



**A Conceptual Framework for Strategy
Selection in Supply Chains. A Case Study in
The Automotive Industry**

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ABSTRACT

This research starts from the suggested idea that within the supply chain management practices and research is taking place a transition trend from lean production to agile production. The main purpose of this paper is to propose a comprehensive framework to determine the optimal supply chain: lean or agile.

From the literature review a list of determinants used by other researchers is presented and discussed. After that, this paper advocates for a specific framework that is considered and selected as being the most suitable for determining which is the optimal strategy for a supply chain. Considering some faults of the frameworks exposed by the literature review, this paper is adjusting the selected framework by making use of PESTLE analysis and Porter's generic business strategies. The resulted framework is used then as an instrument to evaluate which strategy fits best the automotive industry. The conclusion is that within the automotive industry, a lean strategy for the supply chain is more appropriate than an agile strategy.

This study theoretically contributes to the development of the SCM field by integrating a strategic choice perspective. The new created framework can assist practitioners in understanding and deciding which supply strategy fits better they supply chain. The framework is an instrument that can easily be adopted to other industries as well.

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List of abbreviations

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CLM - Council of Logistic Management

DCM -Demand Chain Management

DSCM – Demand Supply Chain Management

GSCM – Global Supply Chain Management

IoT - Internet of Things

NGO – Non-Governmental Organization

OEMs – Original equipment manufacturer

RQ – Research questions

SC – Supply Strategy

SCM - Supply Chain Management

VCA - Value Chain Analysis

CHAPTER 1. INTRODUCTION

This chapter starts with the presentation of the background of the actual research, followed by the motivation for it. The main research questions are expressed through the purpose of the project. Thereafter, the outline of the thesis is presented.

1.1 Background of the research

Starting with the design and coordination of the supply chain and ending with the competition of the players involved along with the information dynamics, the complexity of the management of supply chain (especially on a global scale) challenges the most popular theories of international business (Resource-based view, Network theory, Transactions cost economics, etc.). From small retail stores to the biggest industries actors or the actual internet commerce, the vast applicability of the subject is undeniable.

To obtain raw materials, manufacture it and further deliver it, a company has to cooperate with a variety of suppliers and customers with which it can form a network of enterprises. The “*supply chain*” term refers to a linear relation between those companies involved (Lödding, 2013). In a traditional view, a perfect management of the supply chain can be resulted from the correlation of the supplier, producer and distributor’ s efforts to get the right product, in the right quantity, in the right place at the right time. This requires an efficient utilization of information, materials and financial flows along the supply chain in order to be cost-efficient and fully satisfying for the customer (Hilletoft, 2009).

Moreover, the market development of nowadays is described as being very competitive, with an increased variability of the demand and products, and at the same time with a shortened product life cycle. Many of these features are due (at least partially) globalization phenomenon which has brought new managerial challenges (Hilletoft, 2009). So, with new challenges also new practices have to be designed or adapted to the new context. It is believed that the competition is not only between companies nowadays, but also among supply chains (Diaconu, Alpopi, 2014). More than a competitive environment, a company’s competitive strategy is also influencing the emphasis on its supply chain strategy” (Qi, *et al.*, 2011).

The globalization effects took the form of complex networks of enterprises which, with different levels of control, are spanning multiple countries. New strategic and logistic issues have been created and the “supply chain management” term became more relevant. The Council of Supply Chain Management Professionals defined it as:

"Supply Chain Management is the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole" (Robinson, 2015).

Ellram and Cooper (2014) made a research on the literature available on this topic and drew attention on the fact that “supply chain” term (especially “chain” which should be replaced with “networks” in the view of some researchers) might not be the best choice to describe this concept but they emphasis on the importance of continuing studying this matter. Since its introduction in 1982 (by R.K Oliver and M.D. Weber), the SCM term became very embedded in the business language since, any effort to change it might be in vain. The only rectification suggested by the authors for the future researchers on this field is to: position “*their work within the realm of supply chain management, rather than imply that they are studying the whole supply chain*”. In the end, they choose the next definition as being the most representative for the SCM concept:

... **“a set of three or more entities (organizations or individuals) directly involved in the upstream and downstream flows of products, services, finances, and/or information from a source to a customer, (and return)”** (Mentzer *et al.*, 2001).

The technology development of nowadays allows the instant collection of data from companies all over the world even in real time, making the Supply Chain Management even more relevant at the moment. This emerging discipline has the potential to solve different challenges in the global environment. From different NGOs and governments there is a continuous pressure on the companies to function more sustainable and this makes the study on SCM a necessity. It is required from them to be environmental, economic and social responsible, promoting sustainability.

Also, it is expected from them, to conduct business in an ethic way maintaining the global wellbeing. And maybe the biggest concern of supply managers is cost cutting and value adding. The costs of the supply chain, in general, represent a massive share in the price of the final

product. Since the supply chain is an important source of added costs, it should also be a main target for cost reduction. The configuration of the right strategy, which can make a company overcome this issue, represents a main concern. This is the reason why it is required and relevant to conduct a research focusing on the strategic part of the management of the supply chain. Hoffman (2010) stress the need of supply chain professionals to develop **strategic** managerial competencies in order to close the gap between strategic vision and execution.

However, the supply chain management is already regarded, by many firms now, as a strategic factor. Consequently, there is a need for a managerial perspective on the theoretical development of the supply chain management area. For example, some of the reviewers address it from a logistic or purchasing perspective, but an approach on SCM from a broader organizational perspective is missing (Burgess *et al.*, 2006). As a conclusion, the academia highlights the need for further research in the supply chain management field, but it draws attention on the emerging aspect of the discipline and the multiple existing perspective of it. Therefore, a broader approach on the entire supply chain is needed but its limitations have to be realized.

Jajja *et al.* (2016) remarked the fact that SC practices have been intensely researched in U.S. in the last 15 years, but from developing countries like India, China and others have received very little attention. On another hand, Ibrahim et al. (2013) highlight a lack of theoretical contribution in the area of supply chain strategy which can be useful to practitioners operating in a global environment. “*Is the strategy that guides implementation of practices*”. Also, Hofmann (2010) identifies a gap in theory building in the form of a conceptual framework. At the same time, practitioners suggest a need for SC strategies to include the demand as important factor and then to synchronize the supply and demand to answer the nowadays challenges. Ambe and Badenhorst-Weiss (2011) also support this: SC should be designed rather from “customer backwards”.

1.2 Motivation of the research

The practitioners’ perspective was illustrated in an executive report, made by research team of the IBM institute for Business Value. The aim of it was to provide a strategic insight for senior executives that can help them to realize business value, showing the need for an “*optimal supply chain configuration to synchronize supply and demand*” (Butner, 2010). This was presented as

a solution for a growing volatility of the global market and the increasing variability of the customer demand. Their study was developed in 29 countries from all over the world and their survey was applied to more than 650 supply chain management executives. The report presented the main challenges identified by the supply chain executives and they were summarized in three words: “*volatility*”, “*visibility*” and “*value*” (Butner, 2010).

An industry like the one of automobile is very well described by a very complex supply chain management and it is encountering all of these challenges as well. Also, it is the field of very fierce competitive environment, where every decision is highly important. The mentioned industry represents a good example with a long history behind, with important innovations in engineering and operational management and with a direct involvement in the development of the human kind in 20th century. Starting with the steam and then gasoline to the electrical engine and with mass production to just-in-time management methods, this industry was a pioneer of evolution not only in terms of technology but also as a business pioneer. Not to mention the utility of its products, which facilitated transportation of goods and persons made the globalization possible.

In this context, is it relevant to seize the influences of nowadays globalized environment on the industry and then to analyze how a company is determining its strategy to thrive in business competition. By tradition, the main strategy of these cars manufactures was respecting producer-driven principles. But, according to an analysis of the industry, it was concluded that the report between the supply and demand has changed lately. If in the past the ability to innovate, improve and refine a car was enough to make customers to buy, now the analysis reveals that these are not enough. In a study of Supply chain practices and challenges applied to automotive industry (Talavera, 2015), it was reported the need for a shift “*from firm-level competitiveness to a responsive supply chain to compete in this global environment*”.

These in relation with the analysis executed in chapter number 7, it can be remarked an empowering of the customer. This was possible mainly in three ways which were facilitated (to some degree at least) by the globalization. First of all, the customer now has access almost from everywhere to any kind of information and this allows his to make a fare comparison between products and rise his expectations. Secondly, the general income has increased which opened new markets for cars but this also attracted competitiveness. Thirdly, he also become more aware about the toxic effect of the cars on the environment and he behave more responsibly. As a conclusion, the power report between demand and supply (at least in this

industry) changed. The question is: how to the industry should react to these challenges and changes?

1.3 Purpose or the research

The industrial development of the modern world has been described by three phases: craft production, mass production and lean production. Now the SCM literature suggests a need for the developing of agile production. According to Gligor (2015), the agility of a supply chain allows the firm to respond in a timely and effective manner to environment uncertainty and market volatility and this is putting the companies on a position of competitive advantage. Does this mean that the strategy of a company has to be reconfigured by considering environment and demand uncertainty? Are methods that can completely remove the it? Madhani (2017) says that uncertainty from supply chain is impossible to eliminate sometimes, so a better approach is to accept it and develop a strategy in this direction. A strategy which accepts the uncertainty, but still aims to efficiently and effectively match demand and supply.

To tackle the existing issues of supply chain management within the automobile industry and also to respect the recommendation from the academic literature, the current study is treating the management of the supply chain as a strategic factor. For choosing its strategy, lean or agile, this paper analyses the determinants of a supply chain strategy. Moreover, it will have the demand (customer) as an integrated part of the chain (Hilletoft, 2010) for the strategy configuration process. As a result, the supply and demand will play an equal role in choosing the firm's strategy.

This research does not focus on specific products or individual enterprises, but it integrates various company-specific supply chains into one composite supply chain model, representing the entire industry. This approach is also supported by Gunther *et al.* (2015), who emphasize the importance of applying a full industry supply chain view and not only a single-company perspective. Also, an important mention about this research, it is considering the strategic level of an entire supply chain and does not focus on frameworks or models which are concentrated specifically around operational level. A supply chain is composed by different economic agents (including final customers), which change products, services, money and information. Therefore, the supply chain takes the form of a network where there is a constant exchange (transaction).

This research is analyzing the need for a shift in the SC strategy for the automotive industry, is exploring various SC strategies, identifies the determinants of a more accurate strategy for SCM in automotive industry and develops a conceptual framework to be used as an instrument in choosing the optimal strategy. Then the usage of this tool is exemplified in automobile industry. The main purpose of this paper is to determine which factors need to be considered when adopting a supply chain strategy.

The current paper will provide an answer to the next research questions:

Table 1. Research questions

No.	Research question
RQ 1	Which are the relevant strategic determinants for the supply chain management?
RQ 2	Considering the generic strategies lean and agile, what framework should be used for determining an optimal supply chain?
RQ 3	Regarding the trend of SCM transaction from lean to agile production, to which extent should the automobile industry adopt it, based in the results of the framework?

This research is considering the main strategies of the supply chain, called lean and agile for a firm which is situated between suppliers and customers. It refers to this as to a focal-firm. The main purpose of the project is to find a comprehensive framework that can assist the practitioners in considering the lean or agile strategy for their supply chain.

RQ1. Through the first question research, it will be introduced the main models developed so far in the literature and an analysis of those. After a discussion of the identified determinants in each framework a presentation of those will be revealed.

RQ2. After a description of both, lean and agile strategies, the potential of each framework will be evaluated. Then, based on the literature review and the identified relevant determinants, this paper will suggest the most useful framework for the purpose of this research and it will adjust it based on its limitation and the conclusions of the literature review

RQ3. Here will be analyzed the automobile industry in relation with the two generic strategies. Then it will be presented the main trends and challenges for the industry from the supply chain

perspective. In the end, an exemplification of the use of the new created framework will be made, based in the automobile industry.

Beside these, the uniqueness of this paper consists in the fact that it integrates the demand and supply as equal variables in the configuration of the SC strategy. In the end, this paper will provide practitioners a comprehensive conceptual framework which comes with a method to analyze the main strategic determinants, to identify their influence and to choose an optimal supply chain strategy

1.4 Outline of the thesis

This research is adopting a conceptual analytical approach. This is used to outline possible courses of actions and to reveal a preferred approach to an idea or thought. This theoretical paper is not a strict review of all the issues related to SCM. As Ellram and Cooper (2014) suggests, it will be a mistake to assume that all of them can be treated in only one study. As most of academia tried to come with a different perspective on SCM, this paper tries to focus on choosing the optimal strategy for supply chain. Further, with the contribution of the chosen frameworks or models, it aims to provide an instrument of analysis for the supply chain in order to determine a SC strategy. The structure of the thesis is the following.

The second chapter (literature review) starts with a description of the evolution of the SCM as a concept and its landscape. A deeper understanding of the concept is revealed through its main definitions and perspectives. Then the literature is focusing more on the aim of this project by describing issues related to SCM (like DSC) and its strategies. Also, the main SC strategic frameworks are described and their determinants. In the end, also the literature of SCM related to automobile industry is consulted.

In Chapter 3, the methodology will be presented. Firstly, it will be described the approach of the research, then the research process and which steps are to be followed. The second part of this chapter will present the design of the research. This refers to the research strategy and approach for both, chapters 2 and 6.

In the fourth chapter (Limitations and conclusions of the literature research process and review) are discussed the main limitations encountered during the research process. After short adjustments of them, the main conclusions are drawn in order to answer RQ 1. The discussion of the limitations was done here in order to better to consider them in the next chapter.

In the next chapter is debated the most suitable framework but also its limitations and adjustments in order to answer to RQ 2. Here is built a comprehensive framework for choosing the optimal SC strategy.

The chapter number 6 is analyzing the industry and it describes the strategic determinants of the created framework. Also, this framework is applied in order to exemplify how it can assist the practitioners and to answer to RQ3.

In the end, the final conclusions of the research are presented.

CHAPTER 2. LITERATURE REVIEW

The current chapter is a synthesis on the existing literature which is relevant for this research and which has the role to offer a deeper understanding of the topic and at the same to guide this project to the answer of the proposed questions. As it was mentioned in the previous chapter, this research is within the field of SCM, but it is focusing on the strategy element and it also refers to the demand as an important variable as the supply is. Since these are different terms and concepts, they require a focus on different areas from the literature review, giving also a unique feature to this research. As a result, the literature review is a thematic one and it is structured in four main parts: SCM as concept, the demand side of SCM and supply chain strategies, SCM within automotive industry.

The literature review starts with an outlook of the main ideas, trends and challenges of SCM within the automotive industry. Then the review is considering the Supply Chain Management as a main concept. The existing literature of it is reviewed because it represents the broad view of the chosen topic. Since SCM is considering an emerging discipline, different bodies of literature associated with SCM will be presented. It will start with a short summary on the evolution of the concept. Then, it will be covered the most popular definitions and perspectives on supply chain management. The review is continuing with a presentation of the “demand” side of the chain because this was highlighted as an important element in the SCM which have been ignored by some of the researchers, forming a literature gap. Then, from the literature review are extracted the information on the strategic element of SC (outlined by agile and lean

strategies). Further are presented the main frameworks on differentiating different strategies. Finally, the literature review provides an outlook of the main ideas, trends and challenges of SCM within the automotive industry

2.1 The evolution of the Supply Chain Management concept

Starting with *pallets lifts* (“unit load”) and *warehouse activities and transportation management* (building and moving containers), the history of SCM goes 100 years back, when the focus was on improving the labor-intensive process by engineering and managing world-wide complex networks. To better present the evolution of the SCM, the changes through the ages of Council of Supply Chain Management Professionals will be further narrated. As Grimm & Ren (2015) affirmed, SCM emerged as a natural extension of Logistics and Transportation discipline. Therefore, the roots of supply chain managements are embedded in logistics but also in the military industry.

The two World Wars came with a set of requirements for the operations researchers, who set the basics of “Supply Chain Engineering”. By 1963, the National Council of Physical Distribution Management was created in U.S.A, which gained world-wide recognition from industry and academia for contributions in freight transportation, material handling and warehousing areas. They also embraced the potential of computerization in logistic planning and inventory optimization. The companies became well aware of the importance of the logistics, especially after the transition trend to sea movements in the 1980s. According to Kundu *et al.* (2014), the term “*supply chain management*” was used for the first time by Keith Oliver (a Booz Allen consultant) in 1982. Also, the above-mentioned institution changed its name to Council of Logistic Management (CLM) in 1985 to highlight this evolving discipline, because prior to this, “logistics” term was exclusively used in military industry.

The technology revolution had the next big impact on SCM with the developing of software programs like Enterprise Resource Planning and Advance Planning and Scheduling. All of these allowed the globalization of the manufacturing process. The globalization came also with other challenges, on strategic level (associated with SCM term) and on tactical and operational level (associated with logistics). This association and the distinction between SCM and logistics made the CLM to change once again its name, in 2005, in Council of Supply Chain Management Professionals (Robinson, 2015). Further, the extent of internet usage and the Industry 4.0 (strongly related to the Internet of Things (IoT)) are assumed to be the next phase in the evolution of SCM.

2.2 The Supply Chain Management landscape

The supply chain management has been studied from different perspectives and as a result there is no one single definition of SCM or SC. Moreover, the researchers have been studying this field using different units of analysis: the issue of trust, collaboration or power within business relationships, the flow of information, material or economic value, means of production or human resources. Also, the name varied from co-makership, relationship marketing, industrial networks, etc.. The globalization, technology development, the Japanese production philosophies, the rising competition, etc., all of these had an impact on SCM as a concept and affected its evolution (Zokaei, Hines, 2007). This also explains the diversity of discipline assembled under this concept and variety of definitions.

The supply chain management (SCM) domain is a large research territory with a demand for an interdisciplinary approach. Some researchers relate to SCM as an emergent discipline (Storey *et al.*, 2006). Most of the academia conceptualizes the term of “**supply chain management**” based on the following perspectives: “*SCM as a process, a discipline, a philosophy, a governance structure and a function*” (Ellram, Cooper, 2014). This led to a divergence of views regarding the SCM among researchers, which become the main cause in not considering doubtless the SCM as a developed discipline. Ellram & Cooper (2014) made a research on the literature available on this topic and after that, they classified it according to the five above perspectives. In this way, they realized an assessment on the current supply chain research and practice. They concluded the study by stating that SCM develops through business practices, academic research and education. Also, they underlie a set of SCM principles like improved communication, information transparency, lean principles, quality, inventory management and more.

Even if the subjected reached a certain level of debate and research, SCM is not called a discipline in its own right yet. Also, so far it has been studied from a wide range of different theoretical perspectives included in diverse academic disciplines (Cousins *et al.*, 2006). This encouraged an active debate but at the same it formed a fragmented literature, making it difficult to provide commonly agreed and consistent findings. A unifying theory of supply

chain management is not emerged yet. The table below provides a list SCM definitions identified in the literature. There are presented as they were found with their original sources.

Table 2. Definitions of supply chain management.

Author(s) of the source article	Definition
Danie J. Nel; Johanna A. Badenhorst-Weiss (2011)	“SCM is the design and management of value-added processes (or activities) and relationships within organisations and across the network of organisations that form the supply chain to meet the real needs of the end customer and to increase efficiency and value to gain a sustainable competitive advantage for all the organisations that form part of the supply chain (Mentzer, 2004; Ayers, 2006; Bozarth & Handfield, 2006; Fawcett, Ellram & Ogden, 2007; Wisner, Tan & Leong, 2009)”.
Stevenson, Mark; Spring, Martin; (2007)	. . . “the supply chain is the network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hands of the ultimate customer (Christopher, 1998, Chapter 1)”.
Ibrahim, Hadiyan Wijaya; Zailini, Suhaiza; Tan, Keah Choon; (2013)	“SCM is the systemic and strategic coordination of traditional business functions internally within an organization and externally across businesses within the supply chain, for the purpose of improving the long-term performance of all the business entities along the supply chain (Mentzer et al., 2001)”.
Kumar, C. Ganesh; Nambirajan, T. (2014)	“SCM is defined as set approaches utilized to efficiently integrate suppliers, manufacturers, warehouses and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system wide costs while satisfying service level requirements (Simchi-Levi, Simchi-Levi, & Kaminsky, 1999)”

<p>Ambe, Intaher M.; Badenhorst-Weiss, Johanna A. (2011)</p>	<p>“Supply chain management (SCM) can be defined as the systems approach to managing the entire flow of information, materials and services from the raw materials suppliers through factories and warehouses to the end customer” (Leenders and Fearon, 2004; Ambe, 2010)”.</p> <p>“SCM exists in all types of business organisations and can be classified into three categories: a management philosophy, implementation of a management philosophy and a set of management processes (Klemencic, 2006; Lambert, 2006)”.</p> <p>“SCM involves the management of upstream and downstream relationships with suppliers and customers to deliver superior customer value at less cost to the supply chain as a whole” (Christopher, 2005)”.</p> <p>“Supply chain management (SCM) can be defined as a set of approaches utilised to efficiently integrate and coordinate the materials, information and financial flows across the supply chain, so that merchandise is supplied, produced and distributed at the right quantities, to the right locations, and at the right time, in the most cost-efficient way, while satisfying customer requirements (Hilletoth, 2009)”.</p>
<p>Grimm, Curtis; Ren, Xinyi; (2015),</p>	<p>SCM is “the management of relationships in the network of organizations, from end customers through original suppliers, using key cross-functional business processes to create value for customers and other stakeholders (Lambert, 2014)”.</p> <p>SCM “[...] encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities,” (..) “coordination and collaboration with channel partners, which can be suppliers, intermediaries, third-party service providers, and customers. In essence, SCM integrates supply and demand management within and across companies (Council of Supply Chain Management Professionals (CSCMP), 2013)”</p>
<p>Talavera, Gloria V.; (2015)</p>	<p>“SCM is a management function, (2) SCM involves key stakeholders (e.g., the suppliers, the manufacturers/service providers, and the customers), (3) SCM seeks to meet the requirements of its customers, and (4) SCM involves the relationship between the different supply chain partners to achieve customer satisfaction. SCM is also a discipline founded on the management of</p>

	relationships between corporate functions and across companies” (Talavera, Gloria V.; 2015)
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Christopher and Holweg, in their paper: ““Supply Chain 2.0”: managing supply chains in the era of turbulence” (2011), highlight the effects of the volatility on key business parameters. They refer to this as “turbulence”. Moreover, according to them, the “conventional wisdom” related to the SCM of nowadays is not as much relevant as it should be because the business environment has changed. They draw the attention on the fact that the SCM models were invented in times of relative stability which is no more the case today. They also support the idea of rethinking the SCM in a matter which allows the shift from the “*lowest global cost*” to a flexible supply chain. This turbulence represents a risk, but if the exposure to the risk is correctly managed, then it can be transformed into an opportunity.

A new dimension to be considered within SCM is the globalization. Imbrahim et al. (2013), in their analysis of the global supply chains research, discovered that especially after 2005, the interest in the global perspective over SCM has increased among the published articles and almost no such kind of research was conducted before 2000. Beside the need for a global consideration, Nel and Badenhorst-Weiss (2011) believe that “*supply chains must be designed for strategic advantage[...] to be more efficient and/or to be more effective*”. Mentzer, Myers and Stank (2007) in their “Handbook of Global Supply Chain Management” provide a comprehensive understanding and assessment of the field of GSCM by describing and critically examine key perspectives of supply chain. They describe the global market as being ferocious competitive and in order to succeed in such a market you need to identify a “*considerable source of competitive advantage*”, which they also believe it can be the SCM. They make this statement as in their opinion the fundamentals of global business are different than the ones to which the lower-scale business have been used to. To adapt to or adopt some of these new fundamentals, the management of the global supply chain is suggested to be the starting point.

For example, they mention that in such a competitive environment, the profit is not anymore ensured by the market share. Companies are developing “*cooperative relationships and collaborative partnerships to capture lifetime customer share (...). Viewing the complete supply chain for producing value, they (v.d. firms) recognize the necessity of partnering with other organizations*”. The end-users captured the power from corporate buyers and now the

downstream business becomes even more important as it is important for companies to offer mass customer customization, to self-improve on the competition not only based on quality but also based on time. Constantly, they need to adapt and use in their advantage the developments in technology and communication or government policies.

2.3 Demand (Chain) Management

Remembering the statement of Ellram and Cooper (2014) in which they affirm that “supply chain management” might not be the best term to describe the concept, this part of the literature review will also bring into attention the efforts of other authors to extend or to focus also on demand and not only on supply (as the term might suggest) and its importance. As Hilletoft, (2011) reminds us, many authors of SCM literature tried to incorporate various demand process in the supply chain management definition. Therefore, in the SCM literature, some academicians also mention about “demand management”, “demand chain” or “demand chain management”. The next paragraphs will reveal their opinion, perspective and definition of these terms, and why, according to them, it is required to emphasize more on this part of the chain.

Studying the role of demand in achieving supply chain agility, Gligor (2014) comes to the conclusion that focusing only on manufacturing, procurement or distribution is simply not enough. To achieve a certain level of agility of SC, also flexibility in demand management is required. Demand management is an emerging dimension of SCM which has not received much attention from the academic literature, especially on its impact on supply chain performance (Rexhausen, *et al.*, 2012). By some academicians is considered a source of competitive advantage and also a new evolution step in SCM. A study in this direction has been conducting by Rexhausen, *et al.* (2012), where, they use the definition of the demand management as “*as the ability of a company to understand customer demand and requirements and balance them against the capabilities of the supply chain*” while demand chain management (DCM) “*can be considered as a set of practices for managing and coordinating the supply chain from end-customers backwards to suppliers*”. This element is not reduced only to activities and efforts of forecasting the demand but it also includes practices of product and customer segmentation, operations planning and sales. The study revealed a strong impact of the demand chain management over the entire supply chain performance and a need for

improvement of DCM practices. Walters (2006) shared the same approach, defining demand management as: *“an understanding of current and future customer expectations, market characteristics, and of the available response alternatives to meet these through the deployment of operational processes”*.

Supporting the same idea but with from a different perspective, Hilletofth (2011) describes the demand chain: it *“comprises all the demand processes necessary to understand, create, and stimulate customer demand and is managed within demand chain management (DCM)”*. He continues and also describes the supply chain as different entity: it *“comprises all the supply processes necessary to fulfill customer demand and is managed within supply chain management”*. He actually sees the same chain but from two distinctive perspectives: the one of the demand and from the perspective of supply. Maybe this is not considered a new fact but this is important to mention as some companies, according to him, are focusing either on one part of the chain either on the other, creating two different business models: demand-led or supply-led.

The term of Demand Chain Management was firstly used by Vollmann and Cordon in 1997 (Vural 2015) and they actually proposed a replacement of SCM with DCM. Hilletofth (2011) has an entire different approach and he even goes a step further regarding the SCM concept, by avoiding the replacement of SCM with DCM or the integration of the demand element within the SCM, by rename it into: *“demand-supply chain management”* (DSCM). Even if this new term seems that it has not gained yet the academic approval, Hilletofth (2011) use the next definition of it: *“the strategic coordination of the demand and supply processes within a particular company and across the demand-supply chain in order to provide superior customer value as cost efficiently as possible”*. This idea of coordination and synchronization of the two sides of the chain was also supported by Walters (2006). He stated that the two of them, demand chain and supply chain, rather converge than conflict. An effective demand chain management can lead to an efficient supply chain.

Wong et al. (2012) also demonstrate the need for stakeholder and customer alignment within a supply chain in order to add value for both, stakeholders and costumers. Even if this is also acknowledged by other scholars too, Wong et al. (2012) identified a lack of knowledge within the SCM literature on how this can be achieved. They emphasized the lack of consideration on how shareholder value can be simultaneously considered with customer value. *“Supply chains should be responsive to customer requirements and flexible to demand-and-supply challenges”*

(Talavera, 2015). Even if the superior customer value is the ultimate goal of SCM, it is achieved through the establishment of efficient SCM. In more words, the aim of it is to match the demand with supply using as less resources as possible.

Vural (2015), instead, considers this a wrong approach because it focuses only minimization of disruptions, elimination of uncertainty, adequate inventory levels and lead times. This perspective, as the author mention, fails to “*comprehend what the ultimate customer perceives as valuable and how this perception can be converted into value based market offering*” (Vural, 2015). The focus of SCM is now shifted from supply issues to demand driven value and from companies’ profits to customer satisfaction. These are visible on Porter’s two-dimensional value chain model which presents the ways of improvement for companies under *effectiveness* (increasing value through differentiation) and *efficiency* (cost reduction) concepts (Zokaei, Hines, 2007). As a result, the nature of the demand for a specific product or service is now considered a starting point in developing a strategy (Qrunfleh, Tarafdar, 2013).

On another hand, according to Talavera (2015) the Supply Chain Structure can be different from firm to firm. One of the causes for this could be the different departments which are responsible for handling these processes (production control, logistics, supply and even material department). It is the same for demand management (logistics department, marketing services, sales planning group, and again by the material department). Ambe with Badenhorst-Weiss (2011) and Vural (2015) support the idea that in an ideal world, the SC would be designed rather from “customer backwards”. More than an ideal scenario, is also seen by the authors as a good recommendation. Customer focus, in their view, is about designing a SC that can meet customer’s needs. The satisfaction of the customer becomes the ultimate goal of the company so the client is in charge of the market now which makes the interfirm cooperation crucial (Mentzer *et al.*, 2007). It is imperative for the SC managers to understand the needs of their customer and to choose the best strategy to meet them (Abme, Badenhorst-Weiss, 2011). In case this is not happening and there is a mismatch between supply and demand, the company will have to deal with mediation cost (e.g., markdowns and stock outs, obsolescence, costs of inventory) (Qi *et al.* 2015).

Improving the responsiveness of the SC and its flexibility in meeting customers demand is now considered a strategic capability (Stevenson, Spring, 2007). Datta (2017) mention about empirical evidences found in the Norwegian seafood industry which shows that collaborating

with customers helped in coping with supply uncertainties. The flexibility capabilities can provide a competitive advantage in an uncertain environment for companies.

2.4 Supply Chain Management Strategies

Qi et al. (2011) emphasize on the influence of the environmental uncertainty over the choice and even implementation of a SC strategy. In their view, the environmental uncertainty plays the role of a moderator between the competitive strategy of a firm and its SC strategy. The way this is managed might differ from industry to industry. The supply chain flexibility is seen by many authors (Stevenson, Spring, 2007; Mandal, 2015) a mean to cope with the uncertainty. Beside, striving for flexibility, other authors also suggest other SC strategies which also bring other benefits.

The SC strategy represents the methodology adopted by its members to meet the demand. At a global scale, the competitiveness is even more intense which makes the meticulous managing of a GSC a vital factor (Ibrahim *et al.*, 2013). The strategy of a SC has direct effects on performance (Datta, 2017). A Price Water House Cooper survey (2003) suggests that companies which “*acknowledge supply chain as a strategic asset, achieve 70% higher performance*” (Parulekar, Verulkar, 2015). The creation of strategic differential advantage is the objective of supply chain management (Hofmann, 2010). Also, the role of SC strategy is to ensure a superior value to the end customer in an efficient way (Parulekar, Verulkar, 2015).

The nature of SC activities and the relations among the members within the chain are influenced by the SC strategy of the firm (Datta, 2017). A lot of SCM studies nowadays are related to a growing trend within the field of strategic management and still, a significant body of strategic management research is unexplored. (Grimm, Ren, 2015). A very important core capability of SCM is to design an effective SC strategy (Ambe, Badenhorst-Weiss, 2011). Moreover, a SC strategy can be used to support a corporate strategy (Qi *et al.* 2011). In this sense, Hofmann (2010) identifies a missing link between SC and corporate strategy which is deep by the supply chain managers’ s lack of strategic capabilities and orientation.

According to Birhanu *et al.* (2014): “*companies that focus on a specific SC strategy are more likely to build shareholder value than those who do not*”. The strategic element of a SC became a factor of paramount importance since the complexity of the business environment of nowadays changed the “*the focus of competition from a firm-versus-firm paradigm to a supply-*

versus-supply chain paradigm". To obtain a competitive advantage, the SCM is used as a strategic tool" (Qrunfleh, Tarafdar, 2013). This competitive advantage is obtained by developing means of differentiation in the form of customer responsiveness or by means of low cost in the form of efficiency (Nel, Badenhorst-Weiss, 2011). The strategy of supply chain integrates the end-to-end processes through the value chain to provide an optimal value for the end customer (Qrunfleh, Tarafdar, 2013). In the table below are listed the definitions of SC strategy found in the literature

Table 3. Definitions of supply chain strategy.

Author(s) of the source article	Definitions
Qrunfleh, Sufian; Tarafdar, Monideepa (2013)	..."is defined as a set of approaches utilized to integrate suppliers, manufacturing, warehouses, and stores so that merchandise is produced and distributed at the right quantities, to the right location, at the right time, in order to minimize system-wide costs while satisfying service level requirements".
Danie J. Nel Johanna A. Badenhorst-Weiss (2011)	"Supply chain strategies can be defined as strategies required for managing the integration of all the supply chain activities through improved supply chain relationships to achieve a competitive advantage for the supply chain".
Qrunfleh, Sufian; Tarafdar, Monideepa (2013)	"Supply chain strategy requires an end-to-end focus on integration of business processes throughout the value chain for the purpose of providing optimum value to the end-customer".
Ibrahim, Hadiyan Wijaya; Zailini, Suhaiza; Tan, Keah Choon; (2013)	"Global supply chain strategy describes the overall corporate plan and policy used to manage transnational sourcing, manufacturing, and logistics functions. A firm's global supply chain strategy can vary widely depending on several attributes, such as the scope of activities involved, continuity, complexity, symmetry, and degree of formalization".
Ambe, Intaher M.; Badenhorst-Weiss, Johanna A, (2011)	"A supply chain strategy is part of the overall business strategy, designed around a well-defined basis of competition (innovation, low cost, service, quality) (Cohen and Rousell, 2005)"

	<p>“Supply chain strategy utilises interfirm coordination as the capability that facilitates achievement of objectives focused on revenue growth, operating cost reduction, working capital and fixed capital efficiency to maximise shareholder value (Deffee and Stank, 2005)”.</p> <p>“It is integrated with marketing strategy and with customers' needs, product strategy and power position. In a rapidly evolving global economy, no firm exists in a vacuum (Hugo et al., 2004; Ambe and Badenhorst-Weiss, 2010)”.</p>
Jüttner, Uta; Christopher, Martin; Godsell, Janet; (2010),	“Supply chain strategies comprise a focal firm’s behavioral orientation towards collaborative partners in the chain or network and include process configurations across the key supply chain processes”
Perez-Franco, R.; Phadnis, S.; Caplice, C.; Sheffi, Y. (2016).	“Supply chain strategy of a BU is defined “as the collection of general and specific objectives set for the supply chain of the BU, and the policies and choices put in place to support them, with the purpose of supporting the business strategy, given the BU's context and the environment”.

According to Manuj, Sahin, (2009), the more complex a SC is, the less efficient is likely to be. Their study on antecedents of SC complexity revealed that the size and structure of SC, customer expectations, environmental conditions, globalization and organization structure are the elements which affect the complexity of SC. This existing level of competitiveness requires agility, fastness and flexibility. These can be improved or achieved through coordination of the firms in the supply chain (Mentzer et al., 2007). It might also be considered a necessary condition.

The strategy of a supply chain is determining its nature, goals and objectives. The SC strategies are classified predominately according to their focus: cost efficiency, leanness and quick response, flexibility (Qrunfleh, Tarafdar, 2012). According to Birhanu *et al.* (2014), the SC strategies are classified as being: efficient or responsive; lean or agile; efficient, responsive, risk-hedging or agile; pull or push. Most of them share common elements and even some researchers are finding them as being similar even as synonyms (*e.g.* efficient and lean or responsive and agile (Madhani, 2017)). Nevertheless, most of the researchers have referred to two primary criteria for SC strategies: leanness and agility (Qi *et al.*, 2011). These form two distinctive SC strategies: lean and respectively agile. There is also a hybrid form which is a

combination of agile and lean strategies, (named by some academicians leagile) exploiting the benefits of both but in most of the cases, the returns on the investments are not satisfactory (Nel, Badenhorst-Weiss, 2011).

- **Agile supply chain strategy**

An agile strategy is described as being able to rapidly change, to remain dynamic in continually fragmenting the global markets, context-specific, growth and customer oriented (Birhanu *et al.*, 2014). It mainly has a “wait-and-see” approach to demand instead of speculating *what* might be demanded, the *quantity* and *location* of demand (Madhani, 2017). A company which adopts this strategy does not make any step until the demand is known. The company has to continually respond to the changing customer needs in a quick and dynamic matter (Qrunfleh, Tarafdar, 2012). To achieve this, the SC has to be flexible and to quickly and effectively adapt to changes, which is also bringing a competitive advantage some times. The supply base has to be flexible and to have the ability to smoothly manage the flow of supplies in order to reduce the understocking or the overstocking of the inventory (Jajja *et al.*, 2016).

The main idea of an agile strategy is to focus on differentiation of the product (and less on the costs) in a way which results in a unique feature that is valued by the customer and makes him pay a premium price (Qrunfleh, Tarafdar, 2013). Another focus is on the ability of becoming and remaining flexible in a quick introduction of new products (Jajja *e. al.*, 2016). Some cost may be sacrificed for flexibility and speed (which are key concepts consistently linked to agility (Madhani, 2017)). The main competitive advantage comes from this and from selling a more valuable product than competitors. Also, this strategy facilitates the customization of the product (Qrunfleh, Tarafdar, 2013). It is mainly used when the demand is highly volatile and uncertain.

- **Lean supply chain strategy**

A lean strategy is based on a continuous engagement in improving the activities of eliminating waste and non-value steps along the chain (Birhanu *et al.*, 2014). The adopters of this strategy are mainly driven by cost efficiency. The main methods of achieving this are by eliminating waste and effectively manage (and/or reduce) the inventory (similar with the principles of lean production). Therefore, the selection of the supplier might be based on their ability to generate low-cost input (Qrunfleh, Tarafdar, 2013). But Jajja *et al.* (2016) say that the suppliers are selected based on their quality focus and performance. Moreover, a collaborative relationship, according to them, reduces the opportunistic behavior of suppliers and increases the potential

for quality outcomes. This kind of suppliers brings a competitive advantage, especially in case of new product development (Jajja *et al.*, 2016).

The competitive advantage comes from offering a low costs product. The strategy is based on economies of scale as a result of sales volume. Firms that implement this strategy are trying to control the cost of production, supply and distribution, to increase the capacity utilization and to minimize other costs of activities like advertising, research and development, etc. (Nel, Badenhorst-Weiss, 2011). The aimed result is a high-cost efficiency within the supply chain. For this are eliminated the non-value-added activities and waste is accepted only on terms of inventory, time and process redundancy (this is partially contradicted by Madhani (2017) who says that leanness is meant to eliminate the waste of time too). Simultaneously, the firm will focus on optimization techniques and economies of scale. A strategy based on these elements is recommended when the product variety is low and it is predictable demand. A low demand should stress the need of efficiency.

2.5 Conceptual frameworks. Differentiating supply chain strategies

A framework or model (very often these terms are used interchangeably) is a “*prescriptive set of things to do*” portrayed sometimes through graphical representations or diagrams. A framework is based on “*a set of basic assumptions and fundamental principles of intellectual origin in which discussion and actions can proceed*” (Soni & Kodali, 2013). A sound framework should link concepts with practical application. For this, it has to describe the elements within the system and their relationship, it has to reveal the steps/stages/sequences of activities to reach its goal and to point out what is connecting them. Searching for generalizable strategic inventory framework, Nag *et al.* (2014) came to the conclusion that in the SCM literature “*a parsimonious framework which can be applied to inventory strategy formulation from a practical benchmark perspective*” is missing.

Instead, Soni & Kodali (2013) searched in the literature the existing frameworks on SCM which fit the description above and after analyzing the results they created “*A conceptual framework of SCM excellence*” (see Annex.1). According to their framework, the supply chain strategy selected based on the corporate strategy. Then, these two form the base for the main pillars of the mission of the company, and they are the following: strategic management, logistic

management, integration, manufacturing management, marketing management, demand management, information technology, collaboration management and supplier management. These also define the strategic fit between competitive strategy and supply chain strategy. The supported mission is under the ultimate goal of the company, described by its vision.

Many researchers have advocated for market environment and product characteristics as main components that founded the base for SC strategy choosing decision. Moreover, the research within contingency-based proved that the external environment is also an important variable in this decision process (Qi et al., 2011). To achieve a competitive advantage, Datta (2017) suggests that choosing the appropriate SC strategy is essential. According to Ambe and Badenhorst-Weiss (2011) “*choosing and implementing the right supply chain strategy is believed to enable the improvement of supply chain management performance*”. The authors made a list of models developed by different scholars which have been used for differentiating types of strategy in their view for SC. This is summarized under the table below, Table 4.

Previously, it was agreed by the SC scholars that the nature of a product set up the base for choosing the SC strategy (Madhani, 2017). This is Fisher’s model developed in 1997, where he classified the nature of the products in innovative or functional. He considered both, product and demand, the last being characterized on stability versus evolving characteristics of demand (Ambe, Badenhorst-Weiss (2011) and Datta (2017)). For innovative products, he suggested a responsive supply chain and for functional products (stable goods) an efficient SC.

Lee’s approach on choosing the best strategy was based on the uncertainty of demand and supply. He made a two by two matrix of supply and demand uncertainty to find the suitable SC strategy. According to him, there are four types of SC strategies: agile, responsive, efficient and risk-hedging. According to this, an agile strategy will be utilized to be responsive and flexible to client’s needs while pooling inventory and other capacity resources are used as hedging tools for supply shortages. A responsive SC will use mass-customization processes and build-to-order techniques to manage diverse needs of demand. For a low supply and uncertain demand, Lee’s model suggests an efficient SC because it uses optimization operations to ensure a cost-effective and efficient transmission of flow across SC. The last one, risk-hedging strategy, is proposing a covering of the SC risks through safety stocks and multiple sourcing.

Naylor *et al.* (1999) model (Datta, 2017) tries to combine an upstream chain with cost effectiveness activities with and downstream that delivers high-service levels in condition of a

volatile market. They combine the agile and lean strategy to overcome the volatility of the market. The key to their model is to know precisely when and where to apply lean or agile.

Christopher (2000) framework involves the concept of decoupling point (*“The decoupling point therefore is the point in the product flow stream to which the customer’s order penetrates and where real-time data and forecast-driven activities meet”* (Nel, Badenhorst-Weiss, 2011), see an illustration of this in Annex 3). The point of this is to hold the inventories at a generic level that allows locally customization and it is released when the demand is very well known. This model also involves a mix of lean and agile strategy forming a hybrid form called “leagile” (Datta, 2017). In another study, Christopher *et al.* (2006) propose three dimensions to classify global supply chains: products (standard or special), demand (stable or volatile) and replenishment lead-times (short or long) (Ambe, Badenhorst-Weiss, 2011).

Chopra and Meindl relate to two strategies of SC: responsiveness and efficiency. To achieve a strategic fit, they present three steps: 1st: establish the competitive strategy of the SC and measure the uncertainty level of the SC; 2nd: recognize the SC strategy; 3rd: match the competitive strategy with the SC strategy to obtain a strategic fit. For this, the authors have identified a direct relation between competitive strategy and SC strategy (Ambe, Badenhorst-Weiss, 2011).

A very different approach is offered by Fawcett *et al.* (2007). They consider the product life cycle (PLC) and its nature as a source for SC strategy determination. The products are classified as innovative, hybrid or functional and each one of them goes through introduction, growth, maturity and declining phase. They propose an analysis of each phase of each product and then decide the fit strategy which is narrowed to lean or agile (Ambe, Badenhorst-Weiss, 2011).

The same study of Ambe and Badenhorst-Weiss (2011) describe the model of Simichi-Levi which also consider two types of strategy for SC: push and pull. The first one should be applied in case of homogenized products and stable demand and here the decisions regarding the distribution and production are based on long term forecasts. For the second case, pull strategy, the actual demand is driving the SC. The time to market is variable, low potential for economies of scale.

In the work of Stavroulaki and Davis (2010), they proposed a conceptual alignment framework which is communicating the firm’s strategic vision in relation with a product and its supply chain. They use the manufacturer as a focal point of the SC and consider four types of SC: (build-to-stock (BTS), assemble-to-order (ATO), make-to-order (MTO), and design-to-order

(DTO)) which are determined by the product’s characteristics (Annex 3). By doing this they provide a process-oriented view of SC and explore the linkages between a product, its SC’s processes and its strategy, emphasizing the need for alignment.

In order to deliver performance, a company needs to focus on demand patterns. The companies nowadays are challenged to sacrifice the efficiency for the responsiveness. If it still plans to be a low-cost leader, then it has to build the “*most efficient, economical supply chain possible*” (Nel, Badenhorst-Weiss, 2011). Also, the authors suggest the idea that even if a company deliver a high-quality product which represent a mean of competitive advantage, in order to be a sustainable one, the firm also has to deliver the products in a reliable and quick way. Under this, circumstances, “*the most critical element of a supply chain strategy is deciding how to make the trade-off between responsiveness and efficiency*” (Nel, Badenhorst-Weiss, 2011). For this, the authors built a framework to suggest the most suitable strategy for companies which includes an analysis of market demand predictability, market winners and the decoupling point.

Table 4. Summary of main supply chain strategy frameworks

Author	Criteria used for differentiating type of strategy	Important note about the framework
Fisher ML 1997	The nature of a product: innovative or functional	Functional products need a strategy oriented toward efficiency. Innovative product requests a responsive SC
Lee (2002)	The uncertainty of supply and demand	Efficient and responsive strategy is induced by a stable supply process. Agile and risk-hedging are associated with evolving supply chain process.
Christopher (2000)	The role of decoupling point	The final configuration of a product is delayed until the demand is well known

Christopher <i>et al</i> (2006)	It considers the nature of product, demand and replenishment lead-times	Propose three dimensions to classify global supply chains: products (standard or special), demand (stable or volatile) and replenishment lead-times (short or long)
Naylor, Naim, and Berry 1999; Mason-Jones, Naylor, and Towill 2000; Van Hoek 2000	Combines agility with efficiency	This is meant to solve the problem of demand uncertainty by determine the exact moment and place for apply lean or agile strategy
Chopra and Meindl (2010)	A supply chain strategy that match with competitive strategy	Establish the competitive strategy of SC and measure the uncertainty level faced by the SC. Then the SC strategy is acknowledged. Finally, the competitive strategy of SC and SC strategy are matched to strategic fit zone.
Fawcett et al. (2007)	The product life cycle is considered.	The product goes through an introduction, growth, maturity and a declining phase and the authors also look at the type of product (innovative or functional). Then they decide the right strategy.
Simichi-Levi (2003)	The nature of product and demand	Push strategy is possible for homogenized products and stable demand. Pull strategy

		is recommended if the demand drives the SC.
Nel, Badenhorst-Weiss, (2011)	Demand predictability, market winners and the decoupling point	<i>“The most critical element of a supply chain strategy is deciding how to make the trade-off between responsiveness and efficiency”</i>

Ambe (2012) after an analysis of all the other frameworks, made a classification into three categories of all the included factors for determining the right strategies: the characteristics of the product; the manufacturing characteristics; and the decision drivers of supply chains. Then he proposed a conceptual framework for choosing the optimal strategy for a supply chain by considering each of these category to which he allocated different factors with different description corresponding to a lean SC or an agile SC (see Annex 2).

Mainly, the existing strategic frameworks have focus on three things: the relation between products and processes; the interface between products and SC; description of SC and its processes.

2.6 Supply Chain Management within automotive industry

According to Bennett & O’Kane (2006), the industrial production of modern world has been developed through three major phases or paradigms so far. 1st: *Craft production*, which was mastered and dominant in Europe; 2nd: *Mass production*, which was mastered and dominant in USA; 3rd: *Lean. JIT production*, which was mastered and dominant in Japan. In the vision of the authors, the next phase in manufacturing is the *Agile production*. Traditionally, the production was the seen as the focal point for value creation within the automotive industry (Walters, 2006). Part of academia suggests that the modern manufacturing management needs to be reevaluated in order to move towards the future development of agile manufacturing and consider the adoption of agility.

According to Talavera (2015), the industry is characterized by a strong global competition and the pressure to reduce costs. Also, the author emphasizes the need to deal with the demand

distortion. Another challenge is to speed up the delivery and to reduce the time-to-market distribution of new automotive. Kannegiesser *et al.* (2014) name climate change, limited resources, pollution (along with the new regulatory compliance), noise, congestion and the negative impact of accidents on people' health as major challenges for the industry. Moreover, from the supply chain perspective, the authors suggest that the current industry is transcending a period of reinvention because the new trends like electrification and detachment from crude-oil of the fossil-fuel power trains (diesel, benzene) has begun. The transaction from one type of fuel to another means significant changes for the components of motors (e.g. electric batteries), so for the supply chain as well. New suppliers will be contracted while other relations will be broken.

Other challenges of the car supply chain are presented by Turner & Williams (2005). These refer to both, managerial and as a topic for research. Firstly, they mention about the complexity of the product. Each car is part of a production set which can have distinct specifications in terms of engine, body, color, etc.. Secondly, they talk about the complexity of the supply network. A product of this complexity (a vehicle consists of around 10000 parts (Gunther *et al.* (2015)) needs different suppliers spread on different levels and also multiple stockings locations are needed, from the assembly part to hundreds of dealers in different markets. Another major challenge presented by them is the consumer behavior (e.g. their willingness to wait for a new car to be built-to-order). Also, demand seasonality can be a challenge for level production schedule because. Nevertheless, the ageing stock might require massive discount to sale the unsold cars.

Turner & Williams (2005) highlight the idea that SCM topic within the automotive industry has been a subject of intense research but most of this has focused on the "component supplier-production sections", while the "production-distribution sections of the chains" received much less attention from the academic research. They also stressed the fact the traditional downstream supply chain was starting with the production scheduling. The main purpose was to keep the production as stable as possible and to ensure that the cars are financed by dealers immediately after production. Once the vehicle is assembled, it is quickly send to the dealer, who starts an aggressive process of selling. With this approach, the customer is not involved in the process until the buying phase. Instead, a responsive supply chain should have the capability to support mass customization production. By adopting this approach and allowing the customer to get involved, the result is a car which is matching the specifications of the client.

Gunther *et al.* (2015) tried to investigate by using mathematical modeling framework the electric car as sustainability solution for the industry, its potential as competitor against conventional car and the impact of governmental regulations in this direction. They concluded that the electrification of the vehicles can be improved by lowering battery costs. In this sense, they see the battery production as a key bottleneck for the attempt to increase the fleet size of electrified cars. Also, in this regard, governmental regulations play a very important role, having the power to ensure a lower cost for electricity than for other fuels. Also, it can lower the demand bringing more mobility into public transportation and by issuing more restrictions on carbon emissions. These measures are encouraged by the authors because, according to their calculations on a 20 years horizon, the gas emissions will steadily grow even if are considered the actual climate protection regulations.

CHAPTER 3. METHODOLOGY

This chapter is providing a short presentation on the four levels of understanding (Kuada, 2010) adopted by this research and also, it describes the perspective from which data is interpreted. Further, it details how the literature review was conducted, the selection criteria, the analysis and synthesis criteria.

3.1 Paradigmatic position of the current research

According to Kuada (2011), most of the research methodology textbooks of social science are identifying four levels of understanding in a research design process: Philosophical/Theoretical Viewpoints, Epistemological Choice, Methodological Decisions and Choice of Methods and Techniques. The perspective of the current paper will be presented in the next paragraphs through these four levels in order to offer a description on how the environment is perceived, how the nature of the knowledge is seen, the reason for choosing the specific methods of research process and the description of them. This is following Kuada's (2011) guideline.

Level 1. The philosophical and theoretical level

This level refers to the nature of researched topic, of what the research is seeking something about. The term used for this is *ontology*. The nature of what is searched is described by two broad perspectives: *real and external to an individual human being* or *subjectively created (by the individual)*. So, the relationship between human beings and their environment is described by two situations: the social environment is outside the individual or the social environment and the human being are co-determining factors. In the absence of clear understanding on how the environment and the human beings are determining each other, this research is having the first approach.

Level 2. Epistemological level

This refers to what is conceived as “truth” and describes the nature of the knowledge. Some scholars believe that “truth” about a social world can be known from an external observer’s point of view while others consider that is only possible to understand the social world only from the individual actor’ frame of reference. In this case the, the social world is studied “inter-subjectively” and this is also my view due the limitations of this current paper.

Level 3. Methodological approach

This is describing the selected way to acquire knowledge and the reason for this selection. For social world that can be objectively study from outside, the study should include a methodology that focuses on the examination of relationships as universal laws but for “inter-subjectively” studies, the methodology will focus on individuals’ interpretations of the world. As a result, the current paper uses a methodology that reveals the individual interpretation.

Level 4. Methods and techniques

On this level, there are described the specific methods and techniques adopted by a study. Also, a description of the problems that interfered during the research process and their solution needs to be included. The next sub-chapter is devoted to description of these.

Kuada (2011) also describes the way of seeing the relationships between the complete objective or subjective perspective over the social world. These two perspectives can be mutually exclusive or very different and this is the view of a researcher called *purist*. The same perspectives can be seen as a combination and not as single alternatives depending on the research situation (*situationalist s’s* perspective). The third category or researchers, *pragmatist*, accept both perspectives and they believe that the nature of the research issue and the objectives

of it are determining the choice of perspective. It can be subjective, objective or a combination of them.

Since SCM is an emerging field, where different perspective and opinions are exposed that sometimes are even contradictory and a common ground is not established yet, this research tend to have more of a subjective approach in selecting and then interpreting the perspectives of some individuals in order to gain knowledge. Where is possible this will be done from an objective perspective, where this is considered limited, a subjective approach (especially in interpreting the industries strategic determinants) will be adopted. So, this is better represented by situationalist's view. The goal of this research is not to find the "universal truth", but rather to gain unique understanding of the investigated topic.

3.2 Research process approach and design

For this research, a systematic review was used. Firstly, this was used in the field of medicine where it was developed by the consortia Cochrane Collaboration (Denyer, Tranfield, 2009). This is a methodological approach to localize studies, select and evaluate contributions in order to analyze and synthesis the data with aim of reporting the evidence in way from which clear conclusions can be drawn on what is known or not. It differs from other research methods because is setting specified criteria for selection and inclusion of study materials in way which is transparent for the reader (Denyer, Tranfield, 2009) and it can be reproduced. The reviewers have to summarize all the existing data in unbiased manner. Moreover, it can allow a research on one topic to be conducted in different fields. Also, it has the potential to discover literature gaps and highlight other research needs.

The main critics of this method are founded on 4 main pillars:

1st. In a study which includes different disciplines, there might by a competition on epistemological and ontological level; 2nd. Having a variety of types of studies, different perspectives could be included; 3rd. The undetermined extent to which the proceduralization (or automatization) of systematic review methods can reduce the search bias or mitigate it; 4th. The quality and reliability of the synthesis made by a systematic reviewers.

With an appreciation of these critics and concerns, this research adopted a systematic approach based on five-step method of Denyer and Tranfield (2009). The authors, also are aware that the there is a different situation for each field and the context is very important. This approach is

more an evidence-based management, which in the context of the actual paper, it is considered suitable. According to them, the utility of this approach was also appreciated by other researchers in management and organization studies. Moreover, they detach themselves from the medicine science which uses principles like replicability, exclusivity, etc. and propose other key principles to be followed when conducting a research in the management field.

The revised four principles for systematic review in management and organization studies of Denyer and Tranfield (2009) are:

1. *Transparency*. The reviewers must be explicit and opened about the methods and the process used in the review. Secondly, they have to a clear presentation of the results by forming a link between evidence found and conclusions. Also, a reviewer has to be aware of assumptions and his prior believes. The need for more transparency in the literature reviews of SCM for the traceability of the arguments is also outlined by Seuring and Gold (2012), who encourage the reviewers to “*deliberately head for transparency and rigour in their review*”.

2. *Inclusivity*. According to the belief of some authors, is better to include the articles which “fit the purpose”. Others believe that should be included only those studies which adds something new to the researcher’s knowledge, or by evaluating the contribution of the article in theory building. Others suggest to include broad variety of sources just for a better understanding or to compensate the researcher’s missed judgement. The use of quality of research or journals ratings might not be a favorable choice (Denyer, Tranfield, 2009).

3. *Explanatory*. The process should be a conceptual innovation and reinterpretation of the extracted data from different studies. To obtain this, the reviewer has to juxtapose the theoretical, quantitative and/or qualitative information from one material with the one of another. This can represent a creative method to interpret and to go beyond a descriptive report.

4. *Heuristic*. A systematic review is very likely to offer a result which is relatively abstract. The findings, might help the practitioners in solving a problem but will not provide the exact solution. This is why it has a heuristic feature. It can take the form of guides, rules, suggestion, etc. which are actually “ideas”, “tools” or “methods” for practitioners that can be used in making a progress for finding a solution of a problem.

By applying the new defined principles in order to overcome the weakness of a narrative review, Denyer and Tranfield (2009) propose a five-step approach to obtain a systematic-informed review. These five steps are the following: question formulation, locating studies,

study selection and assessment, analysis and synthesis and reporting. Further the next step is represented by the use of results in automobile industry. In more details, this is how each step is described.

Step 1. Question formulation. In order to have a clear focus and direction of research, the research question and its formulation are critical. Also, according to Denyer and Tranfield (2009) it is important to involve a large number of stakeholders like consumers and policy makers. The authors also developed this acronym called CIMO (Context, Intervention, Mechanism, Outcome). This is useful in formulating and refining well-built systemic question.

Step 2. Locating studies. By using different search strings, keywords combinations and other search conventions, the reviewer has to locate, select and evaluate as much as possible of the relevant materials. So, the search engines and the search strings are key decisions at this step.

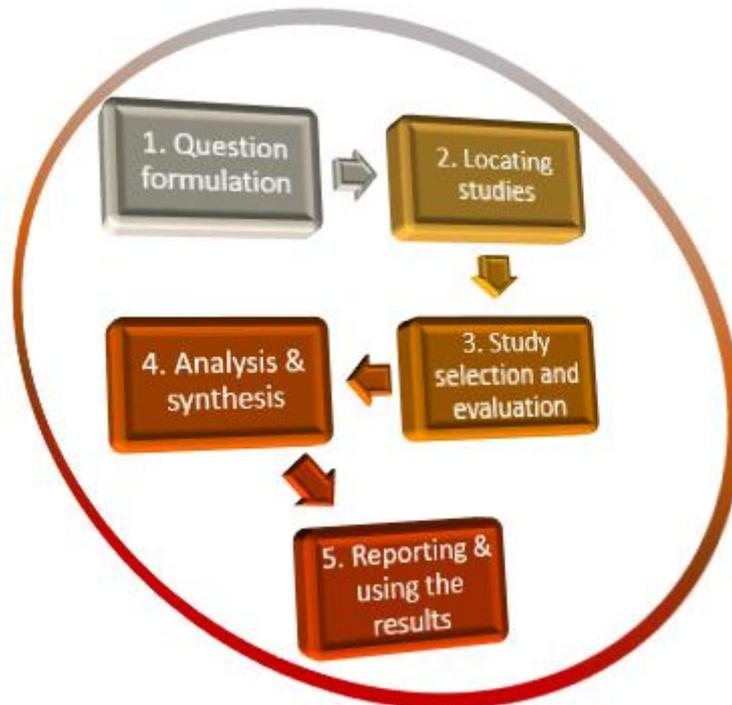
Step 3. Study selection and evaluation. In order to respect the transparency principle, the selection criterion has to be well-explained and helpful in the evaluation of the materials. The aim is to see if the article is really relevant for the research question.

Step 4. Analysis & synthesis. Firstly, the information is extracted from every material, then it is cross-tabulated and after that interpreted analyzed as objective as possible without using researcher's filters.

At this stage, the individual studies are analyzed and divided in constituent parts then these are described and how they relate to each other. By rearranging the information, the synthesis should provide new information or knowledge which is not visible at a first sight.

Step 5. Reporting and using the results.

Figure 1: The five-step systematic literature review process



Source: Adapted from Denyer and Tranfield (2009)

As a conclusion, the methods used in this research were considered to be suitable for the purpose and the nature of the current managerial study. By using the methods, this paper gains considerable potential in empowering the link between the science base of the supply chain management field and practice. The best available academic evidences are coupled with practical needs.

3.3 Application of the designed research process for the literature review

Application of the five steps approach:

1st step: Question formulation

- Which are the relevant strategic determinants for the supply chain management?
- Considering the generic strategies lean and agile, what framework should be used for determining an optimal supply chain?

- Regarding the trend of SCM transaction from lean to agile production, to which extent should the automobile industry adopt it, based in the results of the framework?

2nd step: Locating studies.

In the precedent chapter, it was provided a critical review of different themes which are linked in this research. The process started from three research questions and the concept that they imply. The sources of the reviewed literature are formed mainly by articles and books available on online data bases of Aalborg University Library. The chosen data bases are ABI/INFORM Collection, Emerald Insight and Science Direct, which are the platform for many different management journals. These have been selected because of their high relevant results and their possibility to combine different key words when doing a search. With a lower percentage, were used articles or reports from other data bases or internet resources. For a clear division of the sources and type of studying material, the bibliography of this research is split in a manner which allows the identification of the type of the article.

The search strategy of the materials was mainly focused on keywords and combination of those under each main concept. No specific selection criterion was used, the relevance of the materials being mainly set by the search engines of the selected AAU Library's databases. The preselected papers were mainly articles on the subjected and few chapters from some books were included. Other materials like, dissertations, conferences papers, etc. were excluded.

3rd step. Study selection and evaluation

Since these three data bases were very large, providing thousands (in some cases) of results, the review was limited to the first 2 pages (20 or 25 results/page) of listed materials for each combination of key words. This means that for each combination of words, 140 articles were scanned. In total, there were listed approximatively 840 results and after a preselection of the articles the number was reduced to circa 136. After a review of these, 36 were used because of their relevance for the second chapter of this paper. The chosen key words are listed In Table 5. The number of keywords is relatively higher than other used in other reviews (usually 3 combinations of keywords) because it is an emerging field and a common understanding of SCM is not established. Also, different elements of SCM are linked in this research and this explains the 6 combinations.

The set language of materials was English and the time frame of publications of article was 2005-2017. By choosing this time frame, it was aimed an inclusion of articles written before,

during and after the financial crisis of 2008. This important economic event can be interpreted as a “wake up call” for business management which made the companies to reshape their business models, to focus more on efficiency and/or effectiveness aspects (including the ones of supply chain) and to encourage the research on this area. This is how the time frame is justified.

Nevertheless, under some subjective considerations, some materials were included because they were a related direct recommendation of the mentioned search engines or they represented a relevant source for other found materials. For these exceptions, the database or the time frame might be different. Also, after a scan of the results lists, some materials of the search were not included because the content was highly focus only on a company or industry, the content or parts of it were not available online. So much of the literature review is based in conceptual articles and not that much on empirical ones.

Also, an important note, even if different general quality checklists of journals are often used to evaluate some studies and then to eliminate some of the “so considered low quality” journals, this paper aimed for a literature review with as much as possible articles. This is an effort made to avoid the exclusion of articles which might be relevant but they are not considered because of the quality of the publishing journal.

4th step. Analysis and synthesis. The literature material was reviewed only by one reviewer. It was more of a deductive approach of the descriptive analysis and it focused on the theme related to the SCM.

The thematic analysis brings together studies from different fields within the SCM. It included studies on the general concept of SCM, SC strategies, determinants of SC strategies, customer and SC strategy frameworks. Most of the papers are easy to identify since most of them are published after 2007.

5th step. Reporting and using the results. In this section are summarized all the data extracted from the selected articles and specify what is known or not. The conclusion parts offers a short summary of the review, limitations, recommendations for academia and practitioners among with suggestions on future research needs.

This paper is used for a presentation to an academic audience but it also provides a set of guidelines for practitioners.

Table 5. Summary of research process

Unit of analysis	Relevant articles published on the linkages among SCM, SC strategies, demand-SC, strategies framework, automobile industry. Conference communications and presentations, dissertations and any other article which was not having a strong relation with the keywords from above were excluded
Type of analysis	Mainly qualitative
Period of analysis: 2016-2017	2005-2017
Keywords used in searches:	<ol style="list-style-type: none"> 1. <i>“supply chain management”</i> 2. <i>“supply chain management” AND “literature review”</i> 3. <i>“supply chain management” AND “strategies”</i> 4. <i>“demand” AND “supply chain management”</i> 5. <i>“supply chain management” AND “framework” OR “model”</i> 6. <i>“supply chain management” AND “automotive industry”</i>
Total number of articles evaluated	840. After a scanning of titles it was reduced to 140. In the end 36 articles resulted from the research process were included in the literature

CHAPTER 4. LIMITATIONS AND CONCLUSIONS OF THE LITERATURE RESEARCH PROCESS AND REVIEW

This chapter is discussing the main points of the literature review. It starts with the identification of the limitations of the research process, gaps and a correction of those. After that, the main conclusions of the literature review are drawn.

A limitation of the literature search process is that it did not offer as a result the main original frameworks explained by their creators. The main reason for this is the fact that some of these papers have been written before 2005 and the time frame selected for this search process was 2005-2017. Another reason for this is the type of the study material. Some of the models have been described in books and this type of material has been excluded from the beginning of the search. The third reason is the limited access of this research to those articles. They were not available on Aalborg University's library or on Google Scholar. Still, a list of these frameworks (cited by other researchers) have been composed in the second chapter. After an exclusive search for those specific articles, some of them have been found and the next paragraphs will try to cover some of these mentioned flaws.

4.1 Adjustment of literature review and discussions of supply chain strategy models

In order to complete the literature review, here are the found articles on the mentioned models. Also, a discussion of those is made.

- Fisher's model (1997).

Fisher (1997) assumes that the pattern of the demand is a determining criterion for the nature of the product (innovative or functional) and according to him, "*the root cause of the SC problems is a mismatch between the type of product and the type of supply chain*". He believes that the innovation of a product brings more profit margins comparing to functional products but also has to fight with demand uncertainty. His model assumes that functional products have stable demand and long product life cycle while innovative products tend to be the opposite,

short product life cycle and unpredictable demand. Perez-Franco *et al.* (2016) discuss a set of critics of this model. They mention that there are empirical evidences against Fisher's categorization of products and supply chains. Also, the predicted effects of its framework on performance are not validated. It seems that his model is more focused on factors of a SC strategy rather than its determinants.

- Lee's model (2002)

He expands Fisher's model by including also the dimension of the uncertainty of supply not only of the demand. This new dimension is described as being "*stable*" (the supply base is well established and the manufacturing process along with the underlying technology are mature) or "*evolving*" (when the supply base is limited in size and experience because the manufacturing and the technology involved are still developing and changing). So, the supply chain strategies proposed by him are splits in two types: demand uncertainty reduction and supply uncertainty reduction.

The four strategies developed by him are: efficient supply chains, risk-hedging supply chains, responsive supply chains and agile supply chains. To arrive to these results, he described every combination of each type of product (taken from Fisher (1997) model) with each type of supply base. In the case of combined functional products with stable supply, the company should adopt an efficient supply chain. For the same type of product but combined with an evolving supply he suggests a risk-hedging supply chain strategy. For innovative products and stable supply, he indicates a responsive supply chains. Combining the same type of product with evolving supply should be matched by an agile supply chain.

With these combinations, he actually tries to regard both, the uncertainty of demand and supply when formulating the SC strategy, which is considered a strength point since this is also requested by other researchers as the second chapter showed. But instead of trying to describe directly the dimension of demand uncertainty, as he did with the supply (in stable or evolving), he adopts Fisher's classification of products and correlated type of demand (stable or unpredictable) are right.

- Naylor, J. Ben; Naima, Mohamed M.; Berry, Danny's model (1999)

They support the idea that agile and lean paradigms cannot be completely separated and developed in isolation from each other. They consider that within the supply chain, these two should be combined and their levels are fluctuating within the structure of the SC. To decide

this, the “*decoupling point*” is analyzed and used. This is telling, according to the authors, where to adopt lean or agile manufacturing. An illustration of it is to be found in the annexes (Annex 3). More precisely, it is used to separate the supply chain which is responding directly to the customer from the rest of the chain which is responsible for planning and strategic stock preparation to buffer variability of the demand.

By using this tool, the authors generate five distinguishing types of supply chains which can serve at different times, on different type of locations with different type of products : “Buy-to-order” (unique products, steady locations, long lead-times, highly variable demand); “Make-to-order” (different products, varied locations, increased lead-time and variable demand); “Assemble-to-order” (varied product mix, varied locations, reduced lead-time and known demand); Make-to-Stock (standard product, varied locations, steady demand); Ship-to-Stock (standard product, fixed location, steady demand).

According to their model, in the case of smooth demand and standard product flow, the lean paradigm can be applied to the upstream part of the SC. For a variable demand and product variety, agile paradigm is preferred to be applied in downstream. A questionable thing of this framework in my view, is how to determine the exact position of the decoupling point. The framework is telling what strategy to adopt considering the position of the decoupling point but is not providing tools to determine that position.

- Cristopher M. and Towill D.R.’s model (2002)

The paper of these researchers emphasizes the need of agility for the supply chain management, in order to have a supply chain that can react quickly to the changes in the market demand. They contrast the idea of agility of SC with the philosophy of lean operation. They introduce the “Quick Response” (QR) technique through which is presented a method to “*make demand information decisions at the last possible moment*”. The aimed result of it is to ensure that costs, inventory and time-leads are minimized while diversity of offering is maximized. In this regard, Fisher (1997) provided some examples where he demonstrated that the diversity of offering is not always a good, needed or beneficial thing. The idea of QR is to be as flexible as possible and form a network of enterprises where profitable exchange of activities and rapid information transfer are possible.

Another point of their discussion focuses on “Lean” versus “Agile” approaches to supply chain management. They do not see it as conflicting paradigms but rather as complementing each other. They state that is a need for a “hybrid” form and the focus shouldn’t be on each is the right strategy but rather on the selection and integration of elements from both in order to create a particular suitable supply chain. Their model is composed by three dimensions with binary gradation: product (either standard or special), demand (either stable or volatile), lead times (either short or long). Also, they include the market winner criterion as influencer for the choice of the supply chain strategy. If the cost is the market winner, then the SC strategy should provide efficiency. It should take the form of lean strategy. If availability is the market winner, then an agile strategy is required.

This model seems to have a “customer backwards” approach (supported by Ambe & Badenhorst-Weiss (2011) and Vural (2015)) since is considering the demand uncertainty first among with other factors but, if so, it does not go all the way to the end. Lee (2002) also included the uncertainty of the supplier, which is missing from this model. With this approach, there is a temptation to focus more on “efficiency” and less on “effectiveness” goals, drifting in this way from an “hybrid” strategy. Excluding the potential threats on the supply side and considering it safe, might be a wrong assumption.

- Christopher et al.’s model (2006)

The same authors (Cristopher M. and Towill D.R) but in collaboration with Helen Peck (2006), review their model and simplify it into only two dimensions: predictability and replenishment lead-times. The result of their new matrix suggested four possible generic strategies: “*continuous replenishment*” (predictable demand and short replenishment lead-times); “*postponement*” (unpredictable demand and long lead-times); “*lean*” (predictable demand and long lead-times); “*agile*” (unpredictable demand and short lead-times). They pretend that the answer of supply, measured by replenishment lead-time dimension is defintory for the supply side. Is it only the ability of a supply chain to respond quickly (or not) important when the uncertainty of supply is considered? Their previous model was focusing on the nature of the product and the life-cycle of it while this is concentrated around variability of the demand and the lead-time.

- For the rest of models developed in books: Simchi-Levi, Kaminsky, Simchi-Levi’s model (2003) and Fawcett, Ellram, Ogden Levi’s model (2007) and Chopra, Meindl’s model (2010)

This research did not had access to the original documents in order to provide and individual analysis and opinion. So, these remaining frameworks are only used the perspective of other authors who discussed about these models and the perspective from their lenses presented in the second chapter. With this adjustment of the second chapter, the main conclusions (from a broader perspective that covers the entire chapter) are presented in the next paragraph.

4.2 Conclusions of the literature review

The industrial production of modern world knew three major development paradigms: craft production, mass production, lean production and it is now shifting to agile production. This is also recommended for the automobile industry. Traditionally, the production was considered the focal point for value creation but a shift of attention from component supplier-production sections to production-distribution sections of the chains is recommended. Also, other external factors, like the legal regulations and climate have to be considered by the management of SC.

The SCM concept has its roots in the logistics discipline and it has been used for the first time as a term in 1982. Since then it is considered to be an extended discipline which still has an emerging feature. The technology development and the globalization are considered to be main drivers of the SCM emerging feature.

A unifying theory of supply chain management is not emerged yet, but most of its definitions describe the concept: as a management process of the flow of goods, money and information; as a value-adding process; as an integrated network of organizations. The main SCM objectives are: to better serve to end customer, to gain competitive advantage, to improve the performance of the company by being efficient or effective or both. The involved parties in this are: customers, organizations or networks of these and their stakeholders. Regarding the organizations, the definitions refer to downstream or upstream parts of a business, or organizations as suppliers, intermediaries, third-party service providers.

SCM also has to include the dimensions of globalization, environment uncertainty, demand chain, flexibility, the synchronization of demand and supply management.

There has to be an alignment of business strategy and supply chain strategy. Then also it is need for demand and supply alignment because in case of mismatch, the company will have to suffer mediation costs.

It is an important core capability of SCM to design a good SC strategy and this SC strategy should support the corporate strategy.

The definitions found in the literature of supply chain strategy describe mainly the term as: a set of approaches to manage the integration of supply and demand, an end-to-end focus of SC, an interfirm coordination, as focal firm’s behavioral orientation towards collaborative partners or as a collection of general and specific objectives of supply chain. According to the cited authors, the objectives of SC strategy are: the minimization of costs, competitive advantage, optimum value for end-customer, revenue growth, efficiency, shareholder value, to support business strategy.

The SC strategies are classified as: efficient or responsive; lean or agile; efficient, responsive, risk-hedging or agile; pull or push but most of the researchers focus on lean, agile and a combination of those (or a “hybrid), leagile.

To indicate a strategy or another, the studied models have advocated for different determinants. They are presented in the table below. Beside the determinants included in their framework, this research also considers **environment uncertainty** and **corporate strategy** as important determinants.

Table 6: Summary of models and determinants of choosing the optimal SC strategy

Authors	Criteria
Fisher’s model (1997)	Product type: innovative or functional
Lee’s model (2002)	Supply and demand characteristics: stable vs. evolving
Chopra and Meindl’ model (2010)	Trade-off between efficiency and responsiveness (decoupling point)
Christopher & Towill’ model (2002)	Market winner criterion (along with) Product (either standard or special),

	Demand (either stable or volatile), Lead times (either short or long)
Christopher, Peck & Towill' model (2006)	Predictability Replenishment lead-times
Fawcett, Ellram & Ogden' model (2007)	The product life cycle (PLC)
Simchi-Levi, Kaminsky & Simchi-Levi' model (2003)	Nature of push and pull-based supply chains
Duarte and Machado' determinants (2011)	1) the structure; 2) organizational relationships; and 3) process.
Narasimhan and Kim Machado' determinants (2002)	1) the nature of the business; 2) the competitive environment; 3) technology; and 4) product and market characteristics.
Agarwal, Shankar and Tiwari Machado' determinants (2007)	information technology, centralized and collaborative planning, and process integration are equally important determinants
Ambe, Intaheer M.; (2012)	1) Product characteristics 2) Manufacturing characteristics 3) Decisions drivers of supply chain

Source: Adapted from Ambe, Intaheer M.; (2012)

CHAPTER 5. A STRATEGIC FRAMEWORK SELECTION

Gligor (2015) mention that most of the frameworks are built from a supply side assuming that demand is known. According to the author, a unifying strategic comprehensive model of SC is missing. In this regard, the current study tries to detach itself from these assumptions and equally consider supply, demand and environment uncertainty. This chapter indicates the main gaps of the conceptual frameworks found in the literature and propose one of the frameworks in order to touch the aim of the research questions. Also, some adjustments of the chosen framework are done in order to correct its flaws to better fit with the aim of this research

5.1 Determining the optimal supply chain strategy

The purpose of this research is not to provide an answer as a solution but rather it attempts to inform and help the decision and action management of a firm within the automotive industry. It provides a deeper understanding of the implications of the evidences in relation with practical decisions. As said from the beginning, this research is aiming to reveal a framework that presents a list of determinants to be considered when a company is choosing an agile or lean supply chain strategy. The framework should help in evaluating which out of the two generic strategies is the optimal one.

According to Stavroulaki and Davis (2010), a conceptual framework designed to determine an effective supply chain strategy can provide the following benefits. 1st: It can provide a dashboard view, along with the key performance metrics and it can be used in the assessment of the overall performance of the supply chain. 2nd: it can assist the supply chain managers in making rational strategic decisions. 3rd: can increase the level of communication and understanding among the members and employees of the SC. Other benefits refer to the assessment of the competitive position, evaluation of the need of agility or leanness or leagility, facilitation of the planning process for product's growth strategy (by selecting suitable SC process). These, as revealed by the literature review, depends on each framework and its determinants are discussed above.

Even if Soni & Kodali's framework (2013) is a solid-built framework in consultation with academicians, practitioners and a consultant with a high degree of comprehensiveness given by its large number of pillars, cited by many other authors, the *Comprehensive framework for SCM* is addressing to general SCM and is not touching the aim of this project, the strategic factors. Even if at the base of this model is the SC strategy, their framework is not indicating

how the selection of the SC strategy should be done or what factors to consider in doing so. Since this is the main purpose of this paper, their model will not be considered. Still, I consider that their work is very helpful in the attempt of fully establishing Supply Chain Management as discipline.

A more appropriate tool (framework) that can be used for the aim of this project is Ambe's model (2012). The focus of his work was to form a framework which helps in suggesting the optimal supply chain strategy, lean or agile. His framework is considered the most suitable for this research because of several reasons. Firstly, he only considers the lean and agile generic strategies as this research did from the beginning. Also, his approach is useful because, in comparison with some other frameworks, he is directly focusing on choosing or suggesting one of the two strategies, rather than build a new one. This also corresponds with the initial purpose of this project. Another element of his model that is considered a strength point is the multitude of dimensions. Most of models use two-to-four dimensions. He uses three supply chain characteristics: product characteristics, manufacturing characteristics, decision drivers of supply chain which and all together are described by other 22 different dimensions (see Annex 2). By doing so, he covers more parts of the SCM, from demand and lead time to manufacturing process and inventory for example.

Still, a part of the SCM body literature and of the automotive industry requires also dimensions related to environment uncertainty and corporate business strategy. These are narrated in the next paragraphs.

5.2 Environment uncertainty and corporate business

Datta's (2017) literature review, stressed the fact that there is a lack of empirical studies which are focused on theory building to link SC strategies in specific contexts or markets. In general, the issue of adaptability of a strategic SC to capture competitive advantage is not discussed from a more dynamic perspective. Most of the studies are focusing on pure conceptual or mathematical frameworks which are not capturing different real-world factors or subjective influences. There is a need of a framework which is integrating elements of a strategic fit SC (product demand, competitive advantage, customer value, market characteristics) and characteristics of SC (design, strategy choice and the associated practices).

Also, in the literature, it has been mentioned the need to consider the environmental uncertainty (Qi et al., 2011) but it has been debated. The environmental uncertainty can play the role of a moderator between the competitive strategy of a firm and its SC strategy. Also, the SCM literature on automotive industry suggests the consideration of outsider factors like the governmental regulations, climate changes, traffic congestions, etc. Also, this paper advocate for the introducing of environment uncertainty as a dimension in the configuration of the SC.

Gligor (2015) stresses the need of alignment between customer and suppliers in order to streamline operations to get a level of agility beyond individual firms that can serve as a source of competitive advantage. From a different perspective, in a study of supply chain flexibility, Mandal (2015) treats the matter of the influence of supply and demand as fundamental building blocks of SCM and competences to obtain the ability to deal with disruptions. Also, in his analysis model, he includes the environmental uncertainty as an influential factor on the linkage between SC flexibility and firm performance because he seizes an unexplored gap into literature on this topic.

In this research, it is highlighted the exchange of goods, money and information between the supply chain and focal firm and between the focal firm and the demand. It will be considered a wrong assumption to believe that the channel of this flow of exchanges is not effecting in any way by the external environment. It is important to mention that most of the academia refers to the uncertainty of demand while just few researchers discuss the uncertainty of supplier. But these are internal perspective of SC and external factors are ignored. As it will be demonstrated below, these factors also matter.

The presented frameworks are only considering determinants that are issued or controlled by supplier, customer or focal firm. But examples of political instability or even natural disaster are ignored. For example, it can be the case of a lean production company which follows the principles of high speed of stock and low cost because it aims for stock reduction to cut costs of waste. It will be very difficult for a company like these to react to unforeseen events, so it is more vulnerable to the environment. For example, an air traffic interruption in Germany blocked the transportation of some steering sensors to one of Toyota's supplier in Indiana. So, this lean-production company had troubles with in its Sequoia SUV plant.

This kind of situations and the decisions taken under these conditions can save a company from significant losses. In this context, is difficult to economically quantify the benefit brought by this *resilience* of the supply chain and this is the main reason why companies do not invest

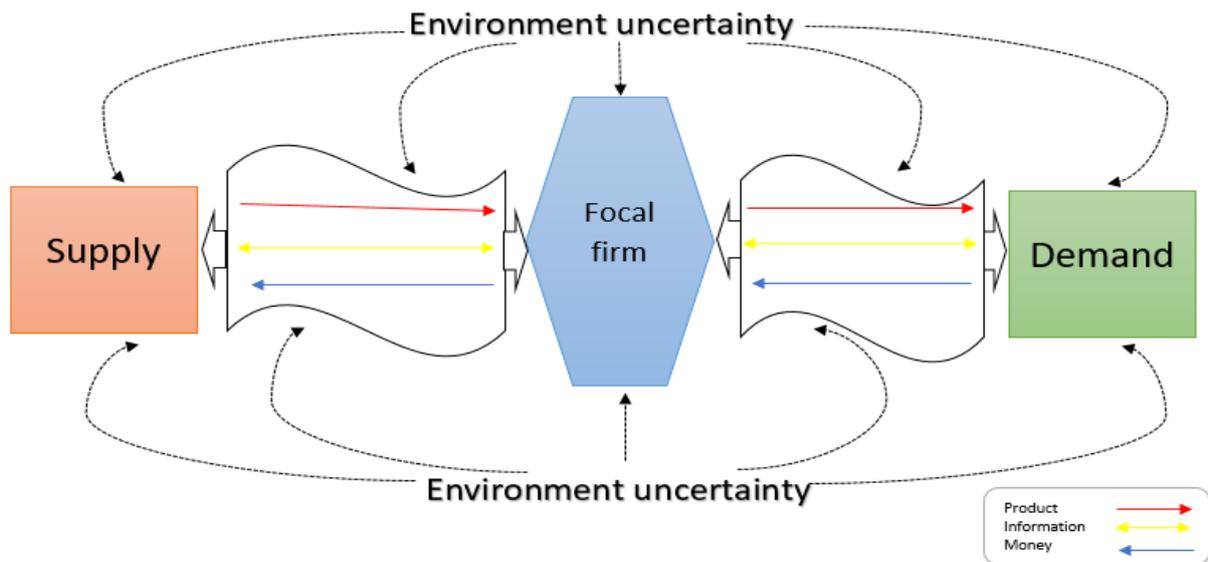
resources in trying to prevent and prepare for these unforeseen events. But they can ensure or cancel the success of a product. For example, Vecchi & Vallisi (2016) present the example of Nokia and Ericsson which had the same chip supplier: Philips NV. The supplier's plant caught fire in New Mexico interrupting the supply of chips for both phone producers. In this situation, Nokia and Ericsson reacted differently. Nokia started monitoring day-by-day Philips NV and discovered that it will take the supplier several weeks to provide the products. Because of this, Nokia decided to arrange with Philips NV to have its chips produced in other plants. Ericsson instead, decided just to wait for the supplier to get back on track. This was a wrong decision because by the time they realize the gravity of the situation it was too late. The majority of chip providers were occupied with producing for Nokia. Because of this shortage of supply, Ericsson failed to launch a new generation of phones. The loss for them was estimated between \$430 and \$570 million USD. In six months Ericsson' market share fell by 3% while Nokia gained 3%.

Vecchi & Vallisi (2016) define a resilient supply chain as being a “*robust supply chain with two additional qualities, which are agility and adaptability*”. Further, they argue for the need of resilience for two main reasons: to reduce the vulnerability of the supply chain and for the avoidance of monetary losses. So, what is the resilience of the supply chain?

“Resilience, a notion borrowed from material science, represents the ability of a material to recover its original shape following a deformation. For companies, it measures their ability to, and speed at which they can, return to their normal performance level (production, services, fill rate, etc.) following a disruption” (Sheffi, 2005).

So, the main conclusion is that the environment uncertainty can cause disruptions for each member of a supply chain (and later even to other linkages) or in the flow of good, information and money. Even if the risks of the environment cannot be calculated all the time, SC managers should be aware of it. This research does not focus on the resilience of the supply chain but it shortly presented it because it shows the concern of some academia about the vulnerability of the SC to the environment. The basic premise of a firm's strategy configuration used in this paper is that it considers the external environment factors which affects all the members of a SC and their relationships in a specific context.

Figure 2. Illustration of simplified perspective over the supply chain



Source: Author's creation

Another missing but important element is the dimension of corporate strategy. The second chapter of this paper showed that many researchers believe that there is a need of alignment of business strategy and SC strategy. Soni & Kodali's framework (2013) ("Comprehensive framework for SCM") actually is built on the idea that the SC strategy is based on corporate strategy. So, this should also be regarded. When the SC strategy is selected, one of determinants should also be the goals of the corporate strategy.

In order to improve the tool or framework that can help a manager from the automotive industry to understand which is the optimal strategy for his supply chain, an adjustment of Ambe's model (2012) is effectuated. This adjustment consists in adding the two dimensions of environment uncertainty and corporate strategy and, at the same time, to eliminate other two. In the next part of the chapter, it will be proposed a method to include the two new dimensions and a reason for the exclusion of the other two.

5.3 Adjustment of the instrument for determining an optimal strategy

In their attempt to build a strategy framework for the inventory of a SC, Nag *et al.* (2014) used Porter's (1980) three generic business strategies: *cost leadership*, *product differentiation* and *focus on a niche market* to study the implications of a certain strategy on the inventory of SC. According to them, a product differentiation strategy is corresponding to an agile supply chain,

where inventory buffer might be hold to hedge against disruptions. On another hand, a cost leadership strategy is better related to a lean supply chain, where inventory waste is reduced to cut costs. This approach can be extended to describe and include the corporate strategy dimension. This will be under “decision drivers of supply chain” section.

Regarding the dimension of environment uncertainty, this paper will use the PESTLE framework to describe it. This tool is known for the fact that is used for the analysis of an organization’s external macro environment. Considering the pressure and probability (high vs. low) of the uncertainty of each dimension: political, economic, social, technological, legal and environmental; this framework will be used to determine the vulnerability to the environment. Since each PESTLE analysis can differ from industry to industry, in this project it will explicitly focus on automotive industry.

Since the dimension of supply uncertainty is missing from the Ambe’s model (2012), this will also represent an adjustment. The manufacturing processes and management are highly depending on the supply, so the new framework will include the dimension of supply uncertainty as a manufacturing characteristic and it will be described as in the Lee’s (2002) model: stable or evolving. Here is the adjusted framework adopted from Ambe (2012). The new added dimensions are marked with blue color.

On another hand, the literature review emphasized the need to recognize, integrate and synchronize both demand and supply uncertainty. As a result, the Integration and Collaborative relationships dimensions are eliminated from the framework. As a statement of Hilletoft (2011) reveals in the literature review, companies tend to create two different business models: supply-led demand-led. Equal attention should be attributed to both integration of manufacturing, purchasing, quality and suppliers and the integration of marketing, engineering, distribution, and information systems to avoid the mediation costs. The eliminated dimensions are marked in red.

Each of the dimensions will be applied and explained on the study case of the automobile industry in the next chapter.

Table 7. The adjusted framework of Ambe (2012)

Criteria	Description of criteria	Lean supply chain	Agile supply chain
Product	Demand uncertainty	Predictable	Unpredictable
	Product type	Functional products	Innovative product

	Profit margin	Low	High
	Product variety	Low	High
	Order lead-time	Long	Short
	Market winner	Cost	Availability
	Product life cycle	Long	Short
Manufacturing characteristics	Supply uncertainty	Stable	Evolving
	Market segment	Serve only current market segment	Develop new product lines and open up new markets
	Manufacturing focus	Maintain high average utilization rate	Deploy excess buffer capacity
	Manufacturing process	Continuous (large volume)	Job shop; batch; line flow
	Production process	Standardized product (Mass production)	Customized products
	Techniques	MTS	MTO; ETO
	Approach	Push-based system	Pull-based system
Decision drivers of supply chain	Integration	Integrate manufacturing, purchasing, quality and suppliers	Integrate marketing, engineering, distribution, and information systems
	Collaborative relationships	High information sharing; traditional alliances	More collaborative barriers; visual organization
	Information technology	Highly desirable; cost of information drops while other costs rise	Obligatory; collect and share timely, accurate data
	Facilities	Narrow focus; few centralized plants	Flexible manufacturing; many small factories
	Inventory	Low inventory levels; few items	High inventory levels
	Location	Few central locations	Many locations

	Transportation	Shipments are few and in large quantities	Frequent shipments
	Sourcing	Supplier attributes include low costs and high quality	Supplier attributes involve speed, flexibility, and quality
	Pricing	Price based on volume	Price based on margins
	Corporate strategy	Cost leadership strategy	Product differentiation strategy
Environment uncertainty	PESTLE		

Source: Adapted from Ambe, Intaher M.; (2012)

CHAPTER 6: ANALYZING THE OPTIMAL SUPPLY CHAIN: THE CASE OF THE AUTOMOTIVE INDUSTRY

This chapter starts with a presentation of the automotive industry foundation and evolution. In this first part, it is valued the importance of understanding the entire industry of focus for this research as it is for any business plan or strategy. Throughout this part of the project, important information will be provided related to the development of the industry, competitive landscape and market conditions with the aim to be further used in the analysis. The second part discuss the chosen framework used the automotive industry in order to show how this tool can be work and how it can suggest the optimal supply chain strategy.

6.1 Industry overview (foundation and evolution)

According to the Dictionary of Human Geography (Castree et al., 2013), the automobile industry is one of the most important worldwide' industry, being a leader employer in many regions around the globe, a major taxpayer for government and a massive consumer of energy, electronic components, metals, plastics, etc.. The big firms involved in this industry (like Nissan, General Motors or BMW) are involved in producing, maintaining, marketing and selling of automobiles. It is an industry of a global scale with producers and suppliers predominately located in North, Central and South America, Western and Eastern Europe and Asia as a result of a geographical restructuring since 1970. Up to this period, the industry was mainly concentrated in the Western capitalist democracies.

In comparison with other industries, the effects of automobile production had a direct involvement in 20th century's development which makes it exceptionally interesting among other fields. Beside the evident facilitation on transportation and economic exchanges, this industry, starting with the first half of the 20th century, invented, introduced and applied mass production techniques (Binder *et al.*, 2017). Through mass production have been applied principles related to the division of labor, specialization and standardization. These new methods decreased the production cost per unit and even a lower cost per unit was achievable as the volumes were growing.

- *Short historical summary*

With the invention of the steam-powered motor, road vehicle started to be produced but the automotive industry is considered to be born approximately in 1870 when it was developed the gasoline engine. This was firstly adopted by French and German producers and by the beginning of the next century, manufactures from Britain, Italy and America (who introduced the mass production) joined the production.

Before the First World War, different companies from the mentioned above countries were producing different types of vehicles and engines (bicycles by Opel and Morris, horse-drawn vehicles by Durant, marine engines by Vauxhall, washing machines by Peerless, etc.) but only Ford in U.S. and Rolls-Royce in Britain were considered founders of car producing companies which combined engineering and business skills. Other companies before these, were mainly following an assembly process of the bought pieces rather than a proper production. That was considered a method which could be financed in comparison with the entire production activity.

The pioneers of the car manufacturing had to solve the technical and financial problem. This was done by the assembly-line mass production (an American invention). This process was revolutionary because it was combining continuity, synchronization, standardization, interchangeability and precision (Binder, Rae, 2017). Henry Ford was the inventor of this method and by 1926 his company produced half of the motor vehicles of the world. Meanwhile, other American competitors started to emerge, General Motors and Chrysler Corporation forming the “Big Three”.

In Europe, the progress was slower because of the political and economic conditions of the market. In Britain, emerged firms like Morris, Austin, Standard, Rootes. In France were three major players: Renault, Peugeot and Citroen (holding 40% of French automotive production). Germany had a hard start because of the war, but Daimler merged with Benz (1926) and General Motors acquired Opel (1929). Admiring the Ford model of production, the Nazi also tried to produce a low-cost car and this is how Volkswagen was born. At that time, Italy had no mass production of cars, focusing only on sports and racing cars.

After the Second World War, the automotive industry was mainly driven by four big players in America: Ford, General Motors, Chrysler and AMC. Instead, the size of the market share was now starting to decrease to the detriment of the American companies (starting with late 1970s) because of imports and new established subsidiaries of European (Volkswagen first) and Japanese (Nissan first) companies. After Honda, Toyota also opened new plants on the American territory forming a joint venture with GM. Also, Renault from France became interested in the American market.

The automobile industry in Europe after the Second World War was consolidating itself as the cars became export goods. British Leyland Corporation (BL) was born as a result of the merger between British Motor Corporation (which actually was a joint between Austin and Morris) and Leyland Motors. BL (which was later acquired by the British state), Vauxhall, Ford and Rootes became the biggest producers in Britain. In Germany, the automobile industry started to rise after the World War II, firstly with Volkswagen and its luxury car segment, Audi. Also, after 1960s BMW was born and Opel became the European main base for the operations of the GM. In Italy, Fiat started to have a mass production in 1950. In France, Renault was nationalized and Citroen was acquired by Peugeot. Sweden also became relevant for this industry with its companies: Volvo and Saab. These were lately acquired by Ford (1990) and respectively GM (1980).

The most spectacular development came from Asia. In 1950s, Japan was considered a negligible producer but in 30 years it became the world's leading car producer. Its main companies were Toyota, Honda and Nissan followed by Suzuki, Isuzu, Mitsubishi and Fuji. As a general valid trend, the period after 1945 the automobile industry was mainly focusing on improving and refining and less on innovation. This was not the case for Japanese producers. They exported fuel-efficient cars and invented just-in-time method of delivering. Moreover, they used statistical process controls for quality improvement. Idea rejected by the Americans producers at that time. This Japanese boom was slowed by their recession in 1990s. Another top Asian car manufacturer was South Korea with its three major companies: Hyundai Motor Corporation, Daewoo Motor Corporation and Kia Motors Corporation.

- ***The modern times of automobile industry***

Nowadays, it can be stated that the world as we know it today it would not be possible without automobiles. Also, it is still depending on these products. *“One of every six American businesses is dependent on the manufacture, distribution, servicing, or use of motor vehicles; sales and receipts of automotive firms represent more than one-fifth of the country's wholesale business and more than one-fourth of its retail trade. For other countries these proportions are somewhat smaller, but Japan, South Korea, and the countries of western Europe have been rapidly approaching the level in the United States”* (Binder, Rae, 2017).

Doubtless, it is a global industry where only the biggest investors can thrive. A fundamental condition for profit in this industry is mass production. Also, the ability to provide different products is important. Many of the mentioned firms are also manufacturing other products than the classical car, from tractors, airplanes to locomotives and even refrigerators. So, skills of engineering and business of the highest level are involved because this industry requires both: economies of scale and scope. The globalization and the high level of competitiveness change the market conditions very fast and this requires a very short process for introducing a new car. From market survey, conceptualization and putting on the market, the time needed for this has to be under five years, (preferable three).

The inventory management is very important now as no company can afford to stockpile different parts or materials. Still, no company managed to move their parts from raw materials to final products with no rest at all. Also, it has to be mentioned the fact that most of the producers rely on independent suppliers for the needed materials as it is considered to be more economical since it cannot exercise their control over so many operations and at the same time

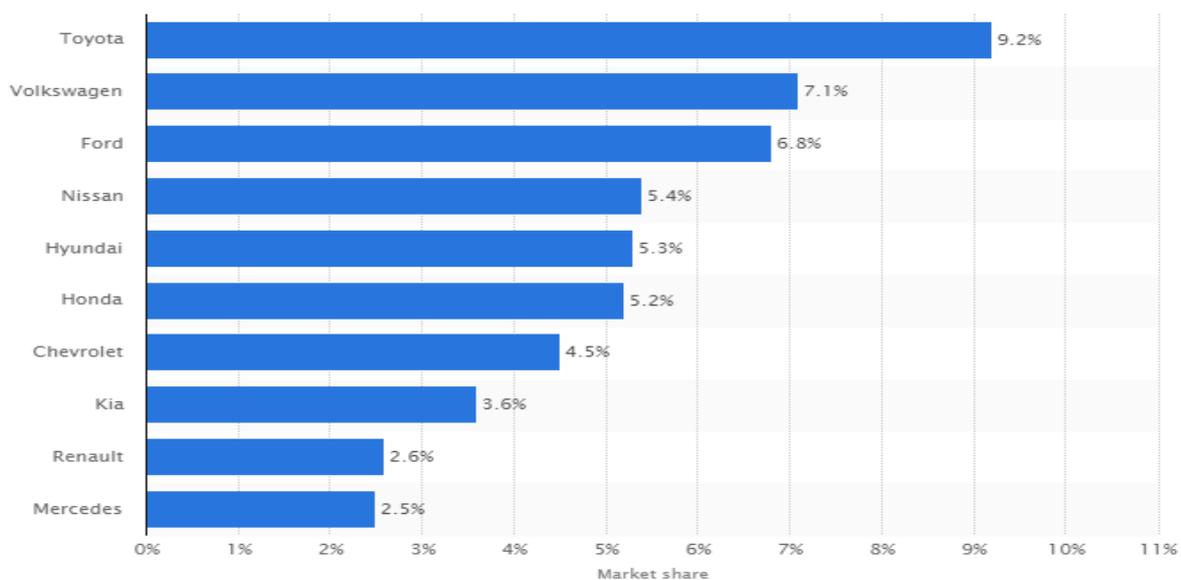
an independent supplier may invest more in a more adequate equipment. In general, these companies are focusing on the assembly line, investing on automatic control systems, computer guided robots, transfer machines, etc..

Nowadays, this is a multibillion industry with a global market where very big brands are competing. China is now the biggest market for cars and the Asian market in general became highly lucrative. Also, the manufacturers are focusing now on fuel efficiency and environment friendliness. This is also giving a change for the electric cars to catch up (Pratap, 2016).

6.2 Major players within the industry

In order to delegate the biggest companies of the automotive industry, three indices are going to be considered: market share, global sold units and the value of the brand for 2016. As it was argued above, the companies are interested in the market size, economic conditions, customer's power of purchase and preferences. Therefore, these indices should report the top performers of this industry and present a reliable comparison among them. The information and statistical analysis for all the indices are extracted from the same source: Statista. Having the same source for all the indices, represent a higher probability for the use of the same methods on analyzing the same data. Moreover, Statista's presentations are based on statistics and studies from more than 18.000 sources making it highly reliable.

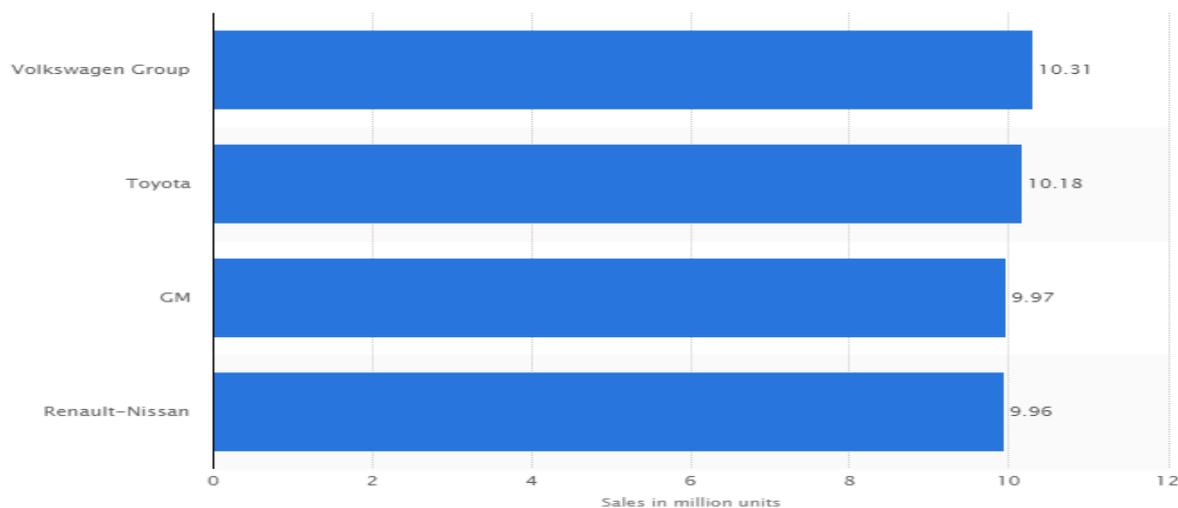
Figure 3. "Global car market share of the world's largest automobile OEMs in 2016"



Source: Statista. The Statistics Portal

In the Figure 3 is illustrated the market share of the top 10 companies for 2016 based on the revenue. The Volkswagen group dropped one position on this ranking mainly because of a scandal related to the manipulation of the numbers representing the toxic emissions in September 2015. Now the Japanese company Toyota is the market leader. The overall picture presented now is expected to change in the following years because of the new trend set by alternative fuel powertrains and the increasing desire of connecting the automobile to the internet. Tesla, for example, which is selling electric cars and it was founded in 2003 is believed to have acquired 0.1 up to 0.2 of the U.S car market share. Also, Apple and Google are highly investing in developing smart cars.

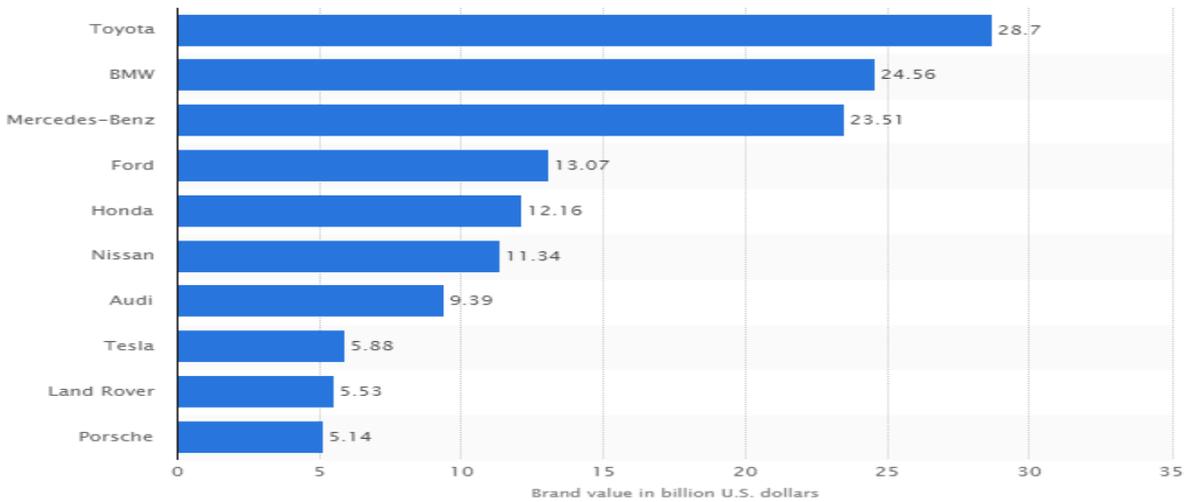
Figure 4. “Leading motor vehicle manufacturers worldwide in 2016, based on global sales (in million units)”



Source: Statista. The Statistics Portal

In terms of sold units globally, the Volkswagen Group managed to stay on top at a slightly difference from Toyota, the second ranked. The difference is also not too big in comparison to the other car sellers like GM and the Renault-Nissan Group. Even if this paper revealed so far, the fact that this industry is facing important challenges, this graph is revealing the fact that is still a high demand for cars since only the first 4 companies sold together approximately 40 million of vehicles in 2016.

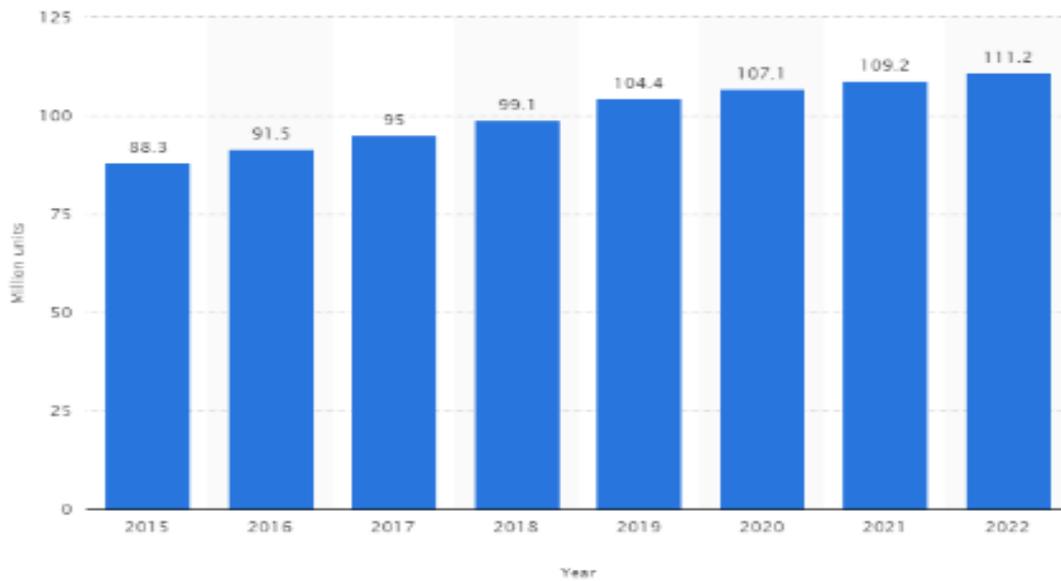
Figure 5. “Most valuable brands within the automotive sector worldwide as of 2017, by brand value (in billion U.S. dollars)



Source: Statista. The Statistics Portal

Regarding the brand value (Figure 5), Toyota is also leading, valuing 23.5 billion US dollars (as a brand). Being active on multiple product segments (SUVs, trucks, motorcycle, etc.), this company invest very much in the research and development of hybrid electric cars and full electric cars. Fuel-efficiency has been a major concern for the company even from the beginning. An interesting fact is the absence of Volkswagen group from this top but it can be mainly explained by the emission scandal. In a complete different situation is Tesla. Even if it has a small market share in comparison to the other competitors, it has a really strong brand. This can be interpreted as a confirmation of the above described trend. A projection of the new trend, of light vehicles production is presented in the Figure 6.

Figure 6. “Global light vehicle production forecast from 2015 to 2022 (in million units)”



Source: Statista. The Statistics Portal

Only by 2016 the global light cars production increased by 3.6%. As the graph is showing, there is an ascending trend for this. Producers have now two options: either they build more efficient engines or they make a shift to other alternative powertrain technologies (Statista, 2017).

6.3 Interpretation of the main determinants in choosing the optimal supply chain strategy for an automotive company

Here it will be applied the new created framework by presenting and analyzing each dimension of it and even the relations between them. After that, it will be considered the results for each category of determinants, and base on that, a set of conclusions and recommendations for the managers who what to analyze which is the optimal strategy for their company will be presented. It is important to mention that the unit of analysis is the entire industry and not a specific company from it. Based on the available information from an outside perspective, it will be difficult to estimate for each determinant what a company’ SC can or wants to achieve. But a person who has inside information should know this kind of data. So, this framework is

conceived to serve him. A practitioner who knows which is the current status of his supply chain can use this paper to decide which strategy is best for his supply chain.

Industry' s product characteristics

- **Demand uncertainty:** Predictable

This dimension was described in Ambe's model (2012) as predictable or unpredictable. This dimension was borrowed from Fisher (1997)'s model. He associated the innovative product with unpredictable demand and functional products with predictable demand.

A car, as a product, is mainly a functional one. During the time, this product came with innovations but because is a product which requires a lot of time from design to market release, these innovations came slowly and they were not reinventing entirely the product. The electrification of cars may be considered an innovation (even if the idea of electric cars goes more approximately 100 years back) but is just a part of the entire product. So, in the automobile industry are mainly sold functional products, so it has a relatively predictable demand.

- **Product type:** Functional

This dimension refers to the nature of the product it is also borrowed from Fisher's model. In the case of automobile industry, the products are mainly functional because of their long-life cycle and long innovation cycle as discussed above

- **Profit margin:** Low

In comparison with other industries, the automotive industry has lower profit margins mainly because of the intense competition (Kallstrom, 2015).

- **Product variety:** High

A high competitive environment is also encouraging the developments of a variety of products because the companies are searching for different niches. This is increasing the cost of production and this is why the firms from this industry are constantly preoccupied with optimization of the assembly lines and its reconfiguration (Altemeier, 2010).

- **Order lead-time:** Long

Because of the complexity of product, the order lead-time is long. According to Holweg & Jones (2001), the automotive industry fails to deliver specific customer ordered cars within a

satisfactory timeframe. That is because the auto industry is very focused on the performance of assembly plants and sales volume. According to the same author, it takes approximately 48 days for a customer to get his ordered product but he could also wait more than 2 months.

- **Market winner:** Cost

Regarding the example of lean production of Toyota who is considered one of the best examples in this case and which is also the market leader, cost seems to be market winner criterion and less the availability. Even if the lead-time is long, I think it is also expected from the customer to be so since the product has a relatively long life-cycle.

- **Product life cycle:** Long

This dimension refers to all the steps from product design and development to the decision to remove it from the market. In average, it takes 5 years for a new car from the design concept until is launched in the market. Moreover, according to a survey made by Woodyard (for USA Today) in 2012, most of the people are waiting up to 10 years buy a new car. So, this industry produces long-life cycle products.

Industry' s manufacturing characteristics

- **Supply uncertainty:** Evolving

The description of the industry showed that the companies are constantly involved in improving manufacturing and the technology used. Especially nowadays, when the expectations and standards for this industry are even higher than before, supply chain is still developing and changing. The example of electrification was indicating the tendency to change from supplier that was providing components for diesel or gasoline motors to the ones who can help in manufacturing electric motors.

- **Market segment:** Serve only current market segment

At the beginnings of the industry, the car manufacturers were also producing other products than cars. Ford for example produced tractors, transport airplane and GM manufactured railway locomotives and even refrigerators. But, by the late 1990s, the trend was to eliminate from production nonautomotive components.

- **Manufacturing focus:** Maintain high average utilization rate

This dimension refers to the proportion of realized outcome out of the total potential economic output. If this is less than 100%, the company can, in theory, to increase production without other costs. The automobile companies are producing large volumes of products and they rely on the economies of scale. So, they will try to maintain a high average of utilization rate.

- **Manufacturing process:** Continuous (large volume)

An agile strategy can include different manufacturing processes. Job shop process are used for customized to specific customer products. Batch process it is a processing mode which allows the production of more products with similar manufacturing requirements. A line flow process is combining different products for different stages of assembling. For a lean strategy is typical a continuous process where the product follows a predetermined sequence of steps (Ambe, 2012). So, this is also typical for automobile industry.

- **Production process:** Standardized product

The automobile industry invented the mass production. Some of the researchers suggested the need for an agile production. But regarding the complexity of the product and the production volumes, producing customized products remain a high target. But the industry made efforts in this direction. If you preorder you can select and combine some features. For example, if you buy from Tesla's website, you can choose the paint, roof, wheels and even the interior of the car. Still the options are limited and standardized. You cannot create new ones. So, at the moment, the industry offers mainly standardized products.

- **Techniques:** MTS

These are techniques to connect sales with production and they were presented in Naylor *et al.*'s model (1999). Ambe (2012) included in his framework Make-to-Stock (MTS) for lean strategy and for agile strategy, Make-to-order (MTO) and Engineer-to-Order (ETO). This dimension, in the case of the automobile industry is related to the production process. As discussed above, it is not possible yet to have mass production using MTO or ETO. So, MTS is the available approach for automotive industry.

- **Approach:** Push-based system

This dimension is from Simchi-Levi *et al.* (2003) who saw the flow as being triggered by actual demand signals and this is the pull-based supply chains or by a forecast of future demand and this is a push-based supply chain. In the literature review was mentioned Turner & Williams

(2005) statement: “once the vehicle is assembled, it is quickly send to the dealer, who starts an aggressive process of selling” empathizing the push-based system of the automobile industry. Also, since Make-to-Order is not an available technique for this kind of product, the push-based system is mainly considered as fit.

Industry’ s decision drivers of supply chain

- **Information technology:** Highly desirable

Ambe (2012) presents three sets of benefits given by IT with SCM. It enables the establishment of better partnership to obtain better performance; it helps a SC in better manage and distribute its resources; it improves the quality of information among the SC members. If the SC members collect and share accurate date of their operations in a timely matter, then the level of responsiveness is improved. While for a lean strategy the quality of this may be sacrificed to reduce costs, in an agile strategy, this factor is obligatory because timing is very important. Since automobile industry deals with long-life cycle products, the share of information as fast as possible is not obligatory but rather desirable.

- **Facilities:** Narrow focus; few centralized plants

Because of the high volumes of production within automobile industry, are preferred centralized plants.

- **Inventory:** High inventory levels

It is an industry where the mass production is required. So, the car producers have to deal with a high level of inventory.

- **Location:** Few central locations

This refers to where supply chain facilities are geographically located. In order to gain economies of scale, usually, in the automotive industry are preferred fewer location but central.

- **Transportation:** -

This is also an important factor because sometimes, the cost of it can represent the third part of the overall cost of a product. The choice of transportation means (ship, rail, trucks) is the one which made the trade-off between responsiveness and efficiency. In the automotive industry,

this is really depending on each situation. It can be shipped a lot of vehicles and this can take longer time than the transportation of fewer vehicles via trucks.

- **Sourcing:** Supplier attributes involve speed, flexibility, and quality

As mentioned in the second chapter, a firm that follows a lean strategy is searching for low cost and high-quality attributes of a supplier while for agile strategy flexibility and speed are more important. Since, the automobile industry does not evolve in a fast-track, it can sacrifice the speed in favor of low costs and high quality especially since the profit margins are low.

- **Pricing:** Price based on margins

“Pricing is the process by which a firm decides how much to charge customers for its goods and services” (Ambe, 2012). Price based on volume allows discounts for bulk purchase. Since the profit margins are already low in the automotive industry, significant discounts are difficult to offer. So, a different approach is needed.

- **Corporate Strategy:** Cost leadership strategy

In the beginning of this paper, was mentioned the need for agility within SC and agility production within the automobile industry. Differentiation comes with higher costs. But since it is a high-competitive environment, a lower cost can decide the market leader. For example, Tesla company (which maybe is the most innovative car company of the moment) lunch its first electric sport car Roadster at a price of \$101,500 in 2008. The second model had a starting price of \$ 83,700, the third one \$69,200 and the next one that is about to be launched is expected at a price of approximatively \$35.000. Tesla’s aim for the future is to produce an electric car at an affordable price of an average consumer. So, this is showing that the final aim is still the low-cost.

Industry’s environment: need for agile strategy

- **Political**

The car industry is highly controlled by the Governments, especially in developing countries. This automobile sector is a source of high revenues for the state and this explain the governmental pressure. This is making even more difficult for the producers to be globally competitive. One another hand, the increasing standards of life and incomes for the middle

class of the developing countries has formed new markets for the car manufacturers, but the political instability and corruption of some of these countries discouraged the producers to directly invest in some of these countries (freepestelanalysis.com).

In general, the political factors have a direct impact on the revenues of car manufacturers. The governments around the world are in favor of low emissions cars (for example UK and EU governments are subsidizing the production of these vehicles) and are taxing the very polluting and luxury cars (Pratap, 2016).

- **Economic**

The performance of this industry is directly related to the economic development. In the case of the developed countries, in times of crises, the sales are dropping. In terms of good market conditions, usually the sales are stagnant as most of the people own a car and innovation is what makes people change their car. Still, in developed countries, in general, the sales are higher. The increasing level of income also in developing countries turns in a sales boom for the companies (freepestelanalysis.com).

In general, the economic conditions, the size of market and the exchange rate are the most important indices for the determination of profitability. But even a more relevant for this, is the purchasing power of the customers. This is the reason why many brands manufactured low cost cars, to capture a bigger market segment (Pratap, 2016).

- **Social**

From its foundation to nowadays, the automotive industry had a major contribution in the development and growth of the human society. If initially was produced only for the upper class, now this industry offers a diversity of products which match each type of customer. In time, the brand of a company became very important in this industry.

The customer's preferences are carefully analyzed by the big brands as socio-cultural trends are also relevant in this industry. They came to the conclusion that certain styles of cars are preferred in specific cultures. Also, the age distribution and people's life style are analyzed (Pratap, 2016).

However, in the latest years, people from North America and Western Europe (especially) started to see the car as an enemy of the environment and of their health. As a result, their searching for non-polluting cars or other transport means like the bicycle.

- **Technological**

The car industry is a traditional innovator. Many of the inventions which was firstly used in this industry have been transferred to other industries too. These are related to both, products and operations. Moreover, the innovation is now an essential feature of the industry since the clients are able to keep tracks of the newest technological developments and they want these also applied to their cars. So, the difference is now consisting in the fact that the car producers also have to be aware of the latest technological innovations of other industries. They need to implement the latest developed smart devices, driverless software or even flying capabilities within the car (freepestelanalysis.com). Technology is also affecting the cars sales.

- **Legal**

On a global scale, the most important legal regulations are related to the safety of the product. Not only once have been the case when the companies (Toyota for example) had the ask their clients the bring back to the service some of the new bought cars for double check. Other laws refer to the quality standards of the product and their carbon emissions. Also, the pressure of the government is affecting the pricing policies. In other cases, is very complicated to start new businesses in some countries and/or are taxes on imports to discourage the competitors.

- **Environmental**

The question of pollution is one of the biggest challenges for the automobile industry which needs a fast solution. The industry is seen as a main threat to the environment. As a result, more and more manufactures are producing environmentally friendly cars. The share of these cars out of the total number of cars is still low at the moment but is expected an increase in the demand since more and more people become worried about the environment degradation (freepestelanalysis.com). Moreover, restrictions on sales are starting to be implemented on the cars which does not pass some specific emissions tests.

Conclusion of the PESTLE analysis

The political factor among with its legal units are encouraging the production of low emissions cars. Also, companies, in terms of technological developments, need to focus on the same thing in order to be able to sell their products and stay competitive. Even if the situation is different from a culture to culture, globally the customers tend to behave environment responsible

requiring more and more eco-friendly cars. This opens an opportunity for the electrical cars. The economic development is very relevant for the profitability of this industry which is also very demanding but the firms also need to consider the environment as a main concern.

Considering all these factors, it seems that the external environment is pressuring the companies from the industry to become more agile. It is requested from there to come with innovative products that can comply with the legal regulations, protect the environment and satisfy the need for technology of the end-consumer. From the perspective of vulnerability to the environment, the company should adopt an agile strategy.

Table 8. The summary of framework of automobile industry

Criteria	Description of criteria	Lean supply chain	Agile supply chain
Product characteristics	Demand uncertainty	Predictable	
	Product type	Functional products	
	Profit margin	Low	
	Product variety		High
	Order lead-time	Long	
	Market winner	Cost	
	Product life cycle	Long	
Manufacturing characteristics	Supply uncertainty		Evolving
	Market segment	Serve only current market segment	
	Manufacturing focus	Maintain high average utilization rate	
	Manufacturing process	Continuous (large volume)	
	Production process	Standardized product (Mass production)	
	Techniques	MTS	
	Approach	Push-based system	
Decision drivers of supply chain	Information technology	Highly desirable; cost of information drops while other costs rise	
	Facilities	Narrow focus; few centralized plants	

	Inventory	Low inventory levels; few items	
	Location	Few central locations	
	Transportation	-	-
	Sourcing		Supplier attributes involve speed, flexibility, and quality
	Pricing		Price based on margins
	Corporate strategy	Cost leadership strategy	
Environment uncertainty	PESTLE		Agile strategy

Source: Adapted from Ambe, Intaher M.; (2012)

Main trend, opportunities and threats of the industry:

As an overall conclusion, the trend in this industry is to produce high-tech cars and integrate new capabilities (like self-driving and even flying) which meet the highest standards of safety and environment friendliness. This represents an opportunity to gain a competitive advantage for the electrical cars and also for the companies which are able to develop and integrate new features to their products. Also, the increasing standard of life and the rising incomes in the developing countries are translated in market opportunities for the car producers. The threats of this industry are coming from the shift in customer's preferences, rough regulations for manufacturing and the developments of new means of transport (Hyperloop for example).

Conclusions of the framework:

First of all, this exercise shows that, at an entire industry level, elements of both, lean and agile are combined but these two are not balanced.

Excepting the environment uncertainty dimension, which seems to pressure the industry to adopt an agile strategy, most of the other determinants are in favor of a lean strategy for the automobile industry. So, a solution for a car producer is to try to add innovational components to his car but to aim for low-cost supply and quality in the end.

One of the benefits, brought by this analysis, is the fact that it has multiple dimensions and some of these are determining the others. For example, the product life-cycle can determine the market-winner element or that technique MTS is influencing the pricing methods.

Also, this exercise had some limitations. First of all, it considered the entire industry as a unit of analysis assuming that this better describing a regular automobile industry. A specific company might have considered more elements of the agile strategy as needed. It cannot be assumed that the lean strategy is optimal for all the companies in this industry but this is the most likely to be. Also, a specific might not consider all the dimensions from the framework.

Another assumption was made about the segment of the industry. In general, it has been considered the average consumer. If it would have been considered the buyers of luxury cars, then it is a high chance that the results would have been different.

CHAPTER 7: FINAL CONCLUSIONS AND LIMITATIONS

This paper theoretically contributes to the development of the SCM field by integrating a strategic choice perspective. Its main purpose was to propose a comprehensive framework to determine the optimal supply chain. It tried to offer an answer to the three research questions by following mainly a theoretical analytical approach. In the course of the literature review and the following analysis a list of strategic determinants was composed, answering in this way to the first research question. Among these were mentioned: product type, supply and demand uncertainty, decoupling point, market winner criterion, lead times, predictability of demand, product life-cycle, the nature and structure of SC, technology and few others.

The second research question asked for the proposal of a framework to assist in determining one of the two generic strategies, lean and agile. The chosen framework was Ambe's (2012)

model who considers a set of 22 elements. These referred to product characteristics, manufacturing characteristics and decision drivers of supply chain. This was considered the most elaborate one and included many elements from other appreciated models. Still, the literature suggested a gap in considering the right supply chain strategy and this was referring to environment uncertainty and corporate business.

As a result, an adjustment was considered necessary to be made in Ambe's (2012) model, these two were included while other dimensions have been not considered because they were not equally considering the supply and demand sides in a synchronized way. The uncertainty of the environment was introduced through PESTLE analysis but other approaches will be needed in order to better describe the vulnerability of the chain to the environment. The corporate strategy was included using Porter's generic business strategies: cost leadership (for lean SC strategy) and product differentiation (agile SC strategy).

Also, the literature revealed three main phases in the developing of the modern industrialization: craft production, mass production and lean production. It is believed that agile production is the following one. Some authors explicitly suggested the need for agility in automotive industry. This new trend was analyzed to answer the third research question. Even there is a high request for innovations within the industry and the external environment is threatening it, by using the new created framework, it was concluded that a lean strategy is still more likely to be optimal for this industry.

The supply chain management is still considered an emerging discipline and different perspectives are presented in the literature. Still, the evolution of the concept showed that it made considerable progress and it extended from the logistic field and now it has a multidisciplinary approach. Also, the number of the included elements extended to a point where supply chain management is not considered an appropriate or comprehensive term to describe the concept. Many other proposals were made in this regard, and one of them is the name demand-supply chain management (DSCM).

An individual definition of the DSCM is this: A network of organizations which develops activities concerning the supply or demand and which tries to manage and match the flow of goods, money and information between them in order to improve the overall performance of the chain, to gain competitive advantage, to satisfy the end customer and to avoid mediation costs.

This paper also has some limitations. Most of them have been revealed in the precedent chapters. The pool of articles resulted from the search process was relatively large. The reason for this was not to exclude any relevant paper but the evaluation process was subjective. As a result, the scrutiny and evaluation of reviewer's decisions could be interpretable. Also, the way in which the dimensions of the framework used to analyze the industry was subjective. Even if a PESTLE analysis was applied on the industry other affecting environmental variables might have not be taken into account. In this sense the Methodology chapter highlighted the situationist approach.

Further research should focus on better describing the environment uncertainty and its effect on the overall supply chain. A good point to start in this direction is the SCM literature on supply chain resilience.

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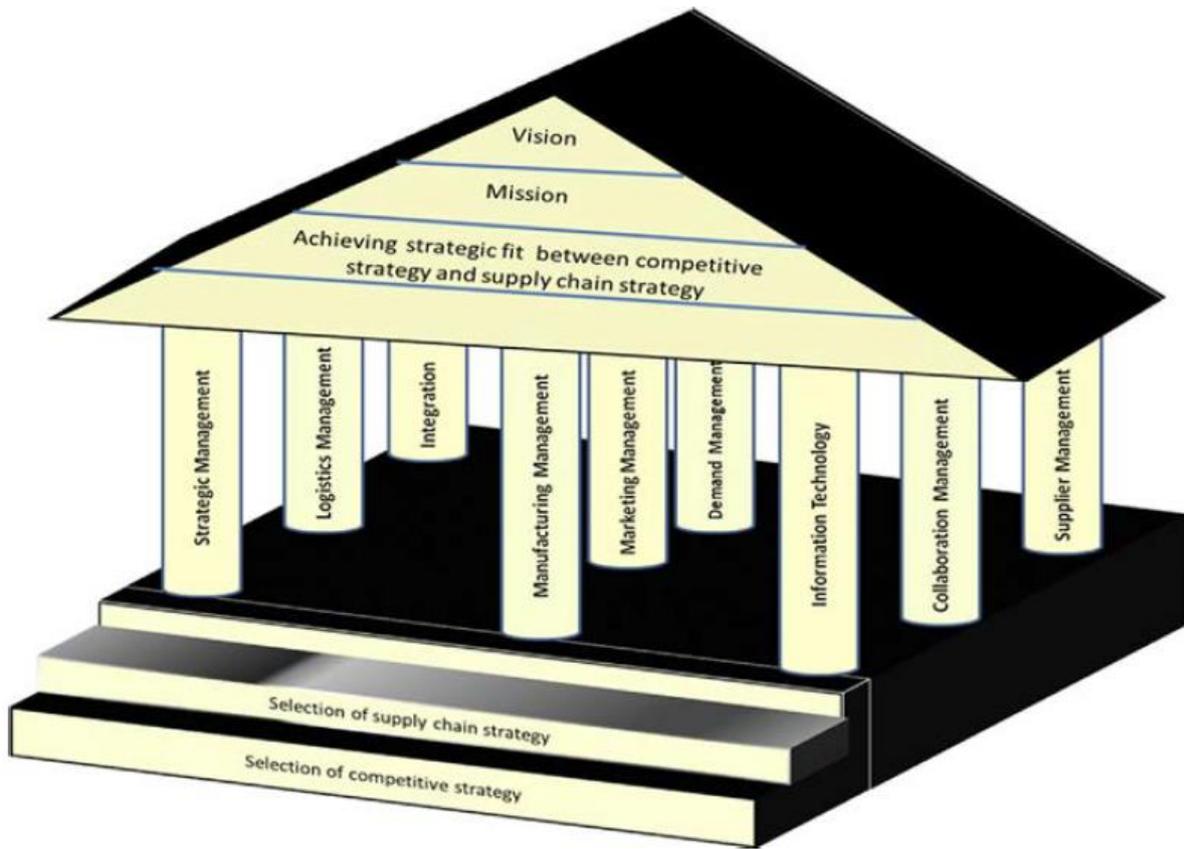
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ANNEXES

Annex 1. “A conceptual framework of SCM excellence”



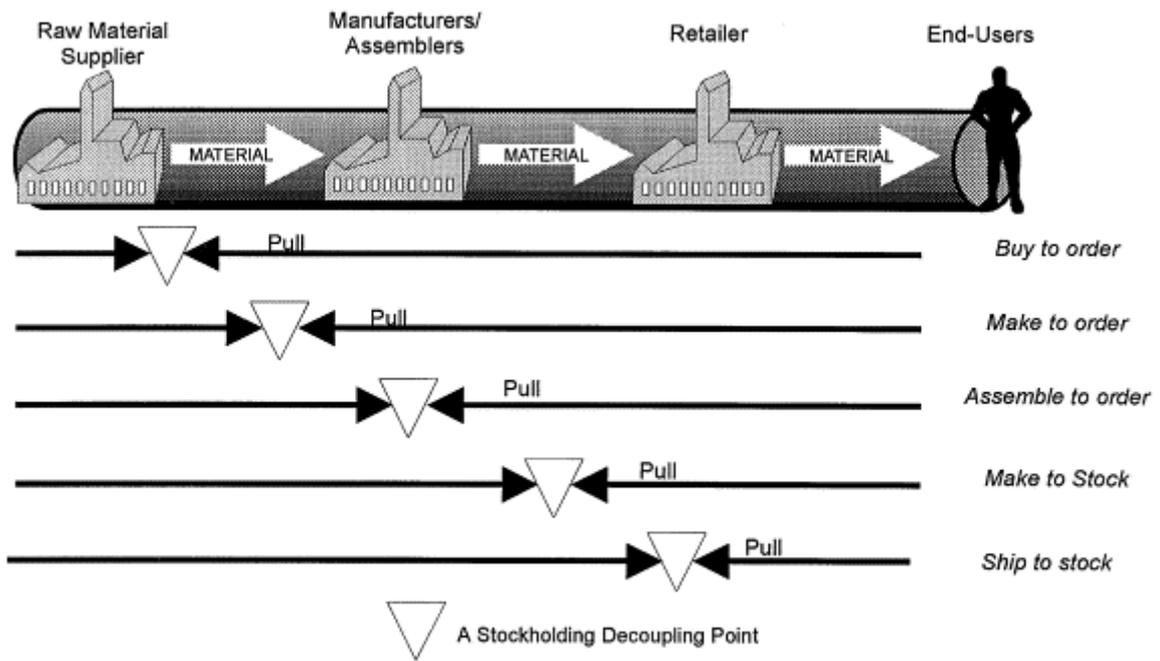
Created by Soni Gunjan & Kodali Rambabu (2013)

Annex 2: “Comprehensive framework for determining supply chain strategies and practices”

Criteria	Description of criteria	Lean supply chain	Agile supply chain
Product characteristics	Demand uncertainty	Predictable	Unpredictable
	Product type	Functional products	Innovative products
	Profit margin	Low	High
	Product variety	Low	High
	Order lead-time	Long	Short
	Market winner	Cost	Availability
	Product life cycle	Long	Short
Manufacturing characteristics	Market segment	Serve only current market segment	Develop new product lines and open up new markets
	Manufacturing focus	Maintain high average utilisation rate	Deploy excess buffer capacity
	Manufacturing process	Continuous (large volume)	Job shop; batch; line flow
	Production process	Standardised product (Mass production)	Customised products
	Techniques	MTS	MTO; ETO
	Approach	Push-based system	Pull-based system
Decision drivers of supply chain	Integration	Integrate manufacturing, purchasing, quality, and suppliers	Integrate marketing, engineering, distribution, and information systems
	Collaborative relationships	High information sharing; traditional alliances	More collaborative barriers; visual organisation
	Information technology	Highly desirable; cost of information drops while other costs rise	Obligatory; collect and share timely, accurate data
	Facilities	Narrow focus; few centralised plants	Flexible manufacturing; many small factories
	Inventory	Low inventory levels; few items	High inventory levels
	Location	Few central locations	Many locations
	Transportation	Shipments are few and in large quantities	Frequent shipments
	Sourcing	Supplier attributes include low costs and high quality	Supplier attributes involve speed, flexibility, and quality
	Pricing	Price based on volume	Price based on margins

Creator: Ambe Intaher M.; (2012)

Annex 3. Naylor et al.'s illustration of the five strategies and decoupling point (1999)



Source: Naylor, J. Ben; Naima, Mohamed M.; Berry, Danny (1999)