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Logistics 4.0: The Cooperative Strategy and Reducing Costs

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Abstract:

The strategic position of each company does not depend exclusively on the quantity and quality of the resources it has, but on the position, it occupies within the network in which it operates. Networking helps reduce transaction costs and business coordination: Valuable information about customers, suppliers, competitors, and good partners is easily shared among network stakeholders, resulting in savings in transaction costs. There may be high transaction costs when there are two different stages of property ownership, and the 4th industrial revolution seeks to challenge the logistical areas for technological digitization and large domain integration and seeks to present a new operational, organizational, and managerial paradigm that will be termed: logistics 4.0. Methodologically, the research is based on a bibliographical review and seeks to find grounds that theoretically justify the reduction of Transaction Costs through Logistics 4.0. Information speed is a major influencer of good results, and improvements in the transmission of information and knowledge seek to improve the management of organizations through their networks and aims to reduce their transaction costs from the new technological and logistical revolutions. Logistics 4.0 is based on intelligence and technological equipment and is developed with online tools, seeking to respond to faster, virtual and automatic information systems.

Keywords: Networks, Logistics 4.0, innovation

1. Introduction

Strategically providing the logistics area with efficient, effective and competent resources, regardless of the institution, has come to be seen as a very important pillar so that they can carry out their activities in a sustainable way so that they reach their most varied objectives (Almeida, 2011).

Logistics in the various sectors as a centerpiece of the company's strategy, over time, becomes a necessity rather than an option and must be applied and managed as a strategic weapon, as like any other industry in the efficient management and effective use of its resources is the most direct way that can exist to assure quality standards demanded by increasingly demanding customers (Carvalho et al, 2017).

Through the work developed by Ballou (2004), Tseng, Yue and Taylor (2005) and Paura (2012) we have to realize that there are three basic activities of logistics: Order Processing (basic factor of identification of the need to be met) ; Maintenance of stock (Ensure that all materials identified as 'stockable' always have quantities in stock to meet existing orders) and Transport (whether internal or external should always be ensured so that the necessary goods can be allocated, where necessary correct time). These activities should always be carried out, as rigorously as possible, so that the logistics cycle itself will never be called into question and at the same time the normal operation of the services will not be jeopardized, and there will always be correct and updated information so that has to manage these processes as accurately as possible (Ballou, 2004, Tseng, Yue and Taylor, 2005 and Paura, 2012).

Whatever the methodology from a logistics point of view, institutions should be concerned about how they communicate and how effective they are, since only secure, effective and immediately accessible information systems can circulate correctly, giving meaning to the purpose of the logistics chain, identify the need and satisfy it in the best possible way (Branco, 2013).

The 4th industrial revolution seeks to challenge the logistic areas for a technological digitization and integration of large domain and tends to present a new operational, organizational and management paradigm, which will be denominated: logistics 4.0.

Methodologically, the study is based on a bibliographical review on the themes (1) Innovation Networks, (2) Transaction Costs, and (3) Logistics 4.0 and tries to find grounds that theoretically justify the reduction of Transaction Costs through the networks created in the Logistics 4.0. Thus, in the first place, several studies were done not only in documents indexed in the ISI Web of Science as in Scopus, in order to find literature favorable to the work within the theme of Logistics and Industry 4.0 and with incidence in the costs of transaction and in the theory of networks. Secondly, all abstracts were analyzed, and interesting and important abstracts were selected for the present study. During the reading of the abstracts, articles with a relevant scale were evaluated; little relevant; and less relevant. For the next phase, only the relevant articles were transited. In the last phase, after checking the abstracts of the initial research and excluding the non-relevant articles, the articles were recovered in full and the studies that were truly relevant to the present study were verified.

The main research question is: 'Can Logistics 4.0 create cooperative conditions to lower transaction costs?' And as such, the main objectives of this research are: to analyze and understand the relationship between Logistics 4.0 and Transaction Costs as well how to assess the influence of innovation networks on this relationship.

The following chapters address the topics (1) Innovation Networks, (2) Transaction Costs, and (3) Logistics 4.0, then a contribution is made to answer our research question and the main conclusions are presented.

2. Literature Review

2.1. Innovation Networks

In the organizational environment, the network represents a form of intermediary organization between the organization and the market. The organizational network is comprehensive and generally means that two or more organizations are involved in long-term relationships, with the main objective of revitalizing the various organizational processes to achieve competitiveness in an increasingly turbulent environment (Håkansson, 1987).

Innovation Networks according to Pyka et al. (2002b), Felman et al. (2006), Braunerhjelm (2008), Huang and Chang (2008), Percival and Cozzarin (2008), Suire and Vicente (2008) and Weber and Khademian (2008) are now widely considered as an effective means of organization complex processes of research and development.

The evolution of organizations led to the existence of an approximation in order to strengthen their relations, interconnected by cooperative relations in order to work continuously and together (Franco and Duarte, 2012). Certainly, a single isolated organization will be unable to train all the resources and competencies to fulfill its objectives, as knowledge will always be deficient compared to the knowledge of a network of organizations. Managers thus seek partners who can provide the information, support and advice needed to complete the complex, increasingly diverse tasks they have on the agenda (Franco and Duarte, 2012).

Whatever the distance between the partners, Veciana (2008) and Simões (2009), both affirms that the networks allow a relationship between the organizations in order to concentrate the exchange of experiences between them, as well as the sharing of knowledge, learning, among others (Felman et al., 2006). The intensity and frequency of the relationship between organizations is greater if they belong to the same network.

As for network content, interpersonal and inter-organizational relationships are seen as the means by which actors have access to a variety of resources, including knowledge, made available by other actors (Hoang & Antoncic, 2003). Innovation networks can bring key benefits to logistics, such as:

- The content of the network: a key benefit of innovation networks is the network's access to a set of information and advice. Relationships may also have reputational or signaling content (Krackhardt & Stern, 1988; Hoang & Antoncic, 2003; Marouf, 2007);
- Network management: another key benefit of innovation network is their management mechanism that manages and coordinates the exchange relationships in the network. Trust among network actors is, for the most part, seen as a critical element that can influence the quality of shared resources. Trust, as well as the depth and richness of exchange relationships, particularly with regard to the exchange of information, will be the critical elements (Granovetter, 1973; Nelson, 1989; Hoang & Antoncic, 2003; Marouf, 2007);
- Network structure: it is defined as the pattern of relationships that result from strong and weak relationships among the actors that make up the same network. A general proposition is that the different positions that the actors occupy in the network structure have an important impact on the flow of resources and, consequently, on the results of the entrepreneurial activities (Granovetter, 1973; Hoang & Antoncic, 2003; Marouf, 2007). The most intuitive unit of measurement is the network size, defined as the number of direct connections between the focused actor and other actors. The analysis of the network dimension measures the extent to which resources can be accessed at the level of entrepreneur and organizations (Aldrich & Reese, 1993; Baum et al., 2000).

Thus, knowledge diffusion is the form of transfer of knowledge, directly or indirectly, from one part to another (Deeds et al., 1997; Malecki, 1985; Gilbert et al., 2008).

In the Logistic context, the cooperation represents a relationship between partners, finding the development of joint activities that are a source of performance improvement in the organizations that interact in this chain.

For Barnes and Liao (2012) it is the skills and competencies of each organization that perform best, not only depending on the organizations' cooperation, but also on internal cooperation (between departments) (Stank et al., 2001) of synchronizing the work of the organization leads to greater efficiency (Jagdev and Thoben, 2001). The non-synchronization of the work in the execution can condition the performance of the Supply Chain, being not only important to share information, but also it is necessary to develop coordination mechanisms (Carvalho et al, 2010).

Christopher (2005) introduces the term interdependent to define logistic cooperation between organizations, presenting them as a network of interdependent organizations working together to manage and improve together flows of materials and information. Organizations when they understand that they do not control all the conditions necessary to individually achieve a given goal (Handfield and Bechtel, 2002) become interdependent with others and seek cooperation as a basic requirement for the creation of value and profitability of organizations (Moura, 2006).

But innovation networks have flaws, or barriers, to integrate a network of innovation, identified by Pyka et al. (2002), Felman et al. (2006), Braunerhjelm (2008) and Huang and Chang (2008). The actors who wish to integrate this network must have the following requirements: (i) Autonomy; (ii) Social skills; (iii) Reactivity; (iv) Proactivity. Failure to meet some of these requirements will hamper integration and participation in the network.

2.2. Transaction Costs

Transaction Costs were first discussed by Coase in 1937, which awarded him the Nobel Prize for Economics in 1991, by questioning under what circumstances organizations produce for their own needs. Coase (1937) cit. in Barros (2012) states that companies exist because of the existence of a cost of using prices, thus arising the idea of the existence of transaction costs. This relationship sees the company as an alternative way in coordinating production, where it will choose how to organize production based on what will translate into lower transaction costs (Barros, 2012).

The transaction costs are according to Pondé (1996) cit. in Fagundes (s.d.) the consumption of economic resources resulting from adapting, structuring and monitoring the interactions between the different agents, ensuring compliance with contracts.

The theory presented by Coase argues that transactions do not only entail costs, but the attempt to minimize these costs ends up influencing the way economic activities organize themselves (Rocha, 2002). As can be seen, all the theories of transaction costs are associated with negotiation costs with other organizations, which are essentially contractual relations costs, resulting from market failures (Rocha, 2002). This theory argues that transaction costs are not only important, but also provide an important tool for understanding certain forms of economic organization (Rocha, 2002). In this way, transaction costs are defined as: '... costs not directly related to production, but which arise as agents interact with each other and the problems of coordination that emerge' (Azevedo, 1996, pp. 28 -29). According to Williamson (1994), the minimization of these costs materializes through the alignment of management structures with the elaboration of unique structures, thus reducing the opportunistic behavior of the other party, especially if there is a dependency relationship between the two parties.

The various factors that influence market failures make it almost impossible for companies to pass on the specific information they need at a reasonable cost (Foss, 1993), and this is due to four main factors: high opportunism, limited rationality, uncertainty / complexity (contractual and organizational) and high presence of specific assets (Moschandreas, 1994).

Figure 1: Information Impactedness - Adapted from Moschandreas (1994)

As can be seen in the figure above, Information Impact, a definition that comes from Oliver Williamson (Nobel Prize in Economics - 2009), is a derived condition that arises when agents are interested to act opportunistically in the presence of uncertainty / complexity and arises when one participant in the transaction is better informed than the other (adverse selection and moral hazard) (Moschandreas, 1994).

Asset specificity is one of the most important factors contributing to high transaction costs and thus to integration. There are other factors leading to market failures that are also relevant to vertical integration. One of these flaws identified by Moschandreas (1994) is limited rationality, which in turn presupposes decision making using simplifying rules that extract key aspects of the problem without capture all its complexity. Since the rationality of economic agents is limited, this leads to incomplete contracts in the sense that it is impossible for them to project all future events (Kato & Margarido, 2000). According to Kreps (1990) cit. in Kato & Margarido, (2000) limited rationality means that it will be very costly for individuals to predict and contract for every eventuality that may arise throughout the transaction.

Considering that the rationality of the economic agents is limited, since they are not able to elaborate a model that can perfectly predict future events, this necessarily implies that contracts pertaining to any transaction are incomplete (Kato & Margarido, 2000). Although the economic agent's rationality is limited, they are aware that their contractual relations need adaptations and negotiations to safeguard their interests (Kato & Margarido, 2000).

Eiriz (2004: 126) mentions that 'a strategic network, in order to be economically efficient, has to offer its actors lower transaction costs than can be obtained internally', and this is a way of knowing if the network will be relatively attractive the benefit / cost ratio.

Networking helps reduce transaction costs and business coordination: valuable information about customers, suppliers, competitors, good partners, etc., is easily shared among network stakeholders, resulting in transaction cost savings (Braunerhjelm, 2008).

Braunerhjelm (2008) argues that networks created to promote innovation among actors can show the following benefits:

- Networks facilitate the exchange of relevant information and knowledge;
- Networking helps reduce transaction costs and business coordination;
- The network transaction leads to rationalization of production;
- Networking increases the ability of companies to exploit economies of scale.

Given this, if there is an informational impact (or problems of asymmetry in complex contracts), opportunism and specific assets, we may be faced with influential determinants of integration.

2.3. Logistics (4.0)

Logistics by itself is defined by USAID (2012, p.13) 'as an operational component of supply chain management, including quantification, procurement, inventory management, transportation, fleet management, data collection (...)' Supply chain management includes logistics activities as well as the coordination and collaboration of workers, levels and functions. The supply chain includes international manufacturers and the dynamics of supply and demand (...).

Stressing the origin of logistics, we have to go back quite a bit in time, since it is associated with a historical figure: Alexander the Great. He was the first, at military level, to adopt strategies (which without being denominated as logistical) promoted the success of military actions developed (Rodrigues, 2007; Dobroruka, 2009 and Rocha, 2012).

Noting that over the centuries this type of strategy has been improved and adapted to the different sectors of activity we can verify that around 1901 it was recognized academically as a research area when the first study about it was published, which study (Leite, Souza, Silva and Oliveira, 2015).

More recently, around the 70's and 80's, new methodologies were applied to the logistics area that shaped this strategic area and its applicability to the business reality and endowed it with the capacity to adapt to the needs that the constant technological and business evolution in the various sectors of activity, culminating in logistics techniques such as Just in Time (maximum stock minimization and continuous flow of product movement) or Kanban (use of visual indicators for distribution control) (Serio, Sampaio and Pereira, 2006; Adnan, Jaffar, Yusof and Halim, 2013 and Oliveira, Almeida and Sousa, 2013).

A logistic cycle is influenced by several vectors, inseparable and influenced from each other, which lead us to changes in momentary, unforeseeable and specific needs, and the responsible service must be prepared to respond to these needs in a timely manner so that never in any case the quality, safety and speed in the provision of the service or product are called into question.

Through the work developed by Ballou (2004), Tseng, Yue and Taylor (2005) and Paura (2012), we have to realize that there are three basic activities of logistics:

- Order Processing: basic factor of identification of the need to be satisfied;
- Stock maintenance: Ensure that all materials identified as 'stockable' always have quantities in stock to meet existing orders;
- Transportation: whether internal or external must always be guaranteed so that the necessary goods can be allocated, in the place necessary in the correct time;

These activities must always be carried out, as rigorously as possible, so that the logistics cycle itself is never called into question and at the same time that the normal operation of production is not jeopardized and there is always correct and updated information so that has to manage these processes as accurately as possible (Ballou, 2004, Tseng, Yue and Taylor, 2005 and Paura, 2012).

Conceptualizing the area under study, it is important to elucidate the concept of Supply Chain Management (SCM), and this integral part of logistics can be defined as the synthesis, maintenance and operationalization of the processes that constitute the supply chain, that as the objective of eliminating the needs of the end consumer identified previously, as well as equipping the institutions with competitive factors that allow them to distinguish themselves from the others (Besugo, 2011; Janvier-James, 2012 and Park, Nayyar and Low, 2013).

Using the studies developed by Courtois, Pillet and Bonnefous (2007) and Ayers (2001), the same author, Besugo (2011), characterizes SCM as having its main impact on the value chain management, fostering its success, through the management of processes that go from the supplier to the final consumer, characterizing this chain as essential when looking for an integrated management of materials, since it has such a scope that encompasses areas such as the acquisition of goods and services (where includes not only purchases but also stock management, storage activities and distribution) (Roldão, 2002 and Besugo, 2011).

From the historical point of view, according to Serio, Sampaio and Pereira (2006) based on the study developed by Boyson, Cors, Dresner and Harrington (1999), subdivide the evolution of logistics in four recent chapters:

- Underdeveloped logistics (until 1970): centralization of transport actions, inventory control, identification of needs and distribution;
- Incipient logistics (between 1970 and 1980): Focus on transport and storage, starting to look at logistics as a process with integrated management needs of its stages;

- Integrated Internal Logistics (up to 2000): integration of the notion that logistics can be a factor of competitiveness through not only managing the internal logistics of the institution, but also as a way of organizing them with a focus on the objectives and provision of its services with the best possible quality;
- Integrated External Logistics (from 2000 to the publication of the article): at this stage of Logistics History, the most recent one, was the moment when it realized that it would not make any sense to look at the logistic cycle without there being a clear what the institutions' objectives are and how it could act in order to be as effective and efficient as possible. In this way, a greater emphasis was placed on forecasting needs (demand), information systems and, above all, how to interconnect all the phases that provide a better logistic performance;

Referring to the previous point, the need arises to frame Logistics 4.0 as an ability to integrate the company with the outside through the information systems. Logistics 4.0 brings increased business-to-business competitiveness, increased revenue and productivity, and process optimization (Dais, 2014).

Industrial evolution has directly influenced Logistics and the capacity of material flows to adapt to revolutions: the first industrial revolution works towards the mechanization and the hydraulic force; the second with mass production and assembly lines and electricity; the third with computing and automation; the fourth focuses on the breakthrough that allows machine-to-machine communication without human intervention (Kagermann et al, 2013 and Dais, 2014).

With the fourth industrial revolution, that is, with Logistics 4.0, the main innovative focus is the ability to develop communication between equipment and machines, through the Internet of Things (IOT), reducing time and costs (Kagermann et al, 2013 and Dais, 2014). In the industrial sphere, the IIOT, or internet of things in Industry, also ensures greater transparency in the supply chain, through the ability to verify the movement of cars, pallets and all the various materials in the supply chain.

In the new industrial era (4.0), the deployment of robotic solutions with less need for manpower will be evident (there are human-robot interaction robots) (Kagermann et al, 2013 and Dais, 2014).

In the context of Logistics 4.0, information transparency is an important factor: with a large number of connected objects and equipment, working in tandem and providing real-time information, it is necessary that communication and transmission standards are efficient, so that information and important data are always prioritized.

2.4. Logistics 4.0 and the Relationship with Transaction Costs

The association of new technologies, at a global level, has assumed over time an extreme preponderance in what is the performance of organizations and their orientation to results. In this sequence, logistics does not escape the rule and given the impact it can have on the daily activity of organizations, it is preponderant that this activity is seen not only as support but as one of the central factors for organizations, so that they can be and to develop their activity in an efficient way.

The concept of logistics 4.0 which, as mentioned previously, associates the use of technology (essentially the internet of things), allowing a large number of activities to be carried out by technological innovations and which may be linked to each other by sharing a real-time information, eventually converging with the identified needs so that transaction costs can be reduced, contributing to the different elements of the movement of goods having useful and timely information, thus contributing to a better take decision-making.

Transaction Costs	Network Cooperation	Logistics 4.0	Stakeholders
Transaction Implies Costs	Networking should allow economic efficiencies;	Through Logistics 4.0, with internet mediation of things, there is network cooperation within the organizations and with the various stakeholders, ensuring the dissemination of information among the various actors and the integration of the various sectors / actors, ensuring coordination and management of the logistics cycle.	Offer your actors lower transaction costs than you can get internally.
Informational Impact	The existence of networks allows to improve the flow of information and knowledge.		Ease of access to information / knowledge. Ability to know in Logistics, networks, prices and essential information; Better coordination and balancing of deliveries, collections and logistics processes.
Asymmetry of Information			
Limited Rationale			
Coordination Problems	The decrease of the distance between actors allows the existence of an improvement in the coordination and in the relation between actors.		

Table 1: Logistics 4.0 and the Relationship with Transaction Costs

Examples such as robotized warehouses, which allow to optimize the storage space and a fast and efficient access to articles or the technology of georeferencing of loads, that allows to locate in real time and to transmit this information to the client, are associated with this phenomenon of logistics 4.0 and are, when optimized, excellent mechanisms of relationship between the various integrating parts of the value chain, since all these examples allow to optimize the existing resources, reducing the costs associated with the process, which are not necessarily of production and allow, on the other access to real-time information that endows data organizations that influence their decision making, improving intrinsically the management of situations related to this area of activity.

Better management, quick and reliable access to information and optimization of resources (infrastructures or human resources) are some of the benefits that the application of technology to the logistics process can have at the level of transaction costs, since all these improvements allow, to provide organizations with greater capacity for relationship and transmission of information between the various internal levels and above all provides organizations with a greater capacity for knowledge and negotiation with the different external agents that are associated with their activity.

3. Conclusion

Considering the definitions presented by Pondé (1996) or Barros (2012) we see that transaction costs are inseparable from any activity, higher or lower, will always be associated costs and, like all others, should be analyzed and evaluated in a way which can be minimized without affecting the level of service provided. In this case, we can suggest different forms of management that benefit the results of this parameter, but it is important to realize that the implementation of technology that allows organizations to perform better, faster and faster to respond to identified needs and that allows them access the information in a quick way so that its decision making is the best possible allows us, possibly, a better management of the Transaction Costs.

Using the studies developed by Courtois, Pillet and Bonnefous (2007) and Ayers (2001), the same author, Besugo (2011), characterizes Logistics as its main incidence in the value chain management, fostering its success through of the management of processes that go from the supplier to the final consumer, characterizing this chain as essential when looking for an integrated management of materials, since it has such a scope that encompasses area such as the acquisition of goods and services (which includes not only the purchases but also the management of stocks, storage activities and distribution) (Roldão, 2002 and Besugo, 2011). Also observing the study by Carvalho (2004) we have to realize that the issue of communication between the various levels of the institution leads to their prudence, the use of information systems equipped with skills that allow an update and quick access to information.

Thus, the main research question presented was: 'Can Logistics 4.0 create cooperative conditions to reduce transaction costs?' Thus, it can be said that the application of technology that is useful and has a direct impact on the performance of organizations, besides being a way to boost this performance, it is also a management tool that allows to be in real time, to receive information that can not only influence the decision making, but above all have data that allow to manage the activity of the organizations of form efficient and effective, as well as endowing them with mechanisms of relationship with the entities with which they relate in the course of their activity. Concluding that Transaction Costs can be influenced directly and positively by the new concept of Logistics 4.0, and this influence will only be noticed if the decision maker realizes that only aligning the human resources of the institutions with their policies and objectives as well as the technology that it implements within the organization is that it can influence positively the same and therefore become a mechanism of reduction of costs among which the Transaction Costs.

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