (Mankiw, 2013, 64).[157]

As the real interest rate is simply the nominal interest rate minus inflation, it is of interest to consider what determines the nominal interest rate. While the interest rate changes, as explained above, to adjust to changes in the supply and demand for real money balances to equilibrate the money market, the interest rate also changes if the GDP of an economy changes. According to the theory of liquidity preference, a change in GDP changes the demand for money in the economy and hence leads to a change in the interest rate: a higher GDP results in an increase of the interest rate. Moreover, the supply of money can be altered by means of monetary policy. If the central bank changes the money supply, the equilibrium interest rate normally changes: an increase in the money supply leads to a lower interest rate, while a decrease in the money supply results in a higher interest rate. However, this is only true in the short-term. In contrast, in the long-term, a decrease in money supply results in a fall in inflation, as well as in expected inflation, which, in turn, decreases nominal interest rates in the long-term, as, according to the Fisher-effect, nominal interest rates are simply the sum of real interest rates and expected inflation (see Mankiw, 2013, 108-111). Hence, a change in the money supply by the central bank affects the nominal interest rate, but differently in the short-term and in the long-term. Overall, interest rates change as a response to portfolio changes, to changes in GDP, as well as to changes in the money supply of the central bank.

Moreover, interest rates vary across different countries, which is referred to as international interest rate differentials.[158] There are two reasons for differences in interest rates across countries: country risk and expected exchange rate changes. When borrowing money in countries with a high country risk (for instance, a high risk that the borrower cannot repay the loan with interest due to

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[157] The relationship between the nominal and the real interest rate is formally captured in the Fisher equation stating that the nominal interest rate is the real interest rate plus inflation.

[158] According to the law of one price, there must not be any differences between interest rates across countries, because higher interest rates in one country would cause people to lend their money to that country to receive the higher return, which would lead to an increase in the country's interest rates. Based on this idea, the simple interest rate approach has been developed to explain foreign investments. The approach assumes that different endowment of capital across countries lead to differences in interest rates across countries. Assuming national capital markets, the interest rate will be low in capital-rich countries and high in capital-poor countries and, as capital is mobile, it will be transferred to countries with high interest rates as long as cross country differences in the interest rate exist (see Mankiw, 2013, 146-147, 370-375; Kutschker and Schmid, 2011, 405-408).Thus, foreign direct investment according to the simple interest rate approach is conducted because of differences in cross-country interest rates, as capital will flow from capital-rich to capital-poor countries thereby equilibrating international interest rates (see Mankiw, 2013, 146-147, 370-375; Kutschker and Schmid, 2011, 405-408).

political instability) or high expected exchange rate changes (e.g., a sharp depreciation), the interest rate is higher due to a risk premium. Hence, a higher country risk or expected exchange rate changes increase the risk premium that must be paid to borrow in the country, and thus leads to higher interest rates (see Kutschker and Schmid, 2011, 403-406).[159] Hence, the risk specific to a certain country leads to a risk premium which borrowers in that country must pay for receiving a loan. This country specific risk premium leads to differences in interest rates between countries, so-called interest rates differentials.

There are two main reasons for taking the interest rate into consideration in the selection process for a production site. First, the interest rate, as cost of capital, reflects the country risk and expected exchange rate changes. It is important to take that country risk into account as the financial risk of the investment also depends on the political, social, or economic conditions in the country in which the investment will be made. The amortization of the investment is at risk if the political, social, or economic conditions impair the construction and operation of the production site, making the investment less profitable or even leading to a loss thereof. Thus, to prevent underestimating the costs of the investment for a production site abroad, the costs of capital should be assessed depending on the risk of default[160] specific to that country (see Meyer, 2006a, 50). Hence, the investment should be profitable at the capital costs specific to the location (the local interest rate) to adequately reflect the country risk.

The second reason for taking the interest rate, and thus the cost of capital, into account in the selection process is that a lower interest rate in the country of the production site enables the OEM to borrow capital at low costs in the country of the production site to pay for its construction and operation. The OEM also needs financial capital for the construction and operation of the production site (Varian, 2006, 323).[161] The OEM can borrow financial capital from local banks at the production site, thereby minimizing exchange rate risks associated with the production site. Hence, a low interest rate in the country can reduce overall costs for the production site by decreasing the

[159] The risk premium, as a reason for interest rate differentials is captured in the extended interest rate theory, stating that capital (e.g., in the form of foreign direct investment) flows only from capital-rich to capital-poor countries as long as the absolute cross country difference in interest rates are higher than the related costs for information and capital transactions, as well as additional risks and uncertainty (see Kutschker and Schmid, 2011, 403-406).
[160] Default is defined as 'the failure to make scheduled payments' (Goldstein and Pevehouse, 2006, 518).
[161] Financial Capital refers to the money needed to 'start up or maintain a business'. The inputs of production, also referred to as factors of production, are land, labor, capital (and raw materials). Capital is distinguished into physical and financial capital. Physical capital are the produced factors of production, such as machines (Varian, 2006, 323).

costs of capital.[162] Risks associated with the interest rate arise if the interest rate changes significantly: if financing is done on variable interest rates and the interest rate increases significantly, then the higher interest rate leads to higher total financing costs. If the financing is done on fixed interest rates, then a fall in interest rates makes the financing costlier relative to market conditions. Local suppliers also suffer from interest rate volatility as they borrow money for their investments in the local capital market.

In order to assess the interest rate in the selection process, it is important to be aware of the variety of interest rates. As mentioned above, there are real and nominal interest rates. But besides these, interest rates are further distinguished depending on their term, their associated credit risk, and their tax treatment. While some loans are made for short periods, other loans are made for long periods, and the interest rate normally increases with the term of the loan. Moreover, the interest rate varies with the credit risk, and thus with the risk of the borrower to default on the loan: 'the higher the perceived probability of default, the higher the interest rate'. Government bonds usually have the lowest interest rates as the perceived risk of governments defaulting on their loans is low. In contrast, corporations with very uncertain financial funding can only issue junk bonds to raise money for which they must pay high interest rate to offset the high associated risk of default. Finally, interest rates depend on the tax treatment, thus on the way the bonds are taxed. For instance, for interest income from municipal bonds, thus state or local government bonds, federal income tax does not need to be paid. Overall, interest rates tend to move together. Still, it is important to consider the adequate interest rate and be aware of differences between them (Mankiw, 2013, 65). For the selection process, it is of interest to look at short-term interest rates, long-term interest rates, and government bond yields (with a 10-year maturity). Government bond yields are the best indicator of country risk. Short- and long-term interest rates are important in the assessment of local borrowing costs for the OEM, depending on the period for which the OEM needs to borrow capital.

Table 30: Information and Instructions on the Choice and Evaluation of the Location Factor *Interest Rates*

Location factor to be evaluated	**Interest Rates**	**Costs for Local Borrowing over the planning horizon of the production site**
Strategic, operational, or general	General	Operational
Process-specific / product-specific	-	-

[162] The advantages of local borrowing that arise with regard to minimizing exchange rate risks must be assessed when analyzing the exchange rate of the country under consideration (see 4.6.2 Exchange Rate).

Location factor to be evaluated	Interest Rates	Costs for Local Borrowing over the planning horizon of the production site
Relevant for production network	-	-
Relevant for the design of the supply chain	-	-
Negotiable	-	-
Semi-external / even performance	-	-
Quantitative or qualitative	Non-cost-related quantitative	Cost-related quantitative
Hard or soft	Soft	Hard
Static or dynamic	Dynamic	Dynamic
Geographic level of analysis	National	National
Unit of measurement	Measured in % and assessed as very high, high, fairly low, low and very low (or numerically as 1 through 5).	Approximated in EUR.
Evaluation method(s)	o Strategic considerations o Profile method o Utility analysis	o Minimum criteria o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, present value method) o Phase 7 (present value method)
Interdependencies with other location factors	o Political Stability o Fixed Investment (including Foreign Direct Investment) o Gross Domestic Product o Business Fixed Investment	-
Source of information: public databases and information	o Central Bank Websites	-
Source of information: commercial external sources	o EIU: CountryData: money supply, interest rate, bond yield o IHS Markit: Global Economic Data: finance and financial markets o Oxford Economics: data tool: money supply, lending rate, short-term interest rate	-
Source of information: internal know-how	o Economic Department	o Economic Department
Source of information: external consultants	-	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.6.11 Debt, Debt Sustainability and Sovereign Credit Ratings

This section does not intend to explain in detail how a country accumulates debt and to analyze the debt sustainability of a country and all related aspects, because that is far beyond the scope of this work. As such, the goal of this section is merely to introduce some overall aspects determining the financial situation of a country which might have an effect on the successful construction and operation of the production site. These aspects are the debt level and debt sustainability of a country and related aspects, such as the government budget, the balance of payments, and sovereign credit ratings.

The IMF defines debt as '[o]utstanding financial liabilities arising from past borrowing' (International Monetary Fund, 2006b). As the government can either borrow from foreign governments or from the domestic private sector to finance its budget deficit, the government can owe its debt to national or international creditors (see International Monetary Fund, 2006b). The government must service its debt, which means that it must pay the '[s]cheduled interest and principal payments (amortization) due on public and publicly guaranteed debt outstanding' (International Monetary Fund, 2006c). The IMF suggests that 'in general terms, public debt can be regarded as sustainable when the primary balance needed to at least stabilize debt under both the baseline and realistic shock scenarios is economically and politically feasible, such that the level of debt is consistent with an acceptably low rollover risk and with preserving potential growth at a satisfactory level. Conversely, if no realistic adjustment in the primary balance — i.e., one that is both economically and politically feasible — can bring debt to below such a level, public debt would be considered unsustainable' (Garcia et al., 2013, 4).

Hence, the debt sustainability of a country is closely related with the government budget and the economic well-being of a country (see 4.6.4 Gross Domestic Product). The government budget, also referred to as government budget balance or public budget balance, is the (planned) expenditures[163] and (expected) revenues, usually for the time span of one year, the so-called fiscal year. The government budget also includes the amount the government must spend on debt services if it has accumulated debt. The government's revenue is principally in the form of taxes. In years on which the government expenditures exceed its revenues, the government runs a budget deficit; when revenues equal the expenditures, the government budget is balanced; and in years in which the government revenues exceed its expenditures, the government has a budget surplus. In contrast to the government budget, the primary budget only consists of the expenditures and revenues, excluding expenditures spent to serve accumulated debt (see Burda and Wyplosz, 2013, 165-166, 173-176). Consequently, a country's primary budget surplus must equal the required debt service for a balanced government budget, as by definition the government budget is only balanced if the primary budget surplus equals the debt service. Hence, the analysis of the government budget is important to assess the debt sustainability of a country. The analysis of the government budget is also important in terms of a country's debt and debt sustainability as a budget deficit must be debt financed and thus adds to a country's debt, potentially reducing its debt sustainability.

In order to analyze the government budget, it is important to know the debt service, as well as the revenues and expenditures, which are partially determined by the fiscal policy of a country,

[163] The government spends from an economic perspective either in its 'microeconomic function' on the provision of public goods or the redistribution of income, or in its 'macroeconomic function' with the goal to stabilize aggregate income (Burda and Wyplosz, 2013, 435-441).

as it determines the level of expenditures and the tax rates. However, while fiscal policy determines the amount of expenditure, fiscal policy only sets the tax rates but does not determine the tax revenues, as these depend on the tax base (e.g., income). Hence, lower tax revenues might reflect lower tax rates or an economic slowdown, while a larger primary budget deficit might reflect a more expansionary fiscal policy or lower tax revenues. With regard to the debt service, it matters whether the debt is denominated in the local currency or a foreign currency. While debt, denominated in the local currency, can be serviced in the local currency, foreign denominated debt must be serviced in the foreign currency (often the US$). The exchange rate determines the value of foreign-denominated debt and the required debt service in terms of the local currency: a depreciation of the local currency increases the debt service in terms of the local currency, while an appreciation of the local currency decreases the debt service in terms of the local currency. A country must service foreign denominated debt in the relevant foreign currency. The country can have this foreign currency either accumulated in the form of foreign currency reserves, generate it in the current year through a trade surplus, or buy it in exchange for local currency. Hence, if the country has foreign denominated debt, it is of interest to analyze the country's foreign reserves, as well as its trade balance. Having to serve foreign denominated debt without having international currency reserves and while running a trade deficit will lead, holding all else constant, to a depreciation of the country's exchange rate as the government must buy foreign currency, thereby increasing the supply of the domestic currency.

Both the trade balance and the international currency reserves are part of the balance of payments of a country, which itself is made up of three parts: the current account, the capital and financial account, as well as errors and omissions. The current account (balance) is the 'sum of the balances of trade in goods and services, international income, and current transfers'. The current account indicates if the country 'is a net borrower or a net lender [….] vis-à-vis the rest of the world' (Burda and Wyplosz, 2013, 42). As the current account is part of the balance of payment which must be zero, any 'current account imbalance must be matched, or financed, one-for-one by either the change in the private financial account or official interventions by the monetary authorities' (Burda and Wyplosz, 2013, 45-46). This means that if the country exports more to the rest of the world than it imports, then more capital is flowing into the country than out of the country, hence, the capital and financial account is in surplus, which means that the country lends 'to the rest of the world' or the country pays 'down its debts'. Hence, overall, the capital and financial account must equal the current account in size but must be 'of opposite sign' to the current account

(Burda and Wyplosz, 2013, 43). If, for instance, a current account is in deficit, capital inflows must cover that current account deficit; if not, foreign exchange reserves decline. This is an important consideration in the assessment of a country's debt sustainability in case it must service foreign denominated debt.

According to economic theory, a country has four options to reduce its debt. First, it can use its budget surplus in total or in part to pay back debt, both debt in local currency and foreign denominated debt. Second, if the public debt is denominated in local currency, the government can increase the money supply to reduce the real value of its debt denominated in local currency. This process is referred to as seigniorage. Seigniorage means that the government borrows money from the central bank, or the central bank buys the government debt, thereby increasing the money supply. By increasing the money supply, inflation increases and thus the real value of the public debt declines. This is why seigniorage is also referred to as inflation tax, given that the (unexpected) inflation acts like a tax on debt-holders. Hence, seigniorage hurts all who hold money or nominal bonds, hence nominal assets. Third, the country can reduce 'the interest rate at which' the country 'borrow[s], either at home or abroad.' The last way for the government to deal with its accumulated debt is to default on all or part of its debt (see Burda and Wyplosz, 2013, 451-456). With rising public debt, the government might become unwilling or unable to service its debt (see Mankiw, 2013, 562) and thus might default on all or part of its debt. Given that a government needs a larger primary surplus to sustain a higher level of public debt holding all else constant, 'the higher the level of public debt, the more likely it is that fiscal policy and public debt are unsustainable' (Garcia et al., 2013, 4). Hence, a government might decide to default on its debt, if the government is unwilling or unable to adjust the fiscal policy, hence the tax level and revenues, such that it can service its debt. This can especially be the case in times of a prolonged economic slowdown, reducing the tax base and thus the tax revenues for the government. A default hurts all who are holding the debt on which the government defaults. The result of a default is a serious 'breach of confidence' and leads to 'long lasting scars on the reputation of the government' (Burda and Wyplosz, 2013, 453). When a government defaults on its foreign debt, the country is normally unable to borrow from abroad for a number of years.

The risk that the debt of a country becomes unsustainable and the government defaults on part or all its financial obligations is assessed by international rating agencies. A country's sovereign credit rating reflects its credit risk. It is an assessment of a government's ability to pay all its financial obligations on time, as well as of its risk of default, hence, of the country's creditworthiness (see U.S. Security and Exchange Commission, 2017). Sovereign credit ratings are based on an analysis of the accumulated domestic and external debt, the government budget, and the long-term outlook of the fiscal policy of a country. The analysis concludes 'the economic, financial and country risks that may affect the country's creditworthiness, as well as the likelihood that an entity would receive external support in the event of financial difficulties' (Capital Intelligence, n.d.). While assigning sovereign credit ratings is not an 'exact science' and unforeseeable developments in the future can prove credit ratings incorrect (S&P Global Ratings, 2018, 5), credit ratings play an important role in solving the problem of asymmetric information between the creditor and the debtor about the creditworthiness of the creditor. 'Market participants may use the ratings as a screening device to match the relative credit risk of an issuer or individual debt issue with their own risk tolerance or credit risk guidelines in making investment and business decisions' (S&P Global Ratings, 2018, 6). By assessing the creditworthiness and the associated credit risk of a country, sovereign credit ratings determine the interest countries must pay to borrow in (international) financial markets. As mentioned above, a country can have accumulated debt in foreign currency or in the local currency; analogically, there are foreign currency ratings and local currency ratings. Foreign currency ratings rate a country's 'ability and willingness to meet its foreign currency denominated financial obligations as they come due'. Specific to the assessment of foreign currency ratings is that they also consider the possibility of the government imposing 'restrictions on the conversion of local currency to foreign currency or on the transfer of foreign currency to residents and non-residents'. Local currency ratings assess the country's 'ability and willingness to meet all of its financial obligations on a timely basis, regardless of the currency in which those obligations are denominated' (Capital Intelligence, n.d.).

Evaluating the government budget, the debt level of the country, its debt sustainability, and sovereign credit ratings helps to assess the overall financial stability of a county and the government's available financial means and ease to raise money. This is important for successfully constructing and operating the production site, and not only with regard to the government's ability to invest in the country's general infrastructure, educational system, or health system. The government finances are also important to understand if the government is able to reliably pay for publicly provided services, such as police or administration. Moreover, it is important to assess the financial situation of the government when evaluating whether the government can reliably provide subsidies to the OEM for constructing and operating the production site or for training institutions or commit to extra investments in support of the OEM, such as infrastructure necessary for the functioning of the production site (e.g., roads or railroads). Moreover, the financial stability of a government is an important condition for political stability. If a government defaults on all or part of its debt, it can have a significant effect on the overall political stability in the country, the well-being of its economy, and thus on the operation of the production site. But even if the government must only significantly reduce its expenditures or raise taxes to be able to sustain its debt, such an action can have major effects on the operation of the production site. Moreover, the analysis of debt reveals the risk of the government imposing capital controls to be able to serve its foreign denominated debt (see 4.2.2.5 Capital Controls). Hence, a thorough analysis of the government budget, the country's debt level, and debt sustainability is very advisable in the selection process.

Table 31: Information and Instructions on the Choice and Evaluation of the Location Factor *Debt, Debt Sustainability and Sovereign Credit Ratings*

Location factor to be evaluated	**Debt and Debt Sustainability**	**Sovereign Credit Ratings**
Strategic, operational, or general	General	General
Process-specific / product-specific	-	-
Relevant for production network	-	-
Relevant for the design of the supply chain	-	-
Negotiable	-	-
Semi-external / even performance	-	-
Quantitative or qualitative	Non-cost-related quantitative	Qualitative
Hard or soft	Soft	Soft
Static or dynamic	Dynamic (if necessary)	
Geographic level of analysis	National	
Unit of measurement	Measured as percentage of GDP and assessed as very low, low, fairly high, high and very high (or numerically as 1 through 5).	Measured in ratings and assessed as very unstable, unstable, fairly stable, stable and very stable (or numerically as 1 through 5).
Evaluation method(s)	o Strategic considerations o Profile method o Utility analysis	
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 7 (utility analysis)	
Interdependencies with other location factors	o Gross Domestic Product o Political Stability o Taxes o Subsidies and State Aid o Exchange Rate o Interest Rates o Fixed Investment (including Foreign Direct Investment) o Business Fixed Investment o Government Spending o Capital Controls	

Location factor to be evaluated	Debt and Debt Sustainability	Sovereign Credit Ratings
Source of information: public databases and information	o IMF: data: general government revenue, general government total expenditure, general government net lending/borrowing, general government structural balance, general government gross debt, current account balance, interest rate – government securities. o OECD: Country Risk Classification	o Fitch: Sovereign Ratings (ratings to the foreign and local currency debt of sovereign governments). o Moody's o Standard & Poor's o Business Environment Risk Intelligence S.A: BERI-Index (R-Factor measures a country's ability to meet its financial obligations).
Source of information: commercial external sources	o Consensus Economics: Consensus forecast: current account balances o EIU: CountryData: budget revenue, budget expenditure, budget balance, current account, total foreign debt, foreign exchange reserves o Oxford Economics: data tool: current account, stock of government debt, government balance, capital flight, government expenditure, government revenue, foreign exchange reserves, external debt o IHS Markit: Global Economic Data: government finance, national accounts	o IHS Markit: Country Risk
Source of information: internal know-how	o Political Department o Economic Department	o Political Department o Economic Department
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.7 Labor Market

4.7.1 General Remarks on the Labor Market as a Location Factor

As explained above (see 4.6.1 General Remarks on the Economic Environment as Location Factor), the labor market is an economic location factor (like those discussed above: *Exchange Rate, Inflation, Gross Domestic Product, Fixed Investment (including Foreign Direct Investment), Productivity, Human Capital, Openness to Trade and Position in the Global Value Chain, Membership in Free Trade Agreements, Interest Rates*, as well as *Debt, Debt Sustainability and Sovereign Credit Ratings*), but due to its importance and the variety of relevant aspects for selecting a production site, the labor market is analyzed separately in this section. From an economic theory perspective, labor is a factor of production which households supply and firms demand in the labor market. The price paid to labor as a factor of production is the wage, which is, in turn, determined by the supply and demand of labor in the labor market.

The local labor market is of utmost importance for selecting a production site. While the wage level has a significant direct effect on the operating costs of the production site, the availability of sufficient skills is a prerequisite for successfully its construction and operation. Still, when selecting a production site, OEMs should not only analyze the relevant wage level and the availability of skills at the production site, but also other characteristics of the labor market, such as the labor force or institutions and regulations impacting the labor market. Thus, this section suggests OEMs analyze the labor market at the production site in a comprehensive way in the selection process. The analysis of the labor market is divided into four location factors: *Labor Force*, *Labor Market Institutions and Regulations*, *Wage Level* and *Availability of Skills*.[164]

As explained in 4.1 Scope and Structure of the Discussion of Relevant Location Factors, all location factors for which a macroeconomic analysis is relevant are explained from a macroeconomic perspective, which includes their macroeconomic description, an explanation of their macroeconomic driving forces, as well as their specific macroeconomic effects on constructing and operating a production site. This macroeconomic analysis is, of course, especially relevant for choosing and evaluating the location factors discussed in this section, as they are also economic location factors.

4.7.2 Labor Force

The labor force is defined as all people of working age (15-65), who are either working or unemployed. Thus, labor force equals employment plus unemployment and excludes young people who are in school or retired people, and all who are unemployed but not looking for work (see Burda and Wyplosz, 2013, 118). A measure of the labor force relative to those who are not in the labor force is the participation rate. The participation rate is defined as the share of the population of working age (15-65 years), that is 'working or registered as unemployed' (Burda and Wyplosz, 2013, 111). A low participation rate in a country implies a potential for an increase in labor force without immigration. All things held constant, an increase in the participation rate leads to an increase in labor force and a downward pressure on overall wages (see Mokyr and Voth, 2010, 16). With regard to an increase of the labor force due to an increase the participation rate, the female participation rate is of special interest. The female participation rate, defined as the percentage of working age women in the labor force, is often determined by culture, institutions, or traditions, and varies significantly between countries. In many countries where the female participation rate

[164] The success of the operation of the production site also depends on how well the OEM is able to adjust its style of management to the local culture at the production site. Local culture can have significant effects on the efficiency and costs of the operation of the production site. However, the purpose of this work is not to discuss which cultures require which kinds of management, and the extensive literature on intercultural management (see Hampden-Turner and Trompendaars, 1993). As cultural dimensions (see Hofstede et al., 2010) or poles (see Hampden-Turner and Trompendaars, 1993) identified in the literature on intercultural management explain, for instance, their understanding of time or hierarchy, they do not seem to allow the drawing of conclusions that are relevant as location factors. These cultural aspects should be considered once the production site has been selected to adapt the style of managing the production site to suit the local culture. This, however, is beyond the scope of this work.

is low, incentives or opportunities for women to join the labor force can drastically increase the labor force. Whether women join the labor force is of crucial importance for the growth and productivity (productive potential) of a country (see Burda and Wyplosz, 2013, 117).

In addition to a change in the participation rate affecting a country's labor force, the sector-specific labor force (namely the agricultural sector, industrial sector, or service sector) can be affected by structural change. Structural change is a change in the labor shares between sectors of an economy (see Ngai and Pissarides, 2007, 429), and normally refers to a decreasing share of employment and output in the agricultural sector and an increasing share of employment and output in the industrial and service sector. As structural change normally reflects a decline in the relative importance of agriculture in an economy (see Malanima, 2010, 236), the impact that structural change can have on the labor force depends on the distribution of current employment between the agricultural and industrial sector (and service sector) in an economy. The more people that are employed in the agricultural sector, the more people can potentially shift into the industrial or service sector, thereby increasing its labor force and putting downward pressure on wages. This is an important difference between the labor market in many Asian and Eastern European countries. The vast availability of cheap labor provides a different situation for OEMs in emerging Asian countries versus the low employment in the agricultural sector (together with relatively low general unemployment) in some Eastern European countries, such as the Czech Republic. While in the former the wages of unskilled workers remain low when OEMs locate their production sites there, in the latter, locating production sites of OEMs therein leads to an increase in wages, not only for skilled but also unskilled labor. This increase in the overall wage level often significantly reduces the cost advantage stemming from low labor costs (see Meyer, 2006a, 50-55).

Moreover, migration can impact the labor force by either decreasing or increasing it in the country or region in question. The potential for migration increasing the labor force of a country depends on the country's immigration laws, memberships in international free trade agreements, which might include the freedom of workers (like in the EU), and the mobility of labor from neighboring countries. The potential for a migration-based increase in the labor force of a certain region where the production site is located from other regions of the same country depends on the labor mobility in that country (or in other regions of that country).[165] Labor is rather immobile relative to goods. In a perfectly competitive labor market, the mechanism that corrects imbalances is the

[165] Labor mobility refers in this context exclusively to geographic labor mobility, i.e., worker's ability and willingness to work at different locations, and not to the occupational mobility of a labor market.

mobility of demanders (employers) and suppliers (employees) of labor, as well as the adjustment of the price, which is the wage in the labor market. However, labor is not mobile to the same extent as goods, simply because the 'suppliers of labor are human beings' and people are, by nature, not very mobile (Burda and Wyplosz, 2013, 478-479). Most people do not choose where they live based solely on their job, but instead many different factors influence their decision. Local, regional, national, as well as international, differences in unemployment and wage rates prove that labor mobility is limited (see Meyer, 2006a, 65). The degree of labor mobility varies between countries and even between certain regions (see Nabar and N'Diaye, 2013, 14): the labor mobility in many emerging countries (e.g., in China, where people come from all over the country to the Southeastern region for work) and in the U.S. is certainly higher than in Germany.[166]

An increase in the labor force due to a higher participation rate, structural change, or migration can have significantly different effects on the wages of unskilled versus skilled workers: An increase in the participation rate, in general, and in the female participation rate, in particular, are likely to bring workers to the labor market who have previously been discouraged workers or women who have not entered the labor market before, and thus are likely to increase the pressure exclusively on the wage of unskilled workers instead of skilled workers. Likewise, a structural change increases the labor force of, for instance, the industrial sector by bringing in workers who have previously worked in agriculture and are not likely to bring the necessary skills to qualify as skilled workers in the industrial sector. Thus, a structural change also tends to increase pressure on the wages of unskilled workers and not the wages of skilled workers. The skill of people enlarging the local labor force due to migration can vary significantly. Hence, the effect of migration on wages of skilled and unskilled workers depends on the skill of the workers immigrating.

Considering the labor force, both for particular sectors and the economy as a whole, along with driving factors of said labor force—such as the participation rate, particularly the female participation rate, structural change, as well as the ease of immigration and the mobility of the domestic labor market—is important when evaluating potential production sites, as they affect the long-term availability of skilled and unskilled labor and, consequently, wage levels.

[166] The labor mobility in a country is determined by history, culture, and tradition. As urbanization refers to the process of an internal migration of people (often peasants) from rural to urban areas (see Leonard and Ljungberg, 2010, 113), labor tends to be more mobile in regions or countries with a high urbanization rate (see Nabar and N'Diaye, 2013, 14). Urbanization, in this work, is not considered as an individual location factor, but instead as one that affects others, such as labor force or consumption.

Table 32: Information and Instructions on the Choice and Evaluation of the Location Factor *Labor Force*

Location factor to be evaluated	**Labor Force**
Strategic, operational, or general	Strategic
Process-specific / product-specific	-
Relevant for production network	+
Relevant for the design of the supply chain	+
Negotiable	-
Semi-external / even performance	-
Quantitative or qualitative	Non-cost-related quantitative
Hard or soft	Soft
Static or dynamic	Dynamic
Geographic level of analysis	National and possibly regional
Unit of measurement	Measured in absolute numbers (participation rate in percentage share of labor force) and assessed as very small, small, fairly large, large and very large (or numerically as 1 through 5).
Evaluation method(s)	o Profile method o Utility analysis
Phase(s) in the selection process	o Phase 2 (profile method) o Phase 7 (utility analysis)
Interdependencies with other location factors	o Wage Level o Membership in Free Trade Agreements o Availability of Skills
Source of information: public databases and information	o World Bank: Databank: labor force, total; labor force participation rate (total and female); employment in agriculture, services and industry (as % of total employment) and output in agriculture, services and industry (as % of total output).
Source of information: commercial external sources	o EIU: CountryData: labor supply, unemployment rate, origin of GDP by sector (agriculture, manufacturing, services) o Oxford Economics: data tool: labor supply, employment, unemployment rate o IHS Markit: Global Economic Data: labor market
Source of information: internal know-how	o Economic Department o Political Department
Source of information: external consultants	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.7.3 Labor Market Institutions and Regulations

Labor market institutions and regulations are important for the operating environment of an economy as they impact wages, additional labor costs, or the labor market flexibility. Labor market regulations are supposed to correct imperfections in the labor market which have a negative effect on the quality and creation of jobs. Hence, labor market regulations aim at mitigating market failures that arise therein, and promoting a 'productive allocation of labor resources within an economy'. Labor market regulations should balance, for one, the goal to create a flexible environment in which firms can react successfully to shocks, business cycle variations, or structural changes (e.g., technological innovation), and, for another, the goal to protect workers, for instance, against unhealthy work or discrimination, thereby enhancing motivation and productivity (The World Bank, 2018, 206).

Labor market institutions are, for instance, labor unions. These are, in other words, employees' organizations which promote their interests, such as labor rights, working conditions, or wages, through collective bargaining, and are characterized by their strength, measured in their number of members. The structure of unions varies from country to country as in some countries they are centralized and in others they are organized by industry, occupation, or craft (see Burda and Wyplosz, 2013, 121). These labor market institutions normally negotiate on behalf of their members with firms and politicians and the outcome of these negotiations are regulations, which often set the framework for the overall labor market-related working conditions in an economy and determine the flexibility of the labor market. The strength of local labor market institutions, given by its members, as well as the local political culture, determines the influence with which the workers' interests are represented at the production site: the stronger these labor unions, the more commitments firms might have to make in labor related negotiations. Thus, all things held equal, firms normally prefer to operate in a labor market where collective bargaining is not very strong, as that would provide firms more flexibility.

Labor market regulations include regulations on the hours that account for a workweek, hiring and firing procedures, social security, health and pension contributions, and paid vacation or direct labor taxes, which determine the flexibility of the local labor market, as well as the costs that a firm must pay in addition to the direct wage. These additional labor costs include additional non-wage labor costs, as well as additional wage labor costs. Additional non-wage labor costs arise as a firm must contribute to employees' social security, health insurance or pension, incurs costs for paid vacation or must pay direct labor taxes. Additional non-wage labor costs are determined, in particular, by regulations on employee profit sharing, pension payments, or contributions to health insurance. Legally required pension payments, often required, for instance, in the US, can have an especially significant effect on costs, as pension payments require firms to contribute payments to a fund for their employees for the time of their employment that they will receive once they retire. These additional non-wage labor costs account, together with the direct wage, for the gross hourly labor cost (see Mankiw, 2013, 291).[167] Additional wage labor costs include wage surcharges for night work, overtime work, or working on holidays (as a percentage of the average

[167] According to microeconomic theory, wage equals the marginal product of labor (MPL), or, put differently, 'the additional revenue from an incremental unit of labor' (Pindyck and Rubinfeld, 2006, 516). However, this definition of wage from a microeconomic perspective must include all payments that the firm must make for an additional unit of labor, the direct wage, as well as all additional labor costs. Thus, firms must pay the gross hourly labor cost, and the direct wage, as well as additional labor costs (see Pindyck and Rubinfeld, 2006, 516).

wage). In this work, labor market flexibility refers to numerical flexibility which is the ease with which firms can adjust their 'headcount' to their 'demand for labo[u]r' even in the short-term (Atkinson, 1984, 29).[168] Labor market flexibility is determined, in particular, by regulations on the maximum working time, the average number of hours worked per week, the flexibility of working hours, the length of notification period for elimination, or the right to strike (see Pindyck and Rubinfeld, 2006, 516).

These labor market regulations and the resulting labor market flexibility have a significant effect on the OEM's ability to adjust its employment to the capacity utilization and on its labor costs at the production site. Longer workweeks, less or no extra pay for working on rest days, or holidays increase the flexibility for the OEM in the use of employed workers at little or no extra costs, while less stringent hiring and firing regulations provide firms the advantage of being able to react to lower capacity utilization by firing some workers quickly and at low cost, thereby enabling the hiring of workers with no long-term consequences in times of high-capacity utilization. In addition, longer workweeks increase the total hours worked by the same worker and longer maximum working time increases the hours potentially worked by the same worker, which decreases the number of employees that must be trained.

The effect of the strength of labor market institutions on operating the production site is difficult to grasp, but it is likely that strong labor market institutions tend to increase the risk of strikes and other forms of collective bargaining, which interrupt the construction and operation of the production site, and thus may have a negative effect on its profitability.[169]

Furthermore, labor market regulations also include regulations on minimum wages or child labor. The effect of these regulations depends on the industry and firm. The regulation of child labor usually has little effect on internationally producing OEMs as public pressure is high enough on international OEMs for them to be cautious not to have children working at their production sites regardless of regulations. Besides this public pressure and possible moral reservations, as well

[168] The flexibility of the labor market is differentiated between functional flexibility and numerical flexibility. Functional flexibility refers to how flexibly workers can use their skills for different tasks (see Atkinson, 1984, 29), and how costly and time intensive it is for a firm to move workers to new tasks (see Van den Berg and Van der Velde, 2005, 111-112).

[169] With regard to strikes, it is interesting that the more consumption-driven the economies of emerging countries become, the fewer labor stoppages result from labor disputes: as people consume more, they take up consumption credit, for which they need regular income to pay back, and, at the same time, workers become more aware that increasing productivity is the main way to reach higher living standards (see Meyer, 2006a, 66).

as the explicit prohibition of child labor in their codes of conduct, the potential benefit for international OEMs from child labor is very constrained in many emerging countries. As the main problem with regard to labor, especially in the automotive industry, is not the availability of unskilled labor, but the scarcity of skilled labor, employing unskilled children is not a remedy. Like regulations on child labor, regulations on the minimum wage should normally not have a considerable effect on the profitability of a production site of an OEM, especially in emerging countries. A minimum wage is a legal restriction on the lower limit of wages. Sometimes collective agreements which are initially negotiated for a limited group of workers are extended to workers that are not covered by the agreement, and thus have the effect of legal minimum wages. While the entire effect of minimum wages is controversially discussed, a minimum wage is, in general, considered disadvantageous for people who have low skill levels, obsolete skills, or no job experience, since they may no longer be employed at a minimum wage. Furthermore, minimum wages have an increasing effect on those wages that are otherwise just above the minimum wage level, as their skills and productivity, compared to those who are unskilled, require some wage premium (see Burda and Wyplosz, 2013, 124). Huang et al. find firms that pay higher wages have 'less negative elasticities of minimum wages' (Huang et al., 2014, 3). Hence, for OEMs, minimum wages are not as relevant because they pay above-average wages, especially in emerging countries. By contrast, in some advanced countries with very high minimum wages, such as Luxembourg, Australia or France, the effect of minimum wages on the total costs for constructing and operating the production site must not be neglected in the selection process.

Due to the complexity of labor market regulations and the effect of labor market institutions, it is important to clearly define the related aspects which are important for constructing and operating the production site: strength of unions, additional non-wage labor costs, additional wage labor costs, normal working time, flexibility of disposing of workers or, if relevant, additional costs due to a minimum wage. Strength of labor unions can be assessed as the ratio of total members to total employees or in the form of the density of unions in a country or a region. Additional non-wage labor costs must be assessed by adding all payments which are required, such as social security, health, pension, or insurance contributions, paid vacation, direct labor taxes or work accident insurance. Additional wage labor costs should be assessed by approximating the expected hours worked in overtime, at night, or on holidays at the production site, and multiplied by the corresponding rates (as a percentage of the average wage). The normal working time should be assessed as the legal working hours per day or year, which gives an idea of how many days workers are, on average, not at work because of sickness or other reasons for absence, such as vacation, and public and religious holidays. The flexibility with which the OEM can dispose of workers at the location depends on the maximum legal working time per day (which determines the maximum time of one shift in hours including overtime), the possibility to work on weekends, the maximum legal overtime per month or year, the notification period and legal requirements (wage surcharge) for weekend workdays and overtime, legal limitation of temporary contracts, and the notification period for terminating the work contract. Overall, it is important for the OEM to evaluate the labor market institutions and regulations at the production site, as they determine the labor market flexibility of the labor market and additional labor costs.

Table 33: Information and Instructions on the Choice and Evaluation of the Location Factor *Labor Market Institutions and Regulations*

Location factor to be evaluated	**Strength of Labor Unions**	**Normal Working Time**	**Flexibility of Disposing of Workers**	**Minimum Wage**	**Additional Non-wage Labor Costs**	**Additional Wage Labor Costs**	**Additional Costs due to Minimum Wage over the planning horizon of the production site**	**Additional Non-wage Labor Costs over the planning horizon of the production site**	**Additional Wage Labor Costs over the planning horizon of the production site**
Strategic, operational, or general	General	General	General	Operational	General	General	General	General	General
Process-specific / product-specific	-	-	-	Process- and product-specific	-	-	-	-	-
Relevant for production network	-	-	-	-	-	-	-	-	-
Relevant for the design of the supply chain	-	-	-	-	-	-	-	-	-
Negotiable	-	-	-	-	-	-	-	-	-
Semi-external / even performance	-	-	-	-	-	-	-	-	-
Quantitative or qualitative	Non-cost-related quantitative						Cost-related quantitative		
Hard or soft	Hard	Hard	Hard	Hard	Hard	Hard	Hard	Hard	Hard
Static or dynamic	Static (unless there is reason for expected change)						Dynamic	Dynamic	Dynamic
Geographic level of analysis	National and regional if there are significant difference across regions in country under consideration								
Unit of measurement	Measured in number of members in unions (also ratio of total members to total employees) or density of unions. Assessed as very restrictive, restrictive, fairly loose, loose	Measured as number of working hours per day or per year. Assessed as very restrictive, restrictive, fairly loose, loose and	Measured in terms of maximum legal working time per day, the possibility to work on weekends, the maximum legal overtime per month	Measured in absolute terms (local currency). Assessed as very high, high, fairly low, low,	Measured as a percentage of the average wage (contributions for social security, health, pension or insurance contributions, paid	Measured as a percentage of the average wage (wage surcharges for night work, overtime	Approximated in EUR. Assessed as very high, high, fairly low, low and very low (or numerically as 1 through 5).		

Location factor to be evaluated	Strength of Labor Unions	Normal Working Time	Flexibility of Disposing of Workers	Minimum Wage	Additional Non-wage Labor Costs	Additional Wage Labor Costs	Additional Costs due to Minimum Wage over the planning horizon of the production site	Additional Non-wage Labor Costs over the planning horizon of the production site	Additional Wage Labor Costs over the planning horizon of the production site
	and very loose (or numerically as 1 through 5).	very loose (or numerically as 1 through 5).	or year, the notification period and legal requirements for weekend workdays and overtime, legal limitation of temporary contracts and the notification period for terminating the work contract. Assessed as very restrictive, restrictive, fairly loose, loose and very loose (or numerically as 1 through 5).	very low (or numerically as 1 through 5).	vacation, direct labor taxes or work accident insurance). Assessed as very high, high, fairly low, low, very low (or numerically as 1 through 5).	work or working on holidays). Assessed as very high, high, fairly low, low, very low (or numerically as 1 through 5).			
Evaluation method(s)	o Minimum criteria o Profile method o Utility analysis			o Minimum criteria o Profile method o Utility Analysis			o Minimum criteria o Operating cost comparison o Present value method		
Phase(s) in the selection process	o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method) o Phase 5 (minimum criteria, profile method, utility analysis) o Phase 7 (utility analysis)			o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method) o Phase 5 (minimum criteria, profile method, utility analysis)			o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)		
Interdependencies with other location factors	o Wage Level								
Source of information: public databases and information	o The Fraser Institute: Economic Freedom of the World Index: systematic information on the national level about the degree of labor market regulation (available for 58-144 countries and measures the minimum wage, hiring and firing regulations, centralized collective bargaining, mandated cost of hiring and worker dismissal, hours regula-	o The Fraser Institute: Economic Freedom of the World Index: systematic information on the national level about the degree of labor market regulation (available for 58-144 countries and measures the minimum wage, hiring and firing	o The Fraser Institute: Economic Freedom of the World Index: systematic information on the national level about the degree of labor market regulation (available for 58-144 countries and measures the minimum wage, hiring and firing regulations, centralized collective bargain-	o World Population Review: Minimum Wage by Country o Government websites	o OECD: OECD.stat provides data on total hours worked, average hours worked per person employed, labor compensation per hour worked and per employee on a national level. o EY: Payroll Operations in Europe, the Middle East, India, and Africa — essential compliance and reporting considerations (annual report).		o World Population Review: Minimum Wage by Country o Government websites o EY: Payroll Operations in Europe, the Middle East, India, and Africa — essential compliance	o OECD: OECD.stat provides data on total hours worked, average hours worked per person employed, labor compensation per hour worked and per employee on a national level. o EY: Payroll Operations in Europe, the Middle East, India, and Africa — essential compliance and reporting considerations (annual report).	

Location factor to be evaluated	Strength of Labor Unions	Normal Working Time	Flexibility of Disposing of Workers	Minimum Wage	Additional Non-wage Labor Costs	Additional Wage Labor Costs	Additional Costs due to Minimum Wage over the planning horizon of the production site	Additional Non-wage Labor Costs over the planning horizon of the production site	Additional Wage Labor Costs over the planning horizon of the production site
	tions and conscriptions). o World Bank: the 'Employing Workers Index' which is an indicator of the degree of market regulation (available for 184 countries and covers the difficulty of firing, rigidity of hours, redundancy rules and redundancy costs). o International Comparative Legal Guides (ICLG): Employment & Labour Law (information on 35 Jurisdictions; annual report) o OECD: OECD.stat provides data on Trade Union Density, Union members and employees. o EY: Payroll Operations in Europe, the Middle East, India, and Africa — essential compliance and reporting considerations (annual report).	regulations, centralized collective bargaining, mandated cost of hiring and worker dismissal, hours regulations and conscriptions). o OECD: OECD.stat provides data on total hours worked, average hours worked per person employed, labor compensation per hour worked and per employee on a national level o EY: Payroll Operations in Europe, the Middle East, India, and Africa — essential compliance and reporting considerations (annual report).	ing, mandated cost of hiring and worker dismissal, hours regulations and conscriptions). o World Bank: the 'Employing Workers Index' which is an indicator of the degree of market regulation (available for 184 countries and covers the difficulty of firing, rigidity of hours, redundancy rules and redundancy costs). o OECD Indicator of Employment Protection. o EY: Payroll Operations in Europe, the Middle East, India, and Africa — essential compliance and reporting considerations (annual report).				and reporting considerations (annual report).		
Source of information: commercial external sources	-	-	-	-	-	-	-	-	-
Source of information: internal know-how	o Economic Department o Political Department							o HR Department of Local Offices o HR Department of Headquarters o Economic Department o Political Department	

Location factor to be evaluated	**Strength of Labor Unions**	**Normal Working Time**	**Flexibility of Disposing of Workers**	**Minimum Wage**	**Additional Non-wage Labor Costs**	**Additional Wage Labor Costs**	**Additional Costs due to Minimum Wage over the planning horizon of the production site**	**Additional Non-wage Labor Costs over the planning horizon of the production site**	**Additional Wage Labor Costs over the planning horizon of the production site**
Source of information: external consultants	+	+	+	+	+	+	+	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.7.4 Wage Level

Direct wages, additional wage labor costs, and costs that arise from deploying expatriates to the production site compose the total labor costs for the construction and operation thereof. While additional labor costs are captured under the location factor *Labor Market Institutions and Regulations* (see 4.7.3 Labor Market Institutions and Regulations) and the costs that arise for deploying expatriates to the production site are captured under the location factor *Costs for Deploying Expatriates* (see 4.14 Costs for Deploying Expatriates), this location factor focuses on the direct wage, here referred to as wage and defined as the 'average hourly labor cost' or hourly compensation for a worker (Mankiw, 2013, 292). Wages are different from salaries: they are paid for manual or mechanic work as payments that are expressed as an hourly rate, while salaries are paid for non-manual or non-mechanic work as payments that are expressed as fixed periodic amounts (e.g., per week, month, or year) (see OECD, 2002, 18-19). Thus, wages and salaries are differentiated based on the work for which employees are compensated, or based on the way in which its basic remuneration is expressed (see Bishaw and Semega, 2008, 12).[170] Wages are determined through negotiations between employers and employees. In these negotiations, only nominal wages are determined as the level of inflation cannot be forecasted with certainty for the time for which the wages are set (see Mankiw, 2013, 292).

According to economic theory, the wage is determined by the marginal product of labor: a competitive firm hires workers until the marginal product of labor times the price of the product equals the wage. The marginal product of labor is the additional output from one additional worker holding capital and technology constant. Consequently, one important driver of wages is labor productivity, as it determines the marginal product of labor (see Mankiw, 2013, 51-53, 60-61). For a discussion of productivity, see 4.6.6 Productivity.

Wages vary greatly between emerging and advanced countries, even though wages of such places have been converging. Real wages, hence nominal wages minus inflation, 'have almost tripled in the emerging and developing countries of the G20, while in advanced G20 countries they have increased by a much lower total of 9 per cent' from 1999 to 2017 (see International Labour

[170] Another term used regarding wages and salaries is earnings. The three main parts of earnings are wages, salary, and income from self-employment. Earnings are often the largest part of overall income (see Bishaw and Semega, 2008, 12). Specifically, earnings are earned income which includes '[w]ages, salaries, tips, and other taxable employee pay', '[u]nion strike benefits', '[l]ong-term disability benefits received prior to minimum retirement age' and '[n]et earnings from self-employment'. Earnings do not include unearned income, such as '[i]nterest and dividends', '[r]etirement income', '[s]ocial security', '[u]nemployment benefits', '[a]limony' or '[c]hild support' (see IRS, n.d.).

Organization, 2018, xiv). While some emerging and developing countries saw significant increases in their wage level in recent years (e.g., China),[171] in many of these countries 'average wages remain low' (see International Labour Organization, 2018, xiv). In fact, the International Labour Organization (ILO) found that in 2017 monthly average wages converted into US$ of advanced countries and of emerging countries of the G20 were about US$3,250 and US$1,555, respectively (see International Labour Organization, 2018, 4). Hence, even though wages of emerging and advanced countries have been and continue to be converging, significant differences in wages remain.

In order to get a better understanding of long-term trends in the labor market in emerging countries, it is important to look at the sectoral structure of those economies: the share of employment in the agricultural sector in many emerging countries is still very high compared to advanced countries. This is interesting with regard to the development of wages, since, in the course of economic development, the productivity and efficiency in the agricultural sector increase, which leads to a decreasing demand for labor in the agricultural sector. This redundant agricultural labor competes with unskilled labor in the industrial sector, thus putting downward pressure on their wages. Due to this development, referred to as structural change (see 4.7.2 Labor Force), the more people who are employed in the agricultural sector, the more people who can potentially shift into the industrial sector, thereby increasing its labor force and putting downward pressure on wages (see Malanima, 2010, 236; Meyer, 2006a, 54-55). This is a notable difference between the labor market in many Asian countries and countries of Eastern Europe: the vast availability of cheap labor provides a different situation for OEMs in emerging Asian countries versus low employment in the agricultural sector (together with relatively low general unemployment) in some Eastern European countries, such as the Czech Republic. While, in the former, the wages of unskilled workers remain low when OEMs locate their production sites there, locating OEM's production sites in the latter leads to an increase in the wages of not only skilled but also unskilled workers. This increase in the overall wage level at the production site often significantly reduces the cost advantage from lower wage levels in emerging countries (see Meyer, 2006a, 55). Thus, the sectoral analysis of an economy and the potential for structural change is important in assessing the development of wages in

[171] Increasing wages in China, for instance, have been the main reason for those in the textile industry to move some of their production sites from China to countries with lower wage levels, like Vietnam, Myanmar, or Bangladesh (see the Guardian, n.d.; Focus Money Online, 2015; Sachmann, 2019).

a country. Similarly, a change in the participation rate or migration can affect a country's labor force (see 4.7.2 Labor Force), thereby affecting wages.[172]

Average wages and growth thereof vary greatly, especially across emerging countries. Moreover, in emerging countries, wages also very greatly across regions (see International Labour Organization, 2018, 1). Even if wages also vary across advanced countries and across different regions in advanced countries, these differences are by far more significant in emerging countries. Also, in advanced countries, there are wage differences between agglomerations, urban or rural areas, as well as between different regions, industries, or qualifications, yet these differences are still larger in emerging countries than in advanced countries. In terms of skill, the significant difference between wages of unskilled and skilled labor results from the scarcity of skilled labor in emerging countries compared to its availability in advanced countries. This significant difference is expected to remain or even increase as the process of educating takes a long time and the demand for skill continues to rise (see Meyer, 2006a, 51, 65-66) (see 4.7.5 Availability of Skills). Moreover, wage levels also vary from region to region or from city to city, but, more generally, between rural and urban areas or, particularly, between rural areas and clusters which are higher due to higher skill and more competition (see Fujita and Thisse, 2013, 13-16, 50-52), but also due to higher costs of living (e.g., higher food and rent prices) (see Allen, 2001, 413-414). Differences in the wage level between different regions are especially large within large countries, while in smaller countries, or in countries with significant collective agreements, interregional differences in wage levels are rather small.

With regard to wages and clusters (see 4.11 Industrial Clusters), the OEM must decide whether participating in a cluster is worth paying higher wages. This means that the advantages associated with participating in the cluster must be evaluated relative to the higher wages that must be paid there: if the OEM values the advantages associated with the cluster (e.g., the availability of skills and infrastructure) enough to pay higher wages, then it should locate the production site in a cluster, while the OEM should consider locating the production site in a rural area with lower wage levels if it regards the advantages associated with the cluster as dispensable for successfully constructing and operating the production site, and is instead confident in its ability to train local, less skilled workers in such a way that they become sufficiently productive. The OEM must decide

[172] Structural change, as well as an increase in the participation rate, generally affect wages of unskilled labor (not wages of skilled workers) by increasing the overall labor force (rise in participation rate) or the sector-specific (structural change) labor force (see 4.7.2 Labor Force), thereby increasing downward pressure on wages.

on these trade-offs in the selection process based on the strategic goals it pursues with the new production site and its operational necessities.

Moreover, studies suggest that differences in wages are not only driven by ‘skill-related characteristics of individuals (such as level of education, age or tenure)’. Instead, factors such as ‘gender, enterprise size, type of contract and the sector in which workers work’ are other important determinants of the wage level (see International Labour Organization, 2016, xvii). While all these factors are interesting for the OEM, the fact that wages vary significantly between firms is especially important, as international firms must pay wages that significantly deviate from the local average wages, a wage premium (see Meyer, 2006a, 58).[173]

As explained above, some emerging markets have undisputable advantages with regard to wages compared to advanced economies. The relatively low wage level in emerging countries compared to advanced countries is among the chief reasons that firms locate their production sites in emerging countries, especially when wages make up a large share of total costs of operating the production site. However, the large differences in the wage level between rural and urban areas, as well as between skilled and unskilled labor, requires evaluating the relevant wage level with regard to skill and regional differences in wage level in advanced countries, but even more so in emerging countries. The importance of evaluating the relevant wage levels has been pointed out by Kinkel and Maloca, who state that higher than expected labor costs have not only led to more costs for operating production sites abroad, but in some cases even prompted firms to relocate their recently established production sites from abroad back into their home country (see Kinkel and Maloca, 2009, 30). Hence, in the selection process, it is certainly not enough to merely consider national levels of average wages, but it is instead necessary to analyze wages on a local level and on the relevant level of skill.

Considering the high skill requirements for constructing and operating an OEM’s production site reveals that an analysis of wages independent of skill is nonsensical. Due to the variety of wage levels, especially in emerging countries, it is important to clearly define the kinds of workers (in

[173] Meyer lists four major reasons for this wage premium: first, international firms normally place their sites in agglomerations, where wage levels are higher than on average in the country; second, the branches in which international firms are active belong to pioneer branches in emerging countries in which labor is required to be relatively highly skilled, and this skilled labor is relatively scarce in emerging markets; third, international firms generally have relatively complex production processes, which require higher qualifications and higher skill levels and with the higher quality requirements come wage raises; fourth, the image and employment policies of international firms is often associated with higher wages, which is also a way to bind trained and qualified workers long-term to the firm (see Meyer, 2006a, 56-57).

terms of skill), who are required for constructing and operating the production site. Depending on the production process, production techniques with different degrees of automation may be utilized. As these different production techniques require varying levels of skilled labor,[174] the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile) must contain the detailed requirements on the production site in terms of skill for all feasible production techniques and degrees of automation for which the production is profitable, and the required quality of production is guaranteed (see 4.7.5 Availability of Skills). The Human Resources Department must provide ranges of wages for each skill group of workers in terms of skill and experience. Skilled groups of workers include engineers, technicians of production, machine operators, mechanics, and electricians. Less skilled workers include those who work in logistics or assemble production steps, and administrative workers. The ranges of wages can be derived from other production sites which are operated under similar conditions.

When analyzing the relevant wage level, it is important to decide which indicators to include and how to acquire pertinent information. Most available data (e.g., EIU, OEF, IHS Markit) only provide data on national average wage levels and, if at all, specifically for the manufacturing sector on the national level. The ILO provides the ILO Global Wage Database on their website, which covers four wage related indicators for the years of 1995 and onwards: average nominal and real wages, as well as average real wage growth and minimum wages. The website does not include any information about regional wage levels, nor does it differentiate between the wage level of skilled and unskilled workers. The ILO also annually provides the Global Wage Report with general information and analysis about trends in the development of wages. In its annual report on Prices & Earnings, UBS publishes wages in 71 cities around the world and explains trends in global wage levels. This information can serve as an initial indicator, but given the large differences, especially in emerging countries, between skilled and unskilled workers or rural areas and clusters, it is not sufficient for evaluating the relevant wage level when selecting a production site. For the analysis of the relevant wage level, it is necessary to find information on the wage level in the region in which the production site may be located, and the wage level for the most relevant work groups depending on skill. This information can be gained through internal know-how and external consultants. Internal know-how about the relevant wage level at the production site can be accumulated through the experiences of both the OEM, and other firms which are willing to share that

[174] See footnote 61.

information. External consultants should already have some of the information on relevant wage levels and can gain the missing information through visits to the production site or exchange with local firms, national, regional, or local governments or locally present international firms.

Furthermore, it is important to be aware in the selection process that wages, especially those of skilled workers, are a semi-external location factor (see 2.5.3 Different Forms of Location Factors), as the demand for skilled workers at the production site will increase significantly once the site is located there, making the already scarce skilled labor even more scarce and thereby putting upward pressure on wages of skilled workers.

Table 34: Information and Instructions on the Choice and Evaluation of the Location Factor *Wage Level*

Location factor to be evaluated	**Wage Level of Management**	**Wage Level of Engineers**	**Wage Level of Technicians**	**Wage Level of Machine Operators**	**Wage Costs of Management over the planning horizon of the production site**	**Wage Costs of Engineers over the planning horizon of the production site**	**Wage Costs of Technicians over the planning horizon of the production site**	**Wage Costs of Machine Operators over the planning horizon of the production site**
Strategic, operational, or general	Operational							
Process-specific / product-specific	Process-specific and product-specific							
Relevant for production network	+	+	+	+	+	+	+	+
Relevant for the design of the supply chain	+	+	+	+	+	+	+	+
Negotiable	-	-	-	-	-	-	-	-
Semi-external / even performance	Semi-external	Semi-external	Semi-external	Semi-external	Semi-external	Semi-external	Semi-external	Semi-external
Quantitative or qualitative	Non-cost-related quantitative				Cost-related quantitative			
Hard or soft	Hard	Hard	Hard	Hard	Hard	Hard	Hard	Hard
Static or dynamic	Dynamic	Dynamic	Dynamic	Dynamic	Dynamic	Dynamic	Dynamic	Dynamic
Geographic level of analysis	Regional and local	Regional and local	Regional and local	Regional and local	Regional and local	Regional and local	Regional and local	Regional and local
Unit of measurement	Measured as hourly rate (wage) in EUR per hour or as weekly, monthly, or yearly rate (salary) in EUR. The wage level in the country and the development of the wage level should be assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).				Approximated in EUR.			
Evaluation method(s)	o Strategic considerations o Profile method				o Minimum criteria o Operating cost comparison o Present value method			
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 5 (profile method)				o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)			
Interdependencies with other location factors	o Availability of Skills o Labor Market Institutions and Regulations o Labor Force							

Location factor to be evaluated	Wage Level of Management	Wage Level of Engineers	Wage Level of Technicians	Wage Level of Machine Operators	Wage Costs of Management over the planning horizon of the production site	Wage Costs of Engineers over the planning horizon of the production site	Wage Costs of Technicians over the planning horizon of the production site	Wage Costs of Machine Operators over the planning horizon of the production site
Source of information: public databases and information	o OECD: • OECD.stat: average annual wages, hourly average earnings (for the private or manufacturing sector) (nominal and real terms) • Annual OECD Employment outlook o The International Labour Organization (ILO): • The ILO Global Wage Database provides data on nominal wages, average real wages, average real wage growth • The Global Wage Report with general information and analysis about trends in the development of wages (annual) o The UBS: annual report on Prices & Earnings in 71 cities around the world and explains trends in global wage levels o National government website or department of labor or national statistic bureaus (e.g., in the U.S. the Bureau of Labor Statistics).							
Source of information: commercial external sources	o EIU: CountryData: average nominal wages, average real wages. o Oxford Economics: data tool: average earnings.							
Source of information: internal know-how	o Accumulated through experiences the OEM has already made. o Accumulated through experiences other firms have made at the location, which are willing to share that information. o Human Resources Department o Local Liaison Offices o Economic Department							
Source of information: external consultants	+							

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.7.5 Availability of Skills

Skills are very specific capabilities acquired in academic or professional degrees or through particular work experience.[175] These skills are a specific qualification for a certain work and, thanks to these, skilled workers are professionals in performing said work. The clear measurability of skill makes it possible to distinguish between skilled and unskilled workers; skilled workers include, for instance, carpenters or engineers, while unskilled workers are, for instance, basic agricultural workers (see Pindyck and Rubinfeld, 2006, 189). However, it should be noted that skill is more than basic education, which 'includes literacy, baseline mathematical understanding, and general life skills' (World Education, n.d.) and is considered 'an essential prerequisite for [...] skills development' (International Labour Organization, 2011, 4), as it 'gives each individual a basis for the development of their potential, laying the foundation for employability'. Thus, though skill is more than basic education, it nevertheless requires basic education. Moreover, the attainment or improvement of skills increases 'people's capacities to work' (International Labour Organization, 2011, 4). While human capital can be enhanced through general education (see 4.6.7 Human Capital), skills can be enhanced and developed through vocational education, training, and work experience. Skills are developed over an individual's entire lifetime and, as such, they can be gained in every stage of a person's life (see International Labour Organization, 2011, 4).

For the skill to be applicable in the labor market, it is important that the worker's skill matches the labor market's required skill. In order to bridge the gap between the formal education attained at schools and the skills required in the labor market, it is important to have training institutions that closely cooperate with firms, in particular, and the industry, in general (see International Labour Organization, 2011, 4). Vocational training is often considered one of the best ways to train those who 'would otherwise lack qualification and ensure their smooth transition into the labor market' (OECD, 2010a, 24). Besides the necessary exchange of required skill between the industry and training institutions, their cooperation is also required for the updating, improvement, and expansion of skill ('lifelong learning'). This is especially important for the adjustment of skills to changes in technology (International Labour Organization, 2011, 4).

[175] Skill differs from the concept of human capital (see 4.6.7 Human Capital). Human capital is the 'intrinsic productive capabilities' of people (Eide and Showalter, 2010, 27), which include 'the knowledge and skills that workers acquire through education' (Mankiw, 2013, 244), but also people's health, social status, or their attitude towards work (see Bröckling, 2003, 18). Hence, while skills are part of human capital, human capital is more than skills.

Skilled labor in emerging countries, when compared to that in advanced countries, is especially scarce. Due to this scarcity of skill, the difference between the wages of skilled and unskilled workers is even larger in emerging countries than advanced countries (see 4.7.4 Wage Level) (see Meyer, 2006a, 50-56). In emerging countries, a large part of the overall population may only have low basic skills, a reason for which may be the low quality of schools, a high number of drop outs, and unequal access to education mainly imposed by financial hurdles (see World Economic Forum, 2014, 6). With regard to university graduates, it is interesting to acknowledge that there is no general shortage of graduates from universities or similar institutions in emerging countries and that the number of graduates tends to grow. However, these graduates often lack the required qualifications to be hired as skilled workers or in a leading position in an international firm, since the education standards differ widely between advanced and emerging countries. Meyer warns that while the number of graduates in developing countries might be high and increases faster than in advanced countries, the quality of the education these graduates receive is often relatively low compared to the education standards of universities in advanced countries. Thus, the availability of skilled labor, which can either perform a management task or skilled work, like a technician, is still low in many emerging countries (see Meyer, 2006a, 56). The skills and knowledge gained in schools often do not match those required in the labor market in emerging markets. While this is also a problem in advanced countries, it is more significant in emerging countries. There, the most urgently required missing skills are 'practical and soft skills' (OECD, 2015, 41). This scarcity of skill and the resulting large difference in wages between skilled and unskilled workers is likely to persist or even increase in the medium-term in many developing countries, as the qualification of unskilled labor on a large scale will take time, while the demand will continue to rise (see Meyer, 2006a, 56, 66). Besides the overall scarcity of skill in emerging countries, the geographic distribution of skill within emerging countries is also considerable: in many emerging countries, such as China, large differences in education exist between rural and urban areas (see OECD, 2015, 41). In general, skill is more available in large cities, closer to universities or other educational institutions, and especially in industrial clusters (see 4.11 Industrial Clusters).

The general scarcity of skill in emerging countries compared to advanced countries, as well as the differences in the availability of skill between rural and urban areas or industrial clusters, is a major problem for international firms producing there. The scarcity of skilled labor, as well as the resulting quality losses and required high costs for quality assurance, are among the main reasons for international firms to relocate their production sites (see Kinkel and Maloca, 2009, 31-32).

Acemoglu and Zilibotti emphasize that technologies which firms from advanced countries import to less advanced countries are often inappropriate for the production in less advanced countries given their scarcity of skilled labor. This inappropriateness stems from the fact that these technologies have been designed to take advantage of the input factors and production conditions in advanced countries. Thus, in order to use the same machines in an efficient manner in emerging countries as in advanced countries, firms need to find enough skilled workers at the production site in emerging countries. If firms are unable to find enough skilled workers and are forced to employ unskilled or less skilled workers to operate their machines or to let unskilled workers fulfill tasks, which in advanced countries are performed by skilled workers, they experience a loss in productivity in emerging countries compared with advanced countries, even if the same technology is available (see Acemoglu and Zilibotti, 2001, 563-564).

As the complexity of the production processes varies greatly between industries, the required level of skills at a production site also varies significantly between industries: in the textile industry, workers hardly require any initial level of skills and can be taught by the international firm everything they need to know in order to produce a high-quality product in a timely manner. In this case, a basic level of language and soft skills, such as social and emotional skills, are important (see OECD, 2017, 77). While this kind of language and soft skills are also needed for the production processes of international OEMs, their normally very complex production processes require a higher level of skills for operating tools and machines to ensure the required level of quality.

International firms are considered capable of employing insufficiently skilled workers in emerging countries and train them, assuming a certain minimum availability of skills. However, the process of training workers is very time intensive (see Meyer, 2006a, 66) and leads to additional costs. Hence, even though international OEMs, which are experienced with constructing and operating production sites in emerging countries, can provide a certain degree of training and schooling of local workers at the production site, the less skill the workers have when they join the OEM, the more training is required, thus increasing the time and cost of constructing and the production site and starting operations. With regard to OEMs providing training and qualification to local workers, it must be mentioned that the qualification and training of local workers is not only time intensive and costly, but also carries the risk of trained and qualified workers leaving the OEM not long after. This is especially problematic as the fluctuation rate tends to be rather high in emerging countries and international firms tend to have difficulties binding their trained workers there (see Meyer, 2006a, 66). Thus, providing training and qualification to local workers is only possible to a certain degree, as it is time intensive and costly for the OEM, meaning that a certain minimum level of skills must already be available.

Due to the scarcity of skilled workers, as well as management personnel, in many emerging countries, international firms cannot fill many positions with local staff. Even though the low labor costs function as an incentive to employ as many local workers as possible (see Simon et al., 2006, 250), in practice, due to the lack of technical and management skills, international firms must send expatriates to the production sites to ensure its efficient construction and operation, to teach local workers, and to guarantee the high-quality standards of production. However, as mentioned under the location factor *Costs for Deploying Expatriates* (see 4.14 Costs for Deploying Expatriates), assigning expatriates is associated with high additional costs. Hence, the more positions at the production site that can be adequately filled with local workers, the fewer expatriates that will be required at the production site.

The availability of skills should be analyzed on the regional level in the selection process as it can be assumed that people are willing to commute to work. In the analysis of the availability of skills at the production site, two other aspects should be considered: the degree of labor market mobility, as well as the competition for skill at the production site. As mentioned under the location factor *Wage Level* (see 4.7.4 Wage Level), labor is immobile relative to goods. However, while labor is in general immobile relative to goods, labor mobility varies between countries and regions. The mobility of the labor market in the region where the production site is located can mitigate or intensify the issue of skilled labor scarcity. A low mobility of labor intensifies the problem of recruiting graduates and skilled workers, as, in addition to their overall scarcity in emerging countries, many well-educated graduates live in cities and are not inclined to move to remote areas (see Meyer, 2006a, 65). Thus, the relative immobility of labor limits the OEM's choice of production sites and forces them to exclude all production sites where sufficient skilled labor is not available. Hence, the degree of labor mobility in a country should play a role in the analysis of the availability of skilled labor: if labor mobility is considered to be very low, then the availability of labor needs to be analyzed on a rather local level, while, with an increasing degree of labor mobility, the availability of skilled labor can be analyzed on a regional, national or even international level.

Besides the degree of labor market mobility, the competition for the available skilled workers at the production site must also be taken into consideration when evaluating the availability thereof. If there are other international firms, especially from the same or related industries, in the same region, they might compete for the same pool of skilled labor, which increases the scarcity of skilled workers and most likely their wages; thus, the proximity to other production sites can have a negative effect.[176] However, the presence of multiple international and national firms of the same or related industries forming an industrial cluster is normally beneficial for the availability of skilled labor (see 4.11 Industrial Clusters), as the most important advantage of being part of clusters is the availability 'of a pool of people with certain skills' (see Krugman, 1991, 64-65). Thus, the OEM might look for industrial clusters of their or related industries in selecting a production site to take advantage of the availability of skilled labor. Part of clusters are generally also academic and training institutions, which are important as the available level of skills also depends on the technological and academic environment. Thus, there is generally more skilled labor and graduates close to academic institutions, such as universities, and to locations where other international firms already produce, than, for instance, in remote rural areas. This geographic concentration of skilled labor is, on the one hand, one of the main advantages of clusters for production sites. On the other hand, this geographical concentration of skilled labor also makes it difficult to find sufficient skilled workers in rather remote areas.

Since the required skills depend on the technology and machinery that is used at the production site, and on the overall complexity of the production process, the required skills for the production process that is implemented and the product that is produced, must be clearly defined to evaluate the availability of skills at potential production sites. In particular, depending on the production process, production techniques, and the different degrees of automation which may be used, varying levels of workers' skill will be required.[177] Hence, the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile) must contain the detailed requirements on the production site in terms of skill for all feasible production techniques and degrees of automation for which production is profitable and the required quality of production is guaranteed. These required skills must be defined in terms of educational degrees, including technical degrees or managerial degrees, as well as in terms of experience. Furthermore, the level of knowledge of English or even the working language of the OEM, which is required for each individual position, must be determined. All these skill requirements must be defined in internal job descriptions by the Human

[176] With regard to car production in the U.S., Tier and Rubenstein explain that international OEMs usually select production sites which are at least two hours from other existing car production sites in order to avoid competing for the same workers (see Klier and Rubenstein, 2010, 343).
[177] See footnote 61.

Resources Department and included in the *Operational Requirement Profile*. Groups of workers with different skills may, for instance, be engineers, technicians of production, or machine operators, who are skilled workers with a focus on industrial or manufacturing work, electricians and mechanics, who are skilled workers responsible for maintaining and controlling the machines, less skilled workers, who may work in logistics or assembly production steps, and administrative workers.

The local availability of skills can be approximately assessed in a first step by the number of blue- and white-collar workers in the region, as well as by the number of graduates of technical vocational schools, technical colleges, and universities therein. People with apprenticeships, other work-based learning programs, as well as vocational education and training, must be taken into consideration. Further, the number of years of on-the-job-training, as well as of work experience in other international firms or local firms in related industries, give some indication of the availability of skills. The number of public research institutes and R&D Departments of other firms in the region, as well as the public and private investment in vocational training institutions and the overall proportion of people with a tertiary education level of the total adult population, are of interest. Moreover, the level of knowledge of the English language can be estimated by looking at the number of years of required English classes at school.

Besides evaluating the local availability of skills, it is also important to analyze the conditions to invest in education and training at the production site. The OEM should consider two ways of providing education and training to locals at the production site. First, through on-the-job training at the new production site and through sending some of the locals to other production sites of the OEM to be trained. The goal at the beginning is to optimize the availability of skills to ensure a successful construction and start of operation of the production site and, once the operation is running, to teach new skills or to expand the work force. The second way to provide training and education to locals is to invest in local training and education institutions and to closely cooperate with them. The latter pursues the medium- to long-term goal of improving the availability of skilled workers, which is worthwhile due to the long planning horizon of the production site (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model). For both, the cooperation of the national, regional, and local governments must be evaluated in terms of possible subsidies, including tax exemptions. It is important to approach the national, regional, or local governments early in the selection process to discuss possible subsidies, including tax exemptions with regard to education and training. It might even be of interest to develop a strategy to improve the local availability of skills together with the national, regional or local governments, for instance, through 'public-private partnerships among governments, employers and unions to continuously develop and improve' the availability of skills and 'the use of skills', by connecting 'education and the working world closer' (World Economic Forum, 2014, 8) at the production site.

Hence, the analysis of the availability of skills is crucial for a successful selection of a production site. In evaluating the available skills at the production site, it is necessary to ensure that at least a minimum level of skills is available at the production site. The required groups of workers with different skills (e.g., engineers, technicians of production, machine operators, electricians, or mechanics) must be specified in terms of type of skill and required number in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile). Moreover, it is important to acknowledge that any required training and education of local employees takes time and costs additional money. Moreover, the required investments in local training and education institutions must be analyzed and discussed early in the selection process with the national, regional, and local governments. Overall, the availability of sufficient skills at the production site is a necessary condition for the successful construction and operation of the production site.

Table 35: Information and Instructions on the Choice and Evaluation of the Location Factor *Availability of Skills*

Location factor to be evaluated	**Availability of Management**	**Availability of Engineers**	**Availability of Technicians**	**Availability of Machine Operators**	**Required Investment in Training and Educational Institutions**
Strategic, operational, or general	Operational	Operational	Operational	Operational	Operational
Process-specific / product-specific	Process-specific and product-specific	Process-specific and product-specific	Process-specific and product-specific	Process-specific and product-specific	Process-specific and product-specific
Relevant for production network	+	+	+	+	-
Relevant for the design of the supply chain	+	+	+	+	-
Negotiable	Not negotiable. However, the availability of skills can be considerably affected by investments in local training and educational institutions. Government investment in these institutions is negotiable.				Subsidies for the OEM for investing in training and educational institutions and for providing training and qualification to local workers are negotiable.
Semi-external / even performance	A semi-external location factor as locating a production site in a region will make skill even more scarce, while investment in training and educational institutions by the government or the OEM will increase the availability of skills at the location. A performance location factor, as the OEM will invest in training or educational institutions and provide training and qualification to local workers at the production site, hence increasing the availability of skills at the production site.				-
Quantitative or qualitative	Non-cost-related quantitative				Cost-related quantitative
Hard or soft	Hard	Hard	Hard	Hard	Hard
Static or dynamic	Dynamic	Dynamic	Dynamic	Dynamic	Dynamic
Geographic level of analysis	Regional and local level	Regional and local level	Regional and local level	Regional and local level	Regional and local
Unit of measurement	Measured for instance in terms of number of graduates from universities, training or vocational institutions in relevant fields, workers at other firms of related industries in terms of years of experience; and assessed as very bad, bad, fairly good, good and very good (or numerically as 1 through 5).				Approximated in EUR.
Evaluation method(s)	o Strategic considerations o Minimum criteria o Profile method o Utility analysis				o Minimum criteria o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria) o Phase 5 (minimum criteria, profile method, utility analysis) o Phase 7 (utility analysis)				o Phase 6 (minimum criteria, present value method) o Phase 7 (present value method)
Interdependencies with other location factors	o Wage Level o Human Capital				o Subsidies and State Aid
Source of information: public databases and information	o OECD: Skills • Survey of Adults • World Indicators of Skill for Employment • Adult Learning Dashboard • Skills for Jobs DataViz o Government websites (e.g., www.studymalaysia.com) and websites of educational institutions (e.g., vocational schools, colleges,				-

Location factor to be evaluated	**Availability of Management**	**Availability of Engineers**	**Availability of Technicians**	**Availability of Machine Operators**	**Required Investment in Training and Educational Institutions**
	universities). o Chamber of Commerce and Industry (e.g., Malaysian-German Chamber of Commerce and Industry). o Investment Promotion Agencies o A.T.Kearney Global Services Location Index: Annual Report and ranking (one of three dimensions is 'people skills and availability'). o ACEA: Statistics: Employment Trends o Other Automobile Manufacturing Associations				
Source of information: commercial external sources	-	-	-	-	-
Source of information: internal know-how	o Experience accumulated by employees of the OEM, especially members of local liaison offices. o Information obtained by other firms which are willing to share it. o Information gained through visits by employees to production sites.				o Political Department
Source of information: external consultants	+	+	+	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.8 Access to Raw Materials

4.8.1 General Remarks on Access to Raw Materials as a Location Factor

Access to raw materials is a strategic capacity of a production network and, as a strategic advantage of locations, it is an important reason for firms to engage in international activities (see Vereecke and Van Dierdonck, 2002, 501-503). According to Hymer, the internationalization of a firm by conducting FDI is an effective means of accessing local raw materials by overcoming '[b]arriers to [i]nternational [o]perations' (Hymer, 1976, 34).[178] Hymer's idea that a firm internationalizes its activities to access local resources is based on the realistic assumption that domestic firms have easier access to local raw materials than foreign firms not producing in the country (see Hymer, 1976, 34-36). Similarly, Dunning explained that one driver of internationalization of production[179] is the ownership advantage, which can for instance consist of a privileged ownership of resources, thereby ensuring better access to them[180] (see Dunning, 2001, 176). Firms and scholars have become increasingly aware of the risks related to the global expansion of production, which often entail single sourcing practices leading to dependencies with regard to raw materials and restricted access to raw materials (see Gereffi, 2014, 440). Based on this understanding, firms must ensure their access to raw materials and take advantage of policy

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[178] Hymer distinguishes between FDI of type I and type II. FDI of type I is conducted to decrease the risk of loss of the investment and can thus be explained by the capital market theory. FDI of type II is conducted for three other motives. The two primary motives are 'control' and 'monopolistic advantage', while 'diversification' is only a secondary motive (Hymer, 1976, 33). Hymer understands, under the motive of control (or removal of conflict), that firms conduct FDI to gain control over units and activities abroad, which would otherwise have to be outsourced and to gain control over competitors, for instance, by their acquisition. For Hymer, the other main motive is the monopolistic advantage which firms have in their domestic market and aim to utilize through FDI abroad, for instance, in order to overcome so-called '[b]arriers to [i]nternational [o]perations' (Hymer, 1976, 34). Thanks to monopolistic advantage, the firm can enter markets abroad and compete there with domestic firms.

[179] For Dunning the internationalization of production implies production undertaken by multinational enterprises (MNEs) and financed through FDI (Dunning, 2001, 176).

[180] When Dunning looks at the internationalization of firms, he focuses on the internationalization of the firm's production (see Dunning, 1980, 9-10). To comprehensively explain why internationalization of firms occurs, or, in particular, why firms conduct FDI to internationalize their production, Dunning developed a paradigm. With this paradigm he aims to distinguish and analyze the different drivers of internationalization 'of value added activities of multinational enterprises (MNEs)' (Dunning, 2001, 175). In other words, he explains the 'determinants of international production', meaning the production undertaken by MNEs and financed through FDI (Dunning, 2001, 176). According to Dunning's paradigm, internationalization of production is driven by three forces. First, the ownership advantage: through the internationalization of activities, firms can obtain a privileged ownership through economies of scale, specialization, network (or synergy) effects, better access to resources, a higher possibility for geographic risk diversification or other advantages related to ownership such as product innovations, technological leadership, patents or governmental preferential treatment. The second and third driver of internationalization of firms' production in Dunning's paradigm is internalization, which has been explained above and location advantages, which stem from conducting certain 'value-adding activities' at a specific location abroad (Dunning, 2001, 176). These location advantages are specific to a certain location, making that particular location more prone to the activity under consideration than other locations (see Kutschker and Schmid, 2011, 459).

incentives which improve their access to scarce resources (see Meyer and Nguyen, 2005, 66-69, 83-85).

In the selection process, access to raw materials should be considered as a location factor, while differentiating between the access to raw materials, in general, and to rare earth materials (REMs), in particular. However, with regard to raw materials as a location factor, it must be noted that, in practice, production and sourcing are strictly separated from each other for many international firms. Most of these firms pursue a global sourcing strategy, meaning that their goal is the global souring of materials and components at minimal costs independent of the locations of their production sites, their sources of materials, and their component suppliers (see Friedli et al., 2013, 55). However, access to raw materials should play a major role in the production network strategy and consequently, in the setting up of the production network, due to its significant impact on the possibility of realizing cost advantages and ensuring the firm access to necessary raw materials. The selection of a production site is a means to pursue such network goals as ensuring access to raw materials or realizing cost advantages related to raw materials. This is because policies often require local production to access local raw materials or give locally producing firms privileged access to local raw material deposits.

In the following sections, *Access to Raw Materials* is split up into *Access to General Raw Materials* and *Access to Rare Earth Materials*, mainly because of the particular relevance of rare earth materials as inputs of production in the automotive industry.

4.8.2 Access to General Raw Materials

The relevance of ‘sufficient access to raw materials at fair and undistorted prices’ (European Commission, 2008, 5) and ‘a level playing field between companies and countries’ in terms of access to raw materials is of utmost importance (European Commission, 2008, 8) for European OEMs which require raw materials for their production while these raw materials are not sufficiently or not at all available in Europe. A major problem regarding access to raw materials is the ‘artificial resource scarcity in other world regions’, which is often induced by government intervention into the market of raw materials (ACEA, 2012, 2).

Raw materials need to be differentiated between localized materials, on the one hand, which are only available at certain locations, such as gas, oil, gold, copper or ore, and ubiquities, on the other.[181] Ubiquities are raw materials, such as air, that are available anywhere under the same conditions. The costs of localized raw materials tend to differ globally, mainly because their prices depend on natural deposits, availability, and transport costs. In practice, the concentrated natural availability of localized raw materials leads to significant differences in their price between different locations. This is especially the case for raw materials with low value density, as they are costlier to transport. This explains why the price of ores and iron, which have a low value density, vary significantly globally and are lower in locations with natural deposits. While transport costs significantly impact the costs of raw materials, regulations and competition in the sector also play a major role in determining the costs of depleting and using raw materials. While in advanced economies the raw materials sector is often dominated by oligopolistic structures, allowing a few firms to generate fairly high margins, these sectors are highly competitive in many emerging economies. There, the raw material sectors are not dominated by a few big firms, but by many smaller firms, which, given their small size, cannot take advantage of scale effects, but can compensate for this with lower wage costs. This sectoral structure is one reason why many raw materials are cheaper in many emerging countries than in advanced countries, in addition to lower labor costs and less strict environmental regulations (see Meyer, 2006a, 60).

With regard to the access to raw materials, representatives of the European automotive industry lament that non-European countries ensure the access to raw materials, which are not available in these non-European countries, for their manufacturing industries (see ACEA, 2012, 2). In contrast, while the European Commission confirms the relevance of access to raw materials (see European Commission, 2008, 3-4), European governments are relatively passive in this regard. Conversely, China is the most evident example of a country that secures access to raw materials for its manufacturing industries on a global scale. China heavily invests in resource-rich countries in Africa and Asia, either directly through resource projects or through general infrastructure, such as roads, harbors or railways, to ensure the best access for its industry to the countries' natural resources (see Danish Institute for International Studies, 2016, 10; Ramdoo, 2011).

While the relevance of access to specific raw materials (or 'proximity of raw materials') varies from industry to industry (see Sule, 2008, 614), it is especially important in the automotive industry. Given that the demand for transportation, in general, is expected to increase further, the demand for raw materials required for the production in the automotive industry is also expected

[181] For a discussion of localized materials versus ubiquities, see Behrens (see Behrens, 1971, 9-10).

to rise. As the automotive industry requires raw materials for the production of its cars, trucks, buses, etc. access to the relevant raw materials is ‘a fundamental prerequisite for the future competitiveness’ of OEMs (ACEA, n.d.b). Raw materials are the largest cost driver in the automotive industry as they account, on average, for 47% of total costs (see Kallstrom, 2015).[182] Hence, cost advantages or disadvantages related to raw materials have a major effect on OEM’s total costs and, in turn, their competitiveness.

In addition, access to raw materials is necessary for each OEM to remain competitive, especially as the automotive industry is expected to increase its demand for raw materials. Consequently, it is important for OEMs to have ‘fair, long-term and secure’ access to global raw materials (ACEA, 2012, 2). This is especially important as current developments (e.g., electric vehicles) in the automotive industry change the required raw materials. The use of new materials is crucial for improving the fuel efficiency of cars or trucks, while ensuring uncompromised safety and high performance. ‘[R]eplacing heavy steel components with materials such as high-strength steel, aluminum, or glass fiber-reinforced polymer composites can decrease component weight by 10-60%.’ This reduced weight increases fuel efficiency, ‘since it takes less energy to accelerate a lighter object than a heavier one’: ‘A 10% reduction in vehicle weight can result in a 6%-8% fuel economy improvement’ (U.S. Department of Energy, n.d.). Specifically, aluminum is increasingly replacing steel in an attempt to make cars as light as possible, while ensuring their safety, given that aluminum is much lighter than steel but has a ‘similar strength’ (Kallstrom, 2015): Aluminum absorbs ‘twice as much crash energy’ as steel, as it is ‘up-to two-and-a-half times stronger than steel’ (Hydro Aluminum Deutschland GmbH, 2007, 43).

Moreover, the rising production of alternative energy vehicles (AEVs) requires the production of batteries made out of lithium and cobalt. Hence, the demand for these two raw materials (see Fishman et al., 2018, 1) is expected to continue to grow given that international OEMs have announced plans to launch over ‘100 new battery electric vehicle (BEV) models by 2024’ making up a 30-35% share of the total car sales in large markets (e.g., China, Europe, and the US) by 2030 (Chatelain et al., 2018). However, at the same time, the supply of required raw materials has become more and more restricted and complicated by environmental concerns (see Fishman et al., 2018, 2).

[182] Raw materials, the largest cost driver in the automotive industry, are followed by costs for (direct) labor (21%), administration (10%), and others, including advertising (7%), depreciation (6%), R&D (6%) and logistics (3%) (see Kallstrom, 2015).

Overall, it is important that during the selection process the OEM considers access to raw materials, both as a source of necessary inputs for production at the new production site and as a possible strategic goal of the OEM which can be pursued by selecting the production site. In terms of regulation, it is crucial to clearly understand the way in which the access (or exploitation), as well as use and export, of raw materials are regulated at the production site, and what effect these regulations have on its costs of operation and on the possibility of the OEM, as a foreign firm, using these raw materials as inputs in production and exporting products containing these. Furthermore, it is necessary to evaluate the extent to which local firms are given better access to raw materials than foreign firms and which additional costs regulations of this kind might cause at the production site (see 4.2.2.2 Non-Tariff Barriers to Trade; 4.8.3 Access to Rare Earth Materials).

Table 36: Information and Instructions on the Choice and Evaluation of the Location Factor *Access to General Raw Materials*

Location factor to be evaluated	**Availability of Relevant General Raw Materials**[183]	**Regulation on Access to Relevant General Raw Materials**	**Regulation on Use and Export of Relevant General Raw Materials**	**Costs for Use of Relevant General Raw Materials over the planning horizon of the production site**
Strategic, operational, or general	Strategic and operational	Strategic and operational	Strategic and operational	Operational
Process-specific / product-specific	Process-specific and product-specific	Process-specific and product-specific	Process-specific and product-specific	Process-specific and product-specific
Relevant for production network	+	+	+	+
Relevant for the design of the supply chain	+	+	+	+
Negotiable	-	Access to General Raw Materials can be negotiable depending on the country's regulations as well as the possibility of exporting products containing certain raw materials. These negotiations should be conducted early in the selection process.	-	Costs for the use of General Raw Materials can be negotiable depending on the country's regulations. These negotiations should be conducted early in the selection process.
Semi-external / even performance	-	Semi-external and performance	-	Semi-external and performance
Quantitative or qualitative	Qualitative	Qualitative	Qualitative	Cost-related quantitative
Hard or soft	Hard	Hard	Hard	Hard
Static or dynamic	Static, unless possible changes for instance due to new discovery of deposits and the consideration of raw materials that might become relevant in the future.	Static, unless possible changes for instance of regulation with significant effect.	Static, unless possible changes for instance of regulation with significant effect.	Dynamic
Geographic level of analysis	National and if regulation varies significantly within countries on the regional level.			

[183] The relevant General Raw Materials for the operation of the production site must be defined in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile) and subsequently evaluated as location factors.

Location factor to be evaluated	Availability of Relevant General Raw Materials[183]	Regulation on Access to Relevant General Raw Materials	Regulation on Use and Export of Relevant General Raw Materials	Costs for Use of Relevant General Raw Materials over the planning horizon of the production site
Unit of measurement	Assessed as very bad, bad, fairly good, good and very good (or numerically as 1 through 5).			Approximated in EUR.
Evaluation method(s)	o Strategic considerations o Profile method o Utility analysis			o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 3 (profile method) o Phase 5 (profile method, utility analysis) o Phase 7 (utility analysis)			o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	o Tariffs o Taxes o Non-Tariff Barriers to Trade o Subsidies and State Aid			
Source of information: public databases and information	o European Commission: • Report on Critical Raw Materials for the EU (including the annexes and Critical Raw Materials Profiles). o OECD: Green Growth Studies; e.g., Material Resources, Productivity and the Environment. o U.S. Geological Survey, National Minerals Information Center: Commodity Statistics and Information: Non-fuel Minerals. o U.S. Department of Energy: Critical Materials Strategy 2010 and 2011 o World Mining Congress: World Mining Data (annual report) (information on production). o FastMarkets: Industrial Minerals: information on non-metallic minerals (including a pricing database) o Fraunhofer Institute for Systems and Innovation Research ISI: Materials and Raw Materials o Bundesanstalt für Geowissenschaften und Rohstoffe: • Studies on deposits and production of minerals and other raw materials • Information on national and international cooperation o Government websites (e.g., China Ministry of Commerce)			-
Source of information: commercial external sources	o Roskill: Market Reports (detailed information on steel alloys, minor metals, industrial minerals, carbon & chemicals, and base metals). o S&P Global Market Intelligence: Mining Industry Research & Analysis Resource Hub (detailed information on production, exploitation, supply chain and industry outlook) o Consensus Economics: Energy & Metals Consensus Forecast: analysis and outlook (price) for more than 30 commodities o SNL Metals&Mining: World Exploration Trends (Annual Report) o Continuum Economics: Commodities Outlook			-
Source of information: internal know-how	o Sourcing Department o Political Department o Local Liaison Offices o Strategy Department			o Production Planning Department o Production Strategy Department
Source of information: external consultants	+	+	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.8.3 Access to Rare Earth Materials

Rare Earth Materials (REMs)—also called rare earths, rare earth metals or rare earth elements—include dysprosium, terbium, neodymium, and yttrium (see Fishman et al., 2018, 1; Baldi et al., 2014, 53, 55). In total, there are 17 REMs, all of which 'are indispensable to the manufacturing of smartphones, electric vehicles, military weapon systems and countless other advanced technologies' (Center for Strategic and International Studies, 2020). REMs are also especially important for generating 'renewable energy' and 'zero-low emissions transport' (e.g., wind turbines, and hybrid and electric vehicles) (Roskill, n.d.). For this reason, the demand for REMs increased fourfold between 1980 and 2009 (see U.S. Department of Energy, 2011, 4, 9, 38; European Commission, 2014, 155), it has since continued to rise even more and is expected to grow by 5% to 9% annually over the next 25 years (see MIT, n.d.; Fishman et al., 2018, 1).

For the automotive industry, REMs are of special significance with regard to electric vehicles (EVs), as both batteries and magnets, necessary for the production of EVs, require the input of REMs[184] (see U.S. Department of Energy, 2011, 9). All EVs need some kind of battery to store energy for the propulsion of the vehicle and almost all EVs (including plug-in hybrid electric vehicles (PHEVs), hybrid electric vehicles (HEVs) and all-electric vehicles (AEVs)) use permanent magnets (see U.S. Department of Energy, 2011, 20-21). Recently, the demand for EVs has been rising significantly (see Fishman et al., 2018, 1) and is expected to continue to grow. Consequently, their production is expected to continue to rise given that international OEMs have announced plans to launch over '100 new battery electric vehicle (BEV) models by 2024', making up a 30-35% share of total car sales in large markets (e.g., China, Europe, and the U.S.) by 2030 (Chatelain et al., 2018). The required REMs for the production of EVs are inputs, which the automotive industry had previously used only in small quantities as input for production or not at all (e.g., neodymium and dysprosium, which are required for the production of permanent magnets) (see Fishman et al., 2018, 1). For an overview of the end use of REMs in the automotive industry, see Table 37, where those REMs which are of special importance for the automotive industry are highlighted in red.

[184] The production of electric vehicle batteries requires the use of the following REMs as inputs: lanthanum, cerium, praseodymium, and neodymium. The production of permanent magnets for motors and generators of electric vehicles and wind turbines requires the following REMs as inputs: neodymium and dysprosium, which could potentially be substituted with samarium, also a REM, or cobalt, not a REM (see U.S. Department of Energy, 2011, 5, 9).

Table 37: Overview of End Use of Rare Earth Materials

Light Rare Earth (more abundant)	Major End Use	Heavy Rare Earth (less abundant)	Major End Use
Lanthanum	hybrid engines, metal alloys	**Terbium**	phsophors, permanent magnets
Cerium	auto catalyst, petrolium refining, metal alloys	**Dysprosium**	permanents magnets, hybrid engines
Praeseodymuium	magnets	**Erbium**	phosphors
Neodymium	auto catalyst, petrolium refining, hard drives in labtops, headphones, hyprid engines	**Yttrium**	red color, fluorescent lamps, ceramics, metal alloy agent
Samarium	magnets	**Holmium**	glass coloring, lasers
Europium	red color for television and computer screens	**Thulium**	medical x-ray units
		Lutetium	catalysts in petroleum refining
		Yetterbium	lasers, steel alloys
		Gadolinium	magnets

Red highlighting indicates special importance for the automotive industry.
(Author illustration in reference to Humphries, 2013, 3)

REMs are not only especially scarce, but they function also as inputs in the production of certain products, and are often, if at all and only with much difficulty, substitutable. While the substitution of many REMs as inputs in production is only possible by significantly reducing the quality and increasing the costs of products (see Silberglitt et al., 2013, 8), other REMs (e.g., dysprosium or neodymium) are not substitutable at all given their magnetic properties which are required for the production of permanent magnets (see Baldi et al., 2014, 53-55). In addition, the production of all kinds of vehicles requires glass and catalysts, which, in turn, also need REMs as inputs[185] (see U.S. Geological Survey, 2011, 3; European Commission, 2014, 153-154).

While the demand for these materials is rising, their supply has become more and more restricted and complicated by political and environmental concerns (see Fishman et al., 2018, 2; Zhang et al., 2015, 82, 89). Relative to other raw materials, the supply of REMs is very concentrated in terms of mines, firms, and countries (see Baldi et al., 2014, 53). For instance, China produced more than 60% of the worldwide production in 2019, followed by the U.S. with about 12%

[185] The production of glass requires the use of the following REMs as inputs: cerium, lanthanum, and praseodymium erbium; while the production of car catalysts requires the use of the following REMs as inputs: cerium, lanthanum, neodymium, and praseodymium (see U.S. Geological Survey, 2011, 9).

(see Yu and Mitchell, 2020). REMs are not rare compared to other raw materials,[186] but '[t]he process of mining' REMs 'and transforming them into usable materials is […] expensive and damaging to the environment.' (Center for Strategic and International Studies, 2020). Consequently, even though REMs 'were first discovered and put into use in the United States', 'production gradually shifted to China, where' (Dreyer, 2020) the Chinese government was able to use its cheap labor and 'lax environmental laws' to build an efficient sector for mining, producing, and processing REMs. Likewise, the Chinese government strongly supported the domestic REM industry 'by issuing export tax rebates in the mid-1980s', which reduced costs for domestic production (Center for Strategic and International Studies, 2020).

With rising Chinese production, firms producing and processing REMs 'in other countries began to shift their production to China to take advantage of the country's low labor costs and weak environmental regulations.' As a response, 'the Chinese government declared rare earths to be protected and strategic minerals' in 1990, prohibiting 'foreign firms from mining rare earths within China and restricted foreign participation in rare earth processing projects, except in joint ventures with Chinese firms'. Moreover, in the late 1990s, the Chinese government imposed strict export quotas on REMs (Center for Strategic and International Studies, 2020), which it steadily tightened in the following years. In addition, in 2007, the Chinese government implemented 'output quotas' for REMS 'to prevent over-mining that damaged the environment' and 'to keep prices high for domestic producers' (Yu and Mitchell, 2020). This protectionist policy triggered the US, EU, and Japan, in 2012, to file 'a series of trade disputes against China in the World Trade Organization', 'claiming that Chinese government policies were unfairly benefiting its industry at the expense of other countries.' After 'the WTO ruled against China in 2014', the nation finally ended its export quota system in 2015 (Center for Strategic and International Studies, 2020).

However, the reliance on China for the miming, production and processing of REMs remains (see Center for Strategic and International Studies, 2020): China continues to control almost all processing facilities worldwide. Processing REMs is difficult, including producing concentrates and isolating REMs 'into high-purity elements'. Due to the high costs and China's competitive advantage in processing REMs, international firms are going so far as to send REMs from other countries for processing to China (Dreyer, 2020). While in recent years many countries tried to

[186] Despite the dominant role that China plays in the supply of REMs and the current scarcity of REMs, there are most likely sufficient REMs in the crust of the earth (with significant deposits of REMs found in Asia, North America, Australia, and Africa (see Baldi et al., 2014, 53)) to meet the increasing demand for these metals in the long-term.

reduce their dependence on China for REMs (Center for Strategic and International Studies, 2020), the coronavirus pandemic has highlighted their economies' 'vulnerability when a critical supply chain originates in China'. As a response, there are alliances and initiatives in place (EU) or building (U.S., U.K., Australia and Canada) to reduce reliance on China for REMs (Vinoski, 2020). At the same time, the demand for REMs is expected to continue to rise, especially as it is driven by the attempt of many governments to make their economies more environmentally friendly, thereby making the supply even tighter (see Roskill, n.d.).

One way for international OEMs to overcome the problem of scarcity of REMs and restrictive local regulations hindering foreign firms to exploit local deposits is to establish joint ventures with local firms. Toyota Motor Corporation, for instance, has established joint ventures and supply deals with several international firms that own REM mines, such as the Vietnamese Coal and Mineral Industries Group or the Wako Bussan Trading Co. (see U.S. Department of Energy, 2011, 65). Hence, as local production in the form of a joint venture with local firms remains, in many countries, a necessary condition to gain access to local REMs, possibilities for forming a joint venture with a local firm should be assessed in the selection process (see 4.15 Potential Partners for Alliances and Joint Ventures).

When evaluating the access to REMs, it is difficult to find necessary information. The U.S. Geological Survey, Mineral Commodity Summaries, the Roskill Information Services or UN Comtrade provide information about REM deposits, production, and regulation on their use. However, there exists, for instance, no comprehensive overview of existing deposits and the amount of exploitation and production of REMs in China. Hence, in addition to the currently available information, it is important to gain knowledge regarding the country under consideration either through visits by employees or external consultants or through exchanges with other firms. Furthermore, it is important to engage in negotiations with the national, regional, or local governments at an early stage in the selection process to understand their willingness and stipulations to secure the OEM reliable access to local REMs if the OEM locates a production site in the country, region, or community, respectively. Moreover, the regulations for using REMs as inputs of production must be evaluated and might be negotiable with regard to the use of REMs as inputs of production and to the export of products containing REMs from local deposits.

Overall, given the scarcity of REMs, restrictive policies and the high concentration of their availability and production, combined with the need for them as production inputs and the impossibility to substitute some of them without quality losses, especially in the automotive industry, they must be considered in the selection process. In the selection process, it is important to know precisely and specify in the *Operational Requirement Profile* which REMs are required for the production at the new production site (see 3.2.2.3 Operational Requirement Profile). If access to REMs is a strategic goal of the OEM that is supposed to be pursued by selecting the new production site, the valuable REMs for the OEM must be defined in the *Strategic Requirement Profile* (see 3.2.2.2 Strategic Requirement Profile). Hence, the availability of REMs and the condition for the access to REMs, as well as the use and export of REMs in the country under consideration, must be analyzed in the selection process.

Table 38: Information and Instructions on the Choice and Evaluation of the Location Factor *Access to Rare Earth Materials*

Location factor to be evaluated	**Availability of Relevant REMs**[187]	**Regulation on Access to Relevant REMs**	**Regulations on the Use and Export of Relevant REMs**	**Costs for the use of Relevant REMs over the planning horizon of the production site**
Strategic, operational, or general	Strategic and operational	Strategic and operational	Strategic and operational	Operational
Process-specific / product-specific	Process-specific and product-specific			
Relevant for production network	+	+	+	+
Relevant for the design of the supply chain	+	+	+	+
Negotiable	-	Access to REMs can be negotiable depending on the country's regulations as well as the possibility of the OEM to export products containing REMs. These negotiations should be conducted early in the selection process.	-	Costs of REMs can be negotiable depending on the country's regulations. These negotiations should be conducted early in the selection process.
Semi-external / even performance	-	Semi-external and performance	-	Semi-external and performance
Quantitative or qualitative	Qualitative	Qualitative	Qualitative	Cost-related quantitative
Hard or soft	Hard	Hard	Hard	Hard
Static or dynamic	Static, unless possible changes for instance due to new discovery of deposits and the consideration of raw materials that might become relevant in the future.	Static, unless possible changes for instance of regulation with significant effect.	Static, unless possible changes for instance of regulation with significant effect.	Dynamic (as REMs are expected to become rarer in the future, the possibility of more restrictive regulations and its effect on costs must be taken into account).
Geographic level of analysis	National and if regulation varies significantly within countries on the regional level.			National and if costs vary significantly within countries on the regional level.
Unit of measurement	Assessed as very bad, bad, fairly good, good and very good (or numerically as 1 through 5).			Approximated in EUR.

[187] The relevant REMs for the operation of the production site must be defined in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile) and these, as relevant defined REMs, must be evaluated as location factors.

Location factor to be evaluated	**Availability of Relevant REMs[187]**	**Regulation on Access to Relevant REMs**	**Regulations on the Use and Export of Relevant REMs**	**Costs for the use of Relevant REMs over the planning horizon of the production site**
Evaluation method(s)	o Strategic considerations o Profile method o Utility analysis			o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 3 (profile method) o Phase 5 (profile method, utility analysis) o Phase 7 (utility analysis)			o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	o Tariffs o Taxes o Non-Tariff Barriers to Trade o Access to General Raw Materials o Availability of Potential Partners for Strategic Alliances or Joint Ventures			
Source of information: public databases and information	o European Commission: Report on Critical Raw Materials for the EU (including the annexes and Critical Raw Materials Profiles) o OECD: Green Growth Studies; e.g., Material Resources, Productivity and the Environment o U.S. Geological Survey, Rare Earth Statistics and Information: annual mineral commodity summaries, mineral yearbooks and special publications (e.g., Rare Earth Element Mines, Deposits, and Occurrences) o U.S. Department of Energy: Critical Materials Strategy 2010 and 2011 o World Mining Congress: World Mining Data (annual report) (information on production) o Industrial Minerals: information on non-metallic minerals (special section on REMs) including battery price reports and a pricing database o Industrial Minerals: information on non-metallic minerals (special section on REMs) including battery price reports and a pricing database o Bundesanstalt für Geowissenschaften und Rohstoffe: • Studie: Vorkommen und Produktion mineralischer Rohstoffe - ein Ländervergleich (annual report) • Information on national and international cooperation o Government websites (e.g., The State Council; The People's Republic of China; Archive; White Paper).			-
Source of information: commercial external sources	o Roskill: Rare Earths (annual report)			-
Source of information: internal know-how	o Sourcing Department o Strategy Department o Members Local Liaison Offices			o Production Planning Department o Production Strategy Department
Source of information: external consultants	+			+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.9 Infrastructure

4.9.1 General Remarks on Infrastructure as a Location Factor

The infrastructure of a country or a region includes streets, railroads, telecommunication networks, the electrical grid, postal service, waste disposal, water distribution systems, public transport, airports, canals, harbors, or navigable rivers. Investment in and availability of high-quality infrastructure enhances productivity and economic growth. Already, a 1994 World Bank study has revealed that an increase in infrastructure stock by 1% leads to a 1% GDP growth (The World

Bank, 1994, 17).[188] Investment in all kinds of infrastructure is considered growth promoting, and this is especially the case for investment in transportation infrastructure which 'promotes growth by increasing the social return to private investment without crowding out other productive investments' (The World Bank, 1996, 1). Transportation infrastructure is especially important for an economy to participate in global value chains (see Gereffi, 2020, 130) 4.6.8. Openness to Trade and Position in the Global Value Chain).

Despite the importance of infrastructure investment for productivity and economic growth, investment therein is usually not conducted by the private sector as private investors are cautious with regard to such investments given the large scale of required investment, high sunk costs, high associated risk, long payback period, as well as high maintenance costs (see Banister and Berechman, 2000, 66). According to economic theory, market failures[189] arise in the provision of infrastructure due to external effects[190] and increasing returns to scale.[191] These market failures lead to a suboptimal provision of infrastructure under market competition (see Blankart, 2008, 55-57; Farhauer and Kröll, 2014, 57-58, 145). Given the high fixed costs, external effects and increasing returns to scale in the provision of infrastructure and its importance for productivity and growth,

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[188] However, the authors of the study warned that even though infrastructure investment enhances growth, '[i]nfrastructure is a necessary, although not sufficient, precondition for growth – adequate complements of other resources must be present as well' (The World Bank, 1994, 17).

[189] According to the theory of market failure, there are some goods in whose provision arise market failures in competitive markets. Due to these market failures, the government, according to the theory, has to intervene in the market to correct them. To determine the kind of product in whose provision market failures arise, the theory differentiates between private goods, public goods, goods produced under increasing returns to scale, and common pooled goods based on the rivalries in their use and the excludability from their use.

[190] The concept of externalities or external effects has been developed among others by Pigou (1920, 1929). External effects occur when the production or consumption of goods or services have positive or negative side effects for others who are not involved in the production or consumption of these goods and services (see Blankart, 2008, 59). Thus, externalities arise when somebody's actions impact others without any compensation occurring. These effects on others result in positive, positive externalities, or negative, negative externalities (see Burda and Wyplosz, 2013, 466).

[191] Many investments in infrastructure projects, such as railroads, are 'indivisible' (Krugman, 1991, 24), which means that the more goods or people are transported, the greater the decrease of the unit cost of transport. As many infrastructure goods require large initial investments (fixed costs) relative to the variable costs, these goods are produced under increasing returns to scale (meaning that the marginal costs of production decline as the unit of production increases). Under increasing returns to scale, one provider can offer these goods cheaper than several providers, hence, these markets are often characterized by a natural monopoly. The government often intervenes in the market either by providing the good itself or by regulating the natural monopoly (see Blankart, 2008, 55-57). Many kinds of infrastructure fall in the category of goods produced under increasing returns to scale from the use of which people can be excluded but in the use of which there is no rivalry (e.g., railroads, highways, water, gas or oil pipelines systems, electricity grids, or postal services). In the provision of goods produced under increasing returns to scale, market failures arise because the initial investments required are so large relative to the running costs, which means that one provider can provide the good cheaper than several providers. Thus, the market for goods produced under increasing returns to scale is characterized by natural monopolies in which a monopolist can determine the price. The government can solve these market failures by either providing the good or regulating the natural monopoly (see Blankart, 2008, 52-60).

infrastructure is usually provided by the government or by some sort of public-private partnership and can usually be used relatively small or no cost (see Gereffi, 2014, 441-442).

Investment in large infrastructure projects requires political stability and a high degree of political integration, thus low political fragmentation (see Bogart et al., 2010, 88-89, 94). Political stability is important because the long payback period and large required investments of infrastructure projects. Furthermore, these required investments are often only affordable for national governments. The functioning and use of the infrastructure require political stability and a certain level of political integration as, for instance, a railroad system connects various regions in a country and travelling between the regions is only possible given political stability and integration.

For the successful construction and operation of the production site, the availability of infrastructure is indispensable as it provides the required water and energy supply facilities, as well as waste disposal facilities, among other necessities. The infrastructure at the production site has a significant effect on the productivity of operating the production site, which suffers heavily from, for instance, unreliable water and energy supply. Furthermore, infrastructure enhances the efficiency of supply chains and production networks by connecting the local or national economy with the national or international economy through harbors, canals, navigable rivers, airports, railroads, or roads, but also through information and communication technologies (see Gereffi, 2014, 441-442). Depending on the strategic role that the production site is supposed to play in the production network of the OEM, infrastructure that connects the production site with other countries and thus creates the possibility for the OEM to transport products easily, affordably, and reliably to and from these other countries is very valuable. Regardless of the production site's role in the OEM's production network, the availability of transport infrastructure at the production site is absolutely necessary for the transport of components to and the produced product from the production site. Thus, the successful construction and operation of a production site requires the availability of infrastructure, as it is necessary for the productive operation of the production site, but also enables the OEM to embed the production site into its global production network and the local and global supply chain.

When evaluating the availability of infrastructure, the advantages of clusters with regard to providing high-quality infrastructure must be taken into consideration (see 4.11 Industrial Clusters), as available infrastructure is one of the most important advantages of being part of clusters (see Krugman, 1991, 64-65). By being part of clusters, firms benefit from scale effects in transportation (see Krugman, 1991, 24-25). Governments of emerging countries are most likely to invest in large infrastructure projects where industrial clusters already exist or where they want to create industrial clusters, as they know that high-quality infrastructure is an important condition for an industrial cluster to emerge and function.

For a general overview of large infrastructure projects in a country but also on a regional level, the OECD's website 'Private Participation in Infrastructure Database' is helpful as it provides an overview of the top infrastructure projects of 139 countries, the amount of US$ invested, top sponsors of these infrastructure projects, an analysis of infrastructure projects by sector, as well as the status of individual projects (see The World Bank, n.d.h). While the analysis of the available infrastructure at the production site is important in advanced countries, it is especially important for production sites in emerging countries, since many emerging countries do not have the necessary capital to finance large infrastructure projects. Hence, in many cases, international OEMs which operate production sites in emerging countries must invest considerably in the infrastructure at the production site, for example, in the form of streets, emergency power generators or waste disposal systems (see Meyer, 2006a, 66-67). Such additional investments must be taken into consideration and possible subsidies for these investments must be negotiated in the selection process with the national, regional, or local government.

Overall, the availability of relevant infrastructure is a necessary condition for the successful construction and operation of the production site. The following analysis of infrastructure differentiates between the location factors *Transportation Facilities*, *Water and Energy Supply*, *Waste Disposal and Sewerage*, as well as *Information and Communication Technologies*.

4.9.2 Transportation Facilities

Transportation facilities include waterways, railroads, highways, roads, harbors, and airports. They are necessary for transporting components to the production site from production sites of suppliers or the OEM's other production sites, as well as for transporting the product produced at the production site to the sales market, if it is a final product, or if the product is a component, to the OEM's other production sites for further processing. Moreover, transportation facilities are necessary for employees and service providers to get to and from the production site. For transporting components and final products, there are several modes of transportation which can be combined (see 4.10.4.2 Modes of Transportation). Considering the feasibility and profitability of modes of transportation has a significant effect on the transportation facilities required at the production site for the successful operation of the production site. If the preferred mode of transportation includes transport by barge, then the OEM must locate the production site either close to an industrial harbor, close to railroads that lead to an industrial harbor, well connected with roads to an industrial harbor, or on navigable waterways that lead to industrial harbors (see Sule, 2008, 612). If the preferred mode is by railroad, then a railroad connection is necessary. Finally, if the preferred mode of transportation is by truck, then only well-maintained streets are required.

Moreover, it is necessary that the production site is connected by streets and, if possible, even by public transportation with larger highways and nearby cities or towns for transporting goods, employees, and service providers to and from the production site. The production site should also be easily accessible from an international airport, thereby easing travel for expatriates. While the connection of the production site with the local street system, as well as the accessibility of an international airport, are required for the successful operation of the production site, the transportation facilities necessary for transporting components and the produced product must be evaluated based on the modes of transportation which are feasible for the products and components under consideration, the location of the production site, and the available transportation facilities at therein.

Transportation facilities are crucial for the successful operation of the production site as they are necessary for components, final products, or people to reach their destination, namely, the OEM's other production sites, the final sales market, local cities and living areas, or the closest (international) airport. Crucially, transportation facilities are necessary for the transport of components from the OEM's other production sites, as well as from suppliers' production sites, to the new production site. The distance from production sites from which components must be shipped to the new production site (downstream connected production sites) or from production sites to which components produced at the new production site must be shipped for further processing (upstream connected production sites) is limited if the processing production sites require a just-in-sequence delivery of components, as is often the case today in OEM's production. If this is the case, the largest possible distance to relevant production sites must be defined in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile). Furthermore, required investments for the development, installation or extension of railroads, roads and highways must be taken into consideration and negotiations over the rates for transport, as well as potential investments in infrastructure with railroad or harbor firms, must be conducted. Moreover, negotiations about subsidies for investments in transportation facilities must be conducted early in the selection process with the national, regional, and local governments. Furthermore, information must be gathered about future transportation facility projects and investments, as well as about their potential use for the production site, by the government or private investors

In the evaluation of the reliability of the transportation facilities, it is important to analyze their quality and functioning. While poor road conditions undermine the safety and reliability of transport by truck, as well as the commute of employees and service providers to and from the production site, inefficiently managed harbors are a major source of delayed deliveries on the route[192] (see Meyer, 2006a, 72-77). Harbors are important nodes in 'global transport chains' facing significant challenges: 'growing concentration and consolidation in the liner shipping market, the growing size of ships, the emergence of mega-alliances' (UNCTAD, 2017, 61) and rising 'cyber-security threats' (UNCTAD, 2017, 63). While the size of ports is captured by its throughput handled volumes, their quality is reflected in their 'turnaround time', hence the time ships spend in the port (the 'dwell time'), and hence the time that the cargo is in the port, as well as the gate operations, intermodal connectivity, and hinterland connection (see UNCTAD, 2017, 68). In particular, ports need to be evaluated as the reliable and efficient transport by ship requires a functioning harbor. In the evaluation of railroads, it is important to analyze whether the railroad system is in good shape overall. Moreover, the availability of a direct train connection (or the possibility and costs of constructing such) from the production site to the closest larger train station must be evaluated. The possibility of building a rail connection from the production site to the closest train station (or industrial harbor) requires, for instance, that the topology and the ground conditions allow for the building of railroad tracks without resulting in extraordinary costs; nonetheless, conditions in terms of the maximum weight of the freight must also be evaluated. The same holds for the street system. The quality of roads must be evaluated, as the transport by trucks requires high-quality roads. Furthermore, it is of course beneficial if the relevant roads have more than one lane. Secure and reliable transportation requires that the traffic is safe with regard to accidents (both on roads and railroads) and road safety in terms of road quality. The road conditions in many emerging countries vary considerably between national highways and the roads in the interior of the countries. The conditions of the roads also depend on weather conditions, such as rainy seasons, which might make

[192] Evaluating the functioning of different harbors must not be left out in the selection process, given the large differences in the efficiency and reliability of different harbors; for instance, between harbors in India or harbors in Singapore, Hong Kong, or Shanghai. The efficiency of harbors can be estimated based on the number of days needed for handling container ships and customs clearance (see Meyer, 2006a, 74).

entire road systems unusable, or certain terrains, which make the transport of products by trucks impossible or dangerous. Likewise, both the use of railroad and roads must be safe with regard to natural hazards and robbery. The impact of natural hazards and weather conditions on the use of transportation facilities is captured in the location factor *Natural Hazards* (see 4.4 Natural Hazards) while possible impairment of road safety due to robbery is captured in the location factor *Security* (see 4.3.2.2 Security). Moreover, it must be evaluated if charges arise for using railroads, highways, or roads.

When evaluating the availability of transportation facilities at the production site, it is important to differentiate between the overall availability on a national level and the availability at the production site on a local level. There are several sources of information on the overall availability of transportation facilities on a national level providing indicators, such as the density of motorway network, or density of railway network, including transport hubs or presence of airports. The overall availability of transportation facilities on a national level is quantified in the Global Enabling Trade Index (ETI) published by the WEF for 138 countries, which includes the pillar 'availability and quality of transport infrastructure'. This indicator measures 'the availability and quality of domestic infrastructure for' the transport modes: road, air, railroad, and seaport, as well as the level of air and sea line connectivity (Hanouz et al., 2014, 4). The International Transport Forum, which is part of the OECD, also provides data on the investment in and maintenance spending for transport infrastructure for 50 countries. Furthermore, to assess the overall efficiency and reliability of the transport system on a national level, it is helpful to understand the amount of goods and passengers transported in a country. Conveniently, the International Transport Forum provides on its website information about the transport of goods and passengers for 56 countries[193] (see International Transport Forum, n.d.).

For the evaluation of transportation facilities at the production site on a local level, this information on transportation facilities, which is exclusively on a national level, is not sufficient. The production site's requirements for transportation facilities depend on the characteristics and destination of the produced product, as well as the characteristics of required components and the production sites of component suppliers. These requirements must be included in the *Operational*

[193] The provided data on the transport of goods includes total amount of inland freight, which can be subdivided into the freight transported by rail, by road, on inland waterways or via pipelines, by coastal shipping, container transport, which is composed of rail containers and maritime containers, and the total inland freight. The provided data on the transport of passengers includes total number of inland passengers, which are split up into rail passengers and road passengers (both cars as well as buses & coaches) (International Transport Forum, n.d.).

Requirement Profile (see 3.2.2.3 Operational Requirement Profile). Information on the availability of the transportation facilities at the production site can be gained through visits to the production site or through the inquiry of locally active consultants or of firms that are already locally present. External consultants may also already have information about the availability of transportation facilities in the region or at the production site.

Table 39: Information and Instructions on the Choice and Evaluation of the Location Factor *Transportation Facilities*

Location factor to be evaluated	**Availability of Transportation Facilities (e.g., harbors, navigable rivers, airports, railroads, roads etc.)**	**Costs for the Required Investment in Transportation Facilities**
Strategic, operational, or general	Operational	Operational
Process-specific / product-specific	Process-specific and product-specific	Process-specific and product-specific
Relevant for production network	+	+
Relevant for the design of the supply chain	+	+
Negotiable	Negotiable as government subsidies and investments in transportation facilities can be negotiated with the national, regional, and local government.	
Semi-external / even performance	Semi-external and even performance	
Quantitative or qualitative	Qualitative	Cost-related quantitative
Hard or soft	Hard	Hard
Static or dynamic	Dynamic	Dynamic
Geographic level of analysis	National (harbors), regional (navigable rivers, airports, harbors) and local level (roads, access to navigable rivers or railroads) depending on facilities.	
Unit of measurement	Assessed as very bad, bad, fairly good, good or very good (or numerically as 1 through 5).	Approximated in EUR.
Evaluation method(s)	o Strategic considerations o Minimum criteria o Preferable criteria o Substitutable criteria o Profile method o Utility analysis	o Minimum criteria o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method, preferable criteria, substitutable criteria) o Phase 4 (minimum criteria, preferable criteria, substitutable criteria) o Phase 5 (profile method, utility analysis) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, present value method) o Phase 7 (present value method)
Interdependencies with other location factors	o Modes of Transportation o Fixed Investment (including Foreign Direct Investment) o Industrial Clusters	o Subsidies and State Aid

Location factor to be evaluated	Availability of Transportation Facilities (e.g., harbors, navigable rivers, airports, railroads, roads etc.)	Costs for the Required Investment in Transportation Facilities
Source of information: public databases and information	o The World Bank: Private Participation in Infrastructure Database (information on projects, their construction status, capacity etc.). o Statistica: Ranking of the countries with the highest quality of railroad infrastructure. o National and regional government websites (e.g., see especially budget plans on infrastructure spending). o The Global Economy.com: Rankings: Roads quality –county rankings, Railroad lines (km), Railroad Transport of Goods, Port traffic, Railroad infrastructure quality, port in frastructure quality. o International Transport Forum (ITF): • Statistics and Data: Key transport indicators reflecting investment in and availability of infrastructure; • Document: Key Transport Statistics; • General information summarized in 'Statistics Briefs', general information on rail, road, maritime and aviation transport; • Reports on 'Time efficiency at works container ports' and on 'local governments and ports'. o The European Commission: Mobility and Transport: Quality of railroad infrastructure, quality of port infrastructure, quality of roads. o Global Enabling Trade Index (ETI) published by the WEF Pillars 4 'Availability and quality of transport infrastructure' measuring 'the availability and quality of domestic infrastructure for each of the four main modes of transport: road, air, railroad and seaport infrastructures. Air connectivity and sea line connectivity are also assessed'. o Logistics Performance Index (LPI): indicators (Competence and quality of logistics services (e.g., transport operators, customs brokers).	-
Source of information: commercial external sources	-	-
Source of information: internal know-how	o Logistic Department o Factory Planning Department o Local Liaison Offices	
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.9.3 Water and Energy Supply

The demand 'for freshwater and energy' is expected to continue to rise considerably over the decades to come given the 'growing populations and economies, changing lifestyles and evolving consumption patterns'. This rise in demand for freshwater and energy will exacerbate the already 'existing pressures on limited natural resources and on ecosystems'. In countries that are experiencing very fast transformation and strong economic growth, these pressures will be even more acute and intensified as, in many emerging countries, significant parts of the population lack access to services providing water and energy (UNESCO, 2014, 2). Especially in the Asia-Pacific region, where the use of water and energy increases exponentially, considerable challenges in their supply arise[194] (see UNESCO, 2014, 6).

[194] Among these challenges are that coal remains the main source of energy, one which requires large quantities of water for its generation (see UNESCO, 2014, 6).

In this location factor, the supply of water is considered first and the supply of energy second. The availability of water with sufficient quality is among the main challenges in emerging countries given the shortage of freshwater sources (see The Association of Academies of Sciences in Asia, 2011, XIX-XX). In many emerging countries, water resources are stressed because of fast urbanization and rising water use in the agricultural and industrial sectors (see PWC, 2013, 1). Moreover, globalization has caused manufacturing firms to locate production processes in emerging countries, thereby exacerbating the water conditions there, as the located production processes are, in many cases, very water intensive and have often been relocated from areas with plenty water resources in Europe or the U.S. to regions with scarce water resources without adapting the production processes (see UNESCO, 2014, 42). For instance, in many regions in western China which are especially water-scarce, production sites and power stations disrupt the natural water supply by securing water 'from local lakes and rivers, drawing down groundwater' and by 'building reservoirs to capture rainwater' (UNESCO, 2014, 42). While in Europe, water use for industrial purposes shows a decreasing trend since 2007, which might be a result of the use of technology which allows for a more water efficient production (see Förster, 2014, 5), in many emerging countries often already scarce water resources are even more stressed by industrial production, increasing the risk of supply shortages.

Reliable and sufficient supply of water, both in terms of quality and capacity, is necessary for the successful construction and operation of the production site. The automotive sector, and thus the OEM, is an 'end-use sector' of water, given that the OEM buys, withdraws or treats water for its own use, and does not resell it to other consumers (U.S. Energy Information Administration, n.d.). The supply of two types of water is required at the production site: potable and industrial. Potable water is necessary so that everybody working on the production site has enough water to drink. Industrial water includes all water used in industrial processes and is used at some point or at several points in the production process of most manufactured goods (e.g., in the fabrication, 'processing, washing, dilution, cooling, or transporting [of] a product'). Industrial water might even be incorporated into a product or used for sanitation purposes at the production site. For most industrial purposes, the water that is used in production processes must be freshwater and cannot be salty, given that the use of salt water accelerates the rusting of metal (see U.S. Geological Survey, n.d.b). Industrial water can be taken from 'self-supplied industrial withdrawals', such as groundwater (e.g., wells) or surface-water (e.g., withdrawal points from a river), as well as from 'public-supply' sources (U.S. Geological Survey, n.d.c).

After considering the supply of water, the supply of energy is considered next. The electricity demand worldwide is expected to increase by about 70% by 2035, nearly all of which will be accounted for by non-OECD countries. India and China alone will account for over 50% of that increase in electricity demand (see UNESCO, 2014, 2). The sharp increase in non-energy-intensive manufacturing, in particular, has led to a considerable increase of electricity and natural gas consumption in the industrial sector in both OECD and non-OECD countries. In 2016, non-energy-intensive industries made up about 30% and 36% of total energy consumption of the industrial sector in OECD and non-OECD countries, respectively. As non-energy-intensive manufacturing increasingly consumes natural gas and electricity, the consumption thereof grew significantly in both OECD and non-OECD countries in comparison with most other energy sources (see U.S. Energy Information Administration, 2016, 116). The demand for electricity in non-OECD Asian countries is likely to increase further, given the many rather downstream industries located there. The increase in demand for electricity depends more on the 'composition of industry than on overall economic growth'. This is evident as 'the growth of industrial sector electricity demand slows' in advanced economies when they 'reach a certain stage in their development' (U.S. Energy Information Administration, 2016**,** 125).

This rising global need for electricity, together with lacking infrastructure, in emerging countries, result in serious risks of energy supply. Consequently, given the lack of necessary capital to finance large infrastructure projects, energy supply facilities are likely to stay underdeveloped for an extended period in many emerging countries (see Meyer, 2006a, 66-67). Thus, interruptions and shortages of electricity supply are expected to be long-term, as they are often the result of underinvestment in emerging countries. This was the case, for instance, in South Africa where the economy struggled heavily with power cuts and electricity shortages in 2015, as a result of 'underinvestment and a shortage of generating capacity' (Hedden, 2015).

Even though the automotive industry qualifies as non-energy-intensive manufacturing in contrast to energy-intensive manufacturing (e.g., food, refining, iron and steel, or pulp and paper industries) (see U.S. Energy Information Administration, 2016, 125), the automotive sector still heavily relies on the supply of electricity and natural gas for its production**.** As for the supply of water, the automotive industry mostly consumes energy from secondary energy sources and, to a lesser extent, from primary energy sources (see U.S. Energy Information Administration, n.d.). As for water, the automotive sector, and thus the OEM, is an 'end-use sector' of energy given that the OEM buys energy for its own use and does not resell energy to other consumers (U.S. Energy

Information Administration, n.d.). As holds for the supply of water, the successful construction and operation of the production site requires a reliable and sufficient supply of energy in terms of both quality and capacity.

Given both water and energy supply risk and the production site's dependence on reliable and sufficient water, as well as energy (electricity and natural gas) supply (in terms of quality and capacity), for its successful construction and operation, the thorough evaluation of the available supply facilities and resources is necessary in the selection process. Cutting off the supply of water or energy, or even a shortage thereof, is likely to lead to significant losses in productivity and to interruptions in the construction and operation of the production site. In many cases, when OEMs select a production site in an emerging country, they must expect water or electricity cut offs, unless they invest in the local water and energy supply facilities, systems (e.g., regional pressure reduction stations), and grids. Only with their own investments, for instance, in the form of emergency power generators, can they ensure a reliable and sufficient supply of water and energy in terms of quality and capacity (see Meyer, 2006a, 66-67). Some firms produce their own electricity by burning fuels, such as coal, oil, gas, or wood, or through the generation of renewable energy. With regard to water, the required amount is the decisive factor: firms can buy water from public facilities so long as the amount of water required for operating the production site is relatively small. In order to purchase water, firms need to make sure that all necessary facilities for the supply thereof are available. If the amount of water required for operating the production site is large, the production site should be located close to a river or lake or where deep-water wells can be drilled easily (see Sule, 2008, 613). For these reasons, it is relevant to take into consideration all necessary investments related to the water and energy supply when assessing a production site in order to prevent an underestimation of its total costs.

To assess the local availability of water and energy supply, it is important to know the exact water and energy requirements for the production processes. These depend on the product that will be produced, and the production process that will be implemented at the production site. While, for any OEM's production site, the supply of electricity, natural gas, and industrial and potable water is usually necessary, the exact strength or level of required supply in terms of megawatts or liters per hour depends on the product produced and the production processes implemented. The exact quantity and capacity (characteristics) of all required kinds of water and energy must be specified in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile). Furthermore, it must be considered in the selection process that production volume might increase above the planned level, which also requires evaluating whether the supply of water and energy can be expanded and at what cost. It is also important to analyze whether it is possible to increase the supply of water and energy at certain hours of the day. These additional requirements must also be specified in detail in the *Operational Requirement Profile*. If the OEM prefers, for some reason, to locate the production site in a region in which the water resources are very scarce, then it should be analyzed to what extent the OEM can adjust its production processes implemented at the production site to the scarcity of water at the location while ensuring high-quality and reliability of production.

Moreover, in the selection process negotiations about expected costs must be conducted with water and energy providers and local firms which construct the required facilities, and with the local, regional, and national government about possible governmental investments, as well as subsidies for the OEM's investments. In addition to the investments in new facilities or development of existing facilities, the costs for running and maintaining the facilities must also be considered for the entire planning horizon of the production site. Besides the sufficient availability of water and energy supply (in terms of capacity and quality) and the necessary investment, the local costs (charges) of water and energy are a very important aspect for the selection of a production site. Costs for energy, in particular, vary drastically across countries and significantly affect the cost of constructing and operating the production site. As such, the costs for water and energy must be evaluated for the entire planning horizon of the production site. In the evaluation of costs for energy, environmental taxes and regulations (see 4.2.3.1 Environmental Regulations) must be taken into account, as energy prices are politically determined in most countries (see Wöhe et al., 2020, 253). In addition to taxes, other regulations restrain water use in some countries, as is evident in some Chinese regions where the government started to increasingly limit the use of water (see Chan, 2018; UNESCO, 2014, 42). These kinds of regulations must also be taken into account in the evaluation of the supply of water and energy at the production site.

Hence, with regard to water and energy supply, it must be evaluated whether the supply is reliable in the long-term, whether water and energy can be supplied at the required liters per hour or megawatts per hour, or whether the government (national, regional or local) is willing to invest in or subsidize investments by the OEM in water and energy supply facilities and, if so, to what extent. Moreover, the expected required investment in water and energy supply facilities and the costs (charges) that are expected to arise for using water and energy for constructing and operating the production site, as well as the costs for running and maintaining the facilities over the planning horizon of the production site, must be approximated.

Table 40: Information and Instructions on the Choice and Evaluation of the Location Factor *Water and Energy Supply*

Location factor to be evaluate	**Capacity of Water (Potable and Industrial) Supply**	**Capacity of Energy (Electricity and Natural Gas) Supply**	**Costs for the Required Investment in Water Supply Facilities**	**Costs for the Required Investment in Energy Supply Facilities**	**Costs for Using Water over the planning horizon of the production site**	**Costs for Using Energy over the planning horizon of the production site**	**General costs for water**	**General Costs for Energy (Electricity and Natural Gas)**
Strategic, operational, or general	Operational							
Process-specific / product-specific	Process-specific and product-specific							
Relevant for production network	-	-	-	-	-	-	-	-
Relevant for the design of the supply chain	-	-	-	-	-	-	-	-
Negotiable	Negotiable as government subsidies and investments in water supply facilities can be negotiated with the national, regional, and local government.	Negotiable as government subsidies and investments in energy supply facilities can be negotiated with the national, regional, and local government.	Negotiable as government subsidies for OEMs investing in water supply facilities can be negotiated with the national, regional, and local government.	Negotiable as government subsidies for OEMs investing in energy supply facilities can be negotiated with the national, regional, and local government.	Negotiable as government subsidies for charges can be negotiated with the national, regional, and local government.	Negotiable as government subsidies for charges can be negotiated with the national, regional, and local government.	Negotiable as government subsidies for charges can be negotiated with the national, regional, and local government.	Negotiable as government subsidies for charges can be negotiated with the national, regional, and local government.
Semi-external / even performance	+						-	-
Quantitative or qualitative	Non-cost-related quantitative		Cost-related quantitative				Non-cost-related quantitative	
Hard or soft	Hard	Hard	Hard	Hard	Hard	Hard	Hard	Hard
Static or dynamic	Dynamic (likelihood of shortage, planned public investments)							
Geographic level of analysis	National, regional, and local level (if it varies on the regional or local level).		Local		National and local level			
Unit of measurement	Measured in liters per day or hour. Assessed as very bad, bad, fairly good,	Measured in megawatts per day or hour. Assessed as very bad, bad,	Approximated in EUR.		Approximated in EUR.		Measured US$ per liters. Assessed as very high, high, fairly	Measured US$ per megawatt. Assessed as very high, high, fairly low,

<table>
<tr><th>Location factor to be evaluate</th><th>Capacity of Water (Potable and Industrial) Supply</th><th>Capacity of Energy (Electricity and Natural Gas) Supply</th><th>Costs for the Required Investment in Water Supply Facilities</th><th>Costs for the Required Investment in Energy Supply Facilities</th><th>Costs for Using Water over the planning horizon of the production site</th><th>Costs for Using Energy over the planning horizon of the production site</th><th>General costs for water</th><th>General Costs for Energy (Electricity and Natural Gas)</th></tr>
<tr><td></td><td>good or very good (or numerically as 1 through 5).</td><td>fairly good, good or very good (or numerically as 1 through 5).</td><td colspan="2"></td><td colspan="2"></td><td>low, low or very low (or numerically as 1 through 5).</td><td>low or very low (or numerically as 1 through 5).</td></tr>
<tr><td>Evaluation method(s)</td><td colspan="2">o Minimum criteria
o Profile method
o Utility analysis</td><td colspan="2">o Minimum criteria
o Present value method</td><td colspan="2">o Minimum criteria
o Operating cost comparison
o Present value method</td><td colspan="2">o Profile method
o Utility analysis</td></tr>
<tr><td>Phase(s) in the selection process</td><td colspan="2">o Phase 2 (minimum criteria, profile method)
o Phase 4 (minimum criteria)
o Phase 5 (profile method, utility analysis)
o Phase 7 (utility analysis)</td><td colspan="2">o Phase 6 (minimum criteria, present value method)
o Phase 7 (present value method)</td><td colspan="2">o Phase 6 (minimum criteria, operating cost comparison, present value method)
o Phase 7 (operating cost comparison, present value method)</td><td colspan="2">o Phase 2 (profile method)
o Phase 5 (profile method, utility analysis)</td></tr>
<tr><td>Interdependencies with other location factors</td><td colspan="6">o Costs for Constructing and Maintaining the Production Site
o Building Codes
o Environmental Regulations
o Taxes</td><td colspan="2">o Environmental Regulations</td></tr>
<tr><td>Source of information: public databases and information</td><td colspan="8">o Gov.UK: Department of Business, Energy & Industrial Strategy: Statistical Data Set: International Industrial energy prices (see here Industrial electricity and gas prices both, including and excluding taxes for 28 countries and for all EU countries for large and extra-large consumers).
o Eurostat: energy statistics- natural gas and electricity prices (industrial consumers (including and excluding taxes and share of non-recoverable taxes and levies by industrial consumer).
o Worldatlas: economics: Power infrastructures most prone to electricity losses by country
o International Water Association (IWA): international Statistics for Water Services (information on global consumption, supply and regulation of consumption of water by country).
o NUS Consulting Group: Energy Market Reports by Country (freely available for several countries; reports for others can be made on order).
o OECD Observer: Environment & Resources: Water: Pricing water
o United Nations: Annual World Water Development Report
o National and regional government websites
o EY: Global Oil and Gas Tax Guide (annual report)</td></tr>
<tr><td>Source of information: commercial external sources</td><td colspan="8">o International Energy Agency (IEA): Annual reports: World Energy Statistics; Electricity information and Natural gas information; Quarterly reports: Energy Prices and Taxes.
o Europe's Energy Portal: County specific data on gas and electricity prices for industrial consumers.</td></tr>
<tr><td>Source of information: internal know-how</td><td colspan="8">o Real Estate Department
o Factory Planning Department
o Logistic Department
o Sourcing Department
o Local Liaison Offices</td></tr>
<tr><td>Source of information: external consultants</td><td>+</td><td>+</td><td>+</td><td>+</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
</table>

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.9.4 Waste Disposal and Sewerage

Most production sites in the automotive industry produce liquid, solid, and gaseous waste.[195] Solid waste can be municipal waste, also referred to as trash or garbage, or industrial waste (see Robinson, 2001, 18; Lone Star College, n.d.). Municipal waste includes all normal waste which accrue at a production site, such as packaging material, which cannot be reused, meal utensils, or used office material. As such, it can usually be disposed of in normal 'trash cans and dumpsters' to be 'collected by a local trash hauler for disposal in a municipal landfill or treatment at a municipal incinerator' (Robinson, 2001, 18). Industrial waste includes non-hazardous or hazardous waste (see Robinson, 2001, 18; Lone Star College, n.d.), though whether industrial waste is categorized as non-hazardous or hazardous depends on its potential harm to the environment, especially to humans. Most wastes produced by industrial production processes are non-hazardous, also sometimes referred to as special waste; in particular, those which accrue in automotive production processes include nonferrous or ferrous metal (see Robinson, 2001, 18-20). Even though this waste is non-hazardous, it is necessary to manage its possible impact on the environment in order to 'minimise the risk of harm to the environment and human health' (Environmental Protection Authority, 2014, 1). Non-hazardous waste is usually 'disposed of in an industrial landfill', which are 'generally more strictly regulated, more highly designed, and more closely monitored than municipal landfills' (Robinson, 2001, 18). While most wastes that result from industrial processes are non-hazardous, some wastes have characteristics which make them 'dangerous or capable of having a harmful effect on human health or the environment' (Environmental Protection Authority, n.d.b). The U.S. Environmental Protection Authority defines hazardous waste as all waste 'that exhibits any one or more of the following characteristic properties: ignitability, corrosively, reactivity or toxicity' (Environmental Protection Authority, n.d.c). 'In some cases, the 'hazard' relates to the activity being carried out with the waste (e.g., transport and handling), while other wastes are inherently hazardous across a range of activities'. The disposal and other forms of management of hazardous wastes is often considerably regulated due to the threat that can arise from it (see Environmental Protection Authority, n.d.a; Environmental Protection Authority, 2014, iv).

Besides solid waste, different kinds of liquid waste also accrue at the production site. The U.S. Environmental Protection Authority defines liquid waste as 'any waste […] that' 'has an angle of repose of less than 5 degrees above horizontal', 'becomes free-flowing at or below 60 degrees

[195] See Footnote 104.

Celsius or when it is transported' or 'is generally not capable of being picked up by a spade or shovel' (Environmental Protection Authority, 2014, 3). Some liquid wastes can also be hazardous (see Environmental Protection Authority, n.d.a). Moreover, waste can also accrue at the production site in the form of gasses. Hence, an adequate waste disposal facility for the specific production site is not only important for solid waste, but also for waste in the form of liquids or gases.

As mentioned under *Environmental Regulations* (see 4.2.3.1 Environmental Regulations) OEMs must be aware of all existing local regulations and requirements regarding the sewerage or waste management (see Sule, 2008, 613), as the construction and operation of waste and sewerage facilities often require specific licenses. To evaluate a potential production site, the existing waste disposal facilities at the production site must be analyzed. If these are not sufficient (in terms of capacity or quality) for constructing and operating the production site, it is necessary to assess the additional costs required for establishing the missing facilities in accordance with existing local regulations for waste disposal (see 4.2.3.3 Building Codes). Thus, while it is of interest how well a country or region is equipped with waste disposal facilities, in regard to the costs and feasibility of constructing and operating the production site, the availability and functioning of the waste disposal facilities and costs for necessary investments must be assessed on the local level. To assess the local availability of waste disposal and sewerage facilities and the necessity of developing them, it is necessary to know the exact kinds of waste (solid, liquid, or gaseous, as well as hazardous or non-hazardous) which arise from the production processes and the expected amounts thereof. These must be specified in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile).

Evaluating the costs for waste disposal and sewerage facilities at the production site requires including not only the initial investment for the construction or extension of the facilities at the production site, but also the necessary investments into the wider system—for instance, in pump stations and treatment facilities but also, if necessary, for facilities to retain rainwater or sewerage at the production site. Further, the costs which occur for running and maintaining the facilities must be considered. As in the evaluation of water and energy supply, the possibility of extending production must be taken into account in the evaluation of waste disposal and sewerage facilities, as well as to which additional costs such an extension would lead with regard to the waste disposal and sewerage facilities. Additional requirements on the waste disposal and sewerage facilities in case of a possible extension of the production site must also be specified in the *Operational Requirement Profile*. Moreover, negotiations must be conducted with local firms which construct the required facilities and with the local, regional, and national governments about possible governmental investments, as well as subsidies for investments into the local waste and sewerage facilities of the OEM.

Besides the investment in waste and sewerage facilities and the costs for running and maintaining these facilities, the costs for the disposal of waste—be it solid, liquid, or gaseous and be it non-hazardous or hazardous—must also be evaluated for the entire planning horizon of the production site. However, these are very difficult to estimate and to compare across different countries, as there are many different factors (such as environmental regulations, transport costs) that affect the total costs for waste disposal and sewerage (see Bode and Lemmel, 2001, 88-92). Overall, the following aspects must be included in the evaluation of costs (in addition to investments and the costs for running and maintaining facilities,) for waste disposal and sewerage:

- Permit fees, which must be paid once and vary by kind of waste
- Charges, which depend on either the weight or the volume of the waste and vary by kind of waste
- Possible enforcement fees, for instance, for any kind of violation or incorrect reporting (see Metropolitan Council, n.d.).

As permit fees, charges and enforcement fees are, in most countries, determined by local governments, they must be evaluated on a local level based on information which is usually available on local government websites or websites of municipalities.

Table 41: Information and Instructions on the Choice and Evaluation of the Location Factor *Waste Disposal and Sewerage*

Location factor to be evaluated	**Capacity of Waste Disposal Facilities**	**Capacity of Sewerage Facilities**	**Costs for the Required Investment in Waste Disposal Facilities**	**Costs for the Required Investment in Sewerage Facilities**	**Costs for Waste Disposal over the planning horizon of the production site**	**Costs for Sewerage over the planning horizon of the production site**
Strategic, operational, or general	Operational					
Process-specific / product-specific	Process-specific and product-specific					
Relevant for production network	-	-	-	-	-	-
Relevant for the design of the supply chain	-	-	-	-	-	-

<table>
<tr><th>Location factor to be evaluated</th><th>Capacity of Waste Disposal Facilities</th><th>Capacity of Sewerage Facilities</th><th>Costs for the Required Investment in Waste Disposal Facilities</th><th>Costs for the Required Investment in Sewerage Facilities</th><th>Costs for Waste Disposal over the planning horizon of the production site</th><th>Costs for Sewerage over the planning horizon of the production site</th></tr>
<tr><td>Negotiable</td><td>Negotiable as government subsidies and investments in waste disposal facilities can be negotiated with the national, regional, and local government.</td><td>Negotiable as government subsidies and investments in sewerage facilities can be negotiated with the national, regional, and local government.</td><td>Negotiable as government subsidies for OEMs investing in waste disposal facilities can be negotiated with the national, regional, and local government.</td><td>Negotiable as government subsidies for the investment of OEM in sewerage facilities can be negotiated with the national, regional, and local government.</td><td>Negotiable as government subsidies for charges can be negotiated with the national, regional, and local government</td><td>Negotiable as government subsidies for charges can be negotiated with the national, regional, and local government.</td></tr>
<tr><td>Semi-external / even performance</td><td colspan="6">Semi-external and even performance</td></tr>
<tr><td>Quantitative or qualitative</td><td colspan="2">Non-cost-related quantitative</td><td colspan="4">Cost-related quantitative</td></tr>
<tr><td>Hard or soft</td><td>Hard</td><td>Hard</td><td>Hard</td><td>Hard</td><td>Hard</td><td>Hard</td></tr>
<tr><td>Static or dynamic</td><td colspan="5">Dynamic (likelihood of shortage, planned public investments).</td><td>Dynamic</td></tr>
<tr><td>Geographic level of analysis</td><td colspan="2">National, regional, and local level (if it varies on the regional or local level).</td><td colspan="2">Local level</td><td colspan="2">National and local level</td></tr>
<tr><td>Unit of measurement</td><td colspan="2">Measured in cubic meters per day or hour. Assessed as very bad, bad, fairly good, good or very good (or numerically as 1 through 5).</td><td colspan="4">Approximated in EUR.</td></tr>
<tr><td>Evaluation method(s)</td><td colspan="2">o Minimum criteria
o Profile method
o Utility analysis</td><td colspan="2">o Minimum criteria
o Present value method</td><td colspan="2">o Minimum criteria
o Operating cost comparison
o Present value method</td></tr>
<tr><td>Phase(s) in the selection process</td><td colspan="2">o Phase 2 (minimum criteria, profile method)
o Phase 4 (minimum criteria)
o Phase 5 (profile method, utility analysis)
o Phase 7 (utility analysis)</td><td colspan="2">o Phase 6 (minimum criteria, present value method)
o Phase 7 (present value method)</td><td colspan="2">o Phase 6 (minimum criteria, operating cost comparison, present value method)
o Phase 7 (operating cost comparison, present value method)</td></tr>
<tr><td>Interdependencies with other location factors</td><td colspan="6">o Cost for Constructing and Maintaining the Production Site
o Building Codes
o Environmental Regulations
o Taxes</td></tr>
<tr><td>Source of information: public databases and information</td><td colspan="6">o European Commission: Eurostat; Water Statistics on national and subnational level (e.g., on treatment capacity of wastewater treatment plants, wastewater treatment plants by treatment level, sewage sludge production and disposal).
o MAPI Foundation: An International Comparison of Pollution Abatement and Waste Management Costs
o World Bank: What is Waste, A Global Review of Solid Waste Management: for a general global overview and comparison.
o National and regional government websites and municipalities' websites
o OECD: Waste Management - Other Websites of Interest (national government websites in waste management).</td></tr>
<tr><td>Source of information: commercial external sources</td><td colspan="6">-</td></tr>
<tr><td>Source of information: internal know-how</td><td colspan="6">o Real Estate Department
o Factory Planning Department
o Logistic Department
o Sourcing Department
o Local Liaison Offices</td></tr>
<tr><td>Source of information: external consultants</td><td colspan="6">+ (e.g., Visits to the production sites)</td></tr>
</table>

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.9.5 Information and Communication Technology Infrastructure

Information and communication technologies (ICTs) constitute a 'part of a country's infrastructure' (United Nations, 2011, 8). 'The potential and capabilities of modern ICT systems are still growing exponentially' driven by 'the progress in electronics, microsystems, networking, the ability to master increasingly complex cyber-physical systems and robots, and progress in data processing and human machine interfaces' (European Commission, n.d.a). ICTs 'are reshaping many aspects of the world's economies, governments, and societies' (The World Bank, n.d.b). With regard to production, the progress in ICTs has led to an 'increasing codification and digitalization of production' (Foster and Graham, 2017, 70) initiating a development in industrial production referred to as Industry 4.0 (see Haverkort and Zimmermann, 2017, 1). This 'Fourth Industrial Revolution is a digital revolution' (The World Bank, n.d.b)[196] which occurs in the production process through the networking of the different parts of the industrial infrastructure, namely machines, raw materials or components, products, and humans through the use of Cyber-Physical Systems (CPS). In CPS, technological innovations, such as ICTs, automation and robotics, sensory, self-monitoring, or embedded systems, are all combined and production processes, people, machines and products communicate and cooperate with each other, making the production processes more efficient, productive and flexible (see Obermaier, 2016, 3, 8, 12-13; Stich et al., 2015, 67). In Industry 4.0 production becomes smart and flexible as the production processes are enhanced among other technologies by ICTs. The core of Industry 4.0 is the real-time capable, intelligent, horizontal, and vertical networking of people, machines, objects, as well as information and technology systems, for the dynamic management of complex systems (see Bauer et al., 2014, 18).[197] In Industry 4.0, the different elements of firms become connected, and this connectivity becomes automated using ICTs. Since the connectivity between different parts of the firm is only possible thanks to ICTs, these technologies are fundamental to any kind of digitalization processes (see Becker et al., 2016, 102).

[196] In the 1980s, IBM had developed the concept of 'Computer Integrated Manufacturing' (CIM), in which all steps of the value chain of a firm are digitally mapped in order to connect and optimize them. Then, software and hardware had not been developed far enough; today, however this concept can be realized (Stockmar, 2014, 226).

[197] This definition is a translation from Bauer et al. ('Im Mittelpunkt von Industrie 4.0 steht die echtzeit-fähige, intelligente, horizontale und vertikale Vernetzung von Menschen, Maschinen, Objekten und IKT-Systemen zum dynamischen Management von komplexen Systemen') (Bauer et al., 2014, 18).

Digitalized production processes (combined in a 'digital factory') also require digital supply chains (see Klug, 2018, 17). ICTs are increasingly applied for many tasks (see Foster and Graham, 2017, 69) along supply chains linking the single parts of production networks. Logistics service providers (see 4.10.4.4 Availability of Logistics Service Providers) heavily rely on the internet and ICTs for providing their services along the supply chain (see Chopra and Meindl, 2014, 521-522). Thanks to ICTs, the processes along the supply chain are becoming increasingly autonomous as, for instance, sensors can acknowledge changes to conditions along the supply chain or Auto-IT technologies identify and follow orders and objects (see Stich et al., 2015, 70-72; Chopra and Meindl, 2014, 521-522). The adaption of ICTs to all production processes, as well as the supply chain, is expected to revolutionize the entire value chain by enabling 'better, personalized products and services' and improving 'efficient, adaptive, and flexible production, provisioning, and supply-chain processes' (Haverkort and Zimmermann, 2017, 8).

Key to the Industry 4.0 are both the 'development of the Internet and the Industrial Internet of Things (IIoT)' (Haverkort and Zimmermann, 2017, 8) as the use of ICTs and other required technologies for the digitalization of production and activities along the supply chain require reliable access to the internet as data infrastructure (see Obermaier, 2016, 9-12). While 'the digital revolution is a global phenomenon, there are still huge disparities between and within countries when it comes to the penetration, affordability, and performance of ICT services'. This is evident as nearly 50% of the 'world population in 2016 had access to the Internet', but the access to the internet is very unevenly distributed: 'the penetration rate in the least developed countries was only 15%, or 1 in 7 individuals' (The World Bank, n.d.b). Moreover, even in many advanced countries, the ICT infrastructure is still insufficiently developed in rural areas (see Johnson, 2016), while in most emerging countries the ICT infrastructure remains constrained to urban areas and is often still completely absent in rural areas. In many emerging countries, the lack of infrastructure investment and 'regulatory bottlenecks' prevent the development of broadband (The World Bank, n.d.b). The main hurdles for ICT infrastructure development, especially in rural areas, are the private sector's negligence of rural areas, low levels of connectivity, or the lacking or generally poor infrastructure (see The World Bank, 2005, 2). Besides the accessibility of the internet, the costs for accessing it also vary considerably between relatively low rates in most advanced countries and often very high rates in many emerging countries. Moreover, the speed of the internet differs between advanced and emerging countries, being significantly lower in many emerging countries than in most advanced countries (see The World Bank, n.d.b). Also, speed bandwidth must be differentiated from latency: while bandwidth defines the ‘amount of data that can be transferred per second’ and hence determines ‘how fast data can be transferred over time’, latency is the delay of the data transmission and hence the time the data needs ‘to travel between its source and destination, measured in milliseconds’ (Hoffman, 2017). Both of these depend on the internet connection, but also on the hardware of the network (e.g., the location and connection of the remote server or the internet routers connecting the device with the server (see Hoffman, 2017)).

In terms of economic growth, the development of ICT infrastructure is considered to positively affect economic growth. A 10% ‘increase in high speed internet connections’ leads to a 1.3% increase in economic growth. This is due to the productivity enhancing effect of ICTs, but even more so to ICT as a means to reach people in ‘rural and poor areas’ and thus provide them with goods and services (The World Bank and IFC, 2010). Hence, investments in ICT infrastructure are considered to be an important source of growth in productivity (see Niebel, 2018, 197-198; Kumar et al., 2016, 103). For example, Ding and Haynes show that differences in investment in ICT infrastructure significantly correlate with differences in growth between different provinces in China (see Ding and Haynes, 2006, 299). Hence, fostering ICT infrastructure in low-income and middle-income countries has considerable ‘potential for productivity gains and […] sustained growth’ (OECD, 2014, 152). Besides the importance of ICT infrastructure for productivity gains in the manufacturing sector thanks to increasing digitalization, ICT infrastructure is crucial for productivity gains in the service sector as they enable storage services, hence making them transportable and tradeable (see The Ghani, 2010, 41, 44-45, 93).[198] Moreover, ICTs create ‘backward and forward linkages and spillover effects’ between the service and industrial sectors (OECD, 2014, 152). Improving the ICT infrastructure enhances the business environment in a country and creates ‘new ways of communication among and between enterprises and governments’. The United Nations in its Information Economy Report 2011 points to three ways in which investments in ICT infrastructure benefits the private sector: first, by enabling the business environment (‘Improving business registration and licensing procedure’, ‘Improving tax policies and administration’, ’Trade facilitation measures’), second, by supporting business development services (‘ICT use in training and advisory services’, ‘Enhancing access to relevant information’), and third, by enhancing access to finance (‘Mobile money services’, ‘Mobile solutions to international remittances’, ‘Microfinance and ICTs’) (United Nations, 2011, 66-89).

[198] Baumohl already defined ICTs in 1985 (in particular, telecommunication) as one of the ‘progressive impersonal services’. These are sectors which have the largest potential for increases in productivity (Baumohl, 1985, 303).

China is an example of a country that invests heavily in developing ICT infrastructure at home and abroad. Domestically, China invests significantly in its ICT infrastructure, for instance, via a fund of 100 billion yuan (ca. $14.55 billion) set up to help investment especially in the internet sector (see Reuters, 2017). Moreover, China has heavily invested in ICT infrastructure on a global scale. The ICT infrastructure is one focus area of China's 'going out' strategy that aims at investing in critical infrastructure in overseas countries. The strategy is based on an 'aid-and-investment package', thus Chinese firms or the government invest in a country's local infrastructure in exchange for access to local energy and natural resources (Danish Institute for International Studies, 2016, 10). For non-Chinese international OEMs, this bears not only the risk that Chinese firms are likely to receive privileged access to ICT infrastructure in these countries, but also that non-Chinese OEMs might have difficulty guaranteeing cyber security at production sites in countries where most ICT infrastructure is either owned by Chinese firms or the Chinese government.

ICTs diffusion can be assessed based on two different indicator sets, one focusing on the penetration rate (for instance, of the internet, broadband, secure services, and mobile phones (2G, 3G, 4G and 5G), and the other on the usage readiness of ICTs by governments, businesses, and individuals (see Vu, 2017, 944-965). The International Communication Union, which is the specialized agency of the United Nations for ICTs, assesses ICTs with indicators in the following categories: fixed network, mobile network, traffic, prices, revenue and investment, employees, internet, broadband, ICT households, broadcasting, and quality of service (see International Telecommunication Union, 2017, 1-5). These categories can help to assess the availability of ICT infrastructure. To assess the future development of ICT infrastructure in a country, it is helpful to analyze policy agendas as reforms can give private firms incentive to invest in ICT infrastructure (see The World Bank, n.d.b). Jorgenson and Vu suggest that an ICT agenda should address seven dimensions along which an ICT policy framework should be developed. These dimension are '(i) connectivity and access; (ii) usage; (iii) legal and regulatory framework; (iv) production and trade; (v) skill and human development; (vi) cybersecurity; and (vii) new applications' (Jorgenson and Vu, 2016, 395). Besides the policy agenda, it is also interesting to evaluate past or announced government investments in public investment projects related to ICTs (e.g., 'broadband rollout') (The World Bank, n.d.b).

When evaluating production sites, it is important to know the requirements with regard to ICT infrastructure for the production processes, as well as for the supply chain of the OEM, including its suppliers and logistics service providers. This information must be included in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile). The investments which are necessary to ensure the required ICT infrastructure at the production site (which includes investment in the internet at the production site and investment in the extension of the public system up to the production site) must be approximated. Not only must the running costs or the required investments to develop the ICT infrastructure be determined, but the time needed to provide the necessary ICT infrastructure must also be determined. Moreover, the costs for the access to the internet must be assessed, and it must be evaluated if the local speed of the internet (in terms of bandwidth and latency) is sufficient for the planned production processes at the production site and the required supply chain activities. It must also be assessed if the production process can and should be adjusted (in terms of digitalization of production processes) to the availability of ICT infrastructure at the production site while maintaining the high quality of production. Moreover, the assessment of the ICT infrastructure must include the availability of relevant skills (which is covered under the location factor *Availability of Skills* (4.7.5 Availability of Skills) in this selection process model) and the required energy supply (covered under the location factor *Water and Energy Supply* (4.9.3 Water and Energy Supply)) at the production site. Moreover, it must be determined which kind of data processing service center is required for the digital operations at the production site and the digital supply chain activities and how and where that can be built given the conditions therein. If the production process is digitalized to any degree, ICT infrastructure is required and, in turn, requirements thereof rise with the degree of digitalization of production and supply chain activities. Moreover, it must be assessed how the requirements for the production process at the production site, as well as for the supply chain on the ICT infrastructure, will change over the planning horizon of the production site; for instance, in case of applying production processes or supply chain activities with a higher degree of digitalization in the years to come at the production site.

Moreover, when evaluating the ICT infrastructure, its privacy protection (cyber security) with regard to the transmitted data must be considered. Normally, Virtual Private Networks (VPN) allow firms to enter the uncensored worldwide web and to send encrypted data between the new production site and other of the OEM's locations (e.g., its headquarters). However, in China, firms may only use VPN-services which belong to government licensed providers since 2018. This is not only more expensive, but, more importantly, it is less reliable in terms of confidentiality as the Chinese government is likely to have access to all VPN-service providers it licenses and, in turn, to all the data and information sent with the help of these VPNs (see European Chamber of Commerce in China, 2018, 29-33). This is a very important aspect with regard to selecting a production site as the OEM must send data and information, which might be sensitive, from the headquarters to the new production site or to and from other production sites or distribution centers (e.g., product information, information on technologies, contracts, personal (employee) data, etc.). While this is an issue related to intellectual property (see 4.3.3.3 Protection of Intellectual Property Rights), it is particular to the use of the ICT infrastructure and hence shall be taken into consideration under this location factor.

Table 42: Information and Instructions on the Choice and Evaluation of the Location Factor *Information and Communication Technologies Infrastructure*

Location factor to be evaluated	**Availability of ICT Infra-structure**	**Penetration Rate**	**Internet speed**	**Costs for the Required Investment in ICT Infrastructure Facilities**	**Costs for using ICT Infrastructure over the planning horizon of the production site**
Strategic, operational, or general	Operational or general	Operational	Operational	Operational	Operational
Process-specific / product-specific	Process-specific	Process-specific	Process-specific	Process-specific	Process-specific
Relevant for production network	+	+	+	+	+
Relevant for the design of the supply chain	+	+	+	+	+
Negotiable	+	+	-	Negotiable as government subsidies for OEMs investing in ICT infrastructure can be negotiated with the national, regional, and local government.	Negotiable as government subsidies for charges can be negotiated with the national, regional, and local government.
Semi-external / even performance	Semi-external and even performance		-	Semi-external and even performance	
Quantitative or qualitative	Non-cost-related quantitative			Cost-related Quantitative	
Hard or soft	Hard	Hard	Hard	Hard	Hard
Static or dynamic	Dynamic	Dynamic	Dynamic	Dynamic	Dynamic
Geographic level of analysis	National, regional, and local level (if it varies on the regional or local level).			Local level	National and local level
Unit of measurement	Measured in terms of fixed network, mobile network, traffic, prices, revenue and investment, employees, internet, broadband, ICT households, broadcasting, and quality of service. Assessed as very bad, bad, fairly good, good or very good (or numerically as 1 through 5).	Measured as Internet users as percentage of population. Assessed as very bad, bad, fairly good, good or very good (or numerically as 1 through 5).	Measured in terms of bandwidth (Mbps) and latency (ms). Assessed as very bad, bad, fairly good, good or very good (or numerically as 1 through 5).	Approximated in EUR.	Approximated in EUR.
Evaluation method(s)	o Strategic considerations o Minimum criteria o Preferable criteria o Profile method o Utility analysis			o Minimum criteria o Present value method	o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method) o Phase 4 (minimum criteria, preferable criteria) o Phase 5 (minimum criteria, profile method, utility analysis) o Phase 7 (utility analysis)			o Phase 6 (minimum criteria, present value method) o Phase 7 (present value method)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)

Location factor to be evaluated	**Availability of ICT Infra-structure**	**Penetration Rate**	**Internet speed**	**Costs for the Required Investment in ICT Infrastructure Facilities**	**Costs for using ICT Infrastructure over the planning horizon of the production site**
Interdependencies with other location factors	o Fixed Investment (including Foreign Direct Investment) o Business Fixed Investment o Cost for of Constructing and Maintaining the Production Site o Subsidies and State Aid				
Source of information: public databases and information	o Global Enabling Trade Index (ETI) published by the WEF: Pillar 6 Availability and Use of ICTs (the use of mobile telephony and Internet by the population at large, by companies for business transact-tions, and by the government for interacting with citizens) o World Economic Forum: Annual Report series: The Global Information Technology Report (Especially pillars of the Network Readiness index: Political and Regulatory Environment, Business and Innovation Environment, Infrastructure). o International Communication Union (ICU) is the United Nations specialized agency for information and communication technologies: General information and analysis. o OECD's Directorate for Science, Technology and Innovation: The 15 ICT indicators. o The Fletcher School: Digital Planet (Digital Evolution Index (DEI)). o European Commission: The Digital Economy and Society Index (DESI) (composed of about 30 indicators measuring the digital performance of Europe which are split down into five categories: Connectivity, Human Capital, Use of Internet, Integration of Digital Technology, Digital Public Services). o World Bank Development Indicators online database. o Fraunhofer-Institut für System- und Innovationsforschung ISI: Innovationsindikator for 35 countries. This innovation indicator includes a digitalization indicator (annual report) o Akamai: The State of the Inter-	o Internet World Stats o World Bank Development Indicators online database (penetration rate on mobile phone, in ternet usage, broadband, secured servers) o International Communication Union (ICU) is the United Nations specialized agency for information and communication technologies: Fixed-telephone subscriptions. o OECD's Directorate for Science, Technology and Innovation: The 14 ICT indicators o Cisco Visual Networking Index: Forecast and Methodology, 2016–2021 (Global IP traffic growth, 2016–2021 on various indicators). o Akamai: The State of the Internet/Connectivity report and The State of the Internet/ Security Report. o McKinsey Global Institute: McKinsey Digital: Digital Insights	o World Economic Forum: Annual Report series: The Global Information Technology Report (Especially pillars of the Network Readiness index: Individual usage, Business usage and Government usage) o Cisco Visual Networking Index: Forecast and Methodology, 2016–2021 (Global IP traffic growth, 2016–2021 on various indicators). o Akamai: The State of the Internet/Connectivity report and The State of the Internet/ Security report.	-	o World Economic Forum: Annual Report series: The Global Information Technology Report (Especially pillars of the Network Readiness index: Affordability)

Location factor to be evaluated	Availability of ICT Infra-structure	Penetration Rate	Internet speed	Costs for the Required Investment in ICT Infrastructure Facilities	Costs for using ICT Infrastructure over the planning horizon of the production site
	net/Connectivity report and The State of the Internet/ Security Report. o Cisco Visual Networking Index: Forecast and Methodology, 2016–2021 (Global IP traffic growth, 2016–2021 on various indicators). o McKinsey Global Institute: McKinsey Digital: Digital Insights o National and regional government websites as well as municipal web sites.				
Source of information: commercial external sources	-	o International Communication Union (ICU) is the United Nations specialized agency for information and communication technologies: Indicator database o TeleGeography, research service, Globalcomms databases service, Global Internet Geography			
Source of information: internal know-how	o Real Estate Department o Factory Planning Department o Production Planning Department o Logistic Department o IT Department o Local Liaison Offices				
Source of information: external consultants	+				

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.10 Production Network

4.10.1 General Remarks on Production Network as a Location Factor

As laid out in *Definitions* (see 2.1 Definitions), an inclusive concept of production network is used in this work. Hence, it includes all actors and locations that are required for a successful functioning of the OEM's production network (e.g., all of an OEM's production sites and distribution centers, all external suppliers (Tier 1 suppliers[199]) and internal, as well as external, logistics service providers). The 'deep value chain integration' (Kotula and Ho, 2014, 6) and the large number of required components in the automotive industry make the use of such an inclusive concept of production network in the selection process model especially necessary. For a thorough analysis of potential production sites with regard to the OEM's production network, the goal must not only be to ensure the successful operation of the new production site but also to successfully embed the new production site into the OEM's production network, thereby enhancing the OEM's overall network-related (strategic) goals (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).

Strategic capacities of each individual production site and the production network determined in the network strategy[200] (see Friedli et al., 2013, 48-50) can include access to information, resources, markets and technologies[201] (see Gulati et al., 2000, 203), local presence, global cost advantages and global learning (see Bartlett and Ghoshal, 1990, 29-31), scale and scope effects (see Friedli et al., 2013, 48), accessibility, thriftiness, mobility[202] (see Friedli et al., 2013, 49; Shi and Gregory, 1998, 208-210), or operational flexibility.[203] In the face of the variety of network

[199] T-1 suppliers directly supply components, systems, or modules to the OEM (see Gehr, 2007, 6).

[200] The goal of the network strategy is to differentiate the OEM from its competitors by building and strengthening capacities that improve the production network and increase its profitability and competitiveness relative to its competitors (see Bartlett and Ghoshal, 1990, 29-31). The network strategy determines the strategic capacities of each individual production site, as well as the strategic capacities of the production network, in such a way as to successfully coordinate the individual production sites (see Friedli et al., 2013, 48-50).

[201] They explain that these capacities enable a firm to take advantage of scale and scope effects, as well as from learning (see Gulati et al., 2000, 203).

[202] Resource accessibility refers to the capacity of a network to reach strategic resources. Thriftiness means the network's capacity to increase its efficiency through better integration and coordination. The production network's capacity of mobility implies the ability to transfer products, production processes and managerial skills within the network, as well as the flexibility of both single production sites and the entire production network. Learning includes a network's capabilities to exchange information, learn about product and production process technologies, management systems (internal learning), local strengths, market, or competitors' development or to learn how to successfully integrate local product requirements into the global product development (see Friedli et al., 2013, 49; Shi and Gregory, 1998, 208-210).

[203] Operational flexibility is a network capacity that increasingly gains importance given the quickly changing global economy with its high market volatility. This is especially true as the profitability of a production network increasingly depends on factors whose current state, as well as future development, can only be assessed with uncertainty. There are unknown events whose impact on the OEM cannot be forecasted, such as natural disasters or terrorist attacks, as

capacities, Miltenburg points out that it is not possible for a firm to achieve 'the highest possible level' for all network capacities, but instead that a firm must make trade-offs between the different network capacities depending on its individual requirements (Miltenburg, 2009, 6187).[204]

The relevant network-related (strategic) goals for selecting the production site, as well as its corresponding strategic requirements, must be defined in the *Strategic Requirement Profile* (see 3.2.2.2 Strategic Requirement Profile). Moreover, from an operational perspective, the successful operation of the production site requires that the new production site is well connected with the OEM's other relevant production sites and distribution centers, and with production sites of high-quality international and local component suppliers. Furthermore, the supply chain must be well-functioning and profitable. The operational requirements regarding the production network on the production site must be determined in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile).

In this section, the evaluation of the new production site as part of the production network is separated into the location factors: *Connectivity to Other Firm-owned Production Sites*, *Availability of Component Suppliers* and *Supply Chain*. In turn, the supply chain is evaluated in four parts: *Modes of Transportation*, *Transport and Logistic Costs*, *Availability of Logistics Service Providers* and *Supply Chain Risks*.

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well as known events whose probability of occurrence is unknown; for instance, exchange rate fluctuations (see Meyer, 2006a, 83). These uncertainties, growing dynamics and high market volatility, along with shorter product cycles, high product and type variety, significant changes in production volume and higher consumer demands reduce the planning security. In order to handle and control this planning insecurity, the production network must consist of flexible production structures with highly agile, flexible and efficient production processes in order to provide the unique opportunity to create sustained competitive advantages (see Osterloh, 2012, 35-37). While many firms have increased their efforts to raise their flexibility in recent years, most of these efforts have been focused on merely raising their flexibility in certain production sites and not in their entire production network. However, production networks are, by nature, not flexible given the widely applied practice of mass production, which reinforces a very low level of flexibility (see Friedli et al., 2013, 5-6), and the general inflexibility of production sites given that the complete divestment of established production sites, as well as the establishment of new production sites, is not a feasible response to short-term developments in costs. This inflexible nature of the production network requires enhancing 'operational flexibility' within the production network. Operational flexibility refers to the capacity of internationally producing firms to transfer resources—for instance, production capacities—between different production sites in response to changes in the environment (Kogut, 1985, 27). A high degree of operational flexibility enables firms to cope with unforeseen short-term changes—for instance, in the development of costs—by configuring their production network in such a way that enables these firms to shift their production capacities between their different production sites depending on the changing conditions (see Fisch and Zschoche, 2012, 807). A high degree of operational flexibility makes internationally producing firms less vulnerable to adverse changes in the environment as they can transfer their resources to a production site with more beneficial conditions (see Kogut, 1985, 27).

[204] Miltenburg's arguments are similar to Skinner's, who highlights the importance of differentiating factors in production; he explains that firms have to make trade-offs in their production strategy between crucial variables, such as cost, time, quality, technology constraints and customer satisfaction. Skinner suggests that these trade-offs should be made such that the production facilities are able to successfully 'perform the tasks' that are crucial to implement the corporate strategy (Skinner, 1969, 139).

4.10.2 Connectivity to Other Firm-owned Production Sites

The production processes of OEMs are highly fragmented, the individual production sites highly specialized and distributed around the globe. The resulting dependency of individual production processes at production sites on the production processes at other of the OEM's production sites requires them to be connected in a global production network. This high degree of interdependency between production sites increases the consequences of delayed deliveries or any supply chain distortions. Moreover, an increasing variety of models and types, the volatility of demand for products (see Klug, 2018, 47; Klier and Rubenstein, 2010, 336, 338), the need to build differentiating factors for products, not only through cost and quality, but through specification, as well as rising customer requirements, intensify the interdependencies between production sites. In addition, requirements regarding delivery reliability, speed, or flexibility (see Friedli et al., 2013, 47-48) can only be met by well-connecting individual production sites of a production network.

To ensure the connectivity of the new production site to the OEM's other production sites or distribution centers, it is necessary to determine the relevant production sites and distribution centers or hubs,[205] both those that already exist as well as those that are being planned. These relevant production sites and distribution centers depend mainly on the product that will be produced at the new production site. From these relevant production sites and distribution centers, components must be delivered reliably and in a timely manner to the new production site. Further, if the product produced at the new production site is a component, connectivity to the OEM's production sites where the component is used as an input must be ensured. If the product is a final product (e.g., cars, vans, trucks, or buses) the connectivity to the sales market must be ensured.

One aspect that has a significant effect on the connectivity of other relevant production sites is the selected delivery schedule at the new production site or, if the produced product is a component, at the OEM's production sites at which the product produced will be processed. If the delivery schedule is a just-in-sequence (JIS) delivery, the components must be delivered in the sequence in which they are used as inputs for production (see Klug, 2018, 329-351; Engelhardt-Nowitzki, 2010, 6).[206] The just-in-sequence delivery schedule restricts the distance between the new production site

[205] In the supply chain literature, hubs are locations where products are accumulated from various warehouses and, from there, distributed in larger amounts to the customers in order to save costs (see Shahabi et al., 2013, 501). Hubs enable the transport of products in 'fewer, indirect connections' instead of many 'direct connections between nodes' of a production network (Cheong et al., 2007, 54).

[206] The main goal of such just-in-sequence delivery is to reduce inventories while ensuring high security of supply (see Engelhardt-Nowitzki, 2010, 6). For a detailed discussion on delivery schedules and criteria for their selection, see Klug, 2018, 329-351).

and other downstream-related or upstream-related production sites to a certain predefined number of hours of transit, and thus to a certain distance, depending on the mode of transport. This predefined maximum number of hours in transit is henceforth referred to as JIS-Distance. The relevant production sites and distribution centers with which the new production site needs to be connected, and the preferred delivery schedule (e.g., just-in-sequence or just-in-time delivery) must be defined in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile).

Besides these operational requirements on the production site, it is important that network-related strategic goals are also enhanced by selecting the production site, in general, and with regard to the OEM's other production sites and distribution centers, in particular (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model). As a part of the OEM's global production network, the new production site should be selected so that it enhances its network-related strategic goals. These, in turn, must be included in the *Strategic Requirement Profile* (see 3.2.2.2 Strategic Requirement Profile). Network-related strategic goals[207], such as operational flexibility, speed or access to markets, all have different implications for the required connectivity of the new production site to the OEM's other production sites and distribution centers: speed requires short distances (in terms of hours in transit) to other relevant production sites or sales markets (for final products); access to markets necessitates the presence of individual production sites of the production network in relevant sales markets or related FTAs;[208] enhancing operational flexibility[209] requires the flexible movement of production processes and production volumes between different production sites and, hence, the ability to produce various products with various production processes in various volumes at individual production sites, while aspects like FTAs (see 4.6.9 Membership in Free

[207] In addition to the strategic network goals (e.g., speed, market access and operational flexibility) that can be enhanced directly by selecting a new production site, other aspects, such as the creation of regional hubs and their function within the network, should still be taken into consideration (see Cheong et al., 2007, 51-54; Shahabi et al., 2013, 489,501).

[208] With regard to market access, an intra-regional approach to a production site within the global production network offers the opportunity to benefit from scale and scope effects, to exploit differences in neighboring markets (see Suder et al., 2015, 406), for instance, with regard to labor costs, taxes, availability of skills, and to take advantage of free trade agreements. Thus, an intra-regional perspective should be part of the network strategy when selecting a new production site by analyzing which of these is most appropriate to serve both local and neighboring markets (ideally, members of the same free trade agreement). Gupta and Wang point out that firms have not often looked at China and India from a regional perspective and, have been treated as peripheral to their global operations rather than as core to their regional operations. A regional approach could reveal how a firm's capabilities in neighboring markets can help succeed in China and India or how the potential of China and India can be used for the firm's success in neighboring markets (see Gupta and Wang, 2007; Gupta and Wang, 2009, 39-61, 108, 116).

[209] The technical aspects necessary to enhance operation flexibility must be defined in the *Operational Requirement Profile* (see 3.2.2.3. Operational Requirement Profile). These technical aspects must include how different products can be produced at the same production site, for instance, by using the same platforms for the products or by installing tools and machines that can be retooled easily and at low costs. Platform strategies aim to reduce costs, logistic efforts, and production complexity, and to increase quality (see Klug, 2018, 65-68).

Trade Agreements), tariffs (see 4.2.2.1 Tariffs) or NTBs (see 4.2.2.2 Non-Tariff Barriers to Trade) must be considered.[210]

Overall, when evaluating the connectivity of the new production site with the OEM's other relevant production sites, it is important to ensure, on the one hand, that the operational requirements are met (e.g., reliability, timeliness, or distance (e.g., JIS-Distance) to all of the OEM's relevant production sites and distribution centers). On the other hand, the connectivity of the new production site to relevant others is important to enhance network-related strategic goals, such as speed, market access or operational flexibility.

Table 43: Information and Instructions on the Choice and Evaluation of the Location Factor *Connectivity to Other Firm-owned Production Sites*

Location factor to be evaluated	**Connectivity to Other Relevant Firm-owned Production Sites (Speed)**	**Connectivity to Other Relevant Firm-owned Production Sites (Reliability)**	**Costs for Transporting Components from Other Firm-owned Production Sites over the planning horizon of the production site**	**Costs for Transporting Produced Products to Other Firm-owned Production sites (if Component) over the planning horizon of the production site**
Strategic, operational, or general	Strategic and operational			
Process-specific / product-specific	Process-specific and product-specific			
Relevant for production network	+	+	+	+
Relevant for the design of the supply chain	+	+	+	+
Negotiable	-	-	-	-
Semi-external / even performance	Semi-external and even performance			
Quantitative or qualitative	Non-cost-related Quantitative	Qualitative	Cost-related Quantitative	
Hard or soft	Hard	Hard	Hard	Hard
Static or dynamic	Dynamic	Dynamic	Dynamic	Dynamic
Geographic level of analysis	National and local level	National and local level	Local	Local
Unit of measurement	Measured in hours required for transport. Assessed as very bad, bad, fairly good, good or very good (or numerically as 1 through 5).	Assessed as very bad, bad, fairly good, good or very good (or numerically as 1 through 5).	Approximated in EUR.	
Evaluation method(s)	o Strategic considerations o Minimum criteria o Profile method o Utility analysis		o Minimum criteria o Operating cost comparison o Present value method	
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method) o Phase 5 (minimum criteria, profile method, utility analysis) o Phase 7 (utility analysis)		o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)	

[210] Osterloh identifies the following kinds of flexibility: flexibility of product types, flexibility of model types, flexibility of start-up, flexibility of technology, flexibility of reaction and flexibility of personnel (see Osterloh, 2012, 39).

Location factor to be evaluated	**Connectivity to Other Relevant Firm-owned Production Sites (Speed)**	**Connectivity to Other Relevant Firm-owned Production Sites (Reliability)**	**Costs for Transporting Components from Other Firm-owned Production Sites over the planning horizon of the production site**	**Costs for Transporting Produced Products to Other Firm-owned Production sites (if Component) over the planning horizon of the production site**
Interdependencies with other location factors	o Transportation Facilities o Modes of Transportation o Supply Chain Risks		o Transport and Logistic Costs	
Source of information: public databases and information	-	-	-	-
Source of information: commercial external sources	-	-	-	-
Source of information: internal know-how	o Production Strategy Department o Logistic Department			
Source of information: external consultants	+	+	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.10.3 Availability of Component Suppliers

In addition to labor and raw materials, production also requires components in most industries. Particularly in the automotive industry, the variety and number of sourced components is extremely high. The total value added of the global automotive supply industry has increased from 455 bn. EUR in 2003, 70% of the value added of the global automotive industry, to 736 bn. EUR in 2010, 80% of the value added of the total automotive industry. Besides the percentage value added of the total automotive industry produced by the automotive supply industry, the complexity of the products produced by the automotive supply industry has also increased. While in the past OEMs had mainly sourced single components (seats) or systems (e.g., brake systems), they now increasingly also source modules in which components and systems are mechanically combined (e.g., cockpits), or integrated systems (e.g., entire passenger compartment) (see Stockmar, 2014, 217, 229, 233; Weingarten, 2006, 37). Thus, OEMs ask their suppliers to not only supply certain components, but, additionally, to help them solve crucial technical or organizational challenges, such as weight reduction and timely delivery of their products, system integration, product quality or innovation, for instance, with regard to electric vehicles (see Stockmar, 2014, 228-234; Trojan, 2007, 12-13). Simultaneously, in an attempt to reduce costs, OEMs try to buy their components from suppliers at the lowest possible costs and also pressure suppliers to continuously reduce their costs. This cost pressure has increased, especially as OEMs source globally, meaning that they place their orders with the suppliers which supply the best components at the lowest cost worldwide. Due to these high-cost pressures, coupled with the high value added of suppliers, the structure of automotive suppliers has changed dramatically: there has been a concentration of global suppliers, due to acquisitions, joint ventures, product diversification and increased production volume of OEMs. From this process of concentration of global suppliers, some suppliers emerged generating more revenues than small OEMs (see Stockmar, 2014, 219).

The OEM's choice of suppliers is crucially important for its success given their high share of value added. When selecting a production site, the availability and choice of local and international suppliers is crucial to ensure the sourcing of high-quality components, which are absolutely necessary for the successful operation of the production site. Components can be sourced locally, meaning from local or international suppliers located close to the production site, or globally, meaning from suppliers that are located anywhere in the world.[211] For all globally sourced components, the location of production sites of component suppliers has a significant effect on the costs for those components, especially if they have a low value density[212], and are thus harder and costlier to transport (see Meyer, 2006a, 50, 60, 72). The proximity to component suppliers is very beneficial with regard to transport costs, not only in terms of direct transport costs, but also indirect transport costs, such as those for containers and handling (see Klug, 2018, 357; 4.10.4.3 Transport and Logistic Costs). Whether the transport is done by the OEM or the supplier, it causes costs that must ultimately be borne by the OEM, as the suppliers will raise their prices by the cost of transport if they are responsible for the transport. Besides the cost factor, the geographic proximity of the new production site and the production sites of main component suppliers also has advantages in that the exchange of information is simplified and the reaction times are reduced (see Kinkel and Zanker, 2007, 112). Proximity ('close linkage') to the OEM means 'for most suppliers' 'a physical location within a one-day delivery range' from the OEM's production site (Klier and Rubenstein, 2010, 342). Thus, the advantages of sourcing locally stem from the short distance which reduces transport costs, makes fast orders possible, and facilitates communication. In addition to these prac-

[211] The advantages and disadvantages of centralized and decentralized sourcing are discussed in Huber and Laverentz's book 'Logistik' (2012): advantages of central sourcing are bargaining power, inventory optimization, sourcing know-how and capacity utilization, while the advantages of decentralized sourcing are flexibility, problem orientation, speed, and technical know-how. Huber and Laverentz suggest that, given these advantages of centralized and decentralized sourcing, the practices should be applied depending on the kind of components sourced (see Huber and Laverentz, 2019, 72).

[212] The product-specific value density is defined as the money value per weight of the product (see Meyer, 2006a, 72).

tical aspects, Kinkel and Zanker point out that OEMs also benefit from sourcing components locally (from international, as well as local suppliers) if there are local content requirements in the country. Thanks to local sourcing of components with local value added, the OEM is less affected and restricted by local content requirements in its own value chain (see Kinkel and Zanker, 2007, 112-113; 4.2.2.2 Non-Tariff Barriers to Trade).

The relevance of geographic proximity to high-quality component suppliers must not be underestimated, especially for German OEMs which still have many production sites in Germany, where they benefit greatly from the geographic proximity to and extensive availability of high-quality suppliers (see Richter and Buchner, 2009, 222-227). The know-how accumulated in the cooperation between the OEM and its suppliers at any production site is usually unique to the 'established framework' at the production site and, therefore, ending the cooperation between the OEM and its suppliers at any production site or even just shifting it to another production site might lead to a loss of this very relevant know-how (Bilbao-Ubillos and Camino-Beldarrain, 2008, 155). Hence, to evaluate the availability of international local suppliers, it is important to analyze their availability at the OEM's other production sites, and to be aware of their quality and their relevance to the functioning of these production sites (see Richter and Buchner, 2009, 222-227). Overall, the local availability of suppliers in close proximity to the new production site is very beneficial for the successful operation of the production site, as long as the components of those local suppliers meet the high-quality requirements of the OEM. For all the components that should be sourced locally, the OEM must either find local suppliers that already meet the quality standards or develop them so that they do, or it must work with international suppliers that are already at the location or could locate a new production site there. For all the components which cannot be sourced locally, the OEM must ensure that the production sites of the suppliers of these components are well connected (e.g., in JIS-Distance) with the new production site.

Thus, for the local sourcing of components, the OEM should evaluate the availability of local and international suppliers at the production site. With regard to local suppliers, the most important aspect that needs to be evaluated is whether they already meet high enough quality standards in their production to supply high-quality components, or if they could be developed efficiently to meet sufficiently high-quality standards. In China many Chinese component suppliers have emerged which are able to meet the high-quality requirements of international OEMs[213] (see

[213] In China, many Chinese component suppliers have clustered around the production sites of international OEMs after they have been located there. While the Chinese component suppliers were initially unable to meet the quality

Wang, 2006, 16), while in other countries local component suppliers which already meet these high quality requirements are often missing. In this case, the sourcing of components from local suppliers requires the OEM to develop these local suppliers. Developing suppliers usually improves price, quality, technology, and timing (see Hofbauer et al., 2016, 80). OEMs are usually willing to invest in developing suppliers given their importance, and since early and systematic investment in developing them ('Front Loading') limits the risk of later 'task force' investments (Hofbauer et al., 2016, 83). Developing local suppliers includes transferring the optimized and efficient production processes of the OEM into their production processes (see Meyer, 2006a, 61-62) or transferring know-how and personnel, providing financial support (see Hofbauer et al., 2016, 84), helping them configure their means of production (technology transfer), planning and controlling their production, developing products, as well as training their workers or exchanging information. Another way to support the efficient production of local suppliers is to help them realize scale effects, as many local suppliers in emerging countries are not able to realize them in their production given their often small size and low output (see Meyer, 2006a, 62, 69).[214] The OEM can help suppliers realize scale effects by sourcing large amounts of components from one supplier, thereby reducing costs and thus prices (see Rothkopf and Pibernik, 2014, 38). However, the OEM also runs into a risk by sourcing large volumes from the same supplier as it strengthens that supplier relative to its competitors and weakens the OEM's position vis-à-vis the supplier in future negotiations. Firms and scholars have become increasingly aware of the risks related to single sourcing, a practice, which has frequently been applied in the course of the global expansion of production, leading to dependencies and restricted access to raw materials and critical inputs (see Gereffi, 2014, 439). Hence, the OEM should develop local suppliers with the goal of optimizing the pool of suppliers and improving their performance (see Hofbauer et al., 2016, 80), as the former reduces the dependence on only one or a few suppliers, and the latter enhances the reliability of these local suppliers, as well as the quality of their products. In addition, the OEM must carefully protect its intellectual property when developing and collaborating with local suppliers (see Wang, 2006, 17; 4.3.3.3 Protection of Intellectual Property Rights).

requirements of international OEMs, after a process of concentration and many joint ventures with international suppliers that enforce the transfer of technology and know-how, many of the remaining Chinese component suppliers are now able to supply high-quality components (see Wang, 2006, 16).

[214] Many local suppliers in emerging countries can compensate for their inability to realize scale effects with low labor costs (see Meyer, 2006a, 69), especially because the low degree of automation of their production processes are less capital intensive, and thus the share of labor costs of total costs is relatively high.

Local sourcing from local suppliers brings advantages not only related to geographic proximity to the suppliers, thereby reducing transport costs, but also potentially reduces costs, given the more competitive sector of simple components in many emerging countries which is highly competitive, as it is not dominated by a few big firms, but instead by high competition between many smaller firms in contrast to advanced countries where the sector of simple components is often dominated by oligopolistic structures in which few firms can generate fairly high margins. These smaller firms cannot take advantage of scale effects. However, as they compensate for this disadvantage with lower wage costs, simple products, such as aluminum casting parts or packaging material, are often cheaper in emerging countries than in advanced countries. However, to take advantage of lower costs of local suppliers, it is necessary to understand the local market of components well: Meyer points out, that international firms, which do not know the local market well enough, often pay higher prices than local firms for their components, especially in Southeast Asia and China. Meyer suggests that, to receive the best possible prices from local suppliers, it is helpful to have a positive local image as an international firm and to guarantee the suppliers orders of 'critical masses' (Meyer, 2006a, 60).

However, Kinkel and Zanker suggest that many, even very experienced international firms, do not succeed in applying a low-cost local sourcing strategy, thus reducing costs by sourcing from local suppliers at new production sites (see Kinkel and Zanker, 2007, 150) while ensuring high quality. In the face of the increasingly high quality requirements of components (see Stockmar, 2014, 222-223), local suppliers are often unable to meet the required quality standards, despite significant investments by the OEM to develop them. Hence, OEMs must normally source many, especially the more complex components, from international suppliers from which they also source components for production processes at their other production sites. For all components that must be sourced from international suppliers, it must be determined in the selection process whether international suppliers are already situated or are close to the new production site. If they are not present at the new production site (see Kinkel and Zanker, 2007, 150), the OEM can approach these international suppliers in negotiations and convince them to move production to the new production site to ensure local sourcing (see Stockmar, 2014, 221). As international OEMs are usually a very important, if not the most important, customers of individual international suppliers, they have considerable leeway (market power) to exercise pressure on their suppliers to follow them. Kinkel and Zanker refer to this pressure as the coercion to follow the customer ('following customer-Zwang') (Kinkel and Zanker, 2007, 96). The OEM can exercise this coercion by communicating that the suppliers will only receive the order for the new production site if they follow them close to the new production site, or the OEM can even increase the pressure by communicating the intent to reduce current orders for these suppliers for the production of the OEM at already existing production sites, if they do not follow the OEM close to the new production site (see Kinkel and Zanker, 2007, 96). Thus, OEMs usually have the market power to pressure the international suppliers they are used to working with and which guarantee a high level of quality of components to construct a production site close to the OEM's new production site. However, in practice the relationships between OEMs and their main component suppliers are based on mutual trust, long-term cooperation, and partnership, rather than on coercion. This collaborative relationship is reinforced by the shift of value added onto suppliers, as well as the relevance of their innovation (see Klug, 2018, 139-156; Pfeiffer and Gehle, 2005, 51; Weingarten, 2006, 37-38). In negotiations with suppliers about following the OEM to the new production site with their own production, it is helpful to guarantee the suppliers a 'critical mass' of orders for an extended period to make their investment profitable (Kinkel and Zanker, 2007, 146).

Overall, it must be thoroughly evaluated which components can possibly be sourced from local suppliers, and which components must be sourced from international suppliers, as well as which international suppliers are already at the production site or are willing to move there. Evaluating and choosing suppliers is very important, especially with regard to local ones. Besides the quality issue, there are other elements that are also important and must be taken very seriously when choosing and evaluating local suppliers to ensure the successful operation of the production site. For instance, supply distortions, such as supply insecurity and supplier insolvency, are major sources of problems in the sourcing of components (see Kotula and Ho, 2014, 16).[215] Thus, when evaluating local suppliers, evaluation criteria, such as 'price, quality and delivery time', as well as logistic competency (Kotula and Ho, 2014, 9; see also Stockmar, 2014, 219), but also 'critical risk factors', including the 'financial position and creditworthiness' of the suppliers, the capabilities of suppliers, their ability to ensure 'supply continuity', changes in prices, compliance, 'suppliers' product or service specifications' (Kotula and Ho, 2014, 19), must be taken into account. Moreover, the required costs and time for developing local suppliers must also be assessed to minimize risks

[215] Schneck has developed, together with the German Association of the Automotive Industry (VDA), a rating tool (VDA Rating Tool) with which the creditworthiness of suppliers can be evaluated. These kinds of external ratings have the potential to improve the OEM-supplier relationship, as the suppliers are not required to disclose all financial information to the OEM (see Schneck, 2006, 49).

in the supply of components with regard to financial stability, costs, quality, and timing (see Hofbauer et al., 2016, 83). With regard to international suppliers, those that are already in close proximity to the location must be approached about the possibility of extending their production for required orders, while those suppliers from which the OEM must source components, but which are not yet close to the OEM's new production site, must be approached to discuss the possibility of building a production site close to the OEM's new one. For all components that cannot be sourced locally, it is necessary to ensure that the production sites from which these components must be sourced are well connected with the new production site (e.g., in JIS-Distance).

Generally, the availability of component suppliers—be it of local or international suppliers close to the new production site or be it of international suppliers well-connected (e.g., in JIS-Distance) to the new production site—is a necessary condition for the successful operation of the production site. This is especially the case for an OEM's production site, as production in the automotive industry is extremely complex, and requires the input of a variety of components which are, by and large, sourced from component suppliers.

Table 44: Information and Instructions on the Choice and Evaluation of the Location Factor *Availability of Component Suppliers*

Location factor to be evaluated	**Connectivity to Production Sites of International Component Suppliers (Speed)**	**Availability of High-quality Local Component Suppliers (Reliability)**	**Costs for Developing High-quality Local Component Suppliers**	**Costs for Transporting Components from Production Sites of Component Suppliers over the planning horizon of the production site**
Strategic, operational, or general	Strategic and operational	Strategic and operational	Strategic and operational	Operational
Process-specific / product-specific	Process-specific and product-specific			Product-specific
Relevant for production network	+	+	-	-
Relevant for the design of the supply chain	+	+	-	-
Negotiable	Negotiable as international suppliers can be approached in negotiations to locate a production site close by.	-	-	Negotiable as international suppliers can be approached in negotiations to locate a production site close by.
Semi-external / even performance	-	A semi-external location factor as it is expected to improve once the production site will be announced and a performance location factor as OEMs may invest in the development of local suppliers.	-	-
Quantitative or qualitative	Non- cost-related quantitative	Qualitative	Cost-related quantitative	
Hard or soft	Hard			
Static or dynamic	Static taking all planned and negotiated relocations into consideration.		Dynamic	Dynamic

Location factor to be evaluated	Connectivity to Production Sites of International Component Suppliers (Speed)	Availability of High-quality Local Component Suppliers (Reliability)	Costs for Developing High-quality Local Component Suppliers	Costs for Transporting Components from Production Sites of Component Suppliers over the planning horizon of the production site
Geographic level of analysis	National and regional			
Unit of measurement	Measured in hours required for transport. Assessed as very bad, bad, fairly good, good or very good (or numerically as 1 through 5).	Assessed as very bad, bad, fairly good, good or very good (or numerically as 1 through 5).	Approximated in EUR.	
Evaluation method(s)	o Strategic considerations o Minimum criteria o Profile method o Utility analysis		o Minimum criteria o Operating cost comparison o Present value method	
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method) o Phase 5 (minimum criteria, profile method, utility analysis) o Phase 7 (utility analysis)		o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)	
Interdependencies with other location factors	o Transportation Facilities o Modes of Transportation	o Industrial Clusters	-	o See Transport and Logistic Costs
Source of information: public databases and information	o U.S. Department of Commerce: International Trade Administration: 'Top Markets Reports: Automotive Parts o PWC: Top Suppliers o Financial reports, websites and press releases of suppliers		-	o See Transport and Logistic Costs
Source of information: commercial external sources	o IHS Markit: • Automotive Supplier Market Data: component forecast, materials and lightweigting • Automotive Research & Analytics: component suppliers, vehicle components, sourcing and supply chain o Roland Berger: Global Automotive Supplier Study o VDA: Topics - Automotive Industry and Markets - Market Supplier Industry o European Association of Automotive Suppliers (CLEPA) o Original Equipment Suppliers Association (OESA)		-	o See Transport and Logistic Costs
Source of information: internal know-how	o Logistic Department o Production Strategy Department o Sourcing Department o Direct contact with component suppliers			o Logistic Department
Source of information: external consultants	+	+	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.10.4 Supply Chain

4.10.4.1 General Remarks on Supply Chain as a Production Factor

A supply chain is a value-added chain involving different firms (see Corsten and Gössinger, 2008, 96-97), which reaches from the sourcing of raw materials and components to the point-of-sales (see Mentzer at al., 2000, 5-7). Similarly, according to Chopra and Meindl, the supply chain consists of all parties which are directly or indirectly involved in the execution of a customer's order (see Chopra and Meindl, 2014, 22).[216] The supply chain constitutes the meta-logistic system, which is determined by the cooperation of independent firms, often between private industrial firms and logistics service providers.[217] For successful production in a global production network, a well functioning supply chain is of utmost importance in the face of the high interdependency between dispersed production sites (see Blyde and Molina, 2015, 319). The functioning of the supply chain is especially important for global production networks in the automotive industry given its numerous component suppliers and the high value added by them, and the large total number of sourced components. Thus, the supply chain in the automotive industry is extremely complex, as the production of a single final product requires the input of a variety of components which are partly produced by the OEM itself and partly sourced from suppliers. The increasing number of components OEMs source from suppliers (see 4.10.3 Availability of Component Suppliers), given the reduced depths of production and R&D of OEMs, is one driver of supply chain complexity in the automotive industry. Other drivers include the higher market and customer requirements, the higher degree of internationalization, and the larger pressure for innovation and new technologies (see Klug, 2018, 46-50). These drivers of supply chain complexity must be reflected in the structure of the OEM's supply chain. The specific requirements on the supply chain with regard to the new production site depend on the production process that takes place at the new production site, as well as on the product produced there. A functioning supply chain at the new production site is not only important for the reliable and profitable operating of the production site but also for the production site's strategic embeddedness into the OEM's production network.

For a general evaluation of the supply chain in the country in which the production site is located, there are two helpful indicators. The pillar 'availability and quality of transport services'

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[216] Huber and Laverentz point out that many definitions of supply chain exist, but that a supply chain and its management are best defined by its five most relevant characteristics: first, supply chains are logistic chains, in which several firms exchange material and information, second, supply chains have a process and cooperation oriented organization, third, supply chain management is responsible for the coordination, planning and control of supply chains, fourth, supply chain management is customer-oriented, and fifth, the goal of the management of the supply chain is to improve the performance of the supply chain to the advantage of all participants (see Huber and Laverentz, 2019, 147-148).

[217] Logistic processes and resources are coordinated, organized, and controlled in logistic systems. In the literature, logistic systems are categorized into micro-logistics, meta-logistics, and macro-logistics. Micro-logistics refers to logistic systems that are provided for by individual firms or public organizations. Meta-logistic systems refer to the supply chain and other forms of cooperation between different micro-systems, for instance, between private industrial firms and logistic service providers. Macro-logistics refers to the logistic systems of the entire economy, such as the traffic system. The availability of a functioning macro-logistic system, thus the infrastructure (see 4.9.1 General Remarks on Infrastructure as Location Factor) is a basic condition for a functioning supply chain and an efficient collaboration between different participants of the supply chain, such as logistics service providers, suppliers, and the OEM (see Huber and Laverentz, 2019, 8-9).

of the Global Enabling Trade Index (ETI) published by the WEF for 138 countries can serve as an indicator for the functioning of the supply chain on a national level. The indicator measures 'the availability and quality of transport services, such as shipping and logistic firms, as well as 'ease, cost and timeliness of shipment' (Hanouz et al., 2014, 4). A further indicator for the overall functioning of the supply chain is the Logistics Performance Index (LPI) published by the World Bank. The LPI score, available for 160 countries, is composed of six sub-indices, namely customs, infrastructure, international shipments, logistic competence, tracking and tracing, and timeliness. While these indicators do provide interesting information on the functioning of the supply chain, they remain on the national level. Besides considering these indicators, selecting a production site requires evaluating the supply chain therein in more detail to ensure its reliable and profitable operation and its strategic embeddedness into the OEM's production network. In regard to this more detailed evaluation of the supply chain, this section discusses the following supply chain related location factors: *Modes of Transportation*, *Transport and Logistic Costs*, *Availability of Logistics Service Providers*, and *Supply Chain Risks*.

4.10.4.2 Modes of Transportation

A mode of transportation 'identifies a basic transportation method or form. The five basic transportation modes are rail, truck […], water, pipeline, and air' (Bowersox et al., 2013, 191). This section briefly introduces the transport modes rail, truck, water, and air, as these are relevant for the supply chain in the automotive industry. Rail transport allows for the transport of bulky and heavy materials and goods (e.g., cars, trucks, buses, cockpits, engines, or machinery) over long distances and leads to high fixed costs, for instance, for 'equipment, right-of-way and tracks, switching yards, and terminals' (Bowersox et al., 2013, 193). By contrast, rail transport enjoys relatively low variable costs which have been reduced thanks to diesel power developments and electricity and has been facilitated by alliances between rail and truck service providers (see Bowersox et al., 2013, 193-196). However, rail transport depends on the railroad network available and the schedules (see Leitner, 2015, 6). New technologies (e.g., unit trains, articulated cars, or double-stack railcars) have been developed with the goal of reducing weight, increasing carrying capacity and facilitating interchange (see Bowersox et al., 2013, 193-194).[218]

[218] In the face of increasing awareness of environmental issues, rail transport has regained market share from truck transport (see Leitner, 2015, 6).

Compared to rail transport, the fixed costs related to truck transport (e.g., for terminal facilities, truck, or load carriers) are relatively low, as they usually drive on publicly financed and maintained roads. Variable costs related to truck transport are relatively high, given fuel costs, expenses of license fees, drivers' compensation, or tolls, which must be paid based on the number of trucks or distance traveled. Other drivers of variable costs of truck transport are labor costs for driving, as well as dock work, which are both affected by safety restrictions. Thus, costs of truck transport are characterized by low fixed costs and high variable costs. Nevertheless, truck transport offers a high degree of flexibility in terms of the departure and destination of the transport (house-to-house transport is possible), as well as in terms of time in comparison with rail transport, while disadvantages are related to rising costs for drivers and increasing truck traffic restrictions for the sake of environmental protection, as well as the truck's relatively low carrying capacity (see Bowersox et al., 2013, 196; Leitner, 2015, 4-6).

In addition to rail and truck transport, water transport is frequently used and generally distinguished into deep-water transport and 'navigable inland water transport' (Bowersox et al., 2013, 196). In Europe, inland water transport is mainly used for the transport of raw materials, while deep-water transport is used for the transport of manufactured goods. Fixed costs of water transport lay between fixed the costs for rail and those for truck transport. Most fixed costs arise from the maintenance and operation of terminals, while the government usually operates and maintains the right-of-way. The variable costs of water transport are relatively low. Similarly, its main advantages are relatively low total costs and a high carrying capacity. The main disadvantages stem from restrained operations due to necessary proximity to navigable waterways or industrial harbors, low speed, as well as certain special requirements, for instance, on packaging (see Leitner, 2015, 7-9; Bowersox et al., 2013, 196; Rodrigue and Notteboom, 2020, 173-175).

In addition to the transport modes of rail, truck and water, air transport is also used in the automotive industry. While air transport has gained increasing importance in other industries for the transport of light, small or perishable products, such as electronic devices or flowers, air transport is not used for the normal transport of goods in the automotive industry. However, air transport is, in some rare cases, relevant in the automotive industry; for instance, to control the quality of single components or products. While the fixed costs for air transport (e.g., for acquisition of aircraft) are fairly low compared to other modes of transportation, the variable costs are extremely high (e.g., costs for fuel, fees, maintenance, and labor). Due to these high variable costs, air transport is only, if at all, profitable for high value products which must be transported with high priority. Other disadvantages of air transport are the low carrying capacity, as well as the limited availability of airports. The main advantages are the speed of transport and the positive side effect of low capital binding (see Leitner, 2015, 9-10; Bowersox et al., 2013, 197-198; Bowen and Rodrigue, 2020, 183).[219]

To identify the most advantageous transport mode for a specific product and between specific locations, the classification of the different transportation modes according to relevant characteristics is helpful. Leitner classifies the transport modes truck, rail, water (in vessels inland and international) in terms of speed, distance, capacity, availability, and flexibility, as well as cost structure (fixed costs and variable costs) (see Table 45) (see Leitner, 2015, 3-4).

Table 45: Characteristics of Transport Modes

	Trucks	Railroads	Vessel (Inland)	Vessel (International)	Air
Speed	Medium-high	Low-medium	Low	Low	High
Distance	Low-medium	Medium	Medium	Large	Large
Capacity	Low	High	High	High	Medium
Availability and Flexibility	High	Medium	Low	Low	Medium
Cost structure (Fixed Costs (FC) and Variable Costs (VC))	Low FC/Medium VC	High FC/Low VC	High FC/ Low VC	High FC/ Low VC	High FC/Medium VC

(Source: Leitner, 2015, 4)

Alternatively, Bowersox et al. rank the transport modes with regard to the following characteristics: speed, availability, dependability, capability and frequency (see Table 46) (see Bowersox et al., 2013, 198).

219 '[T]he legal framework in which transport operates and the liabilities between the parties involved in freight transport' is determined in international transport conventions. There are various transport organizations representing the responsible parties for each mode of transportation (e.g., for truck transport: World Road Transport Organization) (UNECE, n.d.b).

Table 46: Ranking of Transport Modes[220]

	Trucks	Railroad	Water	Air
Speed	2	3	4	1
Availability	1	2	4	3
Dependability	2	3	4	5
Capability	3	2	1	4
Frequency	2	4	5	3
Composite score	10	14	18	16

Lowest ranking is best.
(Source: Bowersox et al., 2013, 198)

In practice, and especially in an international OEM's global production network, it is often not possible to transport the goods in a single mode transport. Instead, for the transport of most goods, various transport modes must be used, and thus, their transport occurs in so-called transport chains (also referred to as multi-modal transport or intermodal transport) (see Bowersox et al., 2013, 201-202). Goods can be transported in transport chains either in the form of parallel multi-mode transport or serial multi-mode transport. In the parallel multi-mode transport, parts of the products are transported by one transport mode and other parts by other transport modes. This is a reasonable course of action as it reduces lost orders and helps control the quality of a product. Specifically, the quality of a product can be controlled in advance by shipping a few products in a fast mode and a large number of products in a slow mode once the quality has been checked. Moreover, serial multi-mode transport refers to the use of different transport modes for different parts of the route, which is mainly done to take advantage of specific characteristics of different transport modes depending on the specifics of the route (see Meyer, 2006a, 77-78). An example of serial multi-mode transport is when products are transported on trucks from the production site to a rail station, then by train to a harbor, and from there by ships across the ocean, and again by truck to their final destination. With regard to multi-mode transport, it is important to be aware that the 'documentary requirements differ from mode to mode' and therefore multi-mode transport often requires multiple types of documentation (UNECE, n.d.b).

The possible mode(s) of transportation of raw materials, components, and the produced product to and from the production site must be evaluated in the selection process. The possibility to transport raw material, components, and the produced product to and from the production site in

[220] The original table published by Bowersox et al. included, in addition to the transport modes in Table 46, the transport mode pipes. This is ignored, here, because it is not relevant for a production site of an OEM.

a profitable transport mode or in a profitable transport chain is of utmost importance for the profitability of the production site. This is especially the case as the choice of modes of transportation can considerably affect the costs of operating the production site. The transportation modes which are feasible (in terms of density) for the transport of the product that will be produced at the production site, along with other required components for its production, must be specified in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile). In addition, the OEM's relevant network-related strategic goals which aim at enhancing at the new production site must be specified in the *Strategic Requirement Profile* (e.g., speed or flexibility) (see 3.2.2.2 Strategic Requirement Profile). Based on this information, the possible modes of transportation for components and produced products to and from the production site must be evaluated. This evaluation first determines if the feasible modes of transportation (in terms of product density) are possible at the production site (in terms of transportation facilities), and second, to what extent they enhance the OEM's relevant network-related strategic goals. Moreover, assessing the feasible and profitable modes of transportation with regard to the production site is important for evaluating the availability of transportation facilities at the production site and the required investment in transportation facilities (see 4.9.2 Transportation Facilities).[221]

Table 47: Information and Instructions on the Choice and Evaluation of the Location Factor *Modes of Transportation*

Location factor to be evaluated	**Availability of Modes of Transportation (e.g., trail, water, road)**
Strategic, operational, or general	Strategic and operational
Process-specific / product-specific	Process-specific and product-specific
Relevant for production network	+
Relevant for the design of the supply chain	+
Negotiable	Modes of Transportation are partially negotiable (via investments in transportation facilities).
Semi-external / even performance	Semi-external and even performance
Quantitative or qualitative	Qualitative
Hard or soft	Hard
Static or dynamic	Dynamic
Geographic level of analysis	National, regional, and local level
Unit of measurement	Yes or no

[221] Closely related to the modes of transportation is the choice of the concept of transport. Concepts of transport include direct transport, collection round tour-transport or groupage freight-transport. When choosing a transport mode, Klug suggests evaluating the transport volume, the structural data of transport (e.g., the distance, the number of variants or the kind of container), the delivery schedule, the load structure (i.e. required space, weight, bulkiness and the ability of the product to be stockpiled), the location of production sites of suppliers (i.e. the possibility of integrating the production site into a round tour), stability of the transport volume, and the ease of combining transport volumes (see Klug, 2018, 249-258). In this selection process model, the transport concepts are chosen based on the selected production site and the suppliers' production sites.

Location factor to be evaluated	Availability of Modes of Transportation (e.g., trail, water, road)
Evaluation method(s)	o Strategic considerations o Minimum criteria o Substitutable criteria o Profile method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, substitutable criteria, profile method) o Phase 3 (minimum criteria, substitutable criteria, profile method) o Phase 4 (minimum criteria, substitutable criteria, profile method)
Interdependencies with other location factors	o Transportation Facilities
Source of information: public databases and information	o UNECE: Trade Facilitation Implementation Guide: Transport Modes o International Road Transport Union o UIC - International union of railways o The International Maritime Organization o ISC Maritime Transportation o See also sources for Transport and Logistic Costs
Source of information: commercial external sources	-
Source of information: internal know-how	o Logistic Department o Factory Planning Department o Strategy Department
Source of information: external consultants	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.10.4.3 Transport and Logistic Costs

Costs of transport include all costs which a firm must pay for the transport of goods (for example, final goods or components) from suppliers to production sites, between production sites, or from production sites to the sales market (see Kinkel and Zanker, 2007, 155).[222] Costs of transport include costs for 'labor, fuel, vehicle maintenance, capital invested in equipment, and administration' while lost or damaged products also lead to costs associated with transport (Bowersox et al., 2013, 187). Total costs of transport can be distinguished into variable costs and fixed costs. While fixed costs do not change regardless of whether or how many goods are being transported, variable costs depend on the 'level of activity' (e.g., amount, distance, volume of product) and are normally quoted in rates per distance or per unit of weight (Bowersox et al., 2013, 205). Variable transport costs include labor costs or operating costs for fuel, electricity, or light, while fixed costs of transport include fixed rents or leases, fixed taxes, or insurance costs, as well as the costs for acquiring the means of transport.

[222] Thus, a firm incurs transport costs if the location at which it produces products and those at which the products are consumed differ. These costs are normally paid by consumers as firms receive the same amount of money for their products regardless of where they are sold ('mill pricing'). This implies that consumers prefer locally produced products as they are – all else equal – cheaper than those produced at more distant locations. Due to this mill-pricing, firms attempt to minimize the transport costs of components and raw materials that they use as inputs in their production on the one hand and to locate production sites close to the sales markets on the other hand (Farhauer and Kröll, 2014, 211).

Transport costs are further distinguished between direct transport costs and indirect transport costs. Direct transport costs are cargo rates, as well as costs for its planning. Indirect transport costs are referred to as carrying costs, which arise due to capital commitment, impairment, and delayed deliveries. Costs due to capital commitment stem from delays in transport, handling or loading and transport-related increases in inventories. Impairment occurs during the time of transport, especially of products with very short life-time cycles and fast, as well as significant, price declines. Delayed deliveries increase costs, especially in the case of make-to-order deliveries, as their delays might force firms to reduce prices or result in competitiveness losses, while delayed deliveries are less costly in the case of a make-to-stock production. These indirect transport costs must not be neglected in the selection process to avoid an underestimation of total transport costs. Indirect costs can be approximated by using a weighted average cost of capital approach for the value of inventories (see Meyer, 2006a, 72-77).

There are three main drivers of transport costs: distance, weight, and density.[223] Distance drives variable costs (e.g., fuel, maintenance, and labor). The main properties of the relationship between distance and transport costs are, first, that there are fixed costs which arise independent of distance (e.g., required expenditures on services, such as 'shipment pickup and delivery') (Bowersox et al., 2013, 203), and second, is that the transport costs increase at a decreasing rate as distance increases, the so-called 'tapering principle' (Bowersox et al., 2013, 203). Hence, the longer the distance which the products are transported, the less the transport cost increases for every additional unit transported (scale effects). Weight is another driver of transport costs, the relationship between which is characterized through scale effects, as the transport costs per transported unit of weight decrease as the entire 'load size increases'. Besides distance and weight, the product density, or the weight per volume of the product, is another transport cost driver. Transport costs usually increase the lower the density of products, as lower density products do not allow spreading the occurring fixed costs over more weight[224] (Bowersox et al., 2013, 203-204). As such, when assessing transport costs, it is important to be aware of these drivers of transport costs.

[223] Klug suggests calculating the expected volume that must be transported based on the number of planned products over the planning horizon, the number of required components, the corresponding need for containers per product and the packaging data of components (see Klug, 2018, 249-250).

[224] Transport costs also depend on other factors, such as the stowability of the product, the special handling requirements, the liability requirement, and whether the transport vehicle has a 'back-haul load' or is 'returned deadheaded empty' (Bowersox et al., 2013, 205).

Nonetheless, there are other factors that affect the transport market and hence transport costs. These cost drivers can be differentiated between supply side factors and demand side factors, of which only the most important are briefly introduced here. One important supply side driver is the price of raw materials which are necessary for the transport of goods: For assessing the development of fuel prices, it is most reasonable to look at oil prices and their development. However, predicting the price of oil is very difficult. Drivers that impact the oil price development are normally also divided into supply side and demand side factors. Among the supply side factors are OPEC production deals, as well as the development and profitability of the fracking industry in the U.S. and globally (see Baffes et al., 2015, 11-13; Ederington et al., 2011, 11-12, 30-32).[225] Furthermore, demand for transport is an important determinant of transport costs. The demand for transport, and thus the transport markets, have become increasingly volatile which leads to higher transport costs as the market volatility makes planning capacities difficult and increases the risk for logistics service providers to make the required long-term investment given their long periods of amortization (see Wittenbrink, 2014, 8-11). The demand for transport depends on the economic activity, as stronger economic activity increases the trade of goods and services and thus the demand for transport (see Baffes et al., 2015, 11-13; Ederington et al., 2011, 11-12, 30-32). However, it is important to understand that long-term prediction of economic growth is very hard. Hence, the mentioned cost drivers of transport costs are multiple, and their development is very difficult to foresee, which makes it very difficult, if not impossible, to determine short-, medium- or long-term transport costs.

In practice, the OEM either organizes the transport of goods itself or outsources the transport to logistics service providers (see 4.10.4.4 Availability of Logistics Service Providers). An OEM organizes the transport of goods itself as it can be profitable it to collect many components ('bundle') it sources from suppliers which produce in a certain region (supply base) at consolidation centers, and to then transport these components together to the new production site (see Klug, 2018, 385).[226] Certainly, these transport costs which arise when an OEM transports goods itself must be differentiated from those transport costs which arise for the OEM if the transport is being

[225] As transport costs depend significantly on fuel prices and considering that transport costs take up a significant share of total costs, Meyer suggests conducting a sensitivity analysis for the transport of products for various future fuel price scenarios. For example, Meyer explains that the one-way transport of a 20-foot container on a ship from Germany to the Chinese coast requires approximately 800 liters of crude oil, which leads to a 2-3% increase in total cost of transport, if the price for crude oil increases by $10.00 per barrel (see Meyer, 2006a, 75).
[226] For information on transport control and, in particular, options to deduce transport costs, see Klug, 2018, 378-393.

sourced from a logistics service provider. While the costs that arise when the OEM transports the goods itself are henceforth referred to as transport costs, the costs that the OEM must pay for outsourced transport services are henceforth referred to as logistic costs. Logistic costs must be approximated based on cargo rates which are composed of two parts: a basic tariff and a load tariff. The basic tariff must be paid for each order or each delivery, thus for each basic unit (see Gudehus, 2010, 178-188). This tariff covers the costs that the logistics service provider incurs due to the single order (see Leitner, 2015, 29). By contrast, the load tariff must be paid depending on the performance of the logistics service (see Gudehus, 2010, 178-188); for instance, on the weight of the unit or the distance of transportation (see Leiter, 2015, 30).

Transport and logistic costs[227] are significant when selecting a production site given the great number of components that must be transported there, and the produced product that must be transported to the sales market, if it is a final good, or to the OEM's other production sites, if it is a component. For the outsourced transport, the logistic costs must be assessed in the form of cargo rates, which have two parts: the basic tariff and the load tariff. Aspects related to indirect transport costs must be taken into consideration and their relevance assessed in accordance with the relevant strategic goals (see 3.2.2.2 Strategic Requirement Profile). Information on cargo rates can be obtained from logistics service providers. However, optimizing the selection of a production site on the basis of cargo rates is very difficult due to the great complexity of transport relations between different production sites and markets, in combination with the variety of transport modes (see Meyer, 2006a, 73).

For assessing transport costs (those costs that arise if the OEM transports goods itself), it is important to evaluate the variable costs and the fixed costs. Fixed costs arise for the OEM, for instance, from the investment (capital commitment) in trucks or distribution centers. The required investment in trucks depends on the number of required load carriers, which depends on the amount of goods and their weight and density, but also on distance. Distance matters for the required investment because the number of required load carriers increases as the distance which the goods must be transported increases.[228] For evaluating both transport and logistic costs, it is important to

[227] As mentioned in Chapter 2, transport costs have been one of the main factors in traditional location theory (mainly in quantitative models) (see Farhauer and Kröll, 2014, 14). Although in more recent literature on location theory other factors have gained relevance, transport costs have remained important (see 2.4.1 Location Determining Theory).
[228] Here, it is important to acknowledge that the load carrier, and thus the invested capital, is bonded while the carriers are carrying a load on their way from distribution centers or other production sites to the new production site and, most of the time, they are empty on their way back.

understand the relationship between costs and the product characteristics in terms of weight and density, as well as the fact that transport and logistic costs are, in general, higher the father the distance the products must be transported. Furthermore, the oil price development and overall economic activity can be considered as drivers of transport costs. Besides evaluating transport or logistic costs, it is also important to evaluate the trade-off between transport or logistic costs and other location factors in the selection process. Urbasch emphasizes that, in the evaluation of transport or logistic costs in the selection of a production site, it is important to consider the trade-off between higher transport or logistic costs and lower labor costs, and to choose the most advantageous balance between these aspects (see Urbasch, 2005, 2). If the OEM locates a production site far away from its suppliers or sales markets to take advantage of lower wages, these cost advantages might be offset by higher transport or logistic costs. Those trade-offs must be taken into account in the selection process based on the strategic goals defined in the *Strategic Requirement Profile* (see 3.2.2.2 Strategic Requirement Profile).

Table 48: Information and Instructions on the Choice and Evaluation of the Location Factor *Transport and Logistic Costs*

Location factor to be evaluated	**Transport and Logistic Costs**	**Costs for Transporting required Raw Materials to the Production Site over the planning horizon of the production site**	**Costs for Transporting other Components (e.g., Bundling) to the Production Site over the planning horizon of the production site**	**Costs for Transporting the Produced Product to the Sales Market (if final good) over the planning horizon of the production site**
Strategic, operational, or general	Operational	Operational	Operational	Operational
Process-specific / product-specific	Product-specific			
Relevant for production network	+	-		
Relevant for the design of the supply chain	+	-		
Negotiable	-			
Semi-external / even performance	-			
Quantitative or qualitative	Non-cost-related quantitative	Cost-related quantitative		
Hard or soft	Hard			
Static or dynamic	Dynamic			
Geographic level of analysis	National	Local		
Unit of measurement	Measured in EUR per km. Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).	Approximated in EUR.		
Evaluation method(s)	o Strategic considerations o Profile method	o Minimum criteria o Operating cost comparison o Present value method		
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 5 (profile method)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)		

Location factor to be evaluated	Transport and Logistic Costs	Costs for Transporting required Raw Materials to the Production Site over the planning horizon of the production site	Costs for Transporting other Components (e.g., Bundling) to the Production Site over the planning horizon of the production site	Costs for Transporting the Produced Product to the Sales Market (if final good) over the planning horizon of the production site
Interdependencies with other location factors	o Modes of Transportation o Transportation Facilities	o Modes of Transportation o Transportation Facilities		
Source of information: public databases and information	o Freightos: Freight Rate Calculator o OECD. Stat: Maritime Transport Costs o The World Bank: INTERNATIONAL LPI Global Ranking (Logistics competence)			
Source of information: commercial external sources	-			
Source of information: internal know-how	o Logistic Department			
Source of information: external consultants	+			

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.10.4.4 Availability of Logistics Service Providers

Meta-logistics refers to the supply chain and other forms of cooperation between different micro-systems, for instance, between private industrial firms and logistic service providers (see Huber and Laverentz, 2019, 8). Thanks to the 'spatial reach' of globally acting logistics service providers their emergence has allowed global production networks to arise (Coe and Yeung, 2015, 53), as their functioning depends on the services provided by logistics service providers (see Weingarten, 2006, 38). Logistics service providers are responsible for the supply security, reliable delivery, and all interfaces in the production network, thereby ensuring stable production processes (see Mantel and Stommel, 2007, 16-17). The market of logistics service providers has become more and more dynamic over the past decades as firms have increasingly outsourced logistic tasks to take advantage of lower costs. In the course of this outsourcing trend, logistics service providers have increased their offered services (see Leitner, 2015, 15-16).

There are a variety of ways to categorize logistics service providers based on: the transported goods, the sector, mode of transport, geographic range, assets, scope of services, degree of network integration, or business activities (see Scholz-Reiter, 2008, 584; Leitner, 2015, 15-16). A famous categorization has been developed by Schulte, who differentiates logistics service providers based on their scope of services and degree of network integration, logistic assets, and sectors. Accordingly, Schulte differentiates logistics service providers into carriers, haulers, system service providers, network integrators and logistic IT service providers, as well as logistic consultants (see

Schulte, 2017, 316-318). These categories of logistics service providers are referred to as First Party Logistics Providers through Fourth Party Logistics Providers (1PL-Provider, 2PL-Provider, 3PL-Provider, and 4PL-Provider) (see Leitner, 2015, 17). Single service providers (1PL-Providers or 2PL-Providers), which include carriers, only conduct limited services such as transport, handling, or storage of goods. They generally specialize on goods from a specific industry and have a limited geographic range. As such, they benefit from their ownership of the means of transport and their highly specialized know-how. Depending on their degree of specialization, the contract period with their customers varies considerably but is generally long-term for highly specialized 1PL-Providers and 2PL-Providers. In contrast, system service providers (3PL-Providers) offer a wider range of services and adjust these services to their largest customers. They connect logistics services in a logistic network by combining their own resources with those of 1PL-Providers and 2PL-Providers (see Scholz-Reiter, 2008, 584-585). 3PL-Providers offer integrated transport, storage, and handling services, as well as the required IT systems, by using both their own and external resources. Notably, large 3PL-Providers are able to use their capacities multiple times and achieve bundling and synergy effects (see Scholz-Reiter, 2008, 585-586; Chopra and Meindl, 2014, 541-544).

Further, there are the network integrators (4PL-Providers) which do not contribute logistic resources as they are exclusively responsible for coordinating the entire supply chain by combining logistic resources and the services of subcontractors. They are especially focused on optimizing the flow of goods and information, as well as on the interfaces between all involved firms and the planning of the allocation of resources (see Scholz-Reiter, 2008, 587). The main advantages of 4PL-Providers are the higher transparency of the supply chain and the improved coordination of the various firms involved in the supply chain, and the supply chain as a whole (see Chopra and Meindl, 2014, 543-544). Thus, 4PL-Providers are responsible for the entire management of the supply chain (see Scholz-Reiter, 2008, 588). They are normally also specialized in the provision of logistics services for certain industries (see Leitner, 2015, 18). These network integrators are what Coe and Yeung refer to as 'intermediaries'[229] which bring different actors of the production network together by providing 'non-asset and skill-based services' (Coe and Yeung, 2015, 34).

[229] Coe and Yeung introduce the concept of intermediaries which 'bridge and connect, multiple actors in a production network, allowing them to engage in value activity of mutual benefit'. Global production networks need these 'enablers […] to function effectively'. These intermediaries are critical for the functioning of global production networks with regard to financing, logistics, and the setting of standards (Coe and Yeung, 2015, 50-51).

They include freight forwarders, shipper associations or brokers (see Bowersox et al., 2013, 202-203), as well as logistic IT service providers, which offer and implement necessary software for operating the supply chain (see Schulte, 2017, 332).

As OEMs outsource most of the transport service, they require logistics service providers to be responsible for a large part of the interface of OEMs with their suppliers, as well as for the transport of components from the OEM's other production sites or distribution centers to the production site, and the transport of final products to the sales markets (see Weingarten, 2006, 37-38). Reliable logistics service providers are not only of utmost importance for the successful operation of the production site, but also for the integration of the production site into the OEM's global production network. This is especially the case for a production site of an OEM due to the large number of components that must be delivered to the production site. For instance, 'for the production of a model range of a luxury SUV' 'more than 33,000 individual parts' must be handled at the production site, which are 'supplied by more than 800 suppliers around the world' (Weingarten, 2006, 38). On top of the overall complexity of services, the delivery schedules (e.g., Just-in-Sequence or Just-in-Time) impose high requirements on logistics service providers, as they are often made responsible for implementing the required delivery schedule and solving quality issues during delivery as fast as possible to avoid production stoppages (see Klug, 2018, 340-346; Poiger and Reiner, 2010, 134; Wöhner and Wimmer, 2010, 23-24). Due to this high degree of complexity of international supply chains of the automotive industry, traditional supply chain concepts for which 1PL-Providers and 2PL-Providers provide services are no longer sufficient. Instead, successful production in global production networks in the automotive industry is only possible with the help of more advanced supply chain concepts provided by 3PL-Providers and 4PL-Providers. These more advanced supply chain concepts must include sequencing centers close to the production site, 'suppliers-on-site', as well as the more complex management of the entire supply chain (Weingarten, 2006, 38).

Given the importance of logistics service providers to the successful operation of the production site and the integration of the production site into the OEM's global production network, the evaluation of these logistics service providers is very important and requires a thorough analysis of their capacities, prices, services, logistic information capacities, development potential, and flexibility (see Leitner, 2015, 21). The related operational requirements must be specified in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile). Moreover, the logistics service providers must, of course, be evaluated in accordance with the related strategic goals that are supposed to be achieved at the new production site to ensure the successful strategic embeddedness of the new production site into the OEM's production network. These strategic goals must be specified in the *Strategic Requirement Profile* (see 3.2.2.2 Strategic Requirement Profile).

As such, the evaluation of logistics service providers in the selection of a production site requires assessing the already-in-use logistics service providers, as well as the possibility of other logistics service providers to start providing their services at the new production site. The evaluation includes collaborations between different international and local logistics service providers. As 3PL-Providers and 4PL-Providers are normally rather specialized to their customers, large international OEMs are likely to have significant leverage to convince international logistics service providers, which they work with in other parts of their production network, to also start offering their services at the new production site. In practice, the relationships between OEMs and their main logistics service providers are based on mutual trust, long-term cooperation, and partnership rather than on coercion. Often, the logistics service providers work in close cooperation with the OEM at many locations in its production network due to their trust-based partnership and are willing to follow the OEM with its services to new production sites. Necessary negotiations with logistics service providers must not be neglected in the selection process.

Table 49: Information and Instructions on the Choice and Evaluation of the Location Factor *Availability of Logistics Service Providers*

Location factor to be evaluated	**Availability of Logistics Service Providers**	**Charges for Logistics Service Providers over the Planning Horizon of the Production Site**
Strategic, operational, or general	Strategic and operational	Strategic and operational
Process-specific / product-specific	Process-specific and product-specific	Process-specific and product-specific
Relevant for production network	+	+
Relevant for the design of the supply chain	+	+
Negotiable	Negotiable as providers can be approached in negotiations to provide their service at the new production site.	Negotiable
Semi-external / even performance	-	-
Quantitative or qualitative	Qualitative	Cost-related quantitative
Hard or soft	Hard	Hard
Static or dynamic	Static (taking all planned negotiated changes into account).	
Geographic level of analysis	National, regional and local	National and local
Unit of measurement	Assessed as very bad, bad, fairly good, good or very good (or numerically as 1 through 5).	Approximated in EUR.
Evaluation method(s)	o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 2 (profile method) o Phase 3 (profile method) o Phase 5 (profile method, utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method)

Location factor to be evaluated	Availability of Logistics Service Providers	Charges for Logistics Service Providers over the Planning Horizon of the Production Site
	o Phase 7 (utility analysis)	o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	-	-
Source of information: public databases and information	o Websites of Logistics Service Providers (e.g., Fraport, ProLogis, Frans Maas, Hapg Lloyd, Lufthansa Cargo, Kühne & Nagels, Schenker, DHL, UPS or FedEX). o The World Bank: Logistics Performance Index (LPI): Indicators (Efficiency of the clearance process, Ease of arranging competitively priced shipments, Competence and quality of logistics services, Ability to track and trace consignments, Timeliness of shipments in reaching destination within the scheduled or expected delivery time).	
Source of information: commercial external sources	-	-
Source of information: internal know-how	o Logistic Department	
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.10.4.5 Supply Chain Risks[230]

Supply chain risks existed before the emergence of production in global production networks, but their impact has increased tremendously since firms have increasingly distributed their different stages of production across many countries around the world (see Coe and Yeung, 2015, 112). Production in global production networks leads to a high degree of interdependencies between individual production sites, distribution centers, and suppliers (see Blyde and Molina, 2015, 319-320).[231] As the supply chain is responsible for optimizing the flow of raw materials, compo-

[230] Risks are defined as known events that occur with a predictable probability while uncertainty is defined as known events that occur with an unpredictable probability (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model). Thus, it is important to distinguish uncertainty from risk. Coe and Yeung follow Frank Knight (1921) in their understanding of uncertainty as 'conditions leading to unknown and random outcomes not amendable to *ex ante* calculations and predictions'. However, they continue to argue, these uncertain outcomes are no longer uncertain once they 'can be predictable subject to probability distributions'. Then, these uncertain events can be assigned a probability of occurrence and are risks (Coe and Yeung, 2015, 110). Following this argument, the location factor is called 'Supply Chain Risks'.

[231] Geographically dispersed production organized in global production networks diversifies risks by spreading sourcing and sales markets and production sites around the world, thereby reducing the potential effect of any kind of downturn or event in one market or location on the firm's activities (see Kutschker and Schmid, 2011, 409-410). Like the interest rate theorists, Rugman (1975) starts from a capital-oriented perspective to explain FDI. Rugman applies the portfolio theory of the capital market theory to FDI, according to which an investor can reduce the risk of his entire portfolio through diversification, meaning that the investor chooses stocks that do not move perfectly together (see Brealey et al., 2020, 198-203). As Rugman applies the portfolio theory to FDI, he excludes capital investments and only considers fixed investments (capital investments in fixed assets). Rugman argues that firms conduct FDI in order to diversify their risk because multinational firms have more stable sales given that international goods markets and factor markets are not perfectly correlated. Thanks to the international diversification of risk, multinational firms have a significant advantage over non-multinational firms and are more attractive to investors (see Rugman, 1975, 651-652). A firm can actively use the globalization of its sourcing markets, production sites, and sales markets to diversify its risks related to changes in exchange rates or costs, as well as to market developments, solely by being present in

nents, goods, and knowledge between the individual parts of the production network, any interruption of the supply chain poses a serious risk to the functioning of the production network, in general, and the operation of individual production sites, in particular. The increased spreading of production sites around the globe and the resulting high complexity of supply chains make them especially vulnerable to interruptions (see Bode and Wagner, 2015, 216-217).

While a supply chain which is coordinated in a cross functional manner—including functions such as sales, in addition to sourcing, production, and logistics—has the potential to provide a significant competitive advantage (see Bogaschewsky et al., 2009, 215), the successful functioning of global supply chains faces a variety of considerable risks. Fierce competition, increased complexity, and the rising number of partnerships along the supply chain result in significant vulnerabilities therein (see da Silva Poberschnigg et al., 2020, 789). It is important to understand that a realization of supply chain risks can have a sizable impact on the revenue stream of a globally producing firm (see Bode and Wagner, 2015, 215-216; Semmler and Mahler, 2007, 38). In a study, managers suggested that 'supply chain disruptions were perceived to be the single biggest threat to their companies' revenue streams' (Kotula and Ho, 2014, 10-11). Supply chain disruptions result in reduced sales, higher costs, liquidity problems (see Chopra and Sodhi, 2004, 53-60), reduced shareholder value, higher share price volatility, and loss of profitability (see Hendricks and Singhal, 2012, 55-63).[232]

Supply chain risks may stem from a variety of sources and vary significantly between different regions. When asked by The Global Supply Chain Institute, supply chain professionals ranked their top ten supply chain risks in declining importance as follows: 'Quality', 'Inventory', 'Natural disasters', 'Economics', 'Transit loss', 'New product delay', 'Cyber Security', 'Intellectual property', 'Political instability', 'Customs', and 'Terrorism' (Dittmann, 2015). Generally, external supply chain risks are distinguished from internal supply chain risks.[233] Specifically, external

many countries across the globe (see Belderbos and Zou, 2009, 600). Geographic dispersion of activities is not only a way to diversify risks with regard to sourcing, production or sales markets, but also a way to diversify risk with regard to loss of know-how and intellectual property (see Meyer, 2006a, 92; Kutschker and Schmid, 2011, 409-410). Likewise, Dunning also explains that part of the ('ownership') advantage of international activities, in general, and international production, in particular, stems from the possibility to geographically diversify risks (Dunning, 2001, 176).

[232] To gain a better understanding of the quantitative effects of supply chain disruptions on publicly traded firms, see Schlegel and Trent (Schlegel and Trent, 2012, 13-16).

[233] Chopra and Meindl distinguish supply chain risks of the following categories: interruptions (e.g., due to natural catastrophes, war), delays (e.g., due to low flexibility of suppliers), systematic risks (e.g., due to interruption of information infrastructure), forecast risks (e.g., due to seasonality, short product life cycles), risks related to intellectual property (e.g., due to vertical integration of supply chain), sourcing risks (e.g., due to exchange rate risks), claim risks

risks include all risks that arise outside of the supply chain and whose realization does not or only partially depend on the behavior of the firms that belong to the supply chain (see Bogaschewsky et al., 2009, 219-220). External supply chain risks can be differentiated in the following risk categories: environmental, geopolitical, economic, and technological risks (World Economic Forum, 2012, 8). External risks to the functioning of a global supply chain stem from a variety of sources; just to highlight a few: labor stoppages, natural disasters (like the tsunami in Fukushima in 2011 or the Icelandic volcanic eruption of 2010),[234] global financial crises, maritime piracy, volatility in supply markets (see Kotula and Ho, 2014, 5-6), geopolitical events (see Semmler and Mahler, 2007, 38), exchange rate fluctuations, changes in tariffs, changes in transport possibilities in terms of required times and costs, changes in property rights, especially intellectual property rights, changes to licensing and administrative procedures (see Meyer, 2006a, 84-85), or changes in preferential or regional trade agreements. Moreover, changes in NTBs pose significant risks to supply chains: while the conclusion of new FTAs (e.g., EU and Canada Comprehensive Economic and Trade Agreement (CETA)) can benefit the operation of the supply chain, changes of existing FTAs or the possible exit of members from FTAs (e.g., Brexit) can significantly hinder the operation of the supply chain. Nowadays, international terrorism also poses a serious risk to the functioning and reliability of global supply chains (see Lehmacher, 2017, 5-10; see U.S. Department of Homeland Security, 2011).[235] Furthermore, the coronavirus pandemic, which began in 2020, shows how globally-spread diseases can have a destructive impact on the functioning of global supply chains.

While external risks occur outside the supply chain, internal risks stem from sources within the supply chain and are further differentiated between those risks that arise from the cooperation between various partners in the supply chain or from single partners in the supply chain and those risks that arise from supply chain-related processes and decisions taking place in the firm (see Bogaschewsky et al., 2009, 219-220). Examples of the former are risks related to component suppliers. These are especially relevant in the automotive industry. The main risks related to component suppliers in the supply chain are 'lock-in situations, supplier bankruptcies or supply security issues' (Kotula and Ho, 2014, 6). Firms are especially affected by supplier insolvencies or any kind of supply problem for components they only source from one supplier. While single sourcing has

(e.g., due to number of customers), inventory risks (e.g., due to inventory costs), and capacity risks (e.g., due to costs or flexibility of capacity) (see Chopra and Meindl, 2014, 189-191).

[234] Supply chain disruptions caused by 'environmental disasters' have increased by 29% between 2012 and 2018 (World Economic Forum, 2019, 16).

[235] For a thorough analysis of the risk of terrorist attacks along the supply chain see Lehmacher (2017).

many advantages for firms, one of the most prevalent being the discounts from the supplier for large volume allocations, single sourcing increases the impact of supplier insolvency or supply issues (see Klug, 2018, 130-131; Rothkopf and Pibernik, 2014, 38). Other examples include inventory issues or new product delays.

Besides the differentiation of supply chain risks based on their source, supply chain risks are also categorized based on the frequency of or impact on recurrent ('normal business risks'), operational and disruptive risks (see Kouvelis et al., 2012, 5; Chopra et al., 2007, 544-545). Recurrent risks arise due to uncertainties which are 'inherent in the business' and which have a 'moderate-to-high frequency of occurrence' (see Kouvelis et al., 2012, 5). Disruptive risks are differentiated further into 'production, supply, and transportation disruptions' depending on where the disruption impacts the firm's operations if the risk materializes (Ivanov et al., 2016, 1439).

In order to develop a successful mitigation strategy and to identify and assess supply chain risks, it is important to know the sources of risks, hence whether the risks are external or internal risks, but also whether the risks are recurrent, operational, or disruptive (see Kouvelis et al., 2012, 5-6; Chopra et al., 2007, 544-545, 551). There is an extensive body of literature on managing supply chain risks, though it is beyond the scope of this work (see Manners-Bell, 2018; Chopra and Meindl, 2014, 189-194; Kouvelis et al., 2012; Tomlin and Wang, 2012; Pettit et al., 2010; Manuj and Mentzer, 2008). Overall, The Global Supply Chain Institute suggests firms manage supply chain risks by carefully evaluating and identifying the possible ones, to prioritize those identified, and to develop plans to mitigate those risks of high priority (see Dittmann, 2014). Likewise, Kouvelis et al. suggest an integrated risk management which consists of two stages: the 'planning stage' and the 'execution stage'. In the planning stage, the risks are identified and assessed, and risk mitigation is planned, while the 'scanning', 'response' and 'measurement' occur in the execution stage (see Kouvelis et al., 2012, 4-7).

Though all highly globalized industries (e.g., apparel or electronics) face substantial supply chain risks given their 'geographically dispersed' activities (Coe and Yeung, 2015, 113), the highly complex global production networks of OEMs are especially vulnerable to supply chain risks. Events and conditions along the supply chain not only affect operation of individual production sites, and the functioning of the OEM's global production network, but they also have a significant effect on overall profitability of the OEM, as well as the sustainability and the reputation of the brand (see Kotula and Ho, 2014, 18, 27-28). While most supply chain risks are relevant to OEMs, the supply chain in the automotive industry is especially 'susceptible to regulatory risks' (Coe and

Yeung, 2015, 113), as well as to supplier issues. Supply chain risks must be considered in the selection process, because, if these risks materialize, the operation of the production site are likely to be interrupted (e.g., production stoppage) and thus cause additional costs or unreliability and delays in transporting the products to their destination (see Semmler and Mahler, 2007, 38). Therefore, given the serious consequences of supply chain disruptions on the operation of the production site, supply chain risks must be thoroughly considered when evaluating production sites.

When making a selection, one goal should be to select a production site for which the supply chain is not extraordinarily at risk compared to other production sites, and to identify and assess risks, and develop mitigation strategies as well as possible. In order to identify all supply chain risks associated with the selection of a certain production site, a 'supply chain vulnerability map' can be used, as suggested by Kouvelis et al., to display all risks according to their probability of occurrence and 'severity of the consequences'. Moreover, the risk assessment requires some form of quantification of the probability of the identified risks materializing and of their impact on the supply chain (see Kouvelis et al., 2012, 5-6). This can be done based on the information gained and the assessment made about other location factors, such as the *Exchange Rate* (see 4.6.2 Exchange Rate), *Political Stability* (see 4.3.2.1 Political Stability), *Protection of Intellectual Property Rights* (see 4.3.3.3 Protection of Intellectual Property Rights), *Economic Regulations and Policies* (see 4.2.2 Economic Regulations and Policies), or *Natural Hazards* (see 4.4 Natural Hazards). While it is possible to quantify certain risks by expressing them in terms of the likelihood of occurrence of damage (see Bogaschewsky et al., 2009, 218), there remain challenges for the assessment, such as lacking data, correlation between the different risks, and their 'multifaceted impact' on the supply chain (Kouvelis et al., 2012, 6).

For the identified and assessed supply chain risks, possible mitigation strategies should be analyzed in the selection process which aim to decrease the probability for the risk to materialize, as well as to minimize the effect of the risk if materialized, on the supply chain (see Kouvelis et al., 2012, 8-9).[236] Mitigation strategies can include having 'back-up suppliers', 'inventory and capacity buffers', 'back-up deposits and transportation channels/modes') (Ivanov et al., 2016, 1439),

[236] To design a supply chain to be less vulnerable to supply chain risks, the role of 'strategic maritime passages', such as the Suez Canal, the Panama Canal, the Horn of Africa, the Strait of Malacca, or the Strait of Hormuz, should be taken into account. Given their key importance for global trade, these maritime passages may be closed due to a political conflict or may be attacked by terrorists (Rodrigue and Notteboom, 2017, 36-47). Moreover, the supply chain in total, as well as single production sites, must be constructed with the awareness that the more countries the goods pass through and the longer the distances the goods are transported, the greater the risks of supply chain disruptions. Thus, the effect certain events have on the supply chain also depends on the structure of the production network and the

as well as sourcing from multiple suppliers or locations, strengthening the suppliers by better integration and cooperation or with investment, and thoroughly selecting them based on their quality (see Tomalin and Wang, 2012, 80-81; Aydin et al., 2012, 391-392). Based on a survey, The Global Supply Chain Institute revealed firms' three main strategies to reduce supply chain risks are to select supplies with strong competencies and financial strength, to reduce the variation of the shipping and cycling time, and to increase the visibility of all processes along the supply chain (see Dittmann, 2014). Hence, to successfully react to materialized supply chain risks[237] at the production site, the OEM should ensure a high degree of resiliency for the supply chain itself. The more resilient a supply chain is, the quicker the activities along the supply chain can resume 'with as little permanent disruption as possible' (U.S. Department of Homeland Security, 2011) after a supply chain risk has materialized. When selecting a production site, it is important to analyze possible supply chain risks associated with the selection of a certain production site over its planning horizon. Moreover, establishing resilience in a supply chain cannot be part of the selection process, though enhancing the supply chain resilience by selecting a production site can.

Table 50: Information and Instructions on the Choice and Evaluation of the Location Factor *Supply Chain Risks*

Location factor to be evaluated	**Supply Chain Risks (e.g., Tsunami, Piracy)**	**Required Costs for the Mitigation of Supply Chain Risks over the planning horizon of the production site**
Strategic, operational, or general	Strategic, operational, or general	Strategic, operational, or general
Process-specific / product-specific	-	-
Relevant for production network	+	+
Relevant for the design of the supply chain	+	+
Negotiable	-	-
Semi-external / even performance	-	-
Quantitative or qualitative	Qualitative	Cost-related quantitative
Hard or soft	Soft	Hard
Static or dynamic	Dynamic	Dynamic

number of borders goods transit (see Riad et al., 2012, 17, 19, 49). A key difference between supply chains in NAFTA, the EU or in Asia is the significance of regional hubs or, put differently, how many countries goods in process pass through before they arrive at their final destination. While in NAFTA and the EU most goods are directly imported from the hub (e.g., the U.S. or the EU 15), in Asia goods in process cross 'borders several times', including the hub (Japan), before they arrive at their final destination (Riad et al., 2012, 17).

[237] Selecting a production site at which the OEM can successfully react to a materialized supply chain risk is based on Ferdows' idea. He suggests building a 'robust' production network. According to Ferdows, the robustness of a production network increases with the proportion of production sites that play a strategic role. According to Ferdows, a production network is robust if it is able to deal with a changing competitive framework without having to apply extreme measures (Ferdows, 1997, 87).

Location factor to be evaluated	**Supply Chain Risks (e.g., Tsunami, Piracy)**	**Required Costs for the Mitigation of Supply Chain Risks over the planning horizon of the production site**
Geographic level of analysis	National and if necessary regional and local	
Unit of measurement	Assessed as very high, high, fairly low, low or very low (or numerically as 1 through 5).	Approximated in EUR.
Evaluation method(s)	o Strategic considerations o Minimum criteria o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method) o Phase 5 (minimum criteria) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria) o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	o Natural Hazards o Rule of Law o Corruption o Administrative Procedures o Availability of Component Suppliers	
Source of information: public databases and information	o FM Global (an U.S. industrial insurance company) o United States Department of State; Bureau of Diplomatic Security (OSAC): Crime and Safety. o Logistic Management Magazine; monthly publications o National and regional government websites o Global Supply Chain Institute o Business Continuity Institute: Supply Chain Resilience (annual report)	-
Source of information: commercial external sources	-	-
Source of information: internal know-how	o Logistic Department o Factory Planning Department o Real Estate Department	
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.11 Industrial Clusters

Clusters are 'geographic concentrations of interconnected companies and institutions in a particular field' (Porter, 1998, 78)[238], typically differentiated into horizontal or vertical clusters. Horizontal clusters are characterized by the geographic proximity of firms which use the same or similar technologies and are not vertically connected in the value chain. In contrast, vertical clusters refer to clusters of firms in the same industry which are vertically connected in the value chain. While there are a variety of clusters (e.g., scientific, IT, artistic, or medical clusters) this location factor focuses on industrial clusters as these are the most relevant for an OEM's selection of a production site.

[238] Clusters are composed of 'suppliers of specialized inputs such as components, machinery, and services, and providers of specialized infrastructure' and even 'governmental or other institutions - such as universities' (Porter, 1998, 78).

The emergence of clusters resulted mainly from the reduced depth of firms' in-house production,[239] as firms increased the share of outsourced or offshored services and components. When firms outsource offshore production steps, clusters emerge because both suppliers and the outsourcing firm benefit from geographic proximity to each other. According to cluster theory, clusters offer the participating firms a strategic comparative advantage by allowing them to focus on their core competencies in production and to be, at the same time, close to the production site of suppliers to which they are vertically linked in the value chain (see Farhauer and Kröll, 2014, 154-155). In order to understand the properties of clusters, it is necessary to approach their existence from a theoretical point of view.[240] Krugman explains that, by being part of clusters, firms benefit from scale effects in transportation, the provision of services, and the availability of skilled (specialized) labor (Krugman, 1991, 24-25). Formally speaking, firms benefit by being part of a cluster from externalities[241] as their productivity improves, for instance, thanks to the specialized knowledge, skills, supporting industries, and infrastructure available in the cluster. Scale effects in transportation arise since many investments in infrastructure projects, such as railroads, are indivisible (see Krugman, 1991, 24-25). This means that the more goods or people are transported, the lower the unit cost of transport, given high fixed costs (see 4.9.1 General Remarks on Infrastructure a Location Factor). Moreover, nontradeable goods—which include most services, such as logistic or police services—are provided in clusters because they follow to where goods are produced[242] (see Krugman, 1991, 65-67). Still, while firms benefit from scale effects in transportation and the provision of services, for Krugman, the most important advantage of being part of clusters is the availability of 'a pool of people with certain skills' (Krugman, 1991, 65).

However, by being part of a cluster, firms benefit not only from cooperation but also from competition. The simultaneous cooperation and competition between firms in clusters is possible

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[239] The lower in-house production depth of firms is mainly due to two global developments: the liberalization of global trade and the reduction of transaction costs of trade. From a theoretical point of view, the optimal size of a firm (or in this case, production debt) can be determined based on the required costs for controlling employees in relation to the advantage of common production (team theory of Alchian and Demsetz (1972)). This argument is also based on Coase's transaction costs approach (Coase (1937) according to which the optimal production depth of a firm is reached when the costs for the organization of an additional unit of transaction within the firm equals the costs of an additional market transaction (see Farhauer and Kröll, 2014, 151-152).

[240] One of the first economists discussing clusters was Marshall, who referred to the phenomenon of clusters as 'localized industry'. Localized industries offer firms three main advantages: first, 'a constant market for skill', second, the provision of industry-specific services ('subsidiary industries'), and third, knowledge spillovers[240] (Marshall, 1920, 156). For a discussion of agglomeration or clusters on the basis of Marshall's analysis, see Krugman (1991, 36-43) and Fujita and Thisse (2013, 13-16, 50-52).

[241] See Footnote 190.

[242] There are also exceptions: a few services, mainly in the financial sector, are tradeable (see Krugman, 1991, 66).

‘because they occur on different dimensions and among different players’ (Porter, 1998, 79). According to Porter, clusters strengthen competition: first, because all participating firms have better access to specialized employees and suppliers, specialized information, components, institutions, and public goods, second, because clusters act as breeding grounds for innovation, enhancing future productivity, and third, because clusters encourage the foundation of new businesses (Porter, 1998, 80). Innovation, as one outcome of the enhanced cooperation and competition in clusters, is particularly facilitated by the access to knowledge that exists outside of the firm in other close-by firms, research institutes, and universities (see McCann, 2000, 528). This physical proximity and the resulting exchange of know-how and ideas are crucial for innovation because they enable employees to know about recent technical developments and social trends (see Meyer and Jacob, 2006, 70).[243] Consequently, most new products and technologies stem from transfers between firms thanks to the mobility of workers across firms or learning between firms (Machikita and Ueki, 2012, 3).

While clusters have become increasingly important in the global value chain, they have at the same time also become increasingly specialized in the production of specific products and specific tasks in the value chain due to growing competitive pressure. Industrial clusters in emerging countries have emerged and continue to strengthen, as firms from advanced countries move their activities there, for instance, to take advantage of knowledge spillovers. An example of industrial clusters in emerging countries is the IT cluster in Bangalore (India) or, in advanced countries, the cluster of IT and High-Tech industry in Silicon Valley (U.S.) (see World Economic Forum, 2006, 54-55). While many industries are geographically highly concentrated, the automotive industry is among the most concentrated industries (Krugman, 1991). An example of an automotive cluster is the region around Stuttgart (Germany) or the automotive assembly cluster in Thailand. Especially in the automotive industry, which is constantly innovating, structural knowledge (see Meyer, 2006a, 66) available among OEMs and suppliers in industrial clusters is very valuable (see Richter and Buchner, 2009, 210-212) and must not be neglected in the selection process.

When selecting a new production site, it is important to decide whether to locate the new production site in or close to an existing industrial or even an automotive cluster, or to instead

[243] According to Boschma, geographic proximity of firms is not enough to enhance the exchange of know-how and innovation; instead, the exchange of know-how also requires a ‘cognitive’, ‘organizational, social’ and ‘instructional [..] proximity’ of the participating firms in a cluster (see Boschma, 2005, 71).

select a production site that is more remote. It is important to differentiate the location factor *Industrial Clusters* from other location factors, such as *Availability of Component Suppliers* (see 4.10.3 Availability of Component Suppliers*)*, *Transportation Facilities* (see 4.9.2 Transportation Facilities), and *Availability of Skills* (see 4.7.5 Availability of Skills), which must all be evaluated independently of each other and with regard to the extent to which they meet the requirements the OEM has on their availability at the new production site, whereas the location factor *Industrial Clusters* reflects the specific advantages for firms arising from their participation therein through scale and external effects.

With regard to selecting production sites, the existence of clusters plays an important role: OEMs benefit from locating their activities where clusters already exist, taking advantage of scale and external effects, as well as knowledge spill-overs, arising in clusters. In particular, if the access to know-how is a strategic goal, joining a cluster might be imperative. Since locating a production site in a cluster also has disadvantages, it is a strategic choice of the OEM whether the advantages of clusters are relevant enough for the OEM to select a production site therein. Given their large resources, OEMs have the choice to also select a production site outside a cluster in contrast to small-and medium size enterprises (SMEs). According to Lejpras, SMEs must join clusters with their new production sites as they have fewer resources at their disposal and thus rely heavily on the local environment in which they produce (see Lejpras, 2015, 737). In contrast, OEMs might decide not to locate their production sites in existing clusters to avoid higher costs for labor and other services that are not dependent on the skill and experience available in clusters. Firms must normally pay higher prices for land, rent and energy in clusters, while greater competition for skilled workers (see Fujita and Thisse, 2013, 13-16, 50-52), as well as higher food and rent prices, lead to higher wage levels (see Allen, 2001, 413-414). These disadvantages might offset the advantages of clusters, specially that of knowledge spillovers (see Aharonson et al., 2007, 117-122; Alcácer and Chung, 2007, 774-775).

Moreover, the close cooperation and high turnover of workers in clusters increases the risk of losing know-how. Hence, when deciding whether to join a cluster, it is also important to consider the know-how (or intellectual property) contained in the product and production process: firms tend to locate production processes which contain a high level of know-how (or intellectual property) outside of industrial clusters in rather remote areas given their concerns over loss of know-how (see Goerzen et al., 2014, 166). When evaluating the advantages of joining a cluster, the protection of intellectual property rights therein must be considered, and the OEM must weigh the risk of lost know-how (intellectual property) against the benefits stemming from being part of a cluster (see 4.3.3.3 Protection of Intellectual Property Rights).

Despite these disadvantages of joining clusters, studies have shown that, for many firms, the advantages of participating in clusters enhance them enough so as to forgo the selection of low-cost production sites (see Romo and Schwartz, 1995, 890, 902-903). In order not to underestimate the relevance of being part of a cluster for the successful operation of a production site, the OEM should analyze the extent to which the operation at its existing production sites benefit from being part of clusters in terms of scale and external effects in the provision of infrastructure and services but also the access to and exchange of know-how (see Richter and Buchner, 2009, 209, 224).

For the automotive industry, the strength of a cluster can be assessed by analyzing the existing automotive industry at the location (and possibly other related industries) in addition to the existence of universities and research institutes. The strength of the local automotive industry can be estimated by the presence and the size of investments of international and local OEMs and suppliers there. Furthermore, it is interesting to look at relevant government policies: the development of clusters can be supported by government policies, for instance, through investments in local infrastructure, in R&D institutions or universities, and tax exemptions for R&D. In China, the government invested heavily in the establishment of industrial clusters: for example, in the metal ware industrial cluster Yongkang in the Zhejiang Province. There, the government enhanced the cluster by 'strengthening the capacity for technical innovation', 'building industrial parks', facilitating 'access to finance', 'facilitating administrative procedures and improving services', 'promoting a regional brand' and 'fostering trade associations and professional agencies' (Dinh et al., 2013, 276-278). Thus, when evaluating whether to join a cluster in the selection process, the implemented government policies should be evaluated as to what extent they promote clusters and especially to what extent they promote the advantages of clusters the OEM is looking for.

Overall, the choice whether to join an industrial or even an automotive cluster is very important in the selection process. This choice is strategic as it depends on how valuable the OEM considers the scale and external effects that arise in clusters and possible knowledge spill-overs for the operation of the production site. The advantages of being part of a cluster must be weighed against the disadvantages, such as higher wage levels, rents, or costs of utilities, but also loss of know-how.

Table 51: Information and Instructions on the Choice and Evaluation of the Location Factor *Industrial Clusters*

Location factor to be evaluated	**Strength of Industrial Clusters**
Strategic, operational, or general	Strategic and operational
Process-specific / product-specific	Process-specific and product-specific
Relevant for production network	+
Relevant for the design of the supply chain	+
Negotiable	-
Semi-external / even performance	Semi-external
Quantitative or qualitative	Non-cost-related quantitative
Hard or soft	Soft
Static or dynamic	Dynamic
Geographic level of analysis	Regional
Unit of measurement	Measured in number of universities, research institutes, and the number and size of investments of international and local OEMs and of international and local suppliers. Assessed as very weak, weak, fairly strong, strong or very strong (or numerically as 1 through 5).
Evaluation method(s)	o Strategic considerations o Minimum criteria o Profile method o Utility analysis
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (minimum criteria, profile method) o Phase 3 (minimum criteria, profile method) o Phase 5 (minimum criteria, profile method, utility analysis) o Phase 7 (utility analysis)
Interdependencies with other location factors	o Availability of Component Suppliers o Wage Level o Infrastructure o Protection of Intellectual Property Rights
Source of information: public databases and information	o VDA: Services – Facts and Figures o ACEA: Statistics: Economic and Market Report, Production. o International Organization of Motor Vehicle Manufacturers / Organization Internationale des Constructeurs d'Automobiles (OICA): World Motor Vehicle Production by country and type as well as by manufacturer. o Automobil Produktion: Hersteller und Zulieferer (OEMs and suppliers). o Roland Berger: Global Automotive Supplier Study (annual report). o Deloitte: Global automotive supplier study (annual report). o Automotive Manufacturing Solutions: Automotive Tier Supplier (annual report). o EY: Worldwide R&D Incentives Reference Guide (annual report).
Source of information: commercial external sources	o IHS Markit: • Automotive Supplier Market Data: component forecast, materials and lightweigting • Automotive Research & Analytics: component suppliers, vehicle components, sourcing and supply chain o Automotive News: information on on-going topics about OEMs and suppliers. o National automobile associations, research institutes (e.g., Here for America).
Source of information: internal know-how	o Contact employees' have with other OEMs or suppliers.
Source of information: external consultants	o Know-how on industrial developments in certain regions, studies of regional economic developments or industry-specific developments.

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.12 Market Size and Market Share

4.12.1 General Remarks on Market Size and Market Share as Location Factor

Access to markets is among the chief reasons why firms locate their production sites abroad (see Kutschker and Schmid, 2011, 421-422; Jacob and Meyer, 2006, 16-17). A production site's proximity to markets is crucial as it reduces transport and logistic costs (see 4.10.4.3 Transport and Logistic Costs) and helps to overcome the liability of foreignness, protectionist tariffs, local content regulations or other import restrictions and market barriers. Shorter reaction time to changes in consumer demand (see Gaur et al., 2011, 225-226) with high product variety is an important advantage of proximity to markets (see Klier and Rubenstein, 2010, 336, 338). The size of the market is only interesting as a location factor if the product produced at the new production site is a final product. However, if the product is a component, e.g., an engine, that must be transported to an OEM's other production sites for further processing, then the demand for that component depends on the demand for the final product for which the component is used. Private research institutes (e.g., IHS Markit or LMC), and industry associations (e.g., VDA or ACEA) provide product-specific information for the past, current and future market size on a country level for products of the automotive industry. The OEM can either rely entirely on these external forecasts and assessments or supplement them with its own assessment of the market size on the basis of its expertise and several macroeconomic and related indicators.

An important first step in assessing the size of the market is to define the geographic area it comprises. This depends on local regulations, on transport costs and transport modes, as well as on the free trade agreements that the country where the production site is located has signed. Facilitated export conditions in a country can incentivize an OEM to locate a production site therein and thus take advantage of potentially lower wages, to then export its products to neighboring countries. Examples are Thailand and Hungary. Thailand offers relatively low wages and has a large automotive cluster, providing the opportunity to export products at low or no tariffs to neighboring countries thanks to the free trade agreements it has signed (Thailand has bilateral free trade agreements with Australia, India, New Zealand and is member of the ASEAN) (see Rastogi, 2018; Das, 2017; Alan, 2010, 47). Similarly, wages in Hungary are relatively low compared with other countries in the EU, it has some automotive industry, and it is a member of the EU, which means that products can be imported free of tariffs into all other EU countries (see Trade.gov, n.d.). Facilitating export conditions has a significant effect on the market size as the market includes not only the market of the considered country, but all markets into which the products are planned to be exported. Hence, the geographic size of the market is the geographic region in which the product is supposed to be sold. Once this geographic market is defined, the market size thereof must be assessed. To do so, a variety of indicators allow for certain conclusions about the medium- to long-term development of the market size for specific products. These indicators include GDP, inflation and GDP per-capita, political stability, and population.

GDP growth and volume have already been discussed above (see 4.6.4 Gross Domestic Product) as a measure of the overall well-being and strength of the economy. As such, GDP is also an important indicator of the market size, as it is positively affected by GDP growth.[244] As explained above, GDP should be analyzed in terms of real or nominal volume and real growth. GDP consists of consumption, investment, government purchases and net exports. Depending on the product, the market size is likely to be most closely related to the level and development of one of these elements of GDP: if the product is a consumption good, like a car, the market size is likely to be most influenced by the development of consumption; if the product is an investment good, like a truck, the market size is likely to be most influenced by the development of investment in particular business fixed investment), and if the product is usually paid for by public expenditures, such as buses, then the market size is likely to be influenced by the development of government spending. Buses may also fall into the category of investment as far as they are purchased for future productive use, such as in the case of travel agencies. Vans fall between these elements of GDP as they are purchased by private consumers, firms, and governments. Exports are not further analyzed herein, as they do not determine the market size of the market under consideration but are included when determining the geographic market size. The element of GDP that is most closely related to the product should be analyzed to assess the market size of that product. Hence, *Consumption*, *Business Fixed Investment* and *Government Spending* are discussed as location factors below, indicating the market size for cars, trucks, and buses, respectively.

In addition to GDP growth and volume, the rate of inflation (see 4.6.3 Inflation) is also important in assessing the market size. On the one hand, levels of inflation significantly above or below the targeted level disturb the overall business environment and lead to uncertainty. On the other hand, inflation decreases real wages given the stickiness of nominal wages (and erodes people's cash savings). Thus, the purchasing power of the local population is affected by the rate of inflation, which is, in turn, likely to affect the local market size.

Furthermore, population and its growth influence the market size in as much as more people

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[244] This is the case unless the good under consideration is an inferior good. For normal goods, an increase in income is considered to have a positive effect on the consumption of these goods. However, the demand for all goods will not necessarily increase with an increasing level of income: while this is the case for most goods, there are a few exceptions, which are referred to as inferior goods, whose demand decreases as income increases, such as cheap food products.

can potentially consume more than fewer people. However, as an indicator for determining the market size, it has very limited significance, as many poor people do not constitute a large market, at least not for a rather expensive product like a car. Nevertheless, information about population volume and growth provides some indication of the potential market size, especially in combination with other indicators, such as per-capita income, as it gives information about the sheer number of people that could potentially become consumers. The effect of population growth on economic growth is controversial and beyond the scope of this work.[245]

Furthermore, per-capita income is an interesting indicator of the overall standard of living of the population. In macroeconomics, per-capita income is often used as a proxy for the living standard or the level of development. Even though per-capita income provides an interesting indicator of the living standard, it has several shortcomings in the assessment. The Human Development Index (HDI), which is developed by the United Nations Development Programme (UNDP), assumes that the living standard or well-being of a population is not only determined by per-capita income, but instead that human development requires the expansion of choice and opportunity. Thus, the HDI not only considers per-capita income, but also life expectancy and the distribution of knowledge[246] within a population (see Leonard and Ljungberg, 2010, 112; Pamuk and van Zanden, 2010, 231). These shortcomings of per-capita income as an indicator of the living standard should be kept in mind when assessing the market size with the help of per-capita income.

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[245] The following aspects only introduce some of the concepts and ideas on the relation between economic growth and population growth, though this is in no way an attempt to introduce the economic literature on this topic. Malthus argued that a continuously expanding population which economies are not able to support will prevent progress and overall economic well-being and cause mankind to stay poor. Conversely, Kramer argued that population growth will lead to more innovation and technological progress as more people invent, innovate, and have ideas. In the Solow growth model, population growth has a negative effect on economic growth, holding saving (capital) constant (see Mankiw, 2013, 225). However, given a simultaneously occurring, sufficient increase in capital, population growth can also have a positive effect on economic growth. With regard to economic growth and population, the age structure of a population also matters: declining fertility rates and slower population growth in India or Indonesia in their young population are expected to enhance growth in the next decade, while the aging population in Europe, Japan and China are expected to or already do weigh on growth. A young and expanding population is considered to have a decreasing effect on labor costs and an increasing effect on household savings, as older people tend to save less and, once they stop working, live off their savings (see OECD, 2014, 38). In order to get a better understanding of the age structure of a population, the dependency ratio is helpful. The dependency ratio, defined as ‘the number of dependents per 100 working-age people’, can be split into the old-age dependency ratio, capturing those people who are too old to work, and the child-dependency ratio, capturing those who are still too young to work (OECD, 2014, 228). Overall, the effect of population growth on economic growth is controversially discussed and the extent of this discussion is beyond the scope of this work.

[246] HDI includes the distribution of knowledge in the form of the literacy rates (‘adult and youth literacy rates’, the ‘share of the adult population with at least some secondary education’, ‘Gross enrolment ratios’, ‘primary school drop-out rate’ and survival rate to the last grade of lower secondary general education’ (United Nations Development Programme, 2018, 19).

The effect that per-capita income has on the market size also depends on aspects that are included in the HDI, such as healthcare, life-expectancy, education, or literacy rate: people who only have access to the health system at high costs seem less inclined to spend their income on a car instead of on their or their family's health.

Moreover, political stability impacts the size of a market in as much as it affects the overall economic performance and creates an environment in which people are able and willing to spend their money on a product and firms are confident to invest. In addition to political stability's effect on confidence and certainty, Jacks emphasizes the important impact of political stability on the degree of market fragmentation. He even argues that improvements in political stability are the main contributor to market integration, even more so than improvements in transportation (Jacks, 2006). This argument highlights the effect that political stability has on the geographic market size as in the absence of political stability markets are more fragmented and thus smaller than in a politically stable territory. Hence, political stability affects the size of the geographically defined market.

Overall, GDP, inflation, population, per-capita income, and political stability should be considered when assessing the market size. The following sections introduce the location factors *Consumption*, *Business Fixed Investment* and *Government Spending* as indicators for the more product-specific market size for cars, trucks, and buses. Moreover, the *Market Share* is discussed as a location factor, since the OEM must assess its own potential market share based on the competitive situation in the local market.

4.12.2 Consumption

The overall level of consumption can serve as an indicator for the market size of cars, as cars are a consumption good. The total volume of consumption can be measured in real or nominal terms, while the growth in consumption should be assessed as the change of real consumption over time. According to economic theory, consumption includes all goods and services purchased by consumers.[247] To assess the development of the level of consumption, it is important to understand its drivers. Economic theory assumes, in general, a positive relationship between income and the

[247] Consumption refers here exclusively to private consumption and not to government consumption.

consumption of a good.[248] The Keynesian consumption function captures this positive relationship between income and consumption. Moreover, this relationship is characterized by three properties: first, the marginal propensity to consume is between zero and one, meaning that the part spent of each additional unit of income is between zero and one. Thus, Keynes assumed that people increase their consumption as their income increases, but not by as much as income increases. Second, the average propensity to consume, the ratio of consumption to income, decreases as income increases, implying that as income increases people save more of that income. Third, consumption is exclusively determined by current income. While the first property is generally accepted, empirical studies have shown that the short-term consumption function has a falling average propensity to consume, while the long-term consumption function has a constant average propensity to consume (see Mankiw, 2013, 464-477; Barro and Sala-i-Martin, 2003, 93-94). However, for this analysis, it is more significant to note that consumption is not exclusively determined by current income. Modigliani points out that income varies over the lifetime of a person and, by saving and borrowing, it is possible to transfer income from periods when income is high, to periods when income is low (life-cycle hypothesis) (see Modigliani, 1986, 705-710).[249] Thus, if there is no borrowing constraint, consumers can consume more than their current resources allow, which consist of their wealth and income. However, the consumer budget has an intertemporal constraint, determined by all resources that are available for consumption in the future and today. Consequently, consumption not only depends on current income but also on future and past income as the consumer can borrow as well as save (see Mankiw, 2013, 464-477; Barro and Sala-i-Martin, 2003, 93-94).

This short introduction into the theory of consumption is supposed to illustrate two points that are especially relevant to the analysis of the market size for cars: first, that consumption is positively related to income, and second, that it is not enough to look at current income to assess consumption, rather, future income, which can be shifted into the present by borrowing, and at past income, that can be saved and spent at a later point in time, must also be looked at. The possibility to borrow depends on a functioning banking system and on the willingness of banks to provide

[248] For normal goods, an increase in income (or also GDP in general) is considered to have a positive effect on the consumption thereof. However, there are exceptional goods for which the demand decreases as income increases, and which are instead referred to as 'inferior goods'. Examples of inferior goods are cheap food products.

[249] Friedman has developed the permanent-income hypothesis, according to which people's income does not follow a regular pattern, but instead is composed of a permanent and a transitory income. Friedman assumes that consumption depends on the permanent income, while transitory income is saved rather than spent (see Friedman, 1957, 26-27, 36-37).

consumer credit. The costs of borrowing depend on the interest rate (see 4.6.10 Interest Rates): the higher the interest rate the more expensive borrowing is, meaning that consumers are more likely to borrow to buy consumption goods at lower interest rates. This is important for consumer goods like cars, which are, for many consumers, among the biggest purchases they ever make. That is also why the housing market or house sales are often a good indicator for car sales, especially for luxury cars sales, in a particular market. Furthermore, the existing wealth can serve as an indicator of past income that can be shifted into the present or future for consumption. Still, 'the link between consumption and disposable income is […] stronger than that between consumption and wealth' (Burda and Wyplosz, 2013, 186).

To assess current and future income, it does not make sense to look at real wages, as they do not indicate how much people have as disposable income because taxes and other dues must be subtracted. A better measurement of disposable income are income brackets. While per-capita income provides, as explained above, an indication of the overall well-being of a population, the underlying income distribution in the form of income brackets provides an indication of how many people dispose of how much income. With regard to the market size of a specific product, it is possible to identify a certain income bracket as most relevant and analyze its size and development. For assessing the market size of luxury cars, the income bracket of 100,000.00 US$ + (per household) might be of interest.

The wealth that influences consumption is the personal wealth (or household wealth), which can be divided into three parts—namely financial assets, non-financial assets and debts—and can be defined as 'the value of financial assets plus real assets (principally housing) owned by households, less their debts'. Equity prices and market capitalization serve as an indicator for the financial part of wealth, while house prices serve as an indicator of the non-financial part of wealth (Credit Suisse, 2015, 7, 13, 18). The stock market can also be an indicator for private (or household) wealth: higher stock prices increase shareholders' wealth, while lower share prices have the opposite effect. Consequently, the development of the stock market tends to affect consumption (see Burda and Wyplosz, 2013, 188-189). When analyzing consumption, especially in regard to the products of OEMs, but even more so of those that sell luxury cars, it is important to consider personal wealth. Several banks such as Credit Suisse, which annually publishes the 'Global Wealth Report' or consultancies such as Knight Frank, which publishes 'The Wealth Report', analyze trends in personal (or household) wealth on a supranational, national, and regional level, as well as for certain cities.

As explained above, in addition to wealth, which is past income that can be shifted into the present, future income can also be transferred into the present and used for present consumption, allowing consumers to make purchases that exceed their current resources. The ability to borrow money, thus the availability of consumer credit, requires a functioning banking system. Consumer credit is, for instance, offered by banks via loans or via credit card. Other sources of consumer credit are retail stores or firm-owned financial institutions, such as the Mercedes-Benz Bank, which is, among other things, responsible for providing loans to consumers for financing the purchase of products from the Daimler AG. This kind of credit is referred to as consumer credit because the debtor uses the money to buy consumption goods or goods that depreciate quickly, such as cars, TVs or washing machines, and must thus be differentiated from loans for investment goods, such as real estate. Still, these kinds of consumption goods are referred to as consumer durables (or durable goods or durables), as they are not frequently purchased and are expected to endure for a minimum time of three years (see Baumohl, 2013, 134). Given the large personal expenditures, along with the extended period of use of these products, the availability of consumer credit is especially relevant for their purchases. This explains why some OEMs have financial institutions, established to provide consumers credit to finance the purchase of their own products, and why firms that sell cheaper products, such as sportswear, do not have such institutions. The relevance of lacking credit availability on the market size of cars is evident when looking at the negative effect which the 2008 financial crisis had on sales of new vehicles, when credit was not easily available and hence consumers could not receive the necessary financing for the purchase of new vehicles (see Klier and Rubenstein, 2010, 342-343). Thus, to assess the market size, it is important to understand the availability of consumer credit in the local market. If there is a functioning banking system that provides credit to consumers, more people will be able to buy a relatively expansive consumption good, such as a car. The OEM can also consider offering credit to its consumers for purchases of products of the OEM at the location through their own bank, if they have one.

Moreover, the existence of urban areas and cities are also an important aspect, as sales are much higher in more densely populated and often wealthier urban areas than in poorer and less densely populated rural areas (see Fujita and Thisse, 2013, 7-8, 62, 187-188). Cities are the 'engines of the world economy and global consumption'. The Global McKinsey Institute predicts that by 2030, 50% of the global population will live in large cities, 81% of consumption will take place therein, as will 91% of consumption growth between 2015 and 2030. Growth in consumption is expected to occur in a concentrated manner in cities, even more so than growth in population or GDP. It is expected that between 2015 and 2030, 75% of global consumption growth is generated in 600 cities, 45% in 100 cities and 25% in only 32 cities (see McKinsey Global Institute, 2016, 81). With regard to income levels and large cities, it is noteworthy that even though the income level in large cites is usually higher than in rural areas, the difference is partly offset by higher costs of living associated with urban life, such as higher rents or food prices (see Allen, 2001, 413-414). Thus, even though people in cities usually have higher incomes, the amount that they can spent on goods like cars is constrained to a certain extent by higher costs of living. In the face of the high contribution of urban areas to total consumption and the expected increase of that contribution, considering urban areas is of utmost importance if the product is a consumption good, like a car.

Thus, when assessing consumption as an indicator of the market size for consumption goods it is interesting to consider the overall consumption, its level (in real or nominal terms) and growth (in real terms), as well as the drivers of consumption, such as income brackets, wealth, the availability of consumer credit, the interest rate, and the existence of urban areas.

Table 52: Information and Instructions on the Choice and Evaluation of the Location Factor *Consumption*

Location factor to be evaluated	**Market Size: Consumption**	**Market Size: Cars (Specific Segment)**
Strategic, operational, or general	Strategic	Strategic
Process-specific / product-specific	Product-specific	Product-specific
Relevant for production network	+	+
Relevant for the design of the supply chain	+	+
Negotiable	-	-
Semi-external / even performance	-	-
Quantitative or qualitative	Non-cost-related quantitative	Non-cost-related quantitative
Hard or soft	Soft	Soft
Static or dynamic	Dynamic	Dynamic
Geographic level of analysis	National	National
Unit of measurement	Measured in absolute terms (e.g., in US$) and as percentage change of real terms. Assessed as very small, small, fairly large, large, very large (or numerically as 1 through 5).	
Evaluation method(s)	o Strategic considerations o Profile method	
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method)	
Interdependencies with other location factors	o Membership in Free Trade Agreements o Gross Domestic Product	
Source of information: public databases and information	o European Commission: European Economic Forecast: private consumption expenditure o IMF: • World Economic Outlook (Annual report containing past and forecasted growth rates for private consumer expenditure);	o VDA: Services – Facts and Figures o ACEA: Statistics: Economic and Market Report, Registration Figures.

Location factor to be evaluated	Market Size: Consumption	Market Size: Cars (Specific Segment)
	• Data: gross domestic product and components: household consumption expenditure; • Global Housing Watch and Global House Price Index • Financial Access Survey. o Bank of International Settlement: Residential property price statistics. o OECD: Data: household debt, household savings, household net worth, household financial assets and analytical house price indicators. o The United Nations Development Programme's (UNDP) Human Development Reports (Human Development Index). o Credit Suisse: Global Wealth Report o Knight Frank: The Wealth Report o McKinsey Global Institute: Reports on Consumption o Global Property Guide: House Prices Worldwide o National and regional government and Central Bank websites	
Source of information: commercial external sources	o Consensus Economics: new housing approvals o EIU: • CountryData: private consumption, personal disposable income • Worldwide Cost of Living 2017 - A Ranking of the world's major cities o IHS Markit: Global Economic Data: cyclical indicators o Oxford Economics: data tool: private consumption, total population, unemployment, personal disposable income, rural population as % of total population, urban population prowth o Global Edge: MSU-CIBER: Market Potential Index (MPI) (For information on general market size)	o IHS Markit: Automotive Research & Analysis: market forecasts o LMC: markets forecasts o National automobile associations, research institutes (e.g., Here for America)
Source of information: internal know-how	o Economic Department	o Sales Department o Marketing Department
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.12.3 Business Fixed Investment

The overall level of investment can serve as indicator for the market size of trucks, as trucks are an investment good. Investment goods are those purchased for future use. As explained under *Fixed Investment (including Foreign Direct Investment)* (see 4.6.5 Fixed Investment (including Foreign Direct Investment)), investments can be divided into three categories: business fixed investment (business fixed investment is also referred to as business investment or fixed asset investment), residential fixed investment, and inventory investment. Business fixed investment refers to firms' 'purchases of new plants and equipment' (Mankiw, 2013, 26). Hence, this section focuses exclusively on business fixed investment as trucks fall under equipment. Business fixed investment refers to firms using their 'valuable resources to produce more goods later'. Firms produce and purchase investment goods merely for the production of other goods in the future and thus to expand their productive capacity (Burda and Wyplosz, 2013, 161-162). While firms invest to achieve the optimal capital stock which has increased or which has not been achieved before, they also invest to compensate for depreciation (see Burda and Wyplosz, 2013, 62, 190; Barro and Sala-i-Martin, 2003, 40). Depreciation affects the capital stock of a firm as a 'fraction of the capital stock is routinely lost', as the capital stock 'wears out' and loses 'some of its economic value' (Burda and Wyplosz, 2013, 62). The optimal capital stock is considered to be achieved when the marginal productivity of capital equals the marginal cost of capital given the real interest rate (see 4.6.10 Interest Rates) and the available level of technology. Thus, according to economic theory, a firm invests until its optimal capital stock is reached, while the firm is considered to take the interest rate and the available level of technology as given (as exogenous). Accordingly, the optimal capital stock varies depending on the real interest rate: a higher real interest rate reduces the optimal capital stock, while a lower real interest rate has the opposite effect (see Burda and Wyplosz, 2013, 190-193). In addition to the real interest rate, the optimal capital stock also varies with the level of technology available to the firm, thereby determining its productivity.

Another way to analyze the firm's investment decision is to assume that firms invest until 'the market value of capital already in place' equals 'the cost of new capital goods' (Burda and Wyplosz, 2013, 197). According to Tobin, firms make their investment decision based on the ratio of the market value of installed capital to its replacement cost. If this ratio called 'q' is above 1, the installed capital is valued more than the replacement cost in the stock market, and thus firms will buy more capital, while, if q is below 1, the stock market values the installed capital as less than its replacement costs, which results in firms not buying new capital (see Mankiw, 2013, 503-505). Tobin's q not only captures the negative effect of a higher real interest rate on investment, but also that higher productivity of capital has a positive effect on investment as higher productivity increases future income of the firms and thus has a positive effect on share prices, thereby encouraging investment. While Tobin's q has some shortcomings in assessing the investment decision, for instance, in regards to the fact that not all firms are traded on stock markets, it still provides a good indication of firms' 'incentive to invest' (Burda and Wyplosz, 2013, 197).

Overall, firms have two ways to finance their investments: first, they can receive financial resources in the capital market via stocks, bonds or by borrowing from banks, or second, they can use their own resources in the form of 'retained earnings' (Burda and Wyplosz, 2013, 162). The cost of investment, thus the cost of capital, is determined by the interest rate. In the firm's decision whether to invest its own resources (retained earnings) in new productive capital or alternatively lend the money to the capital market, 'the real interest rate measures the opportunity cost of the resources used for the investment' (Burda and Wyplosz, 2013, 162-163) in productive capital.

Thus, the higher the real interest rate is, the higher the opportunity cost of the investment in productive capital, thus the less likely the firm to make an investment in productive capital. If the firm must borrow money to make the investment, the real interest rate measures the cost of borrowing the capital for the investment. Thus, also in this case, a higher interest rate makes the investment less likely. In both cases, a higher interest rate has a negative effect on the firm's investment in productive capital and thus on the likelihood that the firm purchases an investment good (see Burda and Wyplosz, 2013, 162-163, 190-191).[250]

Furthermore, the accelerator principle highlights the importance of expectations and uncertainty with regard to investment, suggesting a positive proportional relationship between current investment and expected output (see Burda and Wyplosz, 2013, 194). The relevance of expectations for firms' investment decision stems not only from the fact that firms purchase the investment good for future use in their production but also because investments are generally[251] irreversible, which means that the existing capital stock cannot 'be consumed on a one-for-one basis' (Barro and Sala-i-Martin, 2003, 96). Thus, 'the investment decision has a fundamental intertemporal aspect'. This means that firms must make their investment decision, thus decide whether the acquisition of an additional investment good is profitable, based on their expectations (Burda and Wyplosz, 2013, 162).

Following this discussion, when assessing business fixed investment, it is important to understand that a higher real interest rate makes business investments less likely, while higher stock prices encourage business investments and that expectations about future economic growth affect the firm's investment decision. Hence, the development of the real interest rate and the stock market serve as indicators for the development of business fixed investment. Moreover, to capture expectations, it is interesting to look not only at expected GDP but also at expectations of firms and their management, hence the business climate in a country, which is a valuable albeit short-term indicator for investment. Thus, in addition to forecasts of the overall level of business fixed investment, the real interest rate, the stock market, expected GDP and the business climate are interesting for the assessment of investment and its development.

[250] Another way to assess the profitability of an investment is to calculate its present value. The present value of an investment reflects whether the investment is profitable at the current state of technology and the given real interest rate (see Burda and Wyplosz, 2013, 164).
[251] Exceptional investment goods that are reversible are, for instance, 'farm animals' (Barro and Sala-i-Martin, 2003, 96).

Table 53: Information and Instructions on the Choice and Evaluation of the Location Factor *Business Fixed Investment*

Location factor to be evaluated	**Market Size: Business Fixed Investment**	**Market Size: Trucks**
Strategic, operational, or general	Strategic	Strategic
Process-specific / product-specific	Product-specific	Product-specific
Relevant for production network	+	+
Relevant for the design of the supply chain	+	+
Negotiable	-	-
Semi-external / even performance	-	-
Quantitative or qualitative	Non-cost-related quantitative	Non-cost-related quantitative
Hard or soft	Soft	Soft
Static or dynamic	Dynamic	Dynamic
Geographic level of analysis	National	National
Unit of measurement	Measured in absolute terms (e.g., in US$) and as percentage change of real terms. Assessed as very small, small, fairly large, large, very large (or numerically as 1 through 5).	
Evaluation method(s)	o Strategic considerations o Profile method	
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method)	
Interdependencies with other location factors	o Gross Domestic Product o Membership in Free Trade Agreements	
Source of information: public databases and information	o European Commission: European Economic Forecast: total investment; investment in equipment; public investment o IMF: • World Economic Outlook (annual report containing past and forecasted growth rates for gross fixed capital formation) • Data: gross domestic product and components: gross fixed capital formation • Data: total investment o National and regional government and Central Bank websites o Global Edge: MSU-CIBER: Market Potential Index (MPI) (For information on general market size)	o VDA: Services – Facts and Figures o ACEA: Statistics: Economic and Market Report, Registration Figures
Source of information: commercial external sources	o Consensus Economics: Consensus forecasts: business investment (G7&Western Europe, Latin America, Asia Pacific, Eastern Europe) o EIU: CountryData: gross fixed investment, real stock building, real contribution to GDP growth o IHS Markit: Global Economic Data: cyclical indicators o Oxford Economics: data tool: total fixed investment	o IHS Markit: Automotive Research & Analysis: market forecasts o LMC: markets forecasts o National automobile associations, research institutes (e.g., Here for America)
Source of information: internal know-how	o Economic Department	o Sales Department
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.12.4 Government Spending

The overall level of government spending can serve as indicator for the market size of buses, as buses in most countries are part of the public transportation system. Government spending, also referred to as government purchases or government expenditures, includes all 'goods and services bought by the federal, state, and local government'. Hence, government spending includes expenditures on public services provided by the government, military equipment, or infrastructure. Transfer payments are not included in government purchases as they only reallocate income and do not occur in 'exchange for goods and services' (Mankiw, 2013, 25). Government spending occurs when the government invests or consumes. This includes any investment in the building of roads and other infrastructure projects or public transportation, as well as the building or acquisition of buildings, for instance, for schools. Moreover, government spending includes government's consumption of public services, for instance, in its administration (see Burda and Wyplosz, 2013, 435-436).

From a microeconomic perspective, the government spends to provide public goods and services, goods with increasing returns to scale[252] or goods with positive externalities[253], as well as to redistribute income. From a macroeconomic perspective, government spending is a means 'to stabilize aggregate income and spending' and thus, enhance 'macroeconomic stabilization' (Burda and Wyplosz, 2013, 438). Stabilizing aggregate income and spending also results in stabilizing employment.[254] Thus, the government tends to increase spending when the overall economic activity declines and tends to reduce spending in times of solid economic growth. This countercyclical government spending should stabilize macroeconomic conditions, especially employment, around its long-term equilibrium (see Burda and Wyplosz, 2013, 438-440). Hence, government spending can be driven by the government's attempt to stimulate economic growth, in general, and, in particular, raise employment, prevent an increase in unemployment or reduce unemployment in times of an economic slowdown. Moreover, the government spends to provide public goods and services (e.g., police services), goods with increasing returns to scale (e.g., infrastructure) or goods with positive externalities (e.g., education).

Government spending is one side of fiscal policy, the other side is taxation, and hence, revenues. Normally, the government can finance its spending through taxes. Other sources of financing for the government are its own resources accumulated previously (for instance, through budget surpluses in previous fiscal years) or borrowing in the financial market. If government spending equals taxes in the same period (normally one fiscal year) the government has a balanced budget. Instead, the government runs a budget deficit if government spending surpasses taxes in a fiscal year, and a budget surplus if taxes exceed government spending. The government must finance a budget deficit either by using its financial resources, if available, or by borrowing in the

[252] See footnote 191.
[253] See footnote 190.
[254] This link between output and employment upon which government spending is assumed to encourage employment is captured in Okun's law (see Burda and Wyplosz, 2013, 302).

financial market. If the government has run a budget deficit in previous periods, which it had to finance by borrowing in the financial market, it is indebted and thus must service that debt (see Mankiw, 2013, 65-66; 4.6.11 Debt, Debt Sustainability and Sovereign Credit Ratings). Thus, the government budget of any given fiscal year is determined by tax revenues of the government (which depend on the level of taxes and, in turn, on the economic conditions in an economy), by its debt obligations and the ease with which it can borrow in international financial markets (which, in turn, depends on its sovereign credit ratings). These indicators help to understand the government's scope for expansionary fiscal policy. Additionally, annual budget announcements, speeches of ministers, or other government publications usually unveil a government's intention to spend.

Thus, in addition to external forecasts of the level of government spending, government spending and its development can be estimated on the basis of government announcements to spend, in particular, on infrastructure and public transportation, and the annual government budget, while the government's financial scope for expenditures can be estimated on the basis of its current budget, its debt obligations and its ability to borrow in the financial market.

Table 54: Information and Instructions on the Choice and Evaluation of the Location Factor *Government Spending*

Location factor to be evaluated	**Market Size: Government Spending**	**Market Size: Buses**
Strategic, operational, or general	Strategic	Strategic
Process-specific / product-specific	Product-specific	Product-specific
Relevant for production network	+	+
Relevant for the design of the supply chain	+	+
Negotiable	-	-
Semi-external / even performance	-	-
Quantitative or qualitative	Non-cost-related quantitative	Non-cost-related quantitative
Hard or soft	Soft	Soft
Static or dynamic	Dynamic	Dynamic
Geographic level of analysis	National	National
Unit of measurement	Measured in absolute terms (e.g., in US$) and as percentage change of real terms. Assessed as very small, small, fairly large, large, very large (or numerically as 1 through 5).	
Evaluation method(s)	o Strategic considerations o Profile method	
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method)	
Interdependencies with other location factors	o Gross Domestic Product o Membership in Free Trade Agreements	

Location factor to be evaluated	Market Size: Government Spending	Market Size: Buses
Source of information: public databases and information	o European Commission: European Economic Forecast: total expenditure, general government o IMF: • World Economic Outlook: annual report containing past and forecasted growth rates for public consumption • Data: Gross Domestic Product and Components: Government consumption expenditure o National and regional government and central bank websites o Global Edge: MSU-CIBER: Market Potential Index (MPI) (for information on general market size)	o VDA: Services – Facts and Figures o ACEA: Statistics: Economic and Market Report, Registration Figures
Source of information: commercial external sources	o EIU: CountryData: government consumption, government balance o IHS Markit: Global Economic Data: government finance, national account o Oxford Economics: data tool: government consumption, government balance, government expenditure	o IHS Markit: Automotive Research & Analysis: market forecasts o LMC: markets forecasts o National automobile associations, research institutes (e.g., Here for America)
Source of information: internal know-how	o Economic Department	o Sales Department
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.12.5 Market Share

In addition to assessing the geographically defined market and the corresponding market size of a specific product, it is relevant for the OEM to assess its own potential market share in that geographically defined market. This market share depends on the total market size, as well as on the competitive situation therein. To assess its potential market share, the OEM must analyze the existence and strength of local, as well as international, competitors in that market. To gain a good understanding of the level of competition in the market, it is not enough to analyze the units sold, but rather the level of technology, quality, prices, and services of competitors must also be explored. An indicator of local competitors' strength is the amount of goods they export; this indicates if they can compete internationally (see Schneider and Müller, 1989, 31). The strength of international competitors in the market can be assessed based on past units sold and revenues of these competitors in the market under consideration, as well as their local investments.

Furthermore, to assess the competition at the location, and thus the potential market share, it is necessary to take economic regulations and policies into account (see 4.2.2 Economic Regulations and Policies). These include import tariffs on foreign goods and NTBs, such as local content regulations or procurement policies with regard to public orders. Moreover, industrial policies and regulations often give exclusive advantages to domestic firms in the local market. Subsidies that are exclusively given to domestic firms give them the advantage to sustain losses and not to be forced to adapt to changing economic challenges as much as foreign firms. Subsidized firms do not have to bear the full cost of their operations, as they do not need to pay their factors of production the adequate wage or rent (their marginal productivity) but can employ labor or capital at inefficient levels. This is especially the case in the extreme form of a subsidy: the complete public ownership of firms. Those state-owned enterprises normally receive public money when they run losses either as an outright subsidy from the government or as a loan at interest rates much lower than those that private firms must pay. Likewise, other trade policies, such as tariffs on foreign goods, import quotas, concessions on export credits, or local content regulations, are instruments designed to give domestic firms advantage over foreign firms. Furthermore, procurement policies and so-called 'buy domestic goods' campaigns are a means to privilege domestic firms over foreign firms (Burda and Wyplosz, 2013, 470-473). In China, for instance, state and state partner monopolies dominate the economy, which do not have to compete normally in the domestic market as they are protected, say, by regulations or state support. Such regulations often force foreign firms to gain access to the Chinese market through partnerships with Chinese, often state-owned, firms (see Ahuja, 2012, 7-8).

Moreover, the market share of a particular product, especially in terms of consumption goods, also depends on cultural aspects, such as trends, tastes, tradition, and preferences (see Müller and Gelbrich, 2015, 285-299), but also on regulations (e.g., environmental regulations). These trends, tastes, tradition, and preferences vary largely across countries, determine local consumption patterns, and have a significant effect on differences between the size of different markets for specific products and thus the potential market share of a specific product of the OEM. For this reason, the OEM's Market Research department must evaluate these aspects and the findings must then be incorporated into the OEM's assessment of the market share for a specific product.

Hence, if the produced product at the production site is a final product, the market share of the geographically defined market should be evaluated. This evaluation should include the strength of local, as well as international, competitors in the market, and industrial and procurement policies alike.

Table 55: Information and Instructions on the Choice and Evaluation of the Location Factor *Market Share*

Location factor to be evaluated	**Market Share**
Strategic, operational, or general	Strategic
Process-specific / product-specific	Product-specific

Location factor to be evaluated	Market Share
Relevant for production network	+
Relevant for the design of the supply chain	+
Negotiable	-
Semi-external / even performance	Local production might increase local market share
Quantitative or qualitative	Non-cost-related quantitative
Hard or soft	Soft
Static or dynamic	Dynamic
Geographic level of analysis	National
Unit of measurement	Measured in percentage of the total market size and in absolute terms (e.g., US$). Assessed as very small, small, fairly large, large, very large (or numerically as 1 through 5).
Evaluation method(s)	o Strategic considerations o Profile method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method)
Interdependencies with other location factors	o Membership in Free Trade Agreements o Consumption o Business Fixed Investment o Government Spending
Source of information: public databases and information	-
Source of information: commercial external sources	o VDA: Services – Facts and Figures o ACEA: Statistics: Economic and Market Report, Registration Figures o IHS Markit: Automotive Research & Analysis: market forecasts o LMC: markets forecasts o National automobile associations, research institutes
Source of information: internal know-how	o Sales Department o Strategy Department
Source of information: external consultants	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.13 Production Site

4.13.1 General Remarks on Production Site as a Location Factor

As explained under *Definitions* (see 2.1 Definitions) in this work, a production site is a clearly defined industrial location on which a production plant can be or is constructed and operated. While many of the specific requirements on the production site, such as the size of the land plot, depend on the product that will be produced or the production process that will be implemented therein, other requirements are not product- or process-specific, but are instead general requirements (see 3.2.2.4 General Requirement Profile) on any of the OEM's production sites (e.g., a well-formed, level land plot). The different aspects can be separated in five groups. First, the conditions of the land plot and buildings, if buildings exist on the land plot, such as the size and shape of the plot of land or the load carrying capacity of buildings. Second, the costs for the acquisition or rent of the land plot or buildings, if buildings exist on the land plot, but also for the preparation of the land, such as leveling. Third, the ease of starting operations and of a possible extension which includes the ease of acquisition or lease of the land and buildings, if buildings exist on the land plot, and of the start of construction, as well as operation, of the production site. Fourth, the costs that the OEM incurs for constructing the production site and for its maintenance over the planning horizon, and fifth, the costs that arise for acquiring, transporting, and maintaining machinery over the planning horizon of the production site.

It must be mentioned at this point that besides the aspects introduced below there are many other aspects that could also be evaluated under the location factors included in the topic *Production Site* but that are in this selection process model included in the local analysis of other location factors. An example is the location factor *Transportation Facilities* (see 4.9.2 Transportation Facilities), which includes the local analysis of transportation facilities at or close to the production site, thus those transportation facilities that connect the production site with the regional or national transportation facilities. Other examples are the location factors *Natural Hazards* (see 4.4 Natural Hazards) or *Water and Energy Supply* (see 4.9.3 Water and Energy Supply). The former includes factors such as the risk of mud slides in its local analysis, while under the latter the costs of the required facilities for the supply of water and energy are evaluated (including those facilities on the production site). The requirements on the production site to comply with the provisions specified in the building codes (e.g., fire security), as well as the required costs for that compliance, are evaluated under the location factor *Building Codes* (see 4.2.3.3 Building Codes). In order to avoid any redundancy (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model), all aspects included in the analysis of other location factors on the local level must not be included here again. This means, in turn, that all aspects included here are exclusively considered under the following location factors: *Conditions at the Production Site*, *Costs for Acquiring the Production Site and Additional Costs*, *Ease of Starting Operations at the Production Site and of its Extension*, *Costs for Constructing and Maintaining the Production Site*, as well as *Costs for Acquiring, Transporting and Maintaining Machinery*.

4.13.2 Conditions at the Production Site

The conditions at the production site are very important for its successful construction and operation. While some conditions can eliminate the land plot as a potential production site, other conditions lead to high additional costs for constructing and operating the production site. These conditions are related to the land plot, the surrounding area, and possibly existing buildings therein. First, with regard to the land plot, it is important that it meets the requirements in terms of its size (measured in hectare (ha)). Second, the shape of the land, captured in the ground plot, is important as the land is only usable as production site if the shape is rather rectangular or square, while a land plot with an uneven boundary line is unlikely to be used efficiently as production site. Third, the site occupancy index[255] is an important regulation which specifies 'how many square metres of surface area can be built per square metre of land' (Corpus Sireo Real Estate, n.d.). This is important during selection as it indicates on how much of the land plot the OEM may construct its buildings and thus restricts the OEM's development intensity for the land plot. Fourth, another important indicator with regard to the land is the cubic index which indicates how much cubic capacity may be constructed per square meter of land (see Architektur Lexikon, n.d.) and hence determines the volume of the capacity that can be constructed on the land. Fifth, with regard to the topography, the land plot must be level in order to be used as production site, as industrial buildings can only be built on level ground. This is markedly important as the leveling of land is very expensive. Hence, it must be evaluated if the topography of the land is level enough and, if any leveling is necessary, whether that is possible and how expensive that would be. Sixth, the ground conditions must be evaluated, as very hard soil, such as stony or rocky soil, rules out the plot of land as a production site if it makes digging impossible. If digging is possible, but leads to additional costs, these costs must be taken into account. Still, the ground must also be strong enough to carry the industrial buildings. For instance, there must not be any swamps and, if there are any, then all related additional costs must be assessed (e.g., for drying out swamps). Seventh, the groundwater must be at an adequate level which is dependent on the production process, mainly with regard to the foundation surface of the industrial buildings that will be constructed on the production site (see Ottmann and Lifka, 2010, 75). Eighth, it must be determined if there are any existing land easements, or rights that the owner of the land plot must ensure other users, for instance, the right to cross the land (Trulia, n.d.).[256] Ninth, the previous use of the land plot must be known and, in turn, whether it has any effect on constructing and operating the production site. For instance, a previous use of the land plot for chemical production or as a military base can delay the construction or start of operation or increase the costs for constructing the production site, if, for instance, material must be disposed of. Tenth, it must be ensured that no harmful material is in or on the ground. Eleventh, the land must not be part of any 'protected territory' in any way (e.g., natural reservation or archaeological findings). Twelfth, it is important that there are no existing utility

[255] The site occupancy index is also referred to as 'floor area ratio' (World Bank, n.d.j).
[256] There are also different kinds of land easements (i.e., appurtenant easement and easement in gross), which have different implications for the landowner's right after the acquisition: while some easements stay after the acquisition (appurtenant easements) others do not (easement in gross) (see Trulia, n.d.).

facilities, such as high-voltage power lines or pipelines, on the land plot or in close proximity that might hinder the construction or operation the production site. Thirteenth, it must be evaluated whether there is any potential for problems due to neighboring natural reserves, living areas, or industrial sites. Proximity to nature reserves must be taken into account, as additional requirements on waste and sewage management might be imposed in areas in proximity to nature reserves. Residential areas can, for instance, restrict operations due to noise, light, smoke, or with regard to night-shift production, as well as night or weekend collection, and delivery of components, raw materials, or final products. Fourteenth, if there are already buildings on the land plot, it must be evaluated whether these buildings can be used as industrial buildings for the production, for instance, with regard to their size, load bearing capacity, height, or floor space.

Overall, these are examples of aspects that determine the conditions at the production site with regard to the land plot, the surrounding area, as well as possible buildings on the land plot, which should be assessed in the selection process to ensure the successful construction and operation of the production site. The corresponding requirements on the production site must be determined in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile). Information about the size of the land plot can usually be gained through contact with the owners, while other conditions of the production site, such as the ground plot of the land plot or its topography, must be evaluated by visiting the production site.

Table 56: Information and Instructions on the Choice and Evaluation of the Location Factor *Conditions at the Production Site*

Location factor to be evaluated	**Size of Land**	**Groundwater Level**	**Occupancy Index**	**Cubic Index**	**Load Bearing Capacity**	**Neighboring Surrounding**	**Shape of Land**	**Topography**	**Ground Conditions**	**Protection Status**
Strategic, operational, or general	Operational	Operational	Operational	Operational	Operational	Operational	General	General	Operational	Operational
Process-specific / product-specific	Process-specific and product-specific	Process-specific and product-specific	Process-specific and product-specific	Process-specific and product-specific	Process-specific and product-specific	Process-specific and product-specific	-	-	Process-specific and product-specific	Process-specific and product-specific
Relevant for production network	-	-	-	-	-	-	-	-	-	-
Relevant for the design of the supply chain	-	-	-	-	-	-	-	-	-	-
Negotiable	-	-	-	-	-	-	-	-	-	-
Semi-external / even performance	-	-	-	-	-	-	-	Semi-external and even performance		-
Quantitative or qualitative	Quantitative	Quantitative	Quantitative	Quantitative	Quantitative	Qualitative	Qualitative	Qualitative	Qualitative	Qualitative
Hard or soft	Hard									
Static or dynamic	Static	Static	Static	Static	Static	Static, but possible relevant future changes must be ruled out	Static	Static	Static	Static, but possible relevant future changes must be ruled out.
Geographic level of analysis	Local									
Unit of measurement	Measured in square meters or hectares.	Measured in meters below ground.	Measured in square meters or hectares.	Measured in cubic meters.	Measured in kilos or tons per square meters.	Assessed as prohibitive, problematic, not problematic, good, ideal (or numerically as 1 through 5).				
Evaluation method(s)	o Minimum criteria o Preferable criteria									
Phase(s) in the selection process	o Phase 4									
Interdependencies with other location factors	-	-	-	-	-	o Natural Hazards	o Natural Hazards	o Natural Hazards	-	-
Source of information: public databases and information	-	-	-	-	-	-	-	-	-	o USGS Protected Area Database
Source of information: commercial external sources	o Real Estate Agencies									

Location factor to be evaluated	**Size of Land**	**Groundwater Level**	**Occupancy Index**	**Cubic Index**	**Load Bearing Capacity**	**Neighboring Surrounding**	**Shape of Land**	**Topography**	**Ground Conditions**	**Protection Status**
Source of information: internal know-how	o Real Estate Department o Factory Planning Department o Contact with owners of production sites (providing pictures, ground plot, building plan) or visits to the site.									
Source of information: external consultants	+	+	+	+	+	+	+	+	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.13.3 Costs for Acquiring the Production Site and Additional Costs

Under the costs for acquiring the production site and additional costs fall only those costs that arise for the purchase (or renting) of the land plot(s) and building(s), if buildings exist therein, and preparation of the land plot(s) that is required to start constructing the production site. Hence, the purchase or rental price of the land plot(s) and building(s) must be evaluated (purchasing price in €/m²). As Meyer suggests, prices of land plots and buildings need to be negotiated with the owner(s) (see Meyer, 2006b, 107). With regard to negotiations (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model), it is not only important to negotiate the prices of land plots and buildings with the owners, but also to be aware of the effect of anonymous negotiations in contrast to negotiations conducted openly under the name of the OEM. The advantage of anonymous negotiations is that the prices of land plots and buildings are likely to be lower if the OEM negotiates anonymously. The prices for land plots and buildings normally increase once an OEM expresses interest. As landlords assume that an OEM is willing to pay more, they might raise the price of the land plot (and building(s)), if the OEM negotiates under its name. The main disadvantage of anonymous negotiations, especially if the owner is the (national, regional, or local) government, is that anonymity might prevent the owner from offering their most valuable land plots, and instead offer the possibility to hold them back for the enquiry of a more interesting buyer, perhaps a large international firm. Overall, purchasing price evaluations can serve as a reference value in the assessment of the price of land plots and buildings. These purchasing price evaluations exist for many properties and help to reveal potential mismatches between the offered price and the standard land value. Moreover, it needs to be checked if there are any additional costs for land purchase, such as a land registration cost. Moreover, the costs which arise for the preparation of the land plot so that it can be used as a production site must be included in the evaluation. These costs include costs that may arise for land leveling, as well as for necessary demolition of existing buildings, pipelines or overhead transmission lines, bridges, streets, railroads, or water canals.

Information can be gained through real estate agencies and consultancies. The research consultancy Knight Frank, for instance, publishes Commercial Industrial Reports on the availability and costs of industrial and manufacturing property, which can give a first impression of the overall availability and price level in a country or region. However, the costs of the land and existing buildings must be assessed via the contact with the owners and through visits by external consultants, employees of the OEM, or both.

Table 57: Information and Instructions on the Choice and Evaluation of the Location Factor *Costs for Acquiring the Production Site and Additional Costs*

Location factor to be evaluated	**Costs for Acquiring Production Site (land plot and possible building(s) on the land plot)**	**Additional Costs for Land Purchase**	**Additional Costs for Land Registration**	**Additional Costs for Land Leveling, Adjustments due to Groundwater or Ground Conditions**	**Additional Costs for Demolition of On-site Infrastructure or Buildings**
Strategic, operational, or general	General	General	General	Operational	General
Process-specific / product-specific	-	-	-	Process-specific	-
Relevant for production network	-	-	-	-	-
Relevant for the design of the supply chain	-	-	-	-	-
Negotiable	+	Subsidies can be negotiated with the national, regional, or local government		-	Subsidies can be negotiated with the national, regional, or local government
Semi-external / even performance	Semi-external and even performance	-	-	-	-
Quantitative or qualitative	Cost-related quantitative				
Hard or soft	Hard				
Static or dynamic	Static				
Geographic level of analysis	Local				
Unit of measurement	Approximated in EUR.				
Evaluation method(s)	o Minimum criteria o Present value method				
Phase(s) in the selection process	o Phase 6 (minimum criteria, present value method) o Phase 7 (present value method)				
Interdependencies with other location factors	-	-	o Administrative Procedures	o Conditions at Production Site o Transportation Facilities	
Source of information: public databases and information	o Real Estate Agencies and consultancies (e.g., Knight Frank)	o Local government websites o Real estate agencies and consultancies (e.g., Knight Frank)		-	-
Source of information: commercial external sources	o Real Estate Agencies and consultancies (e.g., Knight Frank) (in depth information only available at a cost)			-	-
Source of information: internal know-how	o Real Estate Department			o Factory Planning Department	
Source of information: external consultants	+	+	+	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.13.4 Ease of Starting Operations at the Production Site and of its Extension

There are many aspects that determine the ease of starting construction and operations at the production site (including the ease of acquiring or renting the land plot(s) and building(s) that exist on the land plot(s)). The following aspects are the most important: first, does the land consist of one plot or multiple plots? If the land consists of multiple plots, it is important to know whether the plots belong to one or multiple zones, and if the plots belong to multiple zones, whether those zones belong to the same or multiple authorities. If the land plots belong to multiple authorities, it is of interest if the relevant regulations are similar. The preferred case is that the land plots belong only to one zone and that it, in turn, belongs to only one authority. Second, do(es) the land plot(s) or the building(s) that exist on the land plot(s) belong to one or multiple owners? The ownership of the land and building(s) is important as negotiations with multiple owners are more complicated and their result less certain. Hence, single ownership of the land plot(s) and building(s) is best. Third, with regard to the owner(s), it is important to confirm their rights of ownership, to know whether the owner(s) is (are) a private entity (entities) or the government, and to assess that they are reliable (e.g., not corrupt). Fourth, it is important that the land plot(s) offers the possibility to sequentially purchase additional land for an extension of the production facilities at a later point in time. The requirements on the additional land should be similar to the ones on the original land and must be determined in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile). Fifth, it must be ensured that the land plot is ready for sale by a determined date (due date), hence whether the land plot(s) is (are) available and whether there is anything that could delay the timely acquisition or rent thereof. Sixth, it must be checked whether the land plot(s) can be ready for the start of construction by the determined date, hence: can the preparation (see 4.13.2 Conditions at the Production Site) of the site for the construction be finished in a timely manner (the ground breaking/site ground clearing)?

The evaluation of these aspects that determine the ease of starting construction and operations at the production site (including the ease of acquisition or rent of the land plot(s) and building(s) that exist on the land plot(s)) is very important, as any delays, complications, or hurdles at the start of construction and operation of the production site can lead to very significant additional costs.

Table 58: Information and Instructions on the Choice and Evaluation of the Location Factor *Ease of Starting Operations at the Production Site and of its Extension*

Location factor to be evaluated	**Number of Land Plots**	**Number of Zones**	**Number of Authorities**	**Number of Owners of Land / Buildings**	**Consistency of Relevant Regulation**	**Proof of Property of Owners of Land/Building**	**Availability of Land for Future Extension of Production Site**	**Readiness for Sale until Due Date**	**Readiness for Ground Breaking / Site Ground Clearing until Due Date**	**Reliability of Owners (e.g., not corrupt)**
Strategic, operational, or general	General									
Process-specific / product-specific	-	-	-	-	-	-	-	-	-	-
Relevant for production network	-	-	-	-	-	-	-	-	-	-
Relevant for the design of the supply chain	-	-	-	-	-	-	-	-	-	-
Negotiable	-	-	-	-	-	-	-	-	-	-
Semi-external / even performance	-	-	-	-	-	-	-	-	-	-
Quantitative or qualitative	Non-cost-related quantitative				Qualitative					
Hard or soft	Hard									
Static or dynamic	Static									
Geographic level of analysis	Local									
Unit of measurement	Measured in absolute numbers.				Assessed as yes or no.					Assessed as very bad, bad, sufficient, good, or very good (or numeri-cally as 1 through 5).
Evaluation method(s)	o Exclusion criteria o Minimum criteria o Preferable criteria									
Phase(s) in the selection process	o Phase 4									
Interdependencies with other location factors	-	-	-	-	-	-	-	o Building Codes		-

Location factor to be evaluated	Number of Land Plots	Number of Zones	Number of Authorities	Number of Owners of Land / Buildings	Consistency of Relevant Regulation	Proof of Property of Owners of Land/Building	Availability of Land for Future Extension of Production Site	Readiness for Sale until Due Date	Readiness for Ground Breaking / Site Ground Clearing until Due Date	Reliability of Owners (e.g., not corrupt)
Source of information: public databases and information	o National and local government websites o Official maps					-	o National and local government websites o Official maps	-	-	-
Source of information: commercial external sources	o Real estate agencies and consultancies (e.g., Knight Frank) (in depth information only available at a cost).								-	-
Source of information: internal know-how	o Real Estate Department (contact with owners and government officials, visits to production sites).									
Source of information: external consultants	+	+	+	+	+	+	+	+	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.13.5 Costs for Constructing and Maintaining the Production Site

The costs for constructing and maintaining the production site include all costs that occur for constructing and maintaining the production site over its planning horizon, but do not include those costs that are considered in any other location factor, such as the costs for constructing and maintaining all necessary facilities for the supply of water and energy or for the disposal of waste or sewerage, as these costs are considered in their corresponding location factors (see 4.9.3 Water and Energy Supply; 4.9.4 Waste Disposal and Sewerage). However, the transportation facilities, which must be constructed on the production site are included in the location factor *Costs for Constructing and Maintaining the Production Site*, while those costs that occur for transportation facilities off the production site are evaluated under the location factor *Transportation Facilities* (see 4.9.2 Transportation Facilities).

Normally, international OEMs order international construction firms to construct the production site with all its industrial buildings. The OEM usually knows these international construction firms, as they have previously built them other production sites. The maintenance tasks of a production site are usually outsourced either to the firms which construct the production site or to local firms. In regard to maintenance tasks, the OEM's employees are responsible only for some, and these are specified in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile), and included in the analysis of the location factors *Availability of Skills* (see 4.7.5 Availability of Skills), *Wage Level* (see 4.7.4 Wage Level) and *Costs for Deploying Expatriates* (see 4.14 Costs for Deploying Expatriates). Only costs for maintenance services outsourced either to international or local firms are included in the costs for constructing and maintaining the production site.

Depending on the product that will be produced and the production process that will be implemented at the new production site, as well as whether one or more buildings exist on the land plot(s) which can be used as industrial buildings for the operations, the costs for the construction of the industrial buildings, as well as other facilities and infrastructure, can be estimated based on the know-how of the OEM and external consultants. Anderson and Chemical suggest that the aspects that determine the costs for constructing a production site include the 'number of units of operations', 'volume of production', 'materials of construction', and the operating conditions (Anderson and Chemical, 2009, 30). The 'number of unit of operations' and 'materials of construction' depend on the product that will be produced, and the production process that will be implemented at the production site, and the 'volume of production' depends on the market size, if it is a final product, or the number of units of the product required at the OEM's other production sites, if the product is a component (and must be specified in the *Operational Requirement Profile*, for instance, by the Factory Planning Department). The 'operating conditions' depend on the conditions at the production site. Additionally, Anderson and Chemical point out that the local temperature is the most important operating condition with regard to the costs of construction (Anderson and Chemical, 2009, 30), as the construction of the production site must be adjusted to the local temperature. Depending on the local temperature, these adjustments may have a significant effect on the costs for constructing and maintaining the production site, as the local temperature has a direct effect on the cooling and heating requirements of industrial buildings: very cold climate may require 'additional shelters' and very warm climate may require 'additional air-conditioning for personnel comfort and additional cooling towers for process equipment' (Sule, 2008, 614). The effect of the local temperature on the construction requirements also depends on the product that will be produced, and the production process that will be implemented at the production site. Some international operating firms have global temperature maps which capture the effect of the temperature on the construction and operation of the production site. Hence, in the *Operational Requirement Profile*, it must be specified which effect the local temperature has on the costs for constructing and maintaining the production site and at which temperatures constructing the production site must be ruled out. Based on this information and the OEM's know-how, as well as that of external consultants, the effect of the temperature on the costs for constructing and maintaining the production site must be estimated.

In addition to the local temperature, the availability of high-quality construction firms and maintenance service providers at the production site is relevant in terms of the costs of construction and maintenance. While international OEMs order international construction firms to construct the production site with all its industrial buildings, these international construction firms often benefit from the availability of local construction firms which meet their quality standard, as they can then outsource some of their tasks to these firms. Besides for the construction of the production site, local high-quality construction firms and maintenance service providers are also important for the maintenance of the production site over its planning horizon. Hence, both the OEM and international construction firms benefit from the availability of local construction firms and maintenance service providers which meet the required quality standard. This required quality standard is necessary for successfully constructing and operating the production site, and also includes a timely and reliable provision of services, as any delayed, unreliable or low-quality service leads to delays in the construction and operation of the production site (e.g., production stoppages).

Overall, the assessment of costs for constructing and maintaining the production site must include the costs for constructing the industrial building(s) and necessary infrastructure, like roads or parking lots, on the production site and the costs for maintaining the production site over its planning horizon. In an early phase in the selection process, the construction and maintenance costs can be assessed based on internal know-how and external consultants. In a later phase in the selection process, the OEM approaches one or several construction firms, which make offers for constructing and maintaining the production site. These offers eventually determine the cost for constructing the production site and maintaining it over its planning horizon. Moreover, the availability of high-quality local construction firms and maintenance service providers should be taken into account.

Table 59: Information and Instructions on the Choice and Evaluation of the Location Factor *Costs for Constructing and Maintaining the Production Site*

Location factor to be evaluated	**Costs for Constructing the Production Site**	**Costs for Maintaining the Production Site over the planning horizon of the production site**
Strategic, operational, or general	Operational	
Process-specific / product-specific	Process-specific and product-specific	
Relevant for production network	-	-
Relevant for the design of the supply chain	-	-
Negotiable	-	-
Semi-external / even performance	-	-
Quantitative or qualitative	Cost-related quantitative	
Hard or soft	Hard	
Static or dynamic	Static	Dynamic
Geographic level of analysis	Local	
Unit of measurement	Approximated in EUR.	
Evaluation method(s)	o Minimum criteria o Present value method	o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 6 (minimum criteria, present value method) o Phase 7 (present value method)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	o Wage Level o Availability of Skills	
Source of information: public databases and information	-	-

Location factor to be evaluated	Costs for Constructing the Production Site	Costs for Maintaining the Production Site over the planning horizon of the production site
Source of information: commercial external sources	-	-
Source of information: internal know-how	o Factory Planning Department	
Source of information: external consultants	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.13.6 Costs for Acquiring, Transporting and Maintaining Machinery

With regard to the machinery, which is necessary for operating the production site, costs arise for their acquisition, transport and maintenance over the planning horizon of the production site. Machinery refers here to all machines, production systems, and robots necessary for production. The necessary machinery for the production process that will be implemented at the production site must be specified by the Factory Planning Department in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile), as the required machinery depends on the production process that will be implemented, and the product that will be produced at the production site. Normally, the OEM buys the required machinery for the new production site from the firms from which it usually buys its production systems, machinery, and robots (e.g., Siemens or Kuka), as they guarantee the high-quality standard of machinery required for production. Depending on the contract, the transport of the machinery is organized by the OEM or by the supplying firm. If the OEM transports the machinery to the production site, the transport costs must also be taken into consideration. If the supplying firm transports the machinery to the production site, the transport costs are part of their price. Regardless of who is responsible for the transport of the machinery, the costs for it will depend on the production site's distance to and the logistic connectivity with the production sites of the machinery suppliers and will, ultimately, be borne by the OEM.

Besides the costs for acquiring and transporting the machinery, the costs which arise for its maintenance must be taken into consideration as they include all costs that arise for the maintenance and necessary replacement of machinery at the production site over its planning horizon. The maintenance of the machinery is usually outsourced, often to the firms which supply them. For other maintenance tasks, OEM employees are responsible at the production site; these are specified in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile) and included in the analysis of the location factors *Availability of Skills* (see 4.7.5 Availability of Skills), *Wage*

Level (see 4.7.4 Wage Level) and *Costs for Deploying Expatriates* (see 4.14 Costs for Deploying Expatriates). Costs for outsourced maintenance services are evaluated under this location factor. With regard to the costs for replacing machinery over the planning horizon of the production site, it is important to be aware that the time of use of machinery is usually shorter in emerging than in advanced countries (see Liebeck et al., 2006a, 203). Hence, it must be estimated how much and how often machinery must be replaced over the planning horizon of the production site under the conditions therein. The replacement costs include the costs for acquiring and transporting, as well as for installing, the new machinery at the production site.

For the costs for acquiring, transporting, and maintaining machinery, the local temperature, as well as the availability of high-quality maintenance service providers, matter. The local temperature has an effect on the use of machinery at the production site, since very high or very low temperatures make the use of certain machinery (see Anderson and Chemical, 2009, 30; Sule, 2008, 614) very expensive, as the machinery requires cooling or heating. Local temperature may also require the use of special machinery, which has a significant effect on costs. The effect of the local temperature on the costs for acquiring, transporting, and maintaining the machinery depends on the used production process at the production site which, in turn, determines the necessary machinery. Because some international operating firms have global temperature maps, the *Operational Requirement Profile* must specify which effects certain temperatures have on the costs for acquiring, transporting, and maintaining the machinery, and at which temperatures the use of certain machinery must be ruled out. Based on this information and the know-how of the OEM and external consultants, the effect of the temperature on costs for acquiring, transporting, and maintaining machinery must be estimated.

The availability of high-quality maintenance service providers at the production site is also relevant for the costs for maintaining machinery at the production site. As explained above, there are maintenance tasks, for which employees of the OEM will be responsible at production sites. However, most international OEMs outsource at least part of the maintenance of machinery to the firms which supply the machinery or to local maintenance service providers. International machinery suppliers benefit in their provision of maintenance services from the availability of local maintenance service providers as long as they meet high-quality standards, as they can then outsource some of their tasks to these firms. The same holds for the OEM. Hence, both the OEM and international machinery suppliers benefit from the availability of local maintenance service providers which meet the required quality standard. This required quality of local maintenance service providers is necessary as any delayed, unreliable, or low-quality service leads to delays in the construction and operation of the production site. Hence, the availability of high-quality local maintenance service providers can have an effect on the costs of maintaining machinery at the production site, be it because the OEM or the machinery suppliers can outsource maintenance services to them.

Overall costs for acquiring, transporting, and maintaining machinery necessary for the successful operation of the production site must be assessed. The maintenance includes the maintenance of machinery and the costs for all required replacements of machinery over the planning horizon of the production site. In an earlier phase in the selection process, the costs for acquiring, transporting, and maintaining the machinery can be assessed based on internal know-how and external consultants. Since the transport and maintenance of machinery are often outsourced to firms which supply the machinery, the costs for the acquisition, transport, and maintenance of the machinery must be assessed in close cooperation with the suppliers of the machinery in a later phase in the selection process. Moreover, the availability of high-quality local maintenance service providers should be taken into account.

Table 60: Information and Instructions on the Choice and Evaluation of the Location Factor *Costs for Acquiring, Transporting and Maintaining Machinery*

Location factor to be evaluated	**Costs for Acquiring Machinery**	**Costs for Transporting Machinery**	**Costs for Maintaining and Replacing Machinery over the planning horizon of the production site**
Strategic, operational, or general	Operational		
Process-specific / product-specific	Process-specific and product-specific		
Relevant for production network	-	-	-
Relevant for the design of the supply chain	-	-	-
Negotiable	+	+	+
Semi-external / even performance	-	Transport of machinery can be done by suppliers or by the OEM.	Maintenance of machinery can be done by suppliers or by the OEM.
Quantitative or qualitative	Cost-related quantitative		
Hard or soft	Hard		
Static or dynamic	Static	Static	Dynamic
Geographic level of analysis	Local		
Unit of measurement	Approximated in EUR.		
Evaluation method(s)	o Minimum criteria o Present value method		o Minimum criteria o Cost comparison o Present value method
Phase(s) in the selection process	o Phase 6 (minimum criteria, present value method) o Phase 7 (present value method)		o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	o Availability of Skills o Natural Hazards o Interest Rates	o Modes of Transportation o Transport and Logistic Costs	o Natural Hazards
Source of information: public databases and information	-	-	-

Location factor to be evaluated	Costs for Acquiring Machinery	Costs for Transporting Machinery	Costs for Maintaining and Replacing Machinery over the planning horizon of the production site
Source of information: commercial external sources	-	-	-
Source of information: internal know-how	o Factory Planning Department o Production Planning Department o Sourcing Department o Logistic Department		o Factory Planning Department o Sourcing Department o Production Planning Department
Source of information: external consultants	+	+	+

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.14 Costs for Deploying Expatriates

The costs that arise for deploying expatriates must be taken into account in the selection process. To avoid any aggregation problems, these costs considered under the location factor *Cost for Deploying Expatriates* only include the wages of expatriates and the additional costs that are directly associated with their deployment. Hence, requirements on the production site due to the general deployment of expatriates—such as the existence of an international school, recreational or sport facilities, or the proximity of an international airport, the possibility for their spouses to work, or a required level of security—are already considered under the location factors *Community* (see 4.5 Community), *Transportation Facilities* (see 4.9.2 Transportation Facilities) or *Security* (see 4.3.2.2 Security). Under the assumption that there will always be some expatriates at the production site, these requirements must be met by the conditions at the production site regardless of the exact number of deployed expatriates. Under the *Costs of Deploying Expatriates*, their wages and additional costs, such as extra bonuses or costs that arise for their and their families' accommodation or travels, are exclusively considered.

Despite the requirement of a certain level of available skills at the production site, in practice, international firms cannot fill many positions with local staff due to the scarcity of skilled workers and management personnel, especially in many emerging countries (see Simon et al., 2006, 250-251). Hence, international OEMs must send expatriates to the production site to ensure its efficient construction and operation, to teach local workers, and to guarantee the high-quality standards of production, but also to convey the OEM's culture and style of management. The presence of expatriates at the production site might be particularly important during its construction and start of its operation, when local employees might need training, technical knowledge, and production methods, as well as of the OEM's management style.

Given the need for expatriates at the production site, especially during construction and at the start of its operation, but also over its entire planning horizon, it is important to understand that deploying expatriates is associated with added high costs, in addition to that of their higher wages. For a realistic assessment of the total costs that arise for constructing and operating the production site, it is important not to underestimate the related costs for their wages (salaries), as well as those related to their travel and stay at the production site. Meyer points out that deploying expatriates is associated with high additional costs, as expatriates not only earn more than locals, but even more than employees in advanced countries in similar positions. These additional costs for expatriates occur because they are compensated, for instance, for their relocation and provided with extra services for their families (see Meyer, 2006a, 56, 97). The additional costs for expatriates also depend on the 'cost of living', and on the expenses for '[h]ealthcare', '[h]ousing', '[f]oreign taxes' and '[c]hildren's education' at the production site, as the salaries of expatriates must be adjusted based on these factors (Sims and Schraeder, 2005, 101-103). The salary of expatriates is usually 'adjusted upward for higher costs of living, but is not adjusted downward if the cost of living in the host country is less than the home country'. The cost of living only refers to the general 'costs of goods and services in the host country' and are added 'as a percentage increase to the expatriate's base pay'. Healthcare, housing, foreign taxes, and children's education are considered separately (Sims and Schraeder, 2005, 101). Usually, all costs to ensure that the expatriates and their families benefit from the same level of health care occur as additional costs for deploying expatriates. Costs for '[a] housing allowance or even free housing' for the expatriates and their families are also part of the additional costs, including their relocation (Sims and Schraeder, 2005, 102). Moreover, in many countries, expatriates face 'the issue of dual taxation', which increases their tax burden, and for which they are usually also compensated, adding to the additional costs (Sims and Schraeder, 2005, 103). Finally, these additional costs also include any costs incurred to ensure the education of the children of expatriates (see Sims and Schraeder, 2005, 103-104).

These additional compensations for expatriates are considered necessary given the additional effort and inconvenience expatriates face compared to when they work at home. In fact, research shows that many expatriates end their foreign assignment earlier than specified in their contract, reasons for which include a failure to adapt to the culture of the country to which they have been deployed (see Grant-Vallone and Ensher, 2001, 263-264), or the extent to which the work is interfering with their personal life, especially in regard to their families (see Okpara and Kabongo, 2011, 23, 25, 29, Grant-Vallone and Ensher, 2001, 264). Hence, given their required presence at the production site for its successful construction and operation, expatriates must be given higher wages and additional compensations (see Meyer, 2006a, 56, 97) to motivate them to move to and stay at the production site.

To estimate the costs for deploying expatriates, it is necessary to estimate how many expatriates will be deployed to the production site and for how long. This should be approximated based on experience with other production sites constructed and operated under similar conditions and included in the *Operational Requirement Profile* (see 3.2.2.3 Operational Requirement Profile). Depending on that information, the costs for deploying expatriates for the construction and operation of the production site over its entire planning horizon should be approximated, and must include higher salaries, bonuses, and all kinds of compensation payments for them and their families, as well as travel expenses.

Table 61: Information and Instructions on the Choice and Evaluation of the Location Factor *Costs for Deploying Expatriates*

Location factor to be evaluated	**Costs for Deploying Expatriates over the planning horizon of the production site**
Strategic, operational, or general	Operational
Process-specific / product-specific	Process-specific and product-specific
Relevant for production network	-
Relevant for the design of the supply chain	-
Negotiable	Salaries, bonuses, other compensation payments and travel expenses are at least partially negotiable.
Semi-external / even performance	-
Quantitative or qualitative	Cost-related quantitative
Hard or soft	Hard
Static or dynamic	Dynamic
Geographic level of analysis	Local
Unit of measurement	Approximated in EUR.
Evaluation method(s)	o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 6 (minimum criteria. operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	o Availability of Skills o Community
Source of information: public databases and information	-
Source of information: commercial external sources	-
Source of information: internal know-how	o Human Resources Department o Production Planning Department o Factory Planning Department
Source of information: external consultants	+

Key: ‘+’: yes / relevant / important; ‘-‘: no / irrelevant / not important

(Author illustration)

4.15 Availability of Potential Partners for Strategic Alliances or Joint Ventures

Strategic alliances and joint ventures are forms of cooperation, which refers to the collaboration of several firms in which the economic independence of the participating firms is only limited in the areas in which they cooperate and for the duration of the cooperation, while the participating firms entirely sustain their legal independence (see Bea and Haas, 2019, 447).[257] While there are also other forms of cooperation, such as cross-shareholdings, long-term contracts, and, more recently, strategic networks (see Müller-Stewens and Lechner, 2016 ,301), this location factor limits its focus to two forms of cooperation: namely, strategic alliances and joint ventures. 'Strategic alliances are institutionalized, voluntary and long-term cooperation between two or more firms, which serve the common goal to ensure or increase the competitiveness of the firms together', if they are not large and profitable enough to reach their strategic goals on their own (see Müller-Stewens and Lechner, 2016, 301).[258] There are strategic alliances between two or multiple partners. In strategic alliances, the partners combine their resources or activities to pursue a common strategy (see Johnson et al., 2018, 455). Firms form strategic alliances, for instance, to 'collaborate on new technology, develop new products, strengthen manufacturing weaknesses, improve supply chain efficiency, gain economies of scale in production or marketing' (Miltenburg, 2005, 27-28) or access innovative know-how, financial resources, sales markets, material or capabilities (see Johnson

[257] The overarching goal of cooperation is the improvement of the sustained competitiveness of the participating firms. More specific motives include the sharing of costs and risks, advantages related to timing, market access, image and reputation, access to resources (raw materials, know-how or technologies) (see Welge et al., 2017, 688-691), the increase of speed of entering new fields of business activity (see Müller-Stewens and Lechner, 2016, 299), to reach scale effects, to reduce costs, to gain market access, to combine resources and capabilities or to enhance market power (see Johnson et al., 2018, 460-461). The motives for cooperation are categorized into five groups: resource-related, time-related, cost-related, market-related, and speculative motives (see Müller-Stewens and Lechner, 2016, 300). The motives for cooperation are resource-related when the resources of a firm or its capabilities are not sufficient for the pursuit of a certain strategy or goal. Time-related motives are predominant when a firm does not have enough time to develop a certain production process, product, or know-how, and hopes to be able to more easily access any of those elements through a cooperation with another firm. Cost-related motives lead firms to form cooperation in order to take advantage of synergy effects and scale effects or to increase the market power. The market-related motive is the reason for forming cooperation when firms aim to access foreign markets to overcome certain protectionist policies like NTBs. Finally, firms form cooperation for speculative motives if they are driven by fears of acquisition or aim at hurting a competitor. Still, there are also risks for firms related to cooperation, which include the high level of instability of cooperation which has been revealed by numerous empirical studies, as well as the high potential for conflict which stems from the legal and economic independence of the partners, often resulting in diverging interests and goals, as well as from different opinions about the best way to achieve them. Moreover, cooperation carries the risk of loss of know-how and a higher level of strategic dependence on the partner (see Müller-Stewens and Lechner, 2016, 299-300). In terms of business function, OEMs tend to form most cooperation to enhance the business functions R&D, production, and sourcing (see Wallentowitz et al., 2009, 45).

[258] There is a wealth of economic and social theories on the reasons for the forming and configuration of cooperation. These include game theory, principal-agent theory, transaction cost theory or the theory on organizational learning (see Wallentowitz et al., 2009, 44).

et al., 2018, 460-461; Kutschker and Schmid, 2011, 897-899). A successful strategic alliance requires the partners to cooperate well and have clear common goals. Nevertheless, forming strategic alliances also carries risks as the partners can become competitors after the strategic alliances break, and former partners can take advantage of the know-how gained during the strategic alliances (see Miltenburg, 2005, 28).

The difference between strategic alliances and joint ventures is that in a strategic alliance no independent business unit is established and there is no capital participation of the partners (see Kutschker and Schmid, 2011, 888). Joint ventures are defined as 'business agreements whereby two or more partners create a separate entity' (Harrigan, 1988, 142). Hence, the partners of joint ventures control the joint venture from a strategic perspective, but, from a legal perspective, the joint venture is an independent unit (see Welge et al., 2017, 684). Joint ventures can be distinguished based on seven criteria: the number of partners, the area of cooperation, the location, the geographic area of cooperation, the direction of cooperation, the capital contribution or voting rates allocation, and the time horizon of the cooperation.[259] Motives for joint ventures include economies of scope and scale, the access to know-how about the local market or technology, sharing of risks, and access to a certain market (see Kutschker and Schmid, 2011, 889-891).

When selecting a production site, the availability of potential partners with which the OEM can form a strategic alliance or joint venture can be of significance. As laid out in Chapter 2, Autschbach suggests evaluating the existence of potential partners for alliances and joint ventures at the production site (see Autschbach, 1997, 199). Furthermore, as selecting a production site should enhance the OEM's supply chain design, which includes decisions on forming a cooperation with other firms (see 3.3 Perspectives and Basic Assumptions of the selection Process Model), evaluating the availability of potential partners for strategic alliances and joint ventures must not be neglected in the selection process (see Surana et al., 2005, 4244). Besides the strategic decision behind forming a cooperation, forming a joint venture is mandatory in many countries for a foreign firm to produce there (which requires investing and holding property), to sell its products in the local market, to export certain goods from there, or to process certain local raw materials (see

[259] The number of partners can range from two to several, the area of cooperation can be, for instance, sales, production or R&D, and the location can be the home country of one of the partners or other countries. The cooperation can be limited to only one country, a region or can even operate globally; also, the cooperation can be horizontal if they are between partners of the same industry, or vertical if they are between vertically connected partners in the value chain; and the cooperation can have different capital participation between the partners be it, for instance, 50% and 50% or 40% and 60%. Finally, the cooperation can be but does not need to be limited in terms of its time horizon (see Kutschker and Schmid, 2011, 886-889).

4.2.2.2 Non-Tariff Barriers to Trade; 4.8. Access to Raw Materials). A predominant example is China. Many governments of developing countries are especially likely to implement protectionist industrial policies to make the access of foreign firms to their markets contingent on forming joint ventures with local firms (see Kutschker and Schmid, 2011, 889).

Besides this mandatory cooperation, in order for foreign firms to be allowed to invest, own property, sell in the local market, process certain raw materials, or export certain goods in many countries, there are many ways in which a cooperation with local partners can be helpful for constructing and operating a production site, especially in terms of helping the foreign firm to overcome what Hymer has referred to as the '[b]arriers to [i]nternational [o]perations' (Hymer, 1976, 34). In particular, local partners can provide their know-how about the local sales and sourcing markets, reduce the wage premium international firms must pay, help overcome bureaucratic hurdles, facilitate acquiring a land plot, hiring workers (see Simon et al., 2006, 247-250), or selling the product in the local market (e.g., through their sales channels). Furthermore, international firms which do not know the local sourcing market well enough often pay higher prices than local firms for their components, especially in Southeast Asia and China. A cooperation with a local partner is one way to have better access to the local sourcing market and to be provided with thorough know-how about it, which might be a way to avoid paying above market prices. Moreover, Meyer points out that the wages international firms must pay, for instance, in China are significantly higher (by about 30%) than those which must be paid by international firms which have formed a cooperation with local firms (see Meyer, 2006a, 57, 60; 4.7.4 Wage Level). Another point that must not be underestimated is the greater ease of local firms to work with local administration and with other local firms (e.g., energy or water providers and landlords), thanks to their knowledge of the local language and norms, as well as their network with people in the local administration or other local firms. Overall, cooperation with local firms can help international firms to overcome the liability of foreignness at the production site, which refers to all additional costs that arise for international firms or all additional effort that international firms must exert in their operations as compared to local firms (see Simon et al., 2006, 247-248).[260]

Besides these advantages of forming strategic alliances and joint ventures with local partners, the related risks for OEMs must not be neglected, especially the loss of know-how or their

[260] The concept of liability of foreignness (LOF) was originally developed by Hymer and refers to the 'costs of doing business abroad. At the core of LOF is the insight that firms face social and economic costs when they operate in foreign markets' (Gaur et al., 2011, 212).

possible failure (see Inkpen at al., 2019, 252) due to a poor choice of partner. For both successful strategic alliances and joint ventures, the choice of partner(s) is of utmost importance (see Kutschker and Schmid, 2011, 895, 900). Important aspects for that choice are the 'strategic' and 'organizational fit', as well as the integrity, reliability, and trust of all partners (Johnson et al., 2018, 448, 460-461). For selecting a production site, three aspects must be determined regarding the need of a partner for a cooperation. First, does the local regulation require the OEM to form a cooperation to access the market, produce in the country (which requires investment and ownership of property), export products out of the country or process local raw materials? Second, does the OEM consider it as beneficial to form a cooperation with a local partner, for instance, to pay lower wages, to know more about the local sales or sourcing market or to have advantages in local procedures? Third, does the OEM want to form a cooperation with a local partner to access know-how or technology? In the first and second case, the need or interest to form a cooperation with a local firm can be acknowledged in the course of the selection process based on the analysis of existing NTBs (see 4.2.2.2 Non-Tariff Barriers to Trade) in the first case, or of location factors such as *Wage Level* (see 4.7.4 Wage Level), *Access to Raw Materials* (see 4.8 Access to Raw Materials), *Water and Energy Supply* (see 4.9.3 Water and Energy Supply), *Availability of Component Suppliers* (see 4.10.3 Availability of Component Suppliers) or *Administrative Procedures* (see 4.3.3.4 Administrative Procedures) in the second case. In the third case, the OEM's interest to form a cooperation with a local partner to access know-how or technology must be specified in the *Strategic Requirement Profile* (see 3.2.2.2 Strategic Requirement Profile). In all three cases, the availability of a potential partner at the production site must be evaluated in the selection process. This must also include negotiations with these potential partners for an agreement of cooperation.

Moreover, when evaluating potential partners for strategic alliances and joint ventures, it is necessary to ensure in the selection process if forming the strategic alliance or joint venture with these potential partner(s) is in compliance with the local competition policy (anti-trust policy) and if forming the planned strategic alliance or joint venture requires notifying the responsible institution (e.g., the European Commission). This is important to avoid any legal uncertainty. In the case of the European Union, it is, with regard to joint ventures, important to know whether the planned joint venture is 'concentrative' or 'cooperative' as concentrative joint ventures are subject to merger control (Morais, 2013, 30). Joint ventures are considered concentrative if they have 'joint control', 'full functionality' and 'EU dimension'.[261] If the planned joint venture could potentially be considered concentrative, then the involved firms (hence the OEM and the planned partner(s)) must notify the European Commission that they are planning to form the joint venture (see Hatton and Cardwell, 2017, 51-52). The European Commission can, after investigating the planned joint venture, 'outright approve' or 'reject' it or, alternatively, approve it 'only if certain conditions are met' (Guay, 2014, 199). With regard to strategic alliances, it must be evaluated if the planned strategic alliance is compatible with the relevant competition (anti-trust) regulations. In the European Union, strategic alliances are only compatible with competition law if they do not 'affect trade between Member States' and 'have as their object or effect the prevention, restriction or distortion of competition within the common market' (European Commission, n.d.g).[262] If there is any risk that the planned strategic alliance could be incompatible with competition law, then the OEM and the planned partner(s) of the strategic alliance should notify the European Commission about their planned strategic alliance and receive a confirmation of its conformity with competition law to avoid any legal uncertainty in the selection process.

Table 62: Information and Instructions on the Choice and Evaluation of the Location Factor Availability of *Potential Partners for Strategic Alliances or Joint Ventures*

Location factor to be evaluated	**Availability of Potential Partners for Alliances or Joint Ventures**	**Costs Required for Planned Alliance or Joint Venture over the planning horizon of the production site**
Strategic, operational, or general	Strategic	Strategic
Process-specific / product-specific	Process-specific and product-specific	Process-specific and product-specific
Relevant for production network	+	-
Relevant for the design of the supply chain	+	-
Negotiable	+	-
Semi-external / even performance	-	-
Quantitative or qualitative	Qualitative	Cost-related quantitative

[261] 'The EU Merger Regulation (EUMR) applies to the creation of any [joint venture] which is considered to be 'concentrative' rather than 'cooperative'. Concentrative joint ventures, which can 'be subject to a filing requirement under the EUMR' 'meet the following three key criteria': first, 'joint control: two or more undertakings are in a position to exert decisive influence over the [joint venture], second, 'full functionality: the [joint venture] will perform all of the normal sort of activities carried out by an autonomous economic entity, on a lasting basis', and third, 'EU dimension: two or more undertakings have sufficient revenues in the EU to meet one of the two sets of EUMR filing thresholds' (Hatton and Cardwell, 2017, 52). The detailed definition of the Turnover threshold for mergers to be of 'EU dimension' are available at the European Commission website under Competition: Merger control procedures (European Commission, n.d.f).

[262] See Article 81 of the EC Treaty for the particular conditions under which 'agreements between undertakings, decisions by associations of undertakings and concerted practices' 'shall be prohibited as incompatible with the common market' (European Commission, n.d.g).

Location factor to be evaluated	**Availability of Potential Partners for Alliances or Joint Ventures**	**Costs Required for Planned Alliance or Joint Venture over the planning horizon of the production site**
Hard or soft	Hard	Hard
Static or dynamic	Static	Dynamic
Geographic level of analysis	National, regional, and local	-
Unit of measurement	Assessed as very low, low, fairly high, high or very high (or numerically a 1 through 5).	Approximated in EUR.
Evaluation method(s)	o Strategic considerations o Profile method o Utility analysis	o Minimum criteria o Operating cost comparison o Present value method
Phase(s) in the selection process	o Phase 1 (strategic considerations) o Phase 2 (profile method) o Phase 7 (utility analysis)	o Phase 6 (minimum criteria, operating cost comparison, present value method) o Phase 7 (operating cost comparison, present value method)
Interdependencies with other location factors	o Non-Tariff Barriers to Trade o Industrial Clusters o Market Size	-
Source of information: public databases and information	o VDA: • Services – Facts and Figures • Topics - Automotive Industry and Markets - Market Supplier Industry o ACEA: Statistics: Production, Economic and Market Report o U.S. Department of Commerce: International trade administration: 'Top Markets Reports: Automotive Parts o PWC: Top Suppliers o Financial reports, websites and press releases of suppliers	-
Source of information: commercial external sources	o IHS Markit: • Automotive Supplier Market Data: component forecast, materi als and lightweigting • Automotive Research & Analytics: component suppliers, vehicle components, sourcing and supply chain o Automotive News: information on on-going topics about OEMs and suppliers o National automobile associations, research institutes (e.g., Here for America) o Roland Berger: Global Automotive Supplier Study o European Association of Automotive Suppliers (CLEPA) o Original Equipment Suppliers Association (OESA)	-
Source of information: internal know-how	o Strategy Department (especially Production Strategy Department)	
Source of information: external consultants	+	

Key: '+': yes / relevant / important; '-': no / irrelevant / not important

(Author illustration)

4.16 Summary of Chapter 4

As an integral part of the selection process model laid out in Chapter 3, Chapter 4 provides a discussion of location factors which are possibly relevant for selecting a production site for an OEM. For the selection process model to be applicable for each OEM in search of any kind of production site, it is constructed such that the OEM or the responsible project team must choose the relevant location factors for the specific production site for which it is searching from this discussion of location factors for evaluation in the selection process. To facilitate the choice and evaluation of location factors, this discussion provides detailed information and instructions.

This discussion facilitates the choice of relevant location factors for the particular selection of a production site:

- By including only those location factors that are possibly relevant for the selection of a production site for OEMs.
- By describing each location factor and specifying its possible importance for constructing and operating a production site.
- By providing additional information on each location factor, including whether the location factor is:
    - a strategic, operational, or general location factor (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).
    - a process- or product-specific location factor (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).
    - relevant to the enhancement of the OEM's production network (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).
    - relevant to the enhancement of the OEM's supply chain design (see 3.3 Perspectives and Basic Assumptions of the Selection Process Model).

This discussion facilitates the evaluation of included location factors in the selection process:

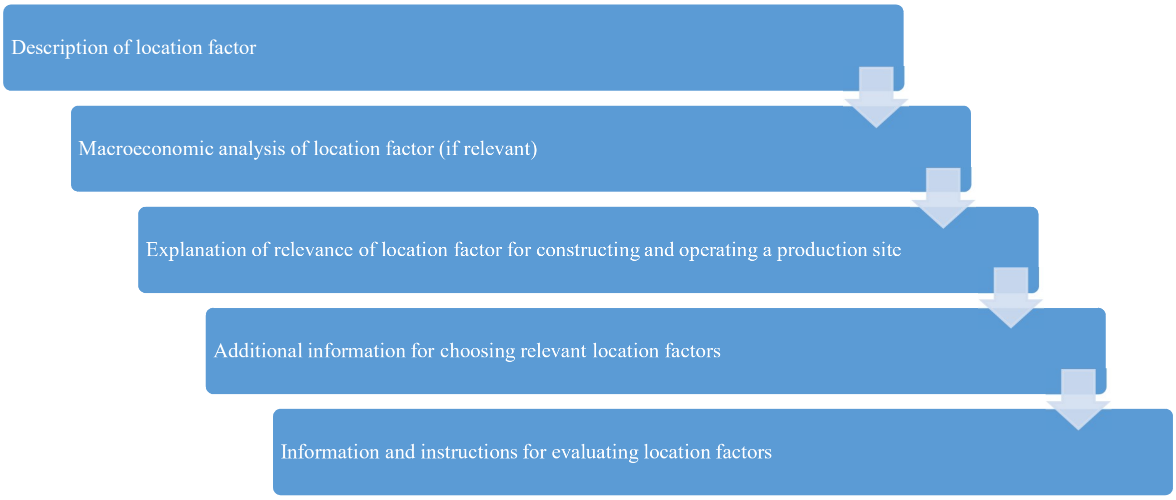
- By determining, for each location factor, whether the corresponding conditions at the production site are negotiable.
- By specifying whether each location factor is a semi-external or even a performance location factor.
- By specifying whether each location factor is quantitative or qualitative.
- By specifying whether each location factor should be considered as hard or soft.
- By specifying whether each location factor should be considered as static or dynamic.
- By determining, for each location factor, the geographic level(s) of analysis (national, regional, or local level), at which the location factor should be evaluated.
- By determining a unit of measurement for each location factor.

- By assigning to each location factor for each phase in the selection process model in which it is supposed to be evaluated an evaluation method(s).
- By determining, for each location factor, the phase(s) in the selection process model in which the evaluation of the location factor should be conducted.
- By identifying, for each location factor, those location factors with which it possibly has relevant interdependencies.
- By identifying, for each location factor, potential sources of information. These potential sources of information are defined as specifically as possible and fall in the following four categories: public databases and information, commercial external sources, internal know-how, and external consultants.

Moreover, all location factors included in this discussion and for which a macroeconomic analysis is relevant are explained from a macroeconomic perspective, which includes their macroeconomic description, an explanation of their macroeconomic driving forces, and their specific macroeconomic effect on constructing and operating a production site. This macroeconomic focus is important as such aspects determine the general environment in which the production site must be constructed and operated, and also have a direct effect thereon. Moreover, macroeconomic location factors are especially complex and hence the macroeconomic focus is an additional means to facilitate the choice and evaluation of location factors, in particular, and to support OEMs in their selection of a production site, in general.

This discussion of location factors contains a description of each location factor, if relevant a macroeconomic analysis of each location factor, an explanation of their relevance for constructing and operating a production site, as well as additional information for the choice of relevant location factors, and information and instructions on their evaluation (see Figure 17).

Figure 17: The Five Elements Included in the Discussion of Each Location Factor



(Author illustration)

This discussion of location factors meets the principle of completeness since it includes all location factors that can be relevant to an OEM's selection of a production site, and it simultaneously meets the principle of substantiality by including only the location factors that are relevant, omitting all other location factors. For the sake of clarity and user-friendliness, the location factors included in this discussion are categorized into 14 topics, namely *Regulations and Policies*, *Political and Legal Framework*, *Natural Hazards*, *Community*, *Economic Environment*, *Labor Market*, *Access to Raw Materials*, *Infrastructure*, *Production Network*, *Industrial Clusters*, *Market Size and Market Share*, *Production Site, Costs for Deploying Expatriates*, and *Availability of Potential Partners for Strategic Alliances or Joint Ventures*.

Hence, Chapter 4 provides a discussion of all location factors which are possibly relevant for an OEM when selecting a production site. This discussion is an integral part of the selection process model laid out in Chapter 3, as the selection process model is constructed such that it can be implemented by any OEM in their search for any kind of production site, and, consequently, the OEM or a responsible project team must choose the relevant location factors for the specific production site for which it is searching from this discussion for evaluation in the selection process. To facilitate this choice and evaluation of location factors for each location factor included in this discussion, detailed information and instructions for their choice and evaluation are provided, thereby ensuring the applicability of the selection process model for OEMs in practice.

5 Conclusion

The global selection of production sites is a very complex task of great strategic importance for OEMs. The selection of production sites is not only of strategic importance for OEMs to ensure their sustained competitiveness, as optimally selected production sites can become a competitive advantage, but also because of the sizeable long-term investment associated with a production site. Moreover, production site selection in the automotive industry is highly complex and the frequent reshoring or closure of offshored production sites shows that production sites are often selected poorly. Weaknesses in the selection process of production sites are among the chief reasons for failures in the operation of selected production sites. Despite the high degree of complexity of the selection and the inherent risk of failure, OEMs will continue to locate production sites abroad in the face of a highly competitive automotive industry, increasing customer demands, and increasingly hindersome trade barriers. Due to the strategic importance and great complexity of the selection of production sites for OEMs, it is crucial for them to have a process model at their disposal with which they can select the most appropriate production site for their specific production activity in practice. Such a model has been developed in this work.

The review of the relevant literature (Chapter 2), in general, and, in particular, the included analysis of the literature on process models for selecting the firm's location, be it for sales markets, individual production sites or production sites as part of production networks, illustrate that no process model has been developed so far that firms, and in particular OEMs, can apply in practice to select the most appropriate production site for their specific production activity. This is the existing gap in the literature which this work closes. While existing selection process models highlight many relevant aspects for developing a process model for selecting production sites for OEMs, these process models are not detailed enough and do not provide all necessary aspects for their application (e.g., instructions on choosing and evaluating location factors). Developing a generic process model which OEMs can apply in practice to select the most appropriate production site for their specific production activity is the academic contribution of this work.

The first step for developing this generic process model for selecting a production site for OEMs is to analyze and systematize existing selection process models in the literature to reveal all relevant aspects of these selection process models (Chapter 2). Based on these aspects, this work develops a generic process model which OEMs can apply in practice to select the most appropriate production site for their specific production activity (Chapter 3 and Chapter 4). Hence, this work combines two academic approaches: one academic approach is to analyze and combine existing relevant sources in the literature. The other academic approach is application-oriented, as this work develops a process model which is applicable in practice for the very complex and strategically important selection of a production site for OEMs.

To be successfully applicable, the selection process model satisfies both the strategic importance and the complexity of an OEM's production site selection. To achieve this, the selection process model is developed based on the assumption that the production site must not be selected in isolation, but as part of the global production network and supply chain of the OEM and, additionally, to advance the OEM's related strategic goals. Furthermore, the selection process model is developed on the premise that a purely quantitative model cannot realistically solve an OEM's complex selection of a production site. Additionally, the selection process model is based on the assumptions that the realistic analysis of the conditions at potential production sites requires evaluating the changes of these conditions over the planning horizon of the production site and that the future development of many of these conditions can only be assessed with uncertainty.

Consequently, the selection process model is developed to pursue four goals: identify the most strategically appropriate production site, avoid selecting any but the most appropriate production site due to structural deficits of the selection process, capture the conditions at potential production sites as realistically as possible, and consider the conditions under which OEMs implement the selection process in practice. For the selection process model to meet these four goals, the properties of the selection process model are determined accordingly. First, to identify the most strategically appropriate production site, the selection process model is guided by an inside-outside perspective, in general, and, in particular, applies a strategic and network perspective, and takes aspects which are relevant to the design of the supply chain into account. Second, to avoid selecting any but the most appropriate production site due to structural deficits of the selection process, all relevant business functions or departments and the point at which they are responsible for their contribution are determined before the selection process starts. Likewise, the planning horizon of the production site is determined early on. Furthermore, the process model follows a top-down procedure to prevent missing any possibly promising options for production sites. In addition, all location factors are defined without redundancy and all interdependencies between location factors are identified, and the selection process model is structured to avoid the problem of aggregation especially with regard to evaluating qualitative location factors. Third, to capture the conditions at potential production sites as realistically as possible, location factors are evaluated in different forms. The selection process model differentiates between quantitative and qualitative location factors, dynamic and static location factors, deterministic and stochastic location factors as well as hard and soft location factors. Moreover, the selection process model takes external and performance location factors into account. Fourth, to consider the conditions under which OEMs must implement the selection process model in practice, it is developed in awareness of the OEMs' time and resource constraints, while avoiding unnecessary complexity. Furthermore, negotiations play an important role in the selection process to ensure the success of operations at the selected production site and the selection process is conducted anonymously at first.

Additionally, the selection process model is developed on the premise that macroeconomic aspects, such as the exchange rate, gross domestic product, inflation, investment, productivity, or labor market, are not only important in determining the general environment in which the production site must be constructed and operated, but that they also directly affect the construction and operation of the production site. However, these macroeconomic location factors are not only particularly important for successfully constructing and operating the production site, but they are also especially complex and must be chosen and evaluated in the selection process by business experts who might not necessarily have an Economics background. Thus, the selection process model is developed with a special focus on macroeconomic location factors, their macroeconomic driving forces and their specific macroeconomic effects on the construction and operation of a production site. This macroeconomic focus is an additional means of the selection process model to facilitate selecting a production site for OEMs.

The selection process model is constructed so that it can be applied by each OEM for the selection of a production site for any kind of production activity. Hence, the selection process model provides sufficient flexibility to be adjusted to the needs of each OEM and the specific production activity for which it is searching for a production site, while simultaneously being detailed enough to ensure its applicability. Consequently, the selection process model consists of two parts. First, in Chapter 3, a generic process model for selecting a production site for OEMs is developed, including instructions for preparing the selection process, choosing and evaluating location factors, as well as the procedure of the selection process. Second, Chapter 4 provides a discussion of all location factors which are possibly relevant when selecting a production site for an OEM, including detailed instructions and information on their choice and evaluation. This structure requires the OEM to choose those location factors that are relevant for the specific production activity for which it is searching for a production site from the discussion of location factors for evaluation in the selection process.

To ensure the successful application of the selection process model, this work specifies all necessary instructions for its application in as much detail as possible. These instructions determine exactly how to prepare the selection process, how to choose and evaluate location factors, as well as the tasks and characteristics of each phase of the procedure of the selection process. The instructions on preparing the selection process include the definition and systematization of all requirements the OEM has on the production site, as well as the set-up of the project team and assignment of responsibilities. Furthermore, instructions on choosing location factors specify on what to focus and how to proceed when choosing location factors: given the importance of choosing location factors for successfully selecting a production site, this work facilitates this choice by providing a discussion of relevant location factors in Chapter 4, which includes only those location factors that are possibly relevant when selecting a production site for OEMs. Moreover, the discussion includes, for each location factor, an explanation of their relevance for constructing and operating a production site, provides, if relevant, a macroeconomic analysis of each location factor, determines whether the location factor is strategic, operational, or general, whether it is process- or product-specific, and whether it is relevant for the enhancement of the production network and supply chain design.

The instructions on evaluating location factors include information on the geographic granularity of their evaluation, sources of information for location factors, the unit of measurement for location factors, and evaluation methods. With regard to the geographic granularity of the evaluation of location factors, the selection process model differentiates between the national, regional, and local level of analysis, and Chapter 4 specifies, for each location factor, the relevant geographic level(s) of analysis, while it is specified for each phase of the generic procedure whether to analyze countries, regions or production sites. Moreover, as a means to facilitate this type of evaluation in the selection process model, particular sources of information are identified (all fall in to one of four categories, namely: public sources and databases, commercial external sources, internal know-how and external consultants) for each location factor in Chapter 4, while it is specified for each phase of the procedure of the selection process model whether the required information can be gathered through desk research or must be collected through field research. In awareness of the prerequisite of measurability of location factors for their evaluation, for each location factor included in Chapter 4, a form of measurement is identified. Finally, based on the understanding that there is not one method with which all relevant location factors can be adequately evaluated, multiple evaluation methods are used in the selection process model, including strategic considerations, different kinds of criteria, profile method, utility analysis, scenarios, operating cost comparison, present value method, EVA method and SWOT analysis. To facilitate implementing the selection process model, Chapter 4 specifies an evaluation method for each location factor for each phase in which that location factor is supposed to be evaluated. Moreover, the determined tasks and characteristics for each phase of the procedure also include whether negotiations should take place and the form of documentation. Thanks to its properties and its macroeconomic focus, as well to its structure and all included instructions and information, this selection process model enables OEMs to select the most appropriate production site for their specific production activity in practice.

Even so, the selection process model entails several limitations. These are briefly discussed here. For instance, limitations of the structure of the selection process model include that the OEM must choose the relevant location factors from the discussion of location factors in Chapter 4 depending on the production activity for which it is searching for a production site, or its strategic goals. This choice takes not only effort and time but can also negatively affect the outcome of the selection process if relevant location factors are not taken into account or irrelevant location factors are evaluated. Moreover, as qualitative location factors cannot be measured like their quantitative counterparts, they are assessed through ratings in this selection process. While a rating of, for instance, very low, low, fairly high, high or very high, is only a rough assessment of the qualities of these qualitative location factors, the rating thereof also requires experts (project team, other employees or external consultants) assess the location factors subjectively. Likewise, the assigning of weights (in a hierarchical form, preferably with the direct rating method) to qualitative location factors is also based on expertise depending on the production activity for which a production site is being searched and the strategic goals of the OEM.

Moreover, due to the great number of location factors included in Chapter 4, the interdependencies between the included location factors are identified only to a certain degree and must be identified in more detail when applying the selection process model based on the chosen location factors. Furthermore, due to the global nature of the selection process model, it is beyond the scope of this work to provide specific sources of information on the local or regional and, in some cases, even the national level on location factors, as these sources are countless. Instead of providing specific sources of information on the local, regional and, in some cases, even the national level on location factors (e.g., information on regulations of constructing disposal facilities for a specific production site), this work specifies, in some cases, a general source (e.g., that information on regulations of constructing disposal facilities are available in building codes) and determines that the information needs to be evaluated on the local level. This requires the OEM to search for the required information in the general provided source on the location factor it wants to evaluate. Moreover, this work does not claim completeness in terms of the provided sources of information, though they are compiled to the author's best knowledge.

With regard to further research building on this work, it is of interest to evaluate the selection process model both in terms of a realistic case study and a further specification of the selection process model. Hence, the first path is any kind of application of the selection process model to an OEM's specific production site selection. However, this is difficult to pursue as an academic publication, since OEMs are unlikely to be interested in publishing their requirements on a production site, their strategic goals, or their technical and technological possibilities and limitations. Therefore, an alternative is the construction of a hypothetical case study in which the characteristics of the OEM, the production process, and the product for which the production site is being searched, as well as the pursued strategic goals and all requirements which the OEM has on the production sites, are assumed. Based on these assumptions, the selection process model could be applied to this hypothetical selection of a production site. The second path of further research is the specification of the selection process model either on a particular country, or region therein, or on the selection of a production site for the production of a certain product or the operation of a certain production process, as well as on certain strategic goals. This specification of the selection process model would limit its global and generic scope either in terms of location, of the production activity for which the production site is searched, or of strategic goals.

Overall, this work makes a significant academic contribution by developing a generic process model with which OEMs can select the most appropriate production site for their specific production activity in practice. Moreover, due to the applicability of the selection process model for OEMs in practice, this work has a strong connection with practical business applications. The selection process model enables OEMs to select the most appropriate production site for their specific production activity, which is of strategic importance for OEMs not only to ensure their sustained competitiveness by selecting a production site which becomes a competitive advantage, but also due to the sizeable long-term investment associated with a production site. Besides this strategic importance of selecting a production site, the production site selection is also a very complex task, especially in the automotive industry. This selection process model enables OEMs to solve this strategically important and complex task of selecting the most appropriate production site for their specific production activity in practice.

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