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<http://hdl.handle.net/11067/7400>

<https://doi.org/10.34628/J9N5-C089>

Metadados

Data de Publicação

2023

Resumo

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Tipo

bookPart

Editora

Universidade Lusíada Editora

Esta página foi gerada automaticamente em 2024-09-21T08:21:43Z com informação proveniente do Repositório

Supply Chain 2.0: the concept evolution in response to market changes

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Abstract. The Supply Chain initial concept has been suffering mutations from its base. This has been adjusted by the fact that supply chains need to be supported on pillars that are speed, scalable, intelligent, and strategically connected. Disruptions in traditional supply chains based on geopolitical conflicts in Eastern Europe, the COVID-19 epidemic and unstable national economies have demonstrated the need to apply key pillars and techniques in restructuring supply chains. According to the literature review of concepts explored by several authors it's possible to identify and support the existence of an association with the concept of industry 4.0. As a consequence of the emergence of fourth industrial revolution (known for the application of industry 4.0) the concept of traditional Supply Chain went directly to Supply Chain 4.0, which leads to the belief that there were the second and third stages. It should be noted that the new version of the supply chain (Supply Chain 2.0) is influenced by the existence of Industry 4.0, but this does not sustain the omission of the intermediate stages. Based on the literature review, the main techniques, and strategies to be used in the restructuring of supply

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chains were identified, namely procurement and purchasing associated with supply chain capacity, redundancy and flexibility as risk mitigation strategies and the definition of the centre of gravity of supply chains that addresses factors related to suppliers and demand.

Keywords: Supply chain 2.0; Logistics; i4.0; SCM framework.

1. Introduction

A new version of the Supply Chain (SC) has been debated due to the influence of increasing market turbulence, uncertainty associated with globalization and the risks exposure. Due to the disruptions that have emerged in the market, supply chains have noted the need to create the supply chains on new and well-defined pillars – speed, scalable, intelligent, and strategic connection. The scenarios that until now were seen as inapplicable, are beginning to be approached as new realities [1]. It is evolving in size, shape, and configuration. The Supply Chain managers are trying to coordinate, control and manage them with a different vision, a vision based on new definitions. Nowadays, the evolution of the supply chains happens in several ways, uncertainty will always exist, but it is different from the past, the external factors are having more impact and happening like an attack.

The definition of supply chain isn't unanimous [1] [2], in this paper we explain the most significant evolutions, according to the literature review carried out that occurred in the supply chains in a response to the market changes.

According to [2] the concept “Supply Chain 4.0” doesn't correspond to the truth because we don't really have the medium stages (SC 2.0 and SC 3.0). To prove this point, this paper is going to use a literature review that explain this evolution and the possibilities to apply some risk mitigation strategies, like redundancy vs flexibility.

The technologies applied to the supply chain brings more effectiveness and efficiency, but we need to know that the risk still there. Risk in SC normally means cost and this cost can be mitigated by some strategies[3]. The evolution to SC 2.0 doesn't appear by coincidence, the application of new technologies provides the exact and perfect time to evolve the supply chain, but this evolution is also derived from the consequences of the geopolitical crisis (COVID-19, Container crisis, lack of microchips). These factors have shown us that the supply chain need to be restructured.

The need to apply SC 2.0 arose with the different disruptions originated in traditional supply chains. Delay in product delivery both customized and standardized created the need to apply the four pillars in the new version of supply chains – speed, scalability, intelligence, and strategic connection. It is necessary to apply a new way of management for the companies to answer to the revolutions that emerged and the new scenarios created [4].

2. Methodology

A literature review was used to support this paper. To sustain this paper two main databases were used: Scopus and Web of Science. Regarding supply chain 2.0, only two articles were found that alluded to the intended requirements. About supply chain 4.0, 96 papers were found, only 47 referred to the topic in the title, keywords or abstract and were not repeated between the various databases, 6 of them were not available, 24 were not aligned with the research objectives. Twelve articles were selected. The sources were analysed according to the criteria mentioned.

3. Instruments that allow the application of Supply Chain 2.0

This section contains the instruments and tools that are used to apply the new version of the supply chain. In this article, three of the various instruments and tools used to create a new version of the supply chain are identified [5].

Supply chains, within organizations, work through very well-established departments that are governed by a set of rules and systems addressed from the beginning. These supply chains, when well established, help many companies achieve competitiveness rates higher than what is common in the sector. However, these traditional supply chains that helped companies to raise their competitiveness index, currently, need to be reformed from their origin and not just a change on what is already implemented. The markets addressed today are completely different from the markets addressed at the time these chains were designed [6].

According to [7], supply chains were formatted to adapt - the Dynamic Flexibility phenomenon -however this restructuring, due to the turbulence existing in the global market, must happen at its base, that must be dynamic and flexible and not adapting the chain's processes and methods to the intended dynamics and flexibility. This change from the ground up is not only reflected in the restructuring of supply chains, but it also means analysing all the processes and methods of business management and, after that critical analysis, adapting the supply chains to these processes and methods.

3.1. Purchasing vs. Supply Chain Capacity

According to [8], one of the methodologies analysed to adapt the traditional supply chain to the new version of it is the divestment of the purchasing department to the development of the chain from its root. In this case, a system of constant communication between purchasing management and supply chain management is important and decisive. Knowing the quantity of components and materials needed for produc-

tion together with the knowledge of demand, it is possible to analyse and modify, if necessary, the respective supply chains.

The alignment of the internal purchasing department with what will be the organisations' supply chain management translates into a competitive advantage. In many cases, this alignment is recognised as an added value and an important differentiation factor in different sectors. The alignment of the two departments is one of the main factors that allows the creation of the phenomenon dynamic flexibility.

They transitioned from supply chains that were entirely focused on factory efficiency, riddled with whiplash and other dynamic distortions, to resilient supply chains that manage seamless operations at every layer of the network.

Structural flexibility refers to the ability of a supply chain to adapt to fundamental changes in the business environment. In doing so, we primarily consider focal points within a company's supply chain system. In this context, we can broadly define centre of gravity as the link between supply and demand. To use a mechanical analogy, if each customer has a rope to pull the product out of your factory (the more items, the stronger the attraction), and the main raw material and component suppliers hold a rope to push the product in to your factory. Bottom line, where your centre of gravity will be, is where all the power is balanced. It is likely that multiple centres will emerge, in many cases by product category or market area.

The association of purchasing with supply chain capability is also explored in section 2.3 where the concept of defining the centre of gravity of the supply chain is explored.

When purchasing and supply chain capability are aligned it is possible to manage this supply chain over turbulence. Turbulence brings risks, but with risks come opportunities. Uncertainty cannot be changed, but the exposure it creates can be managed. In this sense, it is important to take turbulence for granted and understand its impact.

3.2. Procurement vs. Capacity of Supply Chain

According to [9], associating Procurement with the Supply Chain Management is an asset for creating resilience in supply chains. Procurement, with a view to create resilience in supply chains, demonstrates the existence of intra-organization and inter-organization requirements that can help combat the disruptions experienced in today's markets.

Regarding intra-organization requirements, four general principles are defined - acquired knowledge, inventory, product, and technology. Acquired knowledge is a way for organizations to anticipate potential problems and disruptions due to previous experience in similar situations. The inventory management model that can and should

respond to the characteristics of the production systems adopted by companies determines the speed with which the company can combat market needs. Developing a flexible product enables the organization to deal with complicated and unpredictable situations, e.g., regarding product customization. Technology is one of the most important requirements to generate resilience in supply chains, obtaining database management systems that can handle all the information inherent in supply chains.

Regarding inter-organization requirements, four other general principles are defined - strategic sourcing, supply chain design, transportation and risk. Strategic sourcing is a key activity for creating resilient supply chains, if sourcing can be managed properly, organizations can eventually build trusting relationships with their suppliers, and because of that relationship, they can make strategic and efficient decisions with them. Strategic sourcing helps in supply chain design, reduces complexity, and helps to clear information flows in supply chains. Analysing internal and external product movements is central to our supply chain design, if the movements made internally e.g., from assembly line 1 to assembly line 2 and externally e.g., from manufacturing hub 1 to manufacturing hub 2 are known it becomes easier to minimize waste and eliminate unnecessary costs by increasing the flow of product between required destinations. The risk associated with suppliers must be constantly analysed and updated, currently, what was considered certain and safe must be analysed and evaluated again.

If the procurement activity is carried out according to these requirements, the supply chain becomes faster, more scalable, more intelligent and has more strategic connection between the different means required, e.g., connection between the purchasing department and the logistics department that performs the supply chain management and connection between suppliers and organization.

3.3. Supply Chain 2.0 Centre of Gravity

The basis for the change from traditional Supply Chain to Supply Chain 2.0 is the application of new technologies together with the already known pillars – speed, scalable, intelligence, and strategic connection.

According to [7], the need for change related to supply chains is due to different factors that have emerged in recent decades as determinants - materials and components, political factors, energy costs and unstable national economies.

Materials and components today are scarce and limited resources resulting in the long lead-times and limited flexibility of these suppliers, politics has increased its presence in supply chain and transport regulations, energy costs are rising sharply due to the emergence of an energy crisis, and due to inflation from factors such as the

pandemic and the war in Ukraine, national economies are more unstable than ever.

Placing supply chains among the factors that influence both suppliers and customers is a direct illustration of reality, defining the centre of gravity in these chains becomes determinant and a success factor for organizations.

It is necessary to format what is known as the centre of gravity or “mental” model of supply chains according to factors related to suppliers - labour cost, available materials and resources, skills, and transportation costs - and related to demand - changing demographics, changing consumer preferences, available cash, and industry development.

According to [10], change must be carried out by all actors in the supply chain. Intra-organization changes alone are not enough to change the quality of services provided by supply chains, there must be inter-organization changes, i.e., all actors in the chain must make joint changes with emphasis on communication between the parties.

The most studied sector in terms of supply chain management is the automotive sector. This sector has been getting more dynamic through new technologies, new materials, new software, and new production centres. The emergence of these factors until now was not representing a big impact on the supply chains but after the last incidents the impact has increased and required new strategies and new configurations in the supply chains themselves.

3.4. Risk mitigation strategies (redundancy vs. flexibility)

According to [11], one of the fundamental factors to change the known supply chains is the risk, it is associated with supply chains today and is too high, the solution proposed by the mentioned authors addresses a program of mitigation and direct reduction of potential risks. Supply chains are constrained by a variety of risks, problems arise in a variety of ways including suppliers failures, lay-off at manufacturing sites, and sometimes even cyberattacks.

The focus of managers in risk mitigation should be to apply risk reduction strategies with approaches aimed at decreasing the pressure imposed by risk on supply chains. Several scientific papers discussed and demonstrated the existence of various risk mitigation strategies such as buffer inventory [12], cooperation and collaboration among members of the supply chain [13] and increased supply chain flexibility [14]. Risk mitigation policies imposed by companies address two categories depending on the risk associated with the supply chain - redundancy and flexibility.

Redundancy focuses on limiting and mitigating the negative effects of risks through product availability in cases of emergency. Strategically increasing inventory, main-

taining safety stock, and adding capacity to production systems are the most common redundancy strategies to mitigate risk. On the other hand, flexibility-related strategies focus on building organizational and cross-organizational capabilities to anticipate threats to the continued functioning of supply chains and respond to them as quickly as possible. [15]

Table 1 - Risk Mitigation Strategies according [11]

	Risk mitigation strategy (redundancy)	Risk mitigation strategy (flexibility)
Concept	Increased availability of products or increased access to essential materials and components.	Developing the ability to respond quickly and resiliently to risks that may arise.
Inventory Strategy	Creation of buffer inventories of materials, components and finished products.	It generates inventory turns and minimizes inventory along the chain by creating the ability to respond quickly.
Relationship with supply chain members	Focus on transactional relationships with multiple suppliers to hedge risks.	Focus on long-term collaboration, relationships with key supply chain members.
Implementation costs	Expensive, quantity involved high from capital	Less expensive, reduced amount of capital involved
Difficulty of implementation	Relatively easy to implement	Relatively difficult to implement
Implementation Time	It can be implemented quickly, but maintaining the strategy over the long term can be difficult because of the associated implementation cost.	It takes a long time for the processes that provide flexibility to be well structured. Once the strategy is established maintaining it over the long term becomes easier.

4. Supply Chain 2.0 emerging factors

The emergence of the new version of the supply chain comes along with a distinct perception of factors such as Big Data, 3D printing, cloud computing [16].

The factors mentioned in table 2 demonstrate the main drivers for the new version of the supply chain (SC 2.0) to be applied. These factors are also associated with the fourth industrial revolution. Industry 4.0 technologies are transforming supply chain management from a linear model to so-called Supply Chain 2.0, where operations are integrated and processes flow in multiple directions.

Table 2 - Supply chain 2.0 emerging factors according to [16]

	Positive impacts	Negative impacts
<i>Big Data</i>	<p>Increased data processing as a structuring factor in procurement - inventory optimization and warehouse management.</p> <p>Increased visibility along the supply chain.</p> <p>Ease of monitoring and responding to disruptions generated by the unpredictability of demand</p>	<p>Increasing complexity and amount of information.</p> <p>Technological infrastructures still have difficulties in managing overwhelming amounts of data.</p> <p>Increased risks related to Cyber Security.</p>
<i>Cloud Computing</i>	<p>Improvement in logistics management processes (circular information within everyone's reach).</p> <p>Information travels and is available throughout the entire supply chain.</p> <p>Better demand forecasting and planning.</p>	<p>Increased risks related to Cyber Security.</p> <p>High risk when related to data control.</p> <p>The operation of the cloud can damage the operation and reputation of the organization.</p>
<i>3D Printing</i>	<p>Decentralization of production, improving the capacity to respond to the unpredictability of demand.</p> <p>Restructuring of logistical methods and strategic stock (components and materials essential to produce the parts).</p> <p>Changes regarding cost management (mainly associated with procurement).</p> <p>Reduction of supply chain complexity (unnecessary transport is saved and storage space is reduced).</p>	<p>Legal concerns.</p> <p>It is still a pioneering technology and as such there are still many errors and flaws associated with its use.</p>

5. Conclusions

The concept should evolve to SC 2.0 instead to SC 4.0, without the omission of the intermediate stages. In this paper has been proven that the original concept known as supply chain definition has changed from its foundation. A tweak to the fundamental concept that the supply chain must be supported on pillars of speed, scalable, intelligent, and strategic connectivity.

This paper focuses on explaining proactive actions by concentrating on key issues to build resilience within companies and across their supply chain to overcome disruptions that can be considered critical. This resilience can also be addressed from a procurement perspective and, when managed proactively, solutions can be found to

these interruptions. The focus on procurement activity enables the company to extend and reaffirm its relationships with customers and effectively fulfil its boundary spanning responsibilities.

Despite the findings and implications highlighted above, this study also has limitations. First, it is purely exploratory based on the knowledge and theories of other authors. Second, this paper focuses on procurement activities and risk management which although have a strategic function in the firm only represent a part of it. Third, the supply chain was addressed purely and exclusively upstream with the downstream implications also directly influencing the supply chain itself.

Resilience and volatility in the organisational environment have increased significantly and is very likely to remain one of the prominent features of the supply chain landscape for the unpredictability generated by the future. It is very likely that this resilience will continue to increase due to the existing mutations in the organizational world, not only should absolutely change in the management processes of the organization but also between them.

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