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ANALYTICAL SUPPLY CHAINS: ARE THEY MORE RESILIENT? A MODEL’S PROPOSITION

ABSTRACT

Understanding that disruptions can be devastating, the ability of supply chains to return, as quickly as possible, to their normal state, after disruptions, has been considered as important as optimizing their flows. According to the literature, companies must develop capabilities and invest in risk management to improve their supply chain resilience, however almost nothing has been investigated about the role of the analytical orientation for those purposes. Assuming that analytical orientation is essential for supply chains to recover from interruptions, this theoretical essay aimed at proposing its inclusion in an initial supply chain resilience model, based on literature review. As a contribution, this paper aims at presenting a model that will enlarge the discussion about this theme, which can be empirically tested in a future research.

KEYWORDS | Supply chain resilience, analytical supply chains, business analytics, resilience capabilities, model.

Murilo Zamboni Alvarenga
murilozamboni@hotmail.com

Marcos Paulo Valadares de Oliveira
marcos.p.oliveira@ufes.br

Hélio Zanquetto Filho
zanquetto@gmail.com

Washington Romão dos Santos
washington_romao@hotmail.com

Universidade Federal do Espírito Santo, Vitória, ES, Brazil
INTRODUCTION

In today’s turbulent and uncertain environment, characterized by huge global competition, large and complex chains, increased customer expectations, shortened product life cycles, rapid technological innovations, increased outsourcing, and demand volatility, each company in the supply chain is susceptible to an indefinite number of events that can interrupt their operations (Pettit, Fiksel, & Croxton, 2010; Ponomarov & Holcomb, 2009; Scavarda, Ceryno, Pires, & Klingebiel, 2015; Sheffi & Rice Jr., 2005; Skipper & Hanna, 2009).

According to Zsidisin and Wagner (2010), interruptions in supply chains derive from events that can occur both inside and outside the supply chain’s boundaries. Random events (earthquakes, illnesses, storms, hurricanes), accidental events (fires, human errors, equipment breakdown) or intentional situations (terrorism, robberies) are the main causes of supply chain disruptions (Carvalho & Machado, 2007; Sheffi & Rice Jr., 2005).

Given that such disruptions affect performance and can be devastating to supply chain members (Blackhurst, Craighead, Elkins, & Handfield, 2005), an important question, pointed out by Soni, Jain and Kumar (2014), is to identify what leads some organizations to collapse while others can thrive and grow. Thus, to become resilient, and quickly recover from disruptions, is emphasized, by both managers and academics (Brusset & Teller, 2017; Kamalahmadi & Parast, 2016) gaps in current research, and future directions on the topic. For this purpose, we employed two methods to collect publications in supply chain resilience. First, we selected keywords and searched the relevant databases and journals. Next, we tracked the references of those papers collected in the first method to look for other publications published in conference proceedings and book chapters. As a result, a sample of 100 papers was collected, studied, and analyzed. We summarize our findings in several areas including enterprise and supply chain resilience definitions, supply chain resilience principles, and supply chain resilience strategies. Based on the assessment, we develop a framework for the principles of supply chain resilience that can be used as a basis for understanding supply chain resilience. (C.

Thus, a proactive and effective method that allows supply chains to recover from expected and unexpected interruptions, is essential to build capabilities that make them more resilient, i.e. cabable to return, after disruptions, as fast as possible to their normal state or improve in order to avoid collapse of their operations and maintain profitability of their members (Christopher & Peck, 2004; Jüttner & Maklan, 2011; Pettit, Fiksel & Croxton, 2010; Ponomarov & Holcomb, 2009).

In general, resilience capabilities more often identified in literature are collaboration, flexibility, and visibility, as well as risk management procedures (Brandon-Jones, Squire, Autry, & Petersen, 2014; Christopher & Peck, 2004; Colicchia, Dallari, & Melacini, 2010; Jüttner & Maklan, 2011; Pettit, Fiksel, & Croxton, 2010; Ponomarov & Holcomb, 2009; Scholten, Scott, & Fynes, 2014; Wieland & Wallenburg, 2013) capabilities (visibility).

However, there is a gap in literature concerning the role and impact of supply chains ability to collect, analyze and transform data into useful knowledge in order to make decisions based on facts and data, that is, the impact of analytical orientation over supply chain resilience.

The analytical approach, as pointed out by Ladeira et al. (2016, p. 487), involves: “[...] the extensive use of critical data and explanatory and predictive models, as well as fact-based management to guide management decisions and actions.” In this sense, being analytical allows companies to maximize decision-making processes by developing the organization’s capacity to conduct analysis and act, providing better results by generating value and efficiency in decision making (Davenport, 2006; Davenport, Harris, De Long, & Jacobson, 2001; Luersen & Thorlund, 2010).

Under the supply chain perspective, being analytically oriented means being able to provide members with useful information, drawn from the vast amount of data collected, facilitating the decision-making process (Sahay & Ranjan, 2008) to overcome uncertainties (Chen, Chiang, & Storey, 2012) and to favor the recovery from interruptions. Thus, it is pertinent to consider the analytical orientation of supply chains as capability in resilience. According to Galbraith (1974), the more complex and turbulent the environment, the greater is the need for information processing.

Therefore, the present theoretical essay aimed at proposing the inclusion of analytical orientation in the preliminary model of supply chains resilience, based on literature review.
Using the taxonomy of Colquitt and Zapat-Phelan (2007), we expect to contribute to the discussion about resilience in supply chains by presenting a model that, although it has not yet been empirically tested, was conceptually grounded and validated. For this, we used the methodology known as Proknow-C (Afonso et al., 2012), where, based on 72 articles indexed on Web of Science or found on Ebso, Science Direct and Emerald in the last 30 years with titles containing the terms “Supply Chain Resilience” or “Resilient Supply Chain”. From the initial results, the most cited papers were selected (21 articles representing 90% of the citations on the topic) to identify the main antecedents of resilience in supply chains. Moreover, the most current articles, which were compatible with the theme and published in high-impact journals, were used to build the grounds of the initial model.

Thus, in line with Colquitt and Zapat-Phelan (2007), the initial model sought to capture the concepts developed by other theoretical and empirical studies, as well as to clarify and extend the conceptual approach used in previous studies, with two main contributions. The first by including a new construct in the model and the second by introducing new relationships between the model's constructs. That is, the idea is to propose an advance in the resilience knowledge and communicate with other researchers, making possible to test it empirically.

It is worth mentioning that the we intend to carry out empirical tests and publish the results in future paper. We intend to follow the taxonomy already mentioned, expanding the frontier of knowledge by building new theories based on theories available, making the cycle: conceptual advance, empirical test and new conceptual advance. Thus, expanding knowledge and presenting it in a new or different direction is possible (Colquitt & Zapat-Phelan, 2007). In order to develop an extended theoretical model, these two emerging and important themes were unified, aiming at contributing to both academics and practitioneers.

THEORETICAL DISCUSSION

In this chapter the theoretical foundations are presented involving supply chain resilience and supply chain analytics, which support the model presented in this paper.

Supply Chain Resilience

Authors such as Bhamra, Dani, and Burnard (2011) argue that the notion of resilience was grounded in ecology, related to ecosystem stability, whereas Ponomarov and Holcomb (2009) say that it has its roots in social psychology, considering the differences in behavior of individuals when facing adversity (Rutter, 2012).

However, it is known that resilience is a multidisciplinary construct that has many facets, being studied from ecological, psychological, economic and organizational perspectives. In recent years, the term resilience has gained strength in the research on supply chain management (Bhamra, Dani, & Burnard, 2011; Ponomarov & Holcomb, 2009) technological and environmental.

Christopher and Peck (2004) define resilience in supply chains as the chain’s ability to return to its status quo or move to a more desirable one after suffering disruption. Ponomarov and Holcomb (2009, p. 131) argue that supply chain resilience can be conceptualized as “the adaptive capability of the supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function”.

The present study considers, from the readings and main definitions, that resilience of supply chains - SCRRES - should be defined as a result, that is, the return of the chain to its natural state, or even improvement, after the occurrence of disruptive events, driven by the development of adaptive capacity and prevention. Thus, we argue that only recovery should be considered as a SCRRES dimension.

This approach differs, for example, from the definition proposed by Ponomarov and Holcomb (2009) that consider the maintenance of the desired level of operations (robustness) and the preparation for events (risk management) as dimensions of resilience. Similarly, it differs from the definition proposed by Wieland and Wallenburg (2013) that is more closely associated with adaptive capacity, which we consider as being an antecedent of resilience.

Our thought goes along with Brandon-Jones et al. (2014) that consider resilience as a result provided by the development of capabilities, where maintaining operations means robustness and resilience means the return of operations. Similarly, it is observed that a deterministic disruptive event is the starting point of resilience, because only preparing for probabilistic events is related to risk management and does not determine resilience level (Jüttner & Maklan, 2011).
Christopher and Peck (2004), as well as Soni, Jain and Kumar (2014) argue that resilience can be built within the chains, that is, there are certain capabilities that, if developed, increase resilience. Sheffi and Rice (2005) present redundancy and flexibility, while Christopher and Peck (2004) develop a theoretical model involving collaboration, risk orientation/culture, agility and (re) building ability to return from disruptive events.

Research shows that in order to confront vulnerabilities, supply chains must develop capabilities, which are defined as “attributes that enable the company to anticipate or recover from disruptions” (Pettit, Fiksel, & Croxton, 2010, p. 6). It is relevant to point out that these are seen here as attributes which enable chains to recover or be prepared in order to recover from disruptions. As such, recovery would be associated to resilience and anticipation to risk management.

As previously discussed, the capabilities that most appear as determinants of SCRES are: collaboration, visibility, flexibility, speed and, in addition to these capabilities, risk management procedures (Brandon-Jones et al., 2014, Christopher & Peck, 2004, Colicchia et al., 2010, Jüttner & Maklan, 2011, Pettit et al., 2010, Ponomarov & Holcomb, 2009, Scholten et al., 2014, Wieland & Wallenburg, 2013). It is interesting to note that, according to Ponomarov and Holcomb (2009), the capabilities must be interrelated and improved together to be resilient.

It should be noted that although it is one of the capabilities that most appear as antecedents of resilience, speed appears to be a dimension of resilience, that is, the speed at which the supply chain itself manages to recover. Given that the chain’s existing velocity is affected by the rupture, in addition to the absence of studies that specifically address the impact of speed on resilience, we chose not to approach it in the study as a resilience capability belonging to the resilience capability package.

Thus, it is proposed:

**P1a:** Supply chain resilience is positively impacted by a resilience capabilities package.

**Collaboration**

With regard to resilience in supply chains, Jüttner and Maklan (2011) have identified in an empirical multi-case study that, in a scenario of global financial crises, collaboration among members of the supply chain can function as a mechanism to contain negative impacts of disruptions.

It is also known that communication and cooperation among members of the chain impact, in a statistically significant way, the resilience of the chain as a whole (Wieland & Wallenburg, 2013). On the other hand, according to Scholten and Schilder (2015), although the existing literature points out that the collaborative relationship between supply chain members is part of the resilience, little attention has been given to how it actually exerts influence, being one of the gaps discussed in this study.

**P2a:** Collaboration is a resilience capability that belongs to the resilience capability package.

**Flexibility**

The importance of flexibility to adapt to environmental uncertainties is empirically verified in the study by Merschmann and Thonemann (2011), while Swafford, Ghosh, and Murthy (2008) verified the agility of chains and competitive performance of the business. On the other hand, Vickery, Calantone, and Droge (1999) did not find a statistically valid relationship between the importance attributed by the managers’ perception of capabilities on flexibility and the amount of uncertainties suffered by supply chains.

According to Sheffi and Rice (2005), although redundancy, that is, having reserves of resources is an alternative to respond to disruptions, a better way is to improve the flexibility of the chain, as it results in benefits and gains in operating efficiency in normal routine.

In order to be resilient, the chain must develop a certain degree of flexibility, allowing rapid input changes or changes in the way inputs are generated, as well as outputs or the way outputs are generated, as Pettit, Fiksell and Croxton (2010) argue. These can be developed, for example, with multiple sources of supply and replenishment, contract flexibility, risk sharing, inventory management, among others.

Jüttner and Maklan (2011) found that the chain flexibility in reallocating and enhancing capacity utilization, inside or outside the network, allows costs to be managed and profits kept in situations of disruption. Scavarda et al. (2015) found, in a study of the Brazilian auto industry, that flexibility results...
in resilience, however, they also found that the organizations investigated were more concerned with internal flexibility rather than flexibility in the supplier/buyer relationship.

**P3a:** *Flexibility is a resilience capability that belongs to the resilience capabilities package.*

**Visibility**

Visibility is essential to make the supply chain more resilient as it provides the ability to visualize, in complex environments, inventories and demand, enabling changes in flows when there are interruptions, and it is positively associated with agility, i.e. how quickly a supply chain would react to environmental changes (Brandon-Jones et al., 2004; Christopher & Peck, 2004).

Authors such as Jüttner and Maklan (2011) have qualitatively verified the relationship between visibility and resilience, since it makes it possible to quickly perceive the occurrence of the risk event and improve decision making. Brandon-Jones et al. (2014), therefore, were the first ones to verify this relationship quantitatively, observing a significant and positive impact. Therefore, based on these surveys, it is proposed:

**P4a:** *Visibility is a resilience capability that belongs to the resilience capabilities package*

**Supply chain risk management**

Supply chain risk management (SCRM) has a direct impact on the supply chain resilience, especially in relation to risk identification and evaluation, preventing chains from events that may disrupt their operations, as well as allowing the development of actions to recover from disruptions (Colicchia et al., 2010; Graeml & Peinado, 2014; Jüttner & Maklan, 2011; Wieland & Wallenburg, 2013).

Jüttner and Maklan (2011) argue that if risk management provides knowledge about environmental risks as well as how to mitigate their impacts, it makes the supply chain more resilient. Likewise, Graeml and Peinado (2014) found a positive impact of risk orientation over supply chain resilience, and Colicchia, Dallari, and Melacini (2010) found that adopting effective risk management strategies to deal with lead time variability, increases supply chain resilience.

**P5a:** *Supply chain risk management has a positive impact on the supply chain resilience.*

Thus, it is observed that SCRM directly impacts the resilience of the supply chain, preparing it for the occurrence of events that may interrupt its operations, and so prevention can be considered a SCRM dimension, not a resilience dimension. At the same time, it is impacted by the capabilities package developed by the chains. This is because, for risk management to be efficient, the supply chain must adopt a collaborative management approach with its customers and suppliers, be flexible and able to receive and provide information in real time, with quality and precision, favoring visibility (Kilubi & Haasis, 2015; Lavastre, Gunasekaran, & Spalanzani, 2012; Nooraie & Mellat Parast, 2015; Tang, Matsukawa, & Nakashima, 2012; Tang & Musa, 2011; Thun & Hoenig, 2011; Wiengarten, Humphreys, Gimenez, & McIvor, 2015; Zhao, Huo, Sun, & Zhao, 2013).

**P6a:** *Supply chain risk management is positively impacted by the resilience capability package developed by the supply chains.*

**Environmental uncertainty**

Another point to be emphasized is that the need to develop capabilities is associated with the turbulence of the environment where the members of the chain are inserted. Uncertainty is related to events that can not be known with complete precision in order to develop risk mitigation strategies (Radivojevi & Gajovi, 2014). For Galbraith (1977, p. 36), uncertainty “is the difference between the amount of information required to perform the task and the amount of information already possessed by the organization.” The greater the difference, the greater the uncertainty regarding the outcome of the decisions.

Factors such as globalization, outsourcing, supplier dependence and supply networks, consumer behavior and intensive use of technology have raised the level of environmental uncertainty, influencing the decision making and supply chain performance (Tang & Musa, 2011). Scavarda et al. (2006) and Pettit, Fiksel, and Croxton (2010) emphasize the importance of the balance between capabilities and vulnerabilities, since high levels of vulnerabilities and low capabilities result in excessive risk and, conversely, degrade profitability due to excessive investment in protection mechanisms.
Therefore, it is expected that all structural relations of the model will be moderated by the environment, since, when there is low turbulence, the proposed relationships amongst the package of capacities, supply chain risk management (SCRM) and chain resilience (SCRES), tend to be smaller than those of more turbulent environments.

P7a: The strength of the relationship between the capability package and the resilience of supply chains is moderated by the degree of uncertainty and dynamics of the environment.

P8a: The strength of the relationship between the capability package and the supply chain risk management is moderated by the degree of uncertainty and dynamics of the environment.

P9a: The strength of the relationship between supply chain risk management and its resilience is moderated by the degree of uncertainty and dynamics of the environment.

Based on the literature on the subject, the resilience capability package, formed by collaboration, flexibility and visibility, is expected to positively impact the supply chain resilience. In addition, it is expected that this same package will have a positive impact on the supply chain risk management (SCRM) and, finally, on the supply chain resilience (SCRES) itself. Moreover, all relations hypothesised are moderated by the environmental uncertainty. Thus, this initial model is presented in Figure 1.

Figure 1. Proposed modern model

However, it is argued that the model initially presented is capable, but insufficient to explain the resilience of supply chains. This is because the literature ignores an essential factor to face the uncertainties and, consequently, to recover from disruptions. Thus, in view of the increasing volume of data that chain members have and may have access to, and the need to analyze them in order to make analytically grounded decisions, the insertion of analytical orientation as an additional capability in resilience will be discussed next.
Supply Chain Analytics

Simon’s studies (1955, 1956, 1979) brought to the organizational research insights that broke ancient paradigms and paved the way for the emergence of new theories. If classical / economic theory considered an absolute rationality, apart from reality, in which there was the possibility of reaching an optimal decision, the author’s findings showed that, in reality, man is endowed with a bounded rationality, since one does not have the time, information, or the knowledge to make an optimal decision. In this sense, any decision made by the individual will be at most satisfactory.

However, a satisfactory decision is not easy to achieve, requiring individuals, organizations and networks of organizations to have analytical skills to process information, seek alternatives, and calculate consequences for designing actions (Simon, 1979). It is precisely from this need that the studies on the Business Analytics theme emerge.

It occurs that (1) the large amount of data generated in organizations, on a daily basis, outside and inside their chains, (2) the reduction of the gap between business strategy and data management, and (3) the perception that grounded decisions are critical at each organizational level, are movements that intensify the usefulness and need of statistics to work along with information technology and business knowledge to transform data into information in order to improve decision making (Acito & Khatri, 2014). Still, the Business Analytics phenomenon is favored by the decrease in costs associated with the technological elements needed to be analytical (Acito & Khatri, 2014).

Business analytics (BA) is defined, on the basis of Laursen and Thorlund (2010), as to provide the right support for decision, at the right time and for the right people, and can be seen as an information system composed by: technological elements responsible for collecting, storing and providing information; human skills; and business processes. If some information can be used by organizations, by means of simple statistical techniques, the analytical skills go beyond of just simple statistics, since, in addition to information systems, they provide more sophisticated information (Davenport, 2006).

However, as pointed out by Davenport et al. (2001), only investments in sophisticated analysis tools and technologies are not enough for organizations to transform data into business knowledge, that is, useful knowledge that can add value to the organization. According to the authors, it is the human capability to analyze, interpret, generate and act with the insights generated through the data analysis and critical factors of this complex transformation process, using advanced technology and analysis, that is the driver of results that can add value to the business.

This approach is also in line with the arguments by Laursen and Thorlund (2010), since they emphasize the importance and responsibility of decision makers to analyze the information obtained through information systems and transform them into useful knowledge to improve or develop business processes and, consequently, generate value.

Therefore, analytical capabilities consist of a set of analytical methods, tools (Acito & Khatri, 2014) and skills, involving statistics, information technology and business knowledge that provide the opportunity to provide large volumes of data, through organization, availability, analysis and interpretation, considering the reality of the business and the specificities of the environment in which it is inserted, making it possible to develop and apply more satisfactory decisions. Importantly, visibility, previously presented as a capability in resilience, refers to the ability to visualize, in complex environments, inventories and demand. On the other hand, the analytical orientation does not refer to visualization, but to the analysis of descriptive, predictive, prescriptive, and inquisitive nature, conducted to guide and support the decision-making process.

Once organizations have used analytical tools such as statistics, explanatory models, and data analysis for decision making, business processes will be affected by changes and reorganizations, making routines more efficient and generating more value than at an earlier time (Bronzo et al., 2013). Thus, BA results in changes in the way managers see the business, allowing them to observe obsolete processes and replace them with new ones, more efficient and effective to the objectives of the organization. According to Bronzo et al. (2013), for this to occur, the data collected need to be transformed into analytical knowledge, which can be fully exploited and used in decision making.

As discussed by Teo, Nishant and Koh (2016), BA empowers identification of changes in consumer behavior, new product development opportunities,
new markets, and absorption of external information, for example, customer perceptions about the products and services, and thus, is adaptive, innovative and absorptive, therefore, a dynamic capability.

Davenport’s (2006) study of 32 organizations involved in quantitative analysis found that analytical capabilities provide organizations with mechanisms that allow them to improve pricing, identify potential customers, and develop new products. Similarly, Bronzo et al. (2013) found statistically significant results for the impact of using Analytics over the dimensions of the BSC (Balanced Scorecard).

More specifically, Souza (2014, p. 595) describe the application of advanced analytics techniques to supply chain management. The applications are categorized in terms of descriptive, predictive, and prescriptive analytics and along the supply chain operations reference (SCOR) argues that “supply chain analytics focuses on the use of information and analytical tools to make better decisions regarding material flows in the supply chain”. Similarly, Sahay and Ranjan (2008) argue that analytical chains allow, for example, to identify opportunities for cost reduction.

Chae and Olson (2013) propose a framework that would represent analytical supply chains, composed by data management, process management and performance monitoring capabilities. In this way, the analytical approach, through the acquisition and transformation of data into information, qualifies supply chains, for example, to map scenarios, identify the impact of expected and unexpected events, minimize inventories and improve product flows, provide benefits to the key management processes (planning, supplying, producing, delivering, returning) and minimize asymmetries between the desired and actual performance (Chae, Olson, & Sheu, 2013; Chae & Olson, 2013; Davenport, 2006; Souza, 2014) data management resources (DMR).

Taking into account that analytical techniques can be descriptive, prescriptive and predictive, Souza (2014) summarizes them in relation to each dimension of the SCOR model, except to plan, since, according to the author, this dimension is present in all others. The summarization is presented in Table 1, below.

**Exhibition 1. Analytical techniques.**

<table>
<thead>
<tr>
<th>SCOR Model</th>
<th>Analytics techniques</th>
<th>Source</th>
<th>Make</th>
<th>Deliver</th>
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<td></td>
<td>Descriptive</td>
<td>• Supply chain mapping</td>
<td>• Supply chain visualization</td>
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<td></td>
<td>Predictive</td>
<td>• Time series method (moving average, exponential smoothing, autoregressive models)</td>
<td>• Linear, non-linear and logistic regression</td>
<td>• Data-mining techniques (e.g., cluster analysis, market basket analysis)</td>
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<td></td>
<td>Prescriptive</td>
<td>• Analytic hierarchy process</td>
<td>• Mixed-integer linear programming (MILP)</td>
<td>• Game theory</td>
<td>• Non-linear Programming</td>
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Source: Souza (2014).
Empirically, Trkman, McCormack, Oliveira, and Bronzo (2010) found that the use of the set of approaches and procedures that allow organizations to gather information, understand them and be able to apply solutions to SCOR areas of supply chain management, i.e. the analytical approach, in processes, results in better chain performance, with the relationship between analytical capabilities and performance being moderated by the organization’s information systems. Still, Chae, Olson and Sheu (2013) verified the impact of the analytics in supply chains over the individual performance of their members.

Based on the above discussion, it is expected that, if a supply chain is analytically oriented, its members will be able to process information more efficiently, i.e “ [...] to capture, integrate, and analyze data and information, and use the insights gained from data and information in the context of organizational decision making.” (Cao, Duan & Li, 2015, p. 385), favoring resilience through prevention, adaptation and efficient decision making.

If, on the one hand, no studies were found in the literature that directly relate the constructs, on the other hand the theories presented seem to support this relationship, since the definitions of supply chain analytical orientation are extremely related to the ability to collect and analyze information and events from internal / external environment, and make satisfactory decisions that allows organizations / chains to adjust and improve processes, adapt, and consequently facilitate the recovery or improvement of the production flow and information in case of disruptions. Therefore, it can be considered as resilience capability.

Therefore, from the foregoing, it is proposed:

P1b: The analytical orientation in supply chains is a resilience capability.

P2b: The insertion of analytical orientation in supply chains as resilience capability strengthens the relationship between resilience capabilities package and supply chain resilience.

In addition, authors such as Tang and Musa (2011) argue the need to develop the quantitative approach, both academically and in a practical way, in order to manage risks in supply chains, highlighting that the lack of information may undermine decision-making within the chains. Thus, it is necessary to improve computational efficiency. Similarly, it is argued by Tummala and Schoenherr (2011) that data management allows to browse, store, and add information about risks, helping with the management and improvement of SCRM as a whole.

In order to identify, evaluate, propose mitigation strategies and monitor risks, supply chains need to develop the capabilities discussed in previous sections, as well as be analytically oriented in order to efficiently identify risks and transform uncertainties into risks, so that one can manage them, make better decisions and, consequently, make the supply chains more resilient. Therefore, it is proposed:

P3b: The insertion of analytical orientation into supply chains, as a resilience capability, fortifies the relationship between the resilience capability package and SCRM.

P4b: Indirectly, the insertion of analytical orientation into supply chains, as a resilience capability, strengthens the relationship between SCRM and SCRES.

Figure 2 below shows the propositions.
FINAL REMARKS

This theoretical essay was intended to discuss the insertion of the analytical orientation in an initial model of supply chains resilience, proposing an extended model. To justify its insertion, we discussed what is meant as resilience in supply chains, in addition to pointing out the main determinants of resilience addressed in the literature, presenting an initial model that was argued to be insufficient.

We highlight the view of resilience in supply chains adopted in this research. Although some previous researches assume adaptation and prevention as dimensions of resilience, in this research we assume that they both precede it. Therefore, resilience is composed by recovery and improvement dimensions. We assume the premise that resilience can only be identified after disruptions.

In this sense, we argued that resilience in supply chains is a consequence, or a result from capabilities development. Therefore, the resilience capability package, composed by collaboration, flexibility and visibility, is capable to impact and explain resilience variance. Likewise, risk management in supply chains, identification, evaluation and control of events, which can disrupt supply chain operations, makes them more preventive and resilient. Like resilience, risk management in supply chains is expected to be impacted by the resilience capabilities package. In addition, we propose that all relationships in the structural model are moderated by the environment.

However, we found a gap in literature that ignores the role as well as the impact of analytical orientation on the recovery of disruptions. Thus, in our view, a supply chain analytically oriented is more capable to adapt and be prepared, and, consequently, to be more resilient. Therefore, it is theoretically pertinent to extend the initial model by adding analytical orientation as a component of resilience capability.

The expanded model is shown in Figure 3.
The argument that grounds these propositions is that to develop resilience, intuition alone is not enough. Goals, indicators and ongoing follow-up of those involved are required to develop, structure and maintain capabilities that will make possible risk management to return to the previous stage, after disruption. Neglecting such conditionings can increase supply chain risks for participants, decreasing their reputation and their ability to reach commitments made with their customers and suppliers. Reducing uncertainties helps decision-making and allows organizations to capture the appropriate results, improving long-term partnerships and alliances. In a specific context, the socio-political environment, where the supply chain members are inserted, can increase the level of uncertainty and generate the need to improve resilience capabilities to avoid operational collapse.

The disruption of Samarco dam in Mariana in 2015, the truck drivers strike in Brazil in 2018, the Philips factory fire in 2000 and the Japan earthquake in 2007, are just a few events that illustrate the impact of risks and uncertainties not only on a single company, but also on several members of its supply chain (Chopra & Sodhi, 2004; Freitas, Silva, & Menezes, 2016; Jüttner; Maklan, 2011).

Thus, this paper contributions are: (1) the understanding, the importance, and the impacts of developing different resilience capabilities to efficiently manage risks and become resilient; (2) deepening a theoretical debate about supply chains resilience dimensions; (3) theoretical development of a resilience package of capabilities including analytical orientation; (4) propose an extended model, that will be empirically tested, in order to verify whether the proposed relationships are statistically significant. (5) make possible to test the explanatory power of the initial model against the extended one. Moreover, empirically tests the change in strengths of relationship with the inclusion of analytical orientation construct, in the initial model, as a component of resilience capability.
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