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## Market Barrier Integrated Approach for Manufacturing Footprint Decision Support

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# **Market Barrier Integrated Approach for Manufacturing Footprint Decision Support**



# Market Barrier Integrated Approach for Manufacturing Footprint Decision Support

*Thillai Sivakumaran, Philipp Sprenger, Michael Toth and Michael Henke*

The sales potentials for automotive companies in Europe are decreasing, and emerging markets, such as the BRIC-states or the ASEAN countries, are now in the focus of European automobile manufacturer's attention. However, the governments of these high potential market states try to cap the import-rate of European cars and decrease the international competition for the local automotive industry by creating trade barriers. Car manufacturers and suppliers struggle with the planning of following a local manufacturing strategy and the related set up of regional supply chain networks. The decision finding process shows different deficits. Especially the high dynamic of the business environment and the related uncertainties are not in the scope of current planning processes. Approaches are missing which allow decision owners to evaluate the impact of changing trade barriers on the supply chain network. Derived from state-of-the-art analysis, tariff and non-tariff trade barriers will be classified in the context of opening up new automotive markets. Next to a classification, an existing simulation-based planning approach for robust manufacturing footprint decisions is extended by the consideration of the classified trade barriers.

**Keywords:** Trade Barriers, Manufacturing Footprint Decision, Supply Chain Management, Automotive Industry

## 1 Introduction

The global development in vehicle sales reveals two major trends. On the one hand, the main automotive markets West Europe, North America and Japan stagnate on a high level for years now (OICA 2014; VDA 2013). On the other hand, there are emerging markets, which show a growing demand for passenger cars and still have a considerable growth potential (Schade et al. 2012; Dudenhöfer et al. 2012). This saturation of the main markets and its derived competitive pressure between the original equipment manufacturers (OEMs) as well as the structural change in the emerging markets necessitate the opening up of new markets for the car manufacturers (Dehnen 2012; Garcia Sanz 2012). Especially the BRIC-states and the ASEAN member-countries are now in the focus of European automobile manufacturer's attention. The first group of states in particular, led by the now world's largest automobile market, China, shows remarkable high sales potential, which is the result of a strong economic upswing as well as a low car density compared to the main markets (ACEA 2013; Dudenhöfer et al. 2012). Ebel and Hofer, for example, predict that in 2020 only 35 percent of the global car sales will be witnessed in the core markets (Ebel and Hofer 2014). In comparison, in 2013 we saw a 44 % market share of the core markets (OICA 2014).

However, the entry of the European car manufacturers and suppliers into the new economically relevant markets is significantly constrained through protectionist actions in the form of trade barriers (Love and Lattimore 2009). These actions are motivated in different ways. By creating trade barriers, the governments of the high potential market states mostly try to cap

the import-rate of European cars and decrease the international competition for the local automotive industry as well as increase the know-how transfer (Neumair et al. 2012). Due to the trade barriers, the car manufacturers and suppliers need to build up local manufacturing sites in order to be able to offer their products to a competitive price.

Within the footprint planning workflow several planning teams and decision makers are involved in the decision finding process. Most approaches for manufacturing footprint planning do not correlate with the workflow management and the organizational structure of the company, which leads into different “planning isles”, where planners work isolated. These “planning isles” will cause different deficits according to find the right manufacturing footprint. First of all, not all relevant cost components are taken into account over the whole supply chain. For example, costs for supplier development in order to be able to generate the required local content quotas are missing in the established processes. Other cost components missing are market barrier-induced costs, or capital commitment costs. Furthermore trade barriers are only considered in the form of tariffs in the processes although they can have a wide range of forms and can also be very dynamic in their nature caused by changes by the local governments in short time frames. These changes can have significant impacts on the developed supply chain networks. Therefore it is necessary to know the relevant trade barriers in the emerging markets and integrate them in manufacturing footprint decision support systems. Consequently, a model has to be developed, which ensures a holistic view on the complex task of the manufacturing footprint decision.

The paper is organized in five major sections. Section two briefly describes the requirements for a support system and presents the existing planning support approaches. Section three uses a literature and database review to identify and categorize main trade barriers concerning the automotive industry. The 4th section presents the developed planning approach, which integrates the trade barrier view. The final section summarizes the findings of this paper and discusses the need for further research in this field.

## 2 Manufacturing Footprint Decision Support

OEM manufacturing sites are part of a complex supply chain network with several suppliers and logistic providers. Given the problem and the coherence of supply chain networks and footprint decisions, the following requirements can be deduced.

The manufacturing plants are exposed to different dynamic impact factors such as changing inflation and exchange rates or the change of custom rates along intercontinental E2E (end-to-end) supply chain network. Therefore the occurrence of uncertainties along the supply chain and the dynamic adaption of solutions have to be considered in the support system. Next, for long-term strategic decision support problems such as the manufacturing footprint planning a total cost evaluation is required (Kinkel 2009). Especially in the context of developing emerging markets the cost effects of trade barriers increases significantly and should be integrated in footprint decisions. Another requirement to be mentioned is that a planning approach should take qualitative and quantitative factors along the supply chains into account. This is due to the fact that footprint decisions

are determined by manifold impact factors. Additionally, because of the long planning horizon and the related planning uncertainties, the planning approach should support an aggregation of factual connection of supply chains based on the availability of relevant data. At the same time, the approach should support a detailed evaluation of different footprint scenarios. Next to the major requirements mentioned above, there are several more requirements, which have to be met by the planning support systems. They are listed in Sprenger et al. 2014. Following, some of the most prominent planning approaches for the described task are presented.

The planning approach by Chopra and Meindl describes a framework for decision support in supply chain design (Chopra and Meindl 2001). According to supply chain strategy, structural problems, including facility selection, will be solved when using optimization. They have designed a highly practical planning approach for strategic network problems, but realistic uncertainties, the impact of trade barriers as well as typical qualitative (location) factors disappear with highly abstracted KPI-analysis or are not even considered.

The manufacturing footprint planning approach from Kinkel responds to these uncertainties with a scenario-based procedure (Kinkel 2009). There planning uncertainties with optimistic, realistic and pessimistic scenario set ups are encountered (Sprenger et al. 2014). The approach provides different modules such as facility controlling, scenario management and the optimization of the existing footprint (Kinkel 2009). However the number of impact factors is limited and trade barrier aspects stay unstudied within the total cost evaluation.

In contrast Goetschalckx and Fleischmann present a planning approach which reflects quantitative and qualitative factors and provides different holistic methods (Goetschalckx and Fleischmann 2005). The planning approach consists of four planning steps which are developed in an iterative procedure. This approach is designed to solve any SCD-planning problems, which leads to a high abstraction level of this approach. High abstracted information can cause wrong footprint decisions with enormous financial losses, which can't be revised (Günter and Tempelmeier 2012).

A planning approach which enables decision makers to evaluate different supply chain design scenarios in a much more detailed level is provided by Seidel (Seidel 2009). Similar to approach by Chopra and Meindl, the supply chain strategy and targets are defined in the first place to derive relevant scenarios afterwards. Based on the established scenarios, a basic material flow optimization will be implemented. Using the network-simulation, an evaluation according to logistic-related KPI's of different supply chain designs can be conducted. This is an iterative planning procedure and the results can be used for both the decision and implementation. Trade barriers are not in the scope of this approach.

Kuhn et al. have developed a general procedure for strategic logistics planning based on Seidel's planning approach (Kuhn et al. 2010). The central method is the simulation of both basic and detailed planning. Next, qualitative methods are provided for the identification and generation of scenarios. In comparison to Seidel's model, the implementation phase is much more detailed and allows basically an integration of quantitative trade barriers. Qualitative impact factors are only covered rudimentarily in the approach.



The results of the literature review show that there are different planning steps necessary for a stable footprint decision support. Most of the analyzed planning approaches show a similar problem solving procedure based on the supply chain strategy. Some of them integrate qualitative as well as quantitative methods. Based on the review, the existing planning approaches can be characterized as ambivalent. On one hand “classic” footprint approaches (Kinkel 2009) focus especially on location specific impact factors (like labor costs, incentives and facility investment). On the other hand supply chain design (Seidel 2009) approaches consider in the first place logistic-related factors (transport costs, inventory level etc.). However, the understanding and consideration of trade barriers within the analyzed approaches is very limited. That means the evaluation scope and the understanding of total cost should be extended by the qualitative and quantitative impact of trade obstacles.

### **3 State of the Art Review of Trade Barriers Concerning the Automotive Industry**

Trade barriers, also referred as market barriers, remain loosely defined in research and practice. This is due to the fact that trade barriers differ from different industrial sectors and over time there appear new kind of measures while other ones are abolished. This is why literature only states common trade barriers, hardly focusing on specific industrial sectors. In order to generate a common understanding of trade barriers concerning the automotive industry in particular, relevant trade barriers in the international trade are compiled and the findings are validated and extended

through studies and database analysis of the current situation in selected emerging markets regarding the automotive sector. These markets are the ones with a high potential for the automotive industry, namely the BRIC states China, India, Brazil, Russia, and the three largest auto markets of the ASEAN countries Thailand, Indonesia and Malaysia.

### **3.1 Characterization of Trade Barriers**

There are two general principles of trade policy, namely free trade and protectionism. While the former implies a broader waiver of governmental intervention in foreign trade, the latter describes the opposite, the governmental restriction of imports or the support of the export economy (Büter 2013). Protectionism is implemented in the form of trade barriers. These can be national laws, regulations and other measures inducted by governments targeting foreign products and services to affect them adversely against local products (MacLean 2006). However, natural trade barriers such as language barriers, cultural unfamiliarity or transport risks are not included in the definition of protectionism (Haas and Neumair 2006) and are therefore not in the focus of this research paper.

International trade organizations, such as the World Trade Organization (WTO), aim a total waiver of trade barriers in the international trade. Even though the OECD estimates that a further reduction of trade barriers will have a significant positive effect on the global welfare for developing and developed countries alike (Love and Lattimore 2009), there are still different motivations for the governments to implement trade barriers, partially against WTO Regulations. The protection of the local economy is clearly one of the main intentions. Specific industrial sectors are advantaged and

supported against foreign products and services. The argumentation for protectionism is obvious. A developing local industry means a higher deployment and as a result a stronger national economy (Dunn and Mutti 2004). Therefore local investments are focused and a know-how transfer is encouraged through the benefited settlement of new technologies. However, this argumentation is highly discussed in literature (Dunn and Mutti 2004; Love and Lattimore 2009). Another motivation for trade barriers to be mentioned is the increase of the export volume, which will lead to a more equal balance of trade. Furthermore trade barriers are used as an additional source of revenue from governments, as a measure for retaliation for foreign import restrictions, as payments against dumping prices as well as a preferential treatment of certain trading partners (Eibner 2007).

The motivations differ from different sectors and countries. Focusing on the automotive industry, one of the most important motives is the local establishment of automotive know-how in order to develop a local industry and protect it from international competition (Humphrey and Memedovic 2003). Furthermore the establishment of production and sales of more ecologically efficient cars is focused in some emerging markets (ICCT 2013).

### **3.2 Classification of Trade Barriers Concerning the Automotive Industry**

Trade barriers are commonly categorized into tariff and non-tariff trade barriers. The first group consists of duties for imported or exported products as well as duty-like levies (Reuvid & Sherlock 2011; Köhne 2015). Tariffs can be distinguished on the basis of their effect. In the automotive sector, the use of import tariffs is wide-spread in emerging markets. Taking a look

on the BRIC states as well as the three biggest car markets in the ASEAN region, namely Thailand, Malaysia and Indonesia, as shown in table 1, it can be seen that all of these high potential market countries use import tariff measures to protect their developing automotive industry as well as intend to force OEMs to increase production in their countries by lowering the duty rates for knocked down vehicle kits (GTAI 2014a; GTAI 2014b; GTAI 2015a). Export duties on the other hand are not relevant for the automotive sector. It applies to more regulated sectors like the defense industry. Other levies are less common but are still a used measure. In India and Malaysia, for example, the governments demand a levy on light vehicles marking it as a countervailing duty and excise duty respectively, which is to be paid besides the actual import duty (GTAI 2014c; GTAI 2014b). Nonetheless, the advantage of tariffs as trade barriers is that unlike non-tariff trade barriers (NTBs), tariffs are very clear in their definition and are subjected to reporting.

However, the balance between tariff and non-tariff trade barriers is changing through the liberalization of the world trade, which leads to reduction of tariff trade barriers. Therefore governments tend to use more NTBs as they are not clearly defined and less transparent (OECD 2005; Jansen et al. 2014). NTBs can be defined as "any government policy, other than a tariff, which reduces imports but does not similarly restrict domestic production of import substitutes" (Dunn and Mutti 2004). Some kind of measures, like import quotas, can uniquely be identified as trade barriers, while the analysis of administrative measures, due to the fact that they are hard to reveal and their effects on the international trade cannot be readily measured, are difficult to define and analyze (OECD 2005). However, the review has shown

that NTBs take many different forms and are also heterogeneous across different countries. A very wide-spread form of non-tariff trade barriers are quantitative restrictions, such as import quotas, local content schemes or voluntary export restraints (Vousden 1990). Especially local content restrictions and its extension referred as local value added restrictions are very common in the emerging markets. This kind of measure is very powerful to force the European car manufactures to invest in local production as well as to boost a know-how transfer. In Brazil the local content restrictions are put into practice through the INOVAR-AUTO regulations, which describe a new kind of credit point generation system through local investments. Duty and tax reductions can be attained, if the OEM can evince that a sufficient amount of credits has been generated by local sourcing and production. Other measures to generate credits are for example local investments in research and development and the production of more energy efficient vehicles (PWC 2014; ICCT 2013). Thailand is another example, where a local value added of 40% is demanded. Besides the local sourcing and assembly of the cars, there are several processes defined, which have to be conducted locally to attain import duty reductions (GTAI 2015b).

Table 1 Automotive Trade Barriers in selected Emerging Markets  
(Sources: Germany Trade & Invest, Country Automotive Studies 2014 and 2015; Central Board of Excise and Customs, India; International Trade Administration, U.S.; PricewaterhouseCoopers Autofacts Brazil 2012; World Economic Forum Enabling Trade Programme 2014; European Commission Market Access Database; EABC Business Position paper 2012; World Bank Policy Research Working Paper 5060 2009; OECD Trade Policy Study 2005; VDA Annual Report 2013; OEM Expert Interviews)

Trade Barriers	China	India	Brazil	Russia	Thailand	Indonesia	Malaysia
Import Duty	up to 25%	up to 125%	up to 55%	up to 15%	up to 80%	up to 125%	up to 30%
Import Levy		8 – 24%					up to 105%
Import Quota			INOVAR				
Local Content	50-60%		INOVAR				
Local Value Added		Main Car Parts	INOVAR	60%	40%		
Subsidiary Restrictions	Joint Venture Restrictions					After Sales Restrictions	

Trade Barriers	China	India	Brazil	Russia	Thailand	Indonesia	Malaysia
Other Invests	CCC		INOVAR				
Certification			Restrictions for some parts apply				
Licensing			LCVM				Open / Franchise APs
Duty Processing				Apply	Apply		
Approval Processing					Apply		
Nonspecific Terms of Trade				Apply			



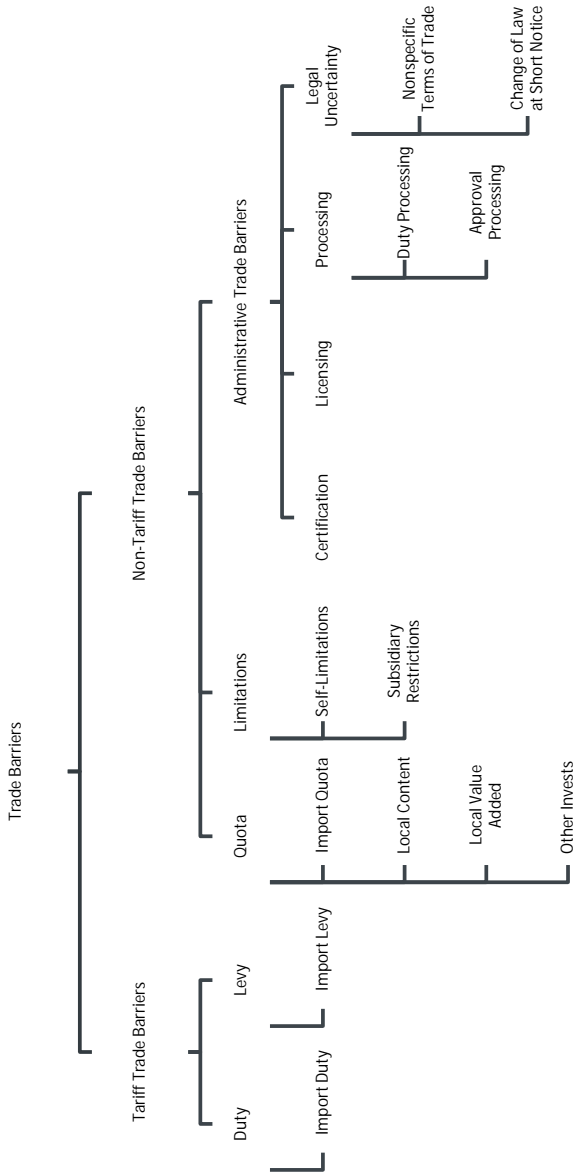


Figure 1: Classification of Trade Barriers concerning the Automotive Industry

Even though India has not specified local content quotas, the government has described several major car parts to be assembled in India in order to get further duty reductions besides a tariff reduction for a part by part supply of the plants. Import quotas for light vehicles are less common in the considered emerging markets or are only implemented in a less restrictive form. For example, the tax reduction in Brazil only applies on the first 4.800 imported cars a year (PWC 2012). Self-limitations also referred as voluntary export restraints, which are imposed by the exporting country do not apply for light vehicles from the European Union. However, another restriction, which is hardly seen in literature, is restriction on subsidiaries. A local production in China can only be conducted by companies, which are in a Chinese majority ownership with a share of minimum 60 % (Liu and Dicken 2006). Indonesia has a similar limitation, which applies to companies performing in the after-sales business (GTAI 2014a). The already mentioned administrative measures can be separated into the four groups: certification, licensing, processing and legal uncertainty. While the first two groups, which are commonly referred as technical barriers to trade (TBT), are very specific and are stated in official documents, the other two groups are hard to reveal. Certifications as well as licensing requirements apply in the considered emerging markets, which mean that the OEMs have to face higher compliance costs (Bao 2014). Although delays in the duty and approval processing as well as unclear terms of trade cannot be stated as official trade barriers, they are cited as one of the most incisive protectionism measures by U.S., European and Asian automotive companies (WEF 2014; OECD 2005). The review of literature as well as the analysis of trade barriers in selected emerging markets results in a classification of trade barriers,

which are highly relevant for the automotive industry. The findings are summarized in figure 1.

#### **4 A Model for a Trade Barrier Integrated Manufacturing Footprint Decision Support**

For the described footprint decision support task, a trade barrier integrated approach has been developed, as shown in figure 2. The developed model is an extension of the existing model described by Sprenger et al. (Sprenger et al. 2014). The aim of this model is to support a cost minimal footprint decision for the opening up of defined target markets while considering the x-tier Supply Chain delivery costs. Therefore, the focus of the original model has been adopted to include an OEM view into the decision finding process and not only limit the focus to a supplier view. One of the most important tasks to reach this goal is the integration of market barrier dynamics into the decision support. As seen in chapter 2, the existing approaches are not adequately considering the market barrier aspects. The proposed approach separates the specific steps of the model as well as the identified market barriers, which are relevant for the auto-motive industry, into qualitative and quantitative factors. The advantage of this procedure is that barriers, which cannot be quantified monetarily, are still taken into consideration to ensure a holistic view. Another advantage is that the decision finding process is designed to scope as much relevant information as possible, which is available in an early phase, before entering the detailed evaluation phase. This process supports a fast and more focused evaluation of a footprint decision support. Before the decision finding support process

can be performed, footprint targets like logistic performance or maximum total costs for a location has to be defined.

The qualitative part of the model consists of three steps. First of all, possible manufacturing footprint locations are identified and checked against specific knock-out criteria in the country, state and community (CSC) analysis. Examples for this kind of criteria are sufficient regional sales volume for OEMs, minimum number of qualified suppliers, which are able to pro-

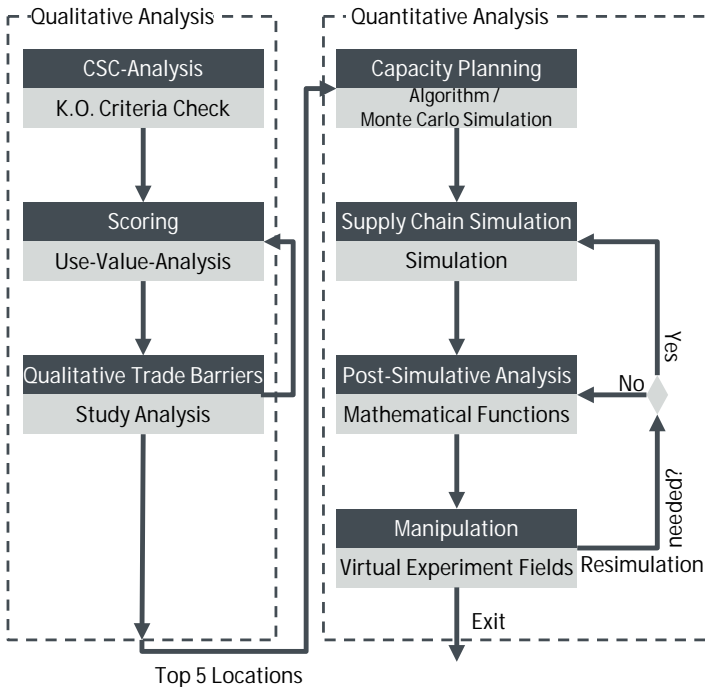


Figure 2 Trade barrier integrated manufacturing footprint decision support approach

duce a sufficient amount of parts or infrastructural criteria such as the distance to an international harbor. Any possible country or region, which fails to fulfill the requirements, will be deleted from the list. The consideration of all the factors together, which can vary within the supply chain, results in a list of regions that may be potential manufacturing locations.

Because in the CSC-analysis only fundamentally relevant criteria are inspected, this step does not have to be performed on every footprint decision finding process. The result of this analysis only has to be validated, if major criteria changes are done or the location environments have changed radically.

Next, a use-value analysis is conducted considering soft location factors, such as political instability or corruption level. Because the quantification of the impact of soft location factors is quite difficult, the weighting and the scoring should be done by experts of the specific region within the company. After this step, a short list of regions for a potential manufacturing plant ordered by company related priorities are identified. The short list should not contain more than three to five countries in order to efficiently perform the next step of the model.

The third step of the presented model is the analysis of qualitative trade barriers, which is the first major addition to the existing model. These are in particular import quotas as well as processing and legal uncertainty listed under administrative trade barriers. Sources like the World Trade Organization (WTO) or the World Bank have to be contacted in order to get the information. These organizations conduct studies on the legal situation regarding trade and therefore gather information about the experiences of companies, which already completed their market entry process. Because

the evaluation of trade barriers is a very time intensive task, the number of countries, which are analyzed, has to be kept very small as mentioned above. It is mandatory to clearly understand the trade barriers. Therefore it can be necessary to get into discussion with the local governments in case of any unclear terms of trade. If the obstacles caused by trade barriers, like too many changes in the terms of trade, which means a high degree of uncertainty in the planning process, are too high, this country will be deleted from the short list. Nevertheless, if there are too many possible locations to be deleted from the list after this analysis step, a reassessment of locations have to be done again in step two following the iterative logic of the model.

As a result of the qualitative analysis part of the presented model a list of the top five possible locations is defined. These five locations are now taken into an in-depth four step quantitative analysis. The first step of the quantitative part is the capacity planning step. In here all location relevant cost factors, such as production costs, personal costs, facility costs and/or incentives are calculated using a linear programming method. Therefore an overview of future projects is needed as an input. It is obvious that due to market dynamics, there is an uncertainty in the probability of occurrence of planned projects. In order to account for uncertainty, a Monte Carlo simulation is used and linked with the project specific confidence level. As a result, the potential locations are listed with a cost evaluation depending on the project constellation of the upcoming years.

The results of the first four steps will be used to lower the number of potential locations and to transform and create relevant data for the further planning step of simulation. First, different supply chain configurations are

modelled and evaluated using the method of simulation by integrating the locations into the existing supply network. Depending on the different project constellations, different sourcing strategies, transportation variants and distribution strategies will be modeled. The results of the supply chain simulation are needed to calculate the relevant cost factors, as described in the following step.

Here a quantitative post-simulation analysis is conducted. This is another major addition to the original model. In this step all relevant cost factors within the supply chain induced by a location are calculated. Therefore a mathematical function is proposed to support the location decision. Here, the quantitative trade barriers are integrated in the analysis. The mathematical function consists of the location cost factors considered in step four, the trade barrier-induced cost factors, material transfer costs and supply chain logistic costs. The authors propose an integration of the x-tier supplier delivery costs as this will have an effect on the material price.

Table 2 Notation of the cost function

Indices	Parameters	Variables
b = Country Boarder (1,...,B)	AIC <sub>b</sub> = Additional Investment Costs	$\alpha_{pv}$ = Transferrate
c = Tariff Category (1,...,C)	ASC <sub>e</sub> = Additional Sourcing Costs	
e = Local Supplier (1,...,E)	CCC <sub>ts</sub> = Capital Comittment Costs	
l = Location (1,...,L)	LABC <sub>l</sub> = Labor Costs	
p = Part (1,...,P)	LEV <sub>bc</sub> = Levy Costs	
s = Supplier (1,...,S)	LIC <sub>l</sub> = Location Investment Costs	
t = Tier-level (1,...,T)	LICLC <sub>l</sub> = Location Intralogistic Costs	
v = Material Transfer (1,...,V)	LS <sub>l</sub> = Location Subsidies	
	MHC <sub>ts</sub> = Material Handling Costs	
	MLC <sub>l</sub> = Manufacturing Loca- tion Costs	



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Indices	Parameters	Variables
	MPC <sub>ts</sub> = Material packaging Costs	
	MTC <sub>ts</sub> = Material Transporta- tion Costs	
	MWC <sub>ts</sub> = Material Warehous- ing Costs	
	PMC <sub>p</sub> = Part Material Costs	
	SCLC <sub>i</sub> = Supply Chain Logistic Costs	
	SDC <sub>e</sub> = Supplier Development Costs	
	TAR <sub>bc</sub> = Tariff Costs	
	TBIC <sub>i</sub> = Trade Barrier induced Costs	

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Cost function:

$$\sum_{l=1}^L (MLC_l + SCLC_l + TBIC_l + TMTC_l) \quad (1)$$

The parameters will be detailed in the following:

$$MLC_l = LABC_l + LIC_l + LILC_l - LS_l \quad (1.1)$$

$$SCLC_l = \sum_{t=1}^T \sum_{s=1}^S (MTC_{ts} + MWC_{ts} + MHC_{ts} + MPC_{ts} + CCC_{ts}) \quad (1.2)$$

$$TBIC_l = \sum_{b=1}^B \sum_{c=1}^C (TAR_{bc} + LEV_{bc}) + \sum_{e=1}^E (ASC_e + SCD_e) + AIC_b \quad (1.3)$$

$$TMTC_l = \sum_{p=1}^P \sum_{v=1}^V PMC_{pv} (1 + \alpha_{pv}) \quad (1.4)$$

Using the presented cost function, the manufacturing footprint costs per location can be calculated. These cost factors are further detailed to a granulation level (formulae 1.1 – 1.4), which allows an in-depth understanding of the cost factors. In the next step, parameters of the simulation model are systematically manipulated and systems behavior is investigated. Manipulated parameters are, for example, volumes, exchange rates and efficiency factors of a plant. Based on an empirical analysis of the model's behavior, an evaluation of robustness is possible. For a reliable realization of different simulation experiments, Virtual Experiment Fields (VEF) and experiment plans are defined. VEF are an effective approach to increase the speed

of decision support based on simulation (Deiseroth et al. 2013). After the data manipulation, it has to be checked if a re-simulation of the model is needed. If not, a post-simulative analysis is done, accordance with the iterative logic of the model. The model exits, when a robust cost minimal location is found, which is within the cost and performance range defined in the beginning in all simulated scenarios.

## 5 Conclusion

This paper presents an approach for a cost minimal manufacturing footprint decision support, which integrates the aspects of trade barriers in the consideration. We analyzed the state-of-the art manufacturing footprint decision support models. The findings have been summarized and critically evaluated in terms of meeting the named requirements. The consideration of trade barriers especially was not sufficient in the analyzed models. Therefore, we conducted an in-depth analysis of automotive relevant trade barriers in selected emerging markets in order to understand the effects of trade barriers on the manufacturing footprint decision process. Using the results, an existing model focusing on automotive supplier footprint decision process is adopted to include the OEM view and to integrate the analysis of trade barriers. The model describes a process, which is designed to include all relevant data available in the specific process phase. The process is separated into a qualitative and a quantitative part, which allows a holistic view on the described task.

The findings presented in this paper do contribute to both research as well as practice. With regard to research, the findings contribute to further developments of process models and frameworks with a holistic view in the context of automotive manufacturing footprint decision finding process research. With regard to practice, the existing planning processes can be focused using the proposed process steps, which can lead to shorter planning durations. For example, it was shown that only a limited number of trade barriers are relevant for the automotive industry. With this knowledge the planning processes can strongly be focused. As a result, the car manufacturers are able to better react to the dynamic environment in the emerging markets. However, the findings of this paper are part of ongoing research of the authors in the field of robust manufacturing footprint decisions and optimization of market entry planning processes in the automotive industry.

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