BBR. Brazilian Business Review
ISSN: 1807-734X
Fucape Business School

Oliveira, Rinaldo de Castro; Gonzalez, Inayara Valéria Defreitas Pedroso
The impact of supply chain integration on the operational process performance: An empirical study under the perspective of Resource Orchestration Theory
BBR. Brazilian Business Review, vol. 19, no. 3, 2022, May-June, pp. 227-245
Fucape Business School

DOI: https://doi.org/10.15728/bbr.2022.19.3.1.en

Available in: https://www.redalyc.org/articulo.oa?id=123071410001

BBR
BRAZILIAN BUSINESS REVIEW

ARTICLE

The impact of supply chain integration on the operational process performance: An empirical study under the perspective of Resource Orchestration Theory

Rinaldo de Castro Oliveira [1]
rinaldocastrooliveira@gmail.com | 0000-0002-3724-0388
Inayara Valéria Defreitas Pedroso Gonzalez [1]
gonzalezinayara@gmail.com | 0000-0003-4873-0101

ABSTRACT

The research evaluated the dimensions that compose the supply chain integration - SCI and their impact on the performance of companies' operational processes. SCI was evaluated based on the Resource Orchestration Theory, and the performance was measured in the level of business processes of the Supply Chain Operation Reference (SCOR) model. A quantitative approach was used, and a questionnaire was applied in Brazilian companies of different sectors. The data were analyzed using structural equation modeling, and the results confirmed the premise that SCI is a multidimensional construct composed by the constructs synchronized planning, strategic partnership, operational coordination and information integration, that have a complementary and interdependent relation. Moreover, SCI has a significant and considerable impact on the operational performance, supporting the assumption that this effect should be examined in the level of business processes, where first-order results are frequently observed.

KEYWORDS

Supply chain integration, Business processes, Operational process performance, Quantitative method

[1]Universidade Federal do Espírito Santo, Vitória, ES, Brazil.

Received: 10/13/2020.
Revised: 02/25/2021.
Accepted: 08/09/2021.
Published Online: 04/27/2022.
DOI: http://dx.doi.org/10.15728/bbr.2022.19.3.1.en

1. INTRODUCTION

Previous studies have verified that SCI impacts on the companies' operational performance in a positive and significant way (Devaraj et al., 2007; Flynn et al., 2010; Liu et al., 2016; Rosenzweig, 2009). However, even though SCI and collaboration are properly recognized as useful factors to increase organizational performance, the results of empirical studies about these relations have been mixed and even controversial (Cao & Zhang, 2011; Flynn et al., 2010).

Cao and Zhang (2011) argue that supply chain collaboration can offer substantial benefits to business partners, due to the fact that companies share risks and resources. Moreover, they reduce transaction costs and increase productivity and performance over time. In addition, the authors (2011) consider that despite those benefits many relationships between partners do not meet their expectations, since few companies really capitalize the potential of collaboration in the supply chain - SC, which indicates an opportunity for deepen investigation about the topic.

Furthermore, Flynn et al. (2010) verified that the integration with clients had a statistically positive impact on operational performance. However, the same effect was not observed on business performance, which was measured by indicators associated with growth in sales, profits, market share and return on investments. Similarly, the empirical study conducted by Qi et al. (2017) did not observe a significant relation between interorganizational integration and financial performance. These different gradations of results can be justified because although performance is a unit often measured by indicators at the business level, business processes are relevant basic units, being the means that companies exploit their resources to implement strategies (Jeffers et al., 2008).

Another important aspect that involves SCI is its comprehensiveness and the descriptions of the dimensions that compose it. For Wiengarten et al. (2013), integration can be defined as an interdepartmental interaction and collaboration process, in which collaboration can be conceptualized as an integration component.

Furthermore, previous studies emphasized the importance of conceptualize SCI as a multidimensional construct, in order to investigate its effects on the company's performance (Cao & Zhang, 2011; Flynn et al., 2010; Liu et al., 2016). It is composed of key dimensions such as: information integration - II, synchronized planning - SC, operational coordination - OC and strategic partnership - STP (Cao & Zhang, 2011; Liu et al., 2016). However, the understanding regarding the relevance of those dimensions in the SCI's formulation process has been little explored.

Therefore, considering the role of integration among the agents of the SC, this research presents as a key issue: What is the impact of SCI on the organization's operational performance, measured in the level of business process? As a specific aim and predecessor to the main objective, the study proposed to evaluate conceptually and empirically the dimensions that compose the SCI, as well as their relevance to the integration process.

In order to evaluate the impact of SCI on the performance of the operational process, constructs related to Resource Orchestration Theory were used. In this research, the operational performance was evaluated considering business processes defined by the Supply Chain Operation Reference (SCOR) model, with focus on operations of planning, supply, production/operation and distribution.

Thus, the gap that this research proposes to evaluate is related to the lack of comprehension regarding the dimensions that compose the SCI, as well as their impact on operational process performance – OPP, measured at the level of business processes defined by de SCOR model. In the best of our knowledge, this approach to evaluate the SCI and its impact in the OPP was

not investigated before. Therefore, the conduction of this research contributed to studies in the organizations' field, especially with emphasis on supply chain management and on companies' performance.

2. LITERATURE REVIEW

2.1. Supply Chain Integration

SCI is defined as the level in which an organization strategically collaborates with its business partners, collaboratively managing the intra and interorganizational processes through a continuous partnership to achieve mutually beneficial strategic goals (Flynn et al., 2010; Kulp et al., 2004; Rai et al., 2006). Therefore, it is highlighted the intrinsic relationship of this construct with the collaboration among agents of a supply chain, conceptualized as an integration component and performing both externally on the organizations' level and internally among people and departments of the company (Wiengarten et al., 2013). Thus, in this study SCI is considered a broad construct which has the intra and interorganizational collaboration as an integration component.

Although SCI is duly recognized as useful factor for increasing organizational performance, the results of empirical studies on such relationships have been mixed and even controversial (Cao & Zhang, 2011; Flynn et al., 2010). Moreover, despite effective supply chain management has become a potentially valuable way of ensuring better organizational performance, an understanding of why and how this process affects company performance, considering important areas and moderating effects, is still incomplete (Trkman et al., 2010).

In order to deepen this discussion, the Resource Orchestration Theory argues that "managers need to orchestrate their resources to realize any potential advantage" (Chirico et al., 2011, p. 310). This theory was developed from the Resource Based View (RBV), which proposes that the company's performance can be explained by the heterogeneity in having valuable, rare, inimitable and non-replaceable resources (Barney, 1991; Sirmon et al., 2011).

However, researches has shown that the influence on companies' performance is not only due to resources possession, but involves management actions related to structuring the company's resources portfolio, and grouping these resources in capabilities in order to obtain competitive advantage (Sirmon et al., 2007). Furthermore, the Resource Orchestration Theory is particularly useful to comprehend the development of resources and capabilities (Liu et al., 2016).

Liu et al. (2016), after reviewing the literature about SCI based on the Resource Orchestration Theory, presented the following constructs, which are complementary and interdependent as described: i) information integration: it reflects the extent in which a company shares information with key partners regarding several activities of the SC, such as information about sales, inventory, production and distribution; ii) Synchronized planning: it refers to the scope in which the company collaborates with its key partners through the preparation of plans, ensuring a greater synchronism regarding future activities of the SC, and the requirements for the continuation of joint efforts; iii) Operational coordination: is related to the extent in which a company simplifies and automates the SC processes with key partners; and iv) Strategic partnership: it refers to the scope in which the company establishes long-term relationships with key partners to achieve strategic goals.

The theoretical model proposed in this study uses these constructs established by Liu et al. (2016), based on the Resource Orchestration Theory to evaluate the SCI.

2.2. Operational Process Performance

An increasing number of research in the field of operations management has sought to identify the benefits derived from information sharing among companies of the SC (Kulp et al., 2004). Moreover, there are evidences that the SCI leads to an improvement on companies' performance (Cao & Zhang, 2011; Devaraj et al., 2007; Lee et al., 2011; Liu et al., 2016; Rosenzweig, 2009; Wiengarten et al., 2015; Wiengarten et al., 2013). Through collaborative business processes, the organizations can create dynamic and flexible integrations in order to synergistically adapt to changing conditions, which allows an improvement on performance and to remain competitive in the global market (Liu et al., 2009).

The SCOR model developed by the Supply Chain Council, in order to contribute to the improvement and dissemination of good practices in supply chains (APICS, 2020), provides a common language directed to processes and to the communication among partners of the SC in the following areas of decision-making: planning, supply, production/operation, distribution, and the processes related to reverse logistics (Lockamy & McCormack, 2004a). The business process associated with reverse logistics was not the focus for the performance analysis due to a series of barriers that limit its usage in Brazilian organizations, such as the governance structure to manage this system (Couto & Lange, 2017).

The SCOR model can be seen as an strategic tool to describe, communicate, implement, control and measure complex processes of the SC to improve the performance (Li et al., 2011). Furthermore, it has been widely used for processes' performance measurement and SC optimization in recent years (Dissanayake & Cross, 2018; Ivanov et al., 2018; Li et al., 2011; Lockamy & McCormack, 2004a; McCormack et al., 2008; Trkman et al., 2010; Wang et al., 2004).

Thus, for the development of this study, the SCOR model was chosen to measure the performance level of business processes of the companies participating in the SC. This choice was due to the SCOR's orientation for the process and the broad adoption by the academic and professional communities of the SC (Lockamy & McCormack, 2004b; McCormack et al., 2008).

3. CONCEPTUAL MODEL

Considering the concepts addressed in the literature review, this research aims to evaluate the conceptual model presented on Figure 1. The construct SCI is considered multidimensional, based on the Resource Orchestration Theory and composed by the constructs: information integration, synchronized planning, operational coordination and strategic partnerships.

Considering the individualized analysis of first-order constructs and based on the premise that they compose SCI, the study conducted by Sundran, Chadran and Bhatti (2016) empirically emphasized that information sharing is positively related to SCI. Mutual information sharing is related to integrated behavior, and it is necessary to occur among business partners in order to implement a management philosophy of the SC, especially regarding monitoring and planning processes (Mentzer et al., 2001).

Similarly, Cooper et al. (1997) emphasize the importance of information integration among the SC members, since it strongly influences the efficiency and it can be characterized as the first component of an integrated supply chain. Furthermore, through effective dissemination and exchange of information among the SC agents, it is possible to have quicker and better decision-making processes that benefit companies' performance (Sundram et al., 2016).

It is also highlighted that the study by Liu et al. (2016) considered information integration as a first-order construct which composes the SCI. Therefore, this study sustains the premise that information integration is a construct which composes the SCI.

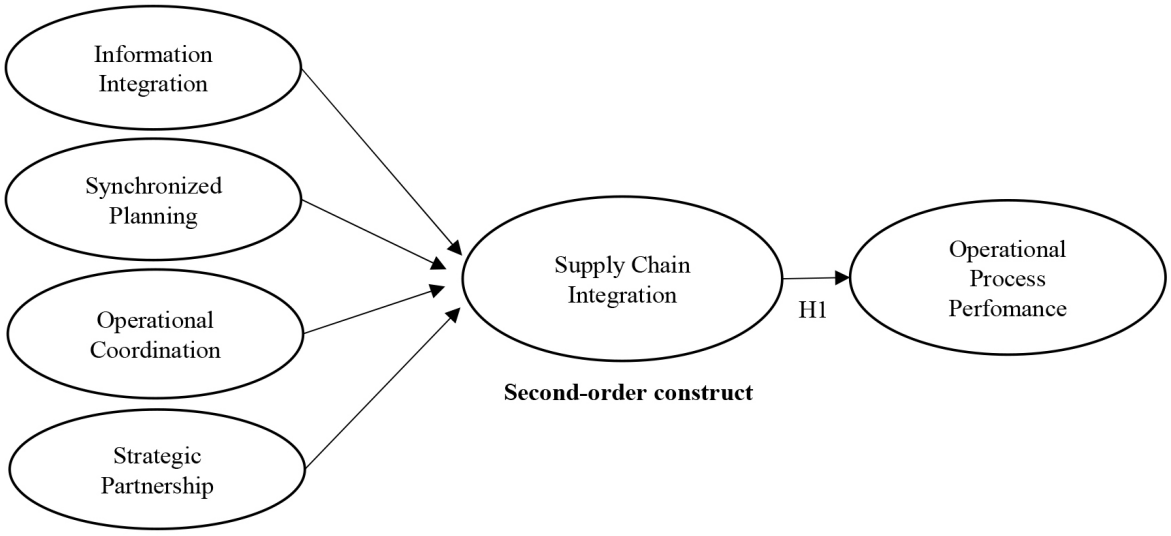

Figure 1. Conceptual model.
Source: elaborated by the authors (2020).

Regarding the construct synchronized planning, there are evidences that point out collaborative planning as an essential part of SC management (Panahifar et al., 2015). The study by Rosenzweig (2009) considered for the measurement scale of the construct collaboration of the SC indicators related to joint planning of business operations, as well as it can be observed in other research (Cai et al., 2016; Devaraj et al., 2007; Wiengarten et al., 2013).

SC collaboration includes, among other dimensions, the synchrony of decisions, which refers to joint planning of actions in the level of markets and products (Cao & Zhang, 2011; Liao & Kuo, 2014). This is necessary to determine more effective and efficient ways of using the company's resources in order to achieve an specific set of goals (Cao & Zhang, 2011).

Furthermore, the study by Liu et al. (2016) considered synchronized planning as a first-order construct that composes the SCI. Thus, this study sustains the premise that synchronized planning is a construct that composes the SCI.

Regarding operational coordination, Cao and Zhang (2011) emphasized that resource sharing composes SC integration and collaboration, and it refers to the leverage process of capabilities and assets with the SC partners, including equipment, installations and manufacturing technologies. Moreover, it has a positive impact on organizational performance.

For Wiengarten et al. (2013), the general consent is that technological resources applied to SC processes have an important role, since they facilitate practices that contribute to improve the performance, such as knowledge sharing, process integration and operational coordination of the SC. In addition, the study by Liu et al. (2016) considered operational coordination as a first-order construct that composes the SCI. Therefore, this study sustains the premise that operational coordination is a construct that composes the SCI.

Regarding the construct strategic partnership, Harland et al. (2007) empirically highlighted that the discrepancy between business strategies of large companies compared with small and medium sized is a barrier to SCI and, therefore, the strategic alignment among business partners is a key factor. Similarly, Cao e Zhang (2011) statistically verified that the congruence of goals among business partners composes the supply chain collaboration.

The practices of partnership regarding strategic suppliers nurture a significant long-term relationship among the SC members, improving organizational capabilities and collaborative integration among

commercial partners in a SC (Sundram et al., 2016). The study by Liu et al. (2016) also considered strategic partnership as a first-order construct that composes the SCI. Therefore, this study sustains the premise that strategic partnership is a construct that composes the SCI.

Regarding the relationship between SCI and organizational performance, previous studies have indicated that a higher SCI positively impacts on the companies' performance (Devaraj et al., 2007; Flynn et al., 2010; Jeffers et al., 2008; Lee et al., 2011; Liu et al., 2016; Panahifar et al., 2018; Rosenzweig, 2009; Sundram et al., 2016; Wiengarten et al., 2013).

The study conducted by Liu et al. (2016) was used as a reference for the definition of the constructs that compose the SCI on the model proposed in this research. In that study, the interaction among the SCI was positively related to the organizational performance, both on the operational and financial scope. Therefore, this study presents the following hypothesis regarding the SCI's effect on the operational process performance.

- **H_1:** SCI will have a positive effect on operational performance measured in the level of business processes.

4. METHODOLOGY

This research has a descriptive nature and quantitative approach. For data collection, a structured questionnaire was applied in Brazilian business organizations, moreover, it is characterized as a cross-section study.

4.1. Data Collection Instrument

The questionnaire was firstly prepared based on the literature review to identify measurement scales validated in research performed by other authors, which properly represented the constructs involved in the research. Regarding SCI it was used as a reference a scale adopted in the study conducted by Liu et al. (2016) to measure the indicators that compose their four constructs. The questionnaire adopted a five-point interval scale, with options that varied from 1 ("strongly disagree") to 5 ("strongly agree").

To measure OPP, it was adopted the scale used by Trkman et al. (2010) based on processes of the SCOR model, considering indicators that focus on the following business processes: planning, supply, production/operation and distribution. It was also used a five-point interval scale, in which the respondents were asked, for each business process, if "in general, it has a very good performance", with response options that varied from 1 ("strongly disagree") to 5 ("strongly agree").

All indicators that compose the conceptual model are reflexive, as described in Table 1. In addition, the questionnaire included items that aimed to characterize the companies' profile, regarding sector, size and location, as well as the respondent's profile, considering the job position/function and field of practice. Considering that the measurement scales quoted are originally in the English language, the questions were translated to Portuguese, and it was performed a consistency analysis of the indicators regarding the criteria of clarity, reach, acceptability (Rea & Parker, 2000), reliability, validity and functionality (Marconi & Lakatos, 2010). Subsequently, a pre-test of the questionnaire was conducted, involving professionals from the academy and managers with experience in the theme of business process management. The objective was to ensure a correct understanding regarding the questions and its content validity.

Table 1
Description of measurement scales

Construct	ID	Indicator
Information Integration	Q1	Business partners (suppliers and clients) that are related to your company are provided with any information that can help them.
	Q2	Your company and your business partners remain informed regarding events or changes that can mutually affect them.
	Q3	Your company frequently exchange key information with your business partners.
	Q4	Your company always exchange key information with your business partners in a satisfying/sufficient time.
Synchronized Planning	Q5	Your company has been preparing joint plans for replenishment of products with business partners.
	Q6	Your company has been developing joint demand forecasting with business partners.
	Q7	You company has been developing joint plans considering the requirements for the definition of inventory levels.
	Q8	Your company has been developing plans for the definition of optimal quantity of requests along with business partners.
	Q9	Your company has been developing plans for new product launches along with business partners.
	Q10	Your company has been developing plans to support the services along with business partners.
Operational Coordination	Q11	Your company has been coordinating, along with business partners, operational activities related to the process of purchase of materials and/or services.
	Q12	Your company has been coordinating, along with business partners, operational activities related to the process of request execution.
	Q13	Your company has been coordinating, along with business partners, operational activities related to the financial process
Strategic Partnership	Q14	Your company and your business partners frequently agree on the best interest of the supply chain.
	Q15	Your company and your business partners work with each other to improve the mutual quality of operations in the long-term.
	Q16	Your company and your business partners jointly work to improve the supply chain as a whole.
	Q17	Your company and your business partners build a long-term relationship.
	Q18	Your company and your business partners consider the relationship as an strategic alliance or a long-term partnership.
Operational process performance	Q19	In general, the planning process for operations works very well in my company.
	Q20	In general, the process for materials and/or services supply works very well in my company.
	Q21	In general, the process for production of goods and/or services works very well in my company.
	Q22	In general, the process for delivering goods and/or services works very well in my company.

Source: elaborated by the authors (2020).

4.2. Data Collection and Analysis

The scientific basis used for collection of secondary data that supported the literature review was mainly the *Scopus*. Regarding primary data, the collection was operationalized in the period from September to December 2019, along companies of the industry, retail, transportation and services sectors, including different segments.

To determine the sample size, it was used the general rule established by Hair et al. (2014), in which the size should be ten times bigger or equal to the number of indicators of the construct that has the greater amount of formative indicators to the measurement model, or the sample size should be ten times bigger or equal to the number of the greater amount of paths directed to an specific construct of the structural model. Therefore, considering the conceptual model proposed, the minimal sample size should be 40 responses.

The questionnaire was sent for completing online and directed to one manager of each participant organization, with focus on key professionals with knowledge in the areas of business strategies, and/or operations management, and/or administrative and financial management, and/or innovation and information technology. For all cases sent it was performed a new request for participation in the research, within fifteen days after the first submission. Therefore, in the end of the data collection it was obtained 92 total responses.

In two situations, it was observed a suspicious behavior in the responses, considering that the participants answered the same score for all questions. These two cases were eliminated from the database. Thus, 90 observations were considered as valid responses.

First, the descriptive analysis was developed to characterize the profile of respondents and companies. Subsequently, it was developed the multivariate statistical analysis, more specifically the Structural Equation Modeling - SEM, through the use of the software Smart PLS 3.0 student version (Ringle et al., 2015).

It is important to highlight that the conceptual model proposed in this study considers the construct SCI as a second-order construct, in which it was assumed all indicators of first-order constructs in the second-order construct, a method known as repetition of indicators (Hair et al., 2014). Thus, the measurement model was tested to evaluate the reliability and validity, specifically through analyses of unidimensionality and internal reliability of the indicators, convergent validity and discriminant validity.

To analyze the structural model, it was performed collinearity tests among the independent latent variables, tests of significance and relevance of path coefficients established between constructs, as well as the analysis of the coefficient of determination (R^2) and effect size f^2. For all statistical tests performed, it was used the significance level (α) of 0.05.

5. PRESENTATION AND DESCRIPTIVE DATA ANALYSIS

Regarding the job position of the respondents, 84% of the participants perform strategic functions in the companies, or at least participate in the unfolding of strategic guidelines for the tactical level, considering that they identified themselves as managing partners (36%), area managers (27%), and general managers or directors (22%). Furthermore, 83% of the participants have informed that they work in areas associated to production/operation, financial-administrative, marketing/commercial, IT/innovation/research, and development and planning. Thus, these data point out the respondents' qualification, who work with and know the main business processes of the organizations.

Moreover, most of the companies were industries (61%), which is characterized as a positive aspect considering that the business processes (planning, supply, production and distribution), are intrinsically related to industry operations. Considering the size, 37% were large companies, 33% in medium-sized and 22% in small-sized companies, and 8% in micro-companies. Therefore, it can be concluded that the sample collected was adequate to conduct the analyses of the conceptual model proposed.

5.1. Conceptual Model Analysis

5.1.1. Evaluation of the reflexive measurement model

The measurement model adopted in this research has the following constructs, composed of their respective reflexive indicators, according to Figure 2.

Thus, the indicators that compose the first-order constructs were submitted to quality tests proposed by Hair et al. (2014), as described in the methodological procedure.

5.1.1.1. Reliability and internal consistency

To analyze internal consistency, it was used as a reference Cronbach's alpha, the composite reliability and DillonGoldstein's rho coefficient.

According to Table 2, all constructs presented adequate internal consistency and unidimensionality for the statistical criteria analyzed.

5.1.1.2. Convergent Validity

The analysis of convergent validity was performed considering the outer loadings and the average variance extracted - AVE related to the constructs.

According to Table 3, the indicators Q1 and Q9 presented values for outer loadings lower than 0.708, which indicates a problem of lack of commonality of these indicators in their respective constructs (Hair et al., 2014). When disregarding those indicators of the measurement model, the AVE values of the respective constructs that contain the indicators presented an increase from 0.597 to 0.684 for the construct "Information integration", and from 0.600 to 0.644 for the construct "Synchronized planning".

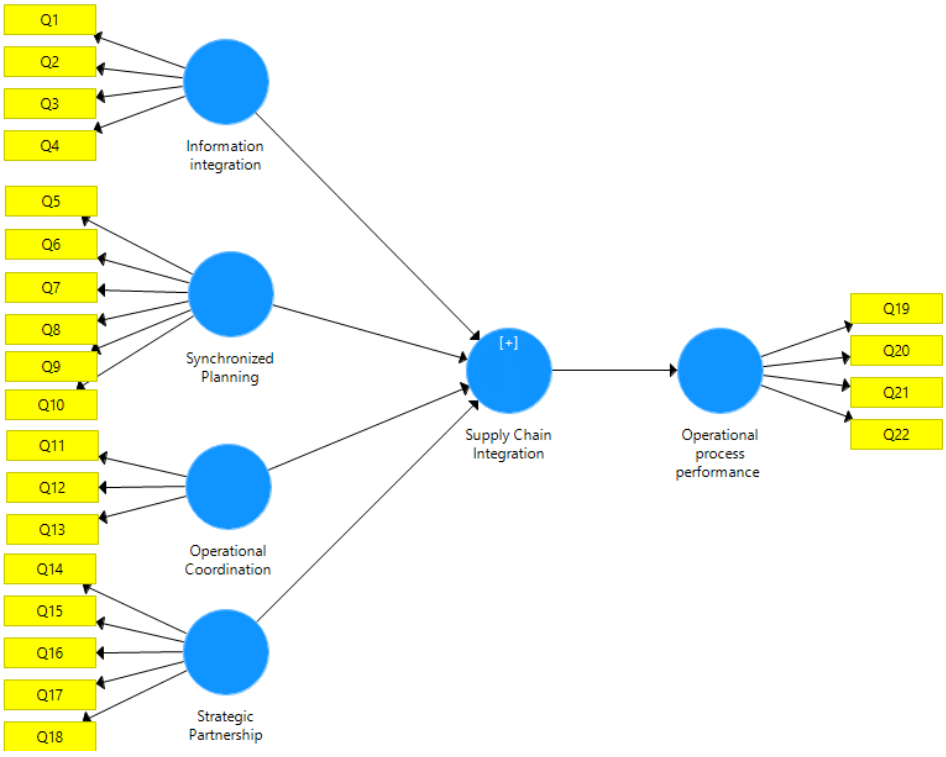

Figure 2. Measurement model.
Source: elaborated by the authors (2020).

Table 2
Reliability of the constructs' internal consistency

Construct	Cronbach's Alpha	DGrho	Composite reliability
OC	0.816	0.817	0.891
OPP	0.879	0.887	0.916
SCI	0.938	0.942	0.945
II	0.772	0.783	0.855
STP	0.861	0.868	0.900
SP	0.866	0.874	0,900

Source: elaborated by the authors (2020).

Table 3
Convergent validity – outer loadings of the indicators and AVE

Construct	Indicator	Outer loading		AVE	
II	Q1	0.675	*	0.597	0.684
	Q2	0.765	0.785		
	Q3	0.853	0.874		
	Q4	0.787	0.820		
SP	Q5	0.806	0.819	0.600	0.644
	Q6	0.816	0.844		
	Q7	0.739	0.746		
	Q8	0.778	0.800		
	Q9	0.684	*		
	Q10	0.817	0.800		
OP	Q11	0.890	0.891	0.732	0.732
	Q12	0.869	0.869		
	Q13	0.805	0.804		
STP	Q14	0.719	0.719	0.644	0.644
	Q15	0.866	0.867		
	Q16	0.836	0.836		
	Q17	0.767	0.766		
	Q18	0.817	0.816		
OPP	Q19	0.888	0.889	0.733	0.733
	Q20	0.840	0.839		
	Q21	0.825	0.826		
	Q22	0.870	0.869		

Source: elaborated by the authors (2020).

Hair et al. (2014) argue that when there is a considerable variation in AVE, it is recommended the removal of the indicators. Thus, indicators Q1 and Q9 were excluded from the measurement model for the benefit of the criterion associated with convergent validity. Therefore, the results of the following statistical tests were obtained considering the exclusion of those indicators.

5.1.1.3. Discriminant validity

The discriminant validity was analyzed based on indicators' cross loadings, and the comparison between square roots of the constructs' AVE values. Table 4 shows that discriminant validity was reached for all indicators.

Table 4
Discriminant validity - cross loadings.

Construct	Indicator	II	SP	OC	STP	OPP
II	Q2	*0.785*	0.506	0.256	0.625	0.432
	Q3	*0.874*	0.545	0.489	0.669	0.422
	Q4	*0.820*	0.652	0.481	0.682	0.616
SP	Q5	0.667	*0.819*	0.548	0.678	0.565
	Q6	0.600	*0.844*	0.591	0.590	0.515
	Q7	0.351	*0.746*	0.390	0.464	0.523
	Q8	0.382	*0.800*	0.579	0.496	0.532
	Q10	0.695	*0.800*	0.566	0.771	0.589
OC	Q11	0.438	0.623	*0.891*	0.517	0.551
	Q12	0.419	0.544	*0.869*	0.433	0.452
	Q13	0.433	0.553	*0.804*	0.553	0.405
STP	Q14	0.604	0.598	0.445	*0.719*	0.515
	Q15	0.692	0.690	0.556	*0.867*	0.490
	Q16	0.601	0.708	0.561	*0.836*	0.601
	Q17	0.621	0.457	0.302	*0.766*	0.471
	Q18	0.684	0.571	0.460	*0.816*	0.525
OPP	Q19	0.588	0.642	0.532	0.562	*0.889*
	Q20	0.584	0.599	0.466	0.670	*0.839*
	Q21	0.398	0.554	0.440	0.422	*0.826*
	Q22	0.441	0.519	0.439	0.538	*0.869*

Source: elaborated by the authors (2020).

In addition, the discriminant validity was analyzed according to the criterion established by Fornell-Larcker, a second and more conservative approach (Hair et al., 2014). This criterion was fully achieved (Table 5).

Table 5
Discriminant validity - Fornell-Larcker criterion

Construct	OC	OPP	II	STP	SP
OC	*0.855*				
OPP	0.551	*0.856*			
II	0.503	0.597	*0.827*		
STP	0.588	0.649	0.797	*0.803*	
SP	0.673	0.680	0.691	0.761	*0.802*

Source: elaborated by the authors (2020).

Henseler, Ringle e Sarstedt (2015) recommend for the discriminant validity to be tested also using the HTMT method (*Heterotrait-Monotrait*), since it is more rigorous.

The coefficient obtained between the constructs "Information integration" and "Strategic partnership" was 0.981 (Table 6), above the limit established (0.9). However, in situations where the loading values that compose the constructs are high and homogeneous, which was a condition that has been met by both constructs, it cannot be affirmed the lack of discriminant validity between them (Henseler et al., 2015).

Therefore, after performing the tests to evaluate the measurement model of this research and considering the changes made in the instrument to better fulfill the statistical criteria established in the literature, the reviewed measurement model properly enables the analysis of the structural model proposed.

Table 6
Discriminant validity - HTMT criterion

Construct	OC	OPP	II	STP
OPP	0.645			
II	0.624	0.708		
STP	0.690	0.736	0.981	
SP	0.793	0.775	0.820	0.860

Source: elaborated by the authors (2020).

5.1.2. Evaluation of the structural model

5.1.2.1. Evaluation of collinearity among the constructs

The results shown on Table 7 do not demonstrate the non-observance of collinearity among the constructs, because the variance inflation factors - VIF of constructs were less than five, considering the evaluation criterion established by Hair et al. (2014).

Therefore, the specific tests to evaluate the structural model can be conducted.

Table 7
VIF values.

Construct	OPP	SCI
OC		1.874
SCI	1.000	
II		2.880
STP		3.654
SP		3.041

Source: elaborated by the authors (2020).

5.1.2.2. Evaluation of significance and relevance of relations of the structural model

The path coefficients observed in the relations among constructs that compose the structural model were all significant, according to Table 8. The relation between the construct SCI and OPP was significant, with a path coefficient of 0.720, which indicates a strong and positive relation between these constructs. Thus, the hypothesis H1 was confirmed.

Table 8
Path coefficients among constructs and significance analysis (α = 0,05).

Construct	Original sample	Average sample	Standard deviation	T-statistic	P-value
OC → SCI	0.203	0.203	0.017	11.795	0.000
SCI → OPP	0.720	0.723	0.061	11.798	0.000
II → SCI	0.206	0.205	0.018	11.375	0.000
STP → SCI	0.359	0.358	0.022	15.991	0.000
SP → SCI	0.367	0.367	0.020	17.977	0.000

Source: elaborated by the authors (2020).

Furthermore, the path coefficients of the first-order constructs - "Information integration", "Synchronized planning", "Operational coordination" and "Strategic partnership" - were positive and significant (Table 8), which corroborates the conceptual premise that they compose the construct SCI. The construct "Synchronized planning" (β=0.367; p<0.05) presented the higher path coefficient, followed by "Strategic partnership" (β=0.359; p<0.05), "Information integration" (β=0.206; p<0.05) and "Operational coordination" (β=0.203; p<0.05).

5.1.2.3. Evaluation of the coefficient of determination of the structural model

Regarding the construct OPP, the adjusted R^2 value was equal to 0.514, which indicates that 51.4% of the variation observed in this construct is explained by the construct SCI. This result corroborates with previous studies, and in general it had a higher predictive accuracy compared to different R^2 obtained by the analysis of the relationship between SCI and organizational performance, as shown further in the discussion section. After the evaluation of the structural model, Figure 3 presents the schematic representation of the model, as well as the statistical results reached.

Regarding the evaluation of the effect size of first-order constructs on the OPP, the results point out that the constructs "Information integration", "Synchronized planning", "Operational coordination" and "Strategic partnership" presented sizes of 0.01, 0.07, 0.02 e 0.02, respectively. Thus, the effect sizes of first-order constructs that compose SCI can be considered small (Hair et al., 2014).

6. RESULTS AND DISCUSSION

6.1. Supply Chain Integration and its Antecedent Constructs

The results have confirmed the conceptual premise, in the sense that the constructs "Information integration", "Synchronized planning", "Operational coordination" and "Strategic partnership" compose SCI, corroborating the results obtained on previous studies (Cao & Zhang, 2011; Liu et al., 2016). The constructs "Synchronized planning" and "Strategic partnership" present, in this order, the higher path coefficients, indicating a positive and relevant influence in SCI. Thus, this result point out that in order to have an integrated and collaborative supply chain, the organizations that compose it should have aligned strategic goals, that favor the integration of business processes and the practice of synchrony of decisions regarding joint planning of actions in the level of market and products (Cao & Zhang, 2011; Liao & Kuo, 2014).

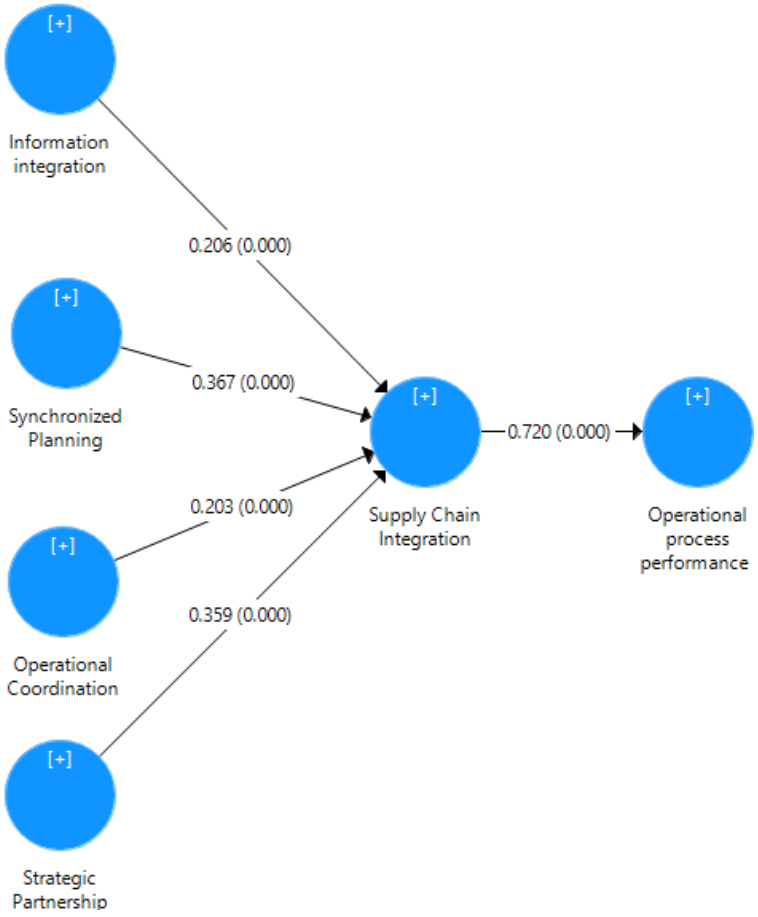

Figure 3. Structural model results.
Source: elaborated by the authors (2020).

Furthermore, in line with this findings, Harland et al. (2007) empirically emphasize that the strategic alignment among business partners is a decisive factor for the integration among large-sized companies in relation to small and medium-sized. The non-compliance with this alignment is characterized as a barrier to SCI.

Similarly, in the study conducted by Cao e Zhang (2011), the congruence of goals among business partners positively influences the integration of the SC. Moreover, it facilitates the understanding and anticipating needs of the industry, in order to better meet the operational requirements (Flynn et al., 2010).

The construct "Synchronized planning" is important in the SC management, since its absence makes it difficult to have integration among organizations and, consequently, to the operation of business processes. Therefore, "Synchronized planning" is essential, it favors the optimization of companies' resources in order to achieve an specific set of goals, through the practice of mutual planning and decision making among collaborative business partners (Cao & Zhang, 2011).

Lockamy and Mccormack (2004a) concluded that the planning processes are important in all areas of decision-making involved in the business processes of the SCOR model, from the strategical level to the operationalization. Thus, they are necessary to determine the most effective way to use the organization's resources, in order to obtain better results for the companies.

The constructs "Operational coordination" and "Information integration" presented lower path coefficients, however, they also present a positive and significant effect in SCI. Considering the increasing amount of transacted data among organizations, boosted by the technological

systems, it is becoming more and more relevant for organizations to expand their analytical capability with the purpose of strengthen the integrated management of the SC. Thus, resource sharing, including equipments, technologies and information, is an important activity for the leverage process of capabilities and assets with partners of the SC, with a positive impact on companies' performance.

6.2. Supply Chain Integration and Operational Process Performance

The path coefficient that measures the impact of SCI in OPP proved to be significant and relevant (β=0.720 p<0.05). This result corroborates with previous researches that analyzed the effect of SCI in the company's performance (Devaraj et al., 2007; Flynn et al., 2010; Lee et al., 2011; Liu et al., 2016; Panahifar et al., 2018; Rosenzweig, 2009; Sundram et al., 2016; Wiengarten et al., 2013).

Regarding the coefficient of determination, it was found that 51.4% of the variation observed in the construct OPP is explained by the construct SCI. In studies that evaluated the impact of SCI in the performance of companies using operational indicators, it was verified R^2 values that ranged of 0.269 (Devaraj et al., 2007), 0.255 (Flynn et al., 2010), 0.456 (Rosenzweig, 2009) and 0.41 (Liu et al., 2016). Concerning the impact on business performance, measured through indicators associated to an increase in sales, and/or profit, and/or market share, and/or return on investments, Flynn et al. (2010) obtained a coefficient of determination of 0.131. This value is lower than the coefficient of determination reached when the performance was measured through operational indicators.

On the other hand, in the research conducted by Panahifar et al. (2018) that assessed the impact of interorganizational collaboration on the business performance jointly indicated through financial and operational indicators, it was obtained an R^2 value of 0.63. Thus, when observed the R^2 value of this research (0.514), measured in the level of business processes, it was superior to most coefficients of determination found in previous studies, except for the study by Panahifar et al. (2018).

Thus, while recognizing that there are differences between the indicators used in these studies to measure organizational performance, the analysis of the coefficient of determination corroborates the assumption that the effect of SCI in companies' performance should be examined in the level of business processes. In this level the resources are allocated and explored to implement strategies, and the first order results are frequently observed (Jeffers et al., 2008).

Regarding the result of effect size (f^2), it was observed no substantial impact of the first-order constructs on OPP, since the effect sizes were all small. This result corroborates the complementary and interdependent character of SCI, aligned with previous studies that emphasize the importance of conceptualize the SCI as a multidimensional construct in order to evaluate the effects on companies' performance (Cao & Zhang, 2011; Flynn et al., 2010; Liu et al., 2016). In other words, the full SCI probably will not be achieved without the complete development of all constructs that compose it.

7. CONCLUSIONS

Initially, regarding the premise that SCI is composed by the antecedent constructs "Information integration", "Synchronized planning", "Operational coordination" and "Strategic partnership", the empirical results have confirmed this conceptual premise, which contributed to the strengthening of Resource Orchestration Theory. This finding corroborates the study by Liu et al. (2016), that

obtained a partial confirmation about first-order constructs, and the idea that they have formed the SCI.

Therefore, this research provides a theoretical contribution since it highlights that in order to have integrated and collaborative supply chains it is important for companies to establish strategic partnerships, to share common goals, and to plan in a synchronized way the business processes associated with SC management. Moreover, the importance for business partners to integrate and share key information allows the coordination of operations, through the adoption of technologies which promote the automation of processes.

This finding emphasizes practical contributions in the level of business management. The acknowledgment about the importance of establishing strategic partnerships as a way of increasing interorganizational integration, require companies to have clarity to identify inside a supply chain who are the strategic suppliers and clients. They need to be recognized as business partners to enhance the results generated from planning processes, supplies, production/operation and distribution of goods and services.

Another preponderant factor to integrate supply chains is the ability of companies to prepare plans along with business processes, which will allow the synchronization of activities and a more assertive decision making. Thus, the results of this research suggest companies and their key partners to develop plans together, sharing information that will favor the establishment of management tools and to expand the capability of business processes allowing, therefore, a better response by the companies when facing the market fluctuations.

Furthermore, the constructs associated with information integration and operational coordination are relevant to the composition of SCI, however, with lower effect when compared to the other two first-order constructs. In practical terms, this result indicates that the search for information integration among companies and automation of business processes are important factors to SCI, however, when alone they might not be enough to ensure the sustainability of this integration in the medium and long term.

It should also be highlighted that this positive relation between SCI and OPP was measured and confirmed in the level of business processes, using the SCOR model, differently from the metrics used in others researches about the topic. Therefore, this finding is also characterized as a theoretical contribution, since it emphasizes that the positive effects of SCI are firstly observed in the level of business processes. Thus, an effective management of the resources allocated in this level is an important key factor to achieve good operational results and, consequently, financial results.

The small sample could be recognized as a limitation, since it did not allow the analysis of the impact of moderators or mediators variables in the conceptual model. Regarding the measurement instrument, another limitation is related to the construct OPP being considered as unidimensional. Thus, the scale used to measure it does not allow to identify indicators of more specific results associated with business processes. Therefore, the performance measured demonstrates the overall perception regarding the results of business processes achieved by the companies.

Concerning the empirical confirmation of the premise that the constructs "Information integration", "Synchronized planning", "Operational coordination" and "Strategic partnership" compose the SCI, suggestions for new research can be presented. The evaluation of the relation between first-order constructs and SCI can change, for instance, depending on the segment be more intensive in technology or the fact that companies are placed more upstream or downstream in the SC. Therefore, new research that consider those contingency factors can contribute for a better understanding of this relation and for deepening regarding Resource Orchestration Theory.

Other opportunity is related to a more exploratory investigation to better understand how the SCI works in practice, recognizing among the constructs that compose it which factors favor or inhibit the integration. The development of a case study based on a specific SC with the participation of business partners placed in different links of this chain, can be useful to deepen the analysis of this phenomenon, providing new findings and contributions.

Regarding the relation between SCI and OPP, it is recommended a new research considering the performance as a multidimensional construct. Thus, the adoption of exogenous constructs in the model that convey business processes based on the SCOR model can contribute to evaluate the effect of SCI in an unfolded way, allowing to recognize in which processes the integration is proven more relevant.

REFERENCES

APICS. (2020). APICS Supply chain council. Retrieved April 2, 2020, from http://www.apics.org/about/overview/about-apics-scc

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99-120.

Cai, Z., Huang, Q., Liu, H., & Liang, L. (2016). The moderating role of information technology capability in the relationship between supply chain collaboration and organizational responsiveness: Evidence from China. *International Journal of Operations & Production Management*, *36*(10), 1247-1271.

Cao, M., & Zhang, Q. (2011). Supply chain collaboration: Impact on collaborative advantage and firm performance. *Journal of Operations Management*, *29*(3), 163-180. https://doi.org/10.1016/j.jom.2010.12.008

Chirico, F., Sirmon, D. G., Sciascia, S., & Mazzola, P. (2011). Resource orchestration in family firms: Investigating how entrepreneurial orientation, generational involvement, and participative strategy affect performance. *Strategic Entrepreneurship Journal*, *5*(4), 307-326. https://doi.org/10.1002/sej.121

Cooper, M. C., Lambert, D. M., & Pagh, J. D. (1997). Supply chain management: More than a new name for logistics. *The International Journal of Logistics Management*, *8*(1), 1-14.

Couto, M. C. L., & Lange, L. C. (2017). Análise dos sistemas de logística reversa no Brasil. *Eng Sanit Ambient*, *22*(5), 889-898. https://doi.org/10.1590/S1413-41522017149403

Devaraj, S., Krajewski, L., & Wei, J. C. (2007). Impact of eBusiness technologies on operational performance: The role of production information integration in the supply chain. *Journal of Operations Management*, *25*(6), 1199-1216. https://doi.org/10.1016/j.jom.2007.01.002

Dissanayake, C. K., & Cross, J. A. (2018). Systematic mechanism for identifying the relative impact of supply chain performance areas on the overall supply chain performance using SCOR model and SEM. *International Journal of Production Economics*, *201*, 102-115. https://doi.org/10.1016/j.ijpe.2018.04.027

Flynn, B. B., Huo, B., & Zhao, X. (2010). The impact of supply chain integration on performance: A contingency and configuration approach. *Journal of Operations Management*, *28*(1), 58-71. https://doi.org/10.1016/j.jom.2009.06.001

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2014). Partial least squares structural equation modeling. In *Handbook of Market Research* (1st edition). Sage Publications. https://doi.org/10.1007/978-3-319-05542-8_15-1

Harland, C. M., Caldwell, N. D., Powell, P., & Zheng, J. (2007). Barriers to supply chain information integration: SMEs adrift of eLands. *Journal of Operations Management*, *25*(6), 1234-1254. https://doi.org/10.1016/j.jom.2007.01.004

Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science volume*, *43*(1), 115-135. https://doi.org/10.1007/s11747-014-0403-8

Ivanov, D., Dolgui, A., & Sokolov, B. (2018). The impact of digital technology and Industry 4.0 on the ripple effect and supply chain risk analytics. *International Journal of Production Research*, *57*(3), 1-18. https://doi.org/10.1080/00207543.2018.1488086

Jeffers, P. I., Muhanna, W. A., & Nault, B. R. (2008). Information technology and process performance: An empirical investigation of the interaction between IT and non-IT resources. *Decision Sciences*, *39*(4), 703-735. https://doi.org/10.1111/j.1540-5915.2008.00209.x

Kulp, S. C., Lee, H. L., & Ofek, E. (2004). Manufacturer benefits from information integration with retail customers. *Management Science*, *50*(4), 431-444. https://doi.org/10.1287/mnsc.1030.0182

Lee, S. M., Lee, D. H., & Schniederjans, M. J. (2011). Supply chain innovation and organizational performance in the healthcare industry. *International Journal of Operations and Production Management*, *31*(11), 1193-1214. https://doi.org/10.1108/01443571111178493

Li, L., Su, Q., & Chen, X. (2011). Ensuring supply chain quality performance through applying the SCOR model. *International Journal of Production Research*, *49*(1), 33-57. https://doi.org/10.1080/00207543.2010.508934

Liao, S., & Kuo, F. (2014). The study of relationships between the collaboration for supply chain, supply chain capabilities and firm performance: A case of the Taiwan ' s TFT-LCD industry. *Internacional Journal of Production Economics*, *156*, 295-304. https://doi.org/10.1016/j.ijpe.2014.06.020

Liu, C., Li, Q., & Zhao, X. (2009). Challenges and opportunities in collaborative business process management: Overview of recent advances and introduction to the special issue. *Information Systems Frontiers*, *11*(3), 201-209. https://doi.org/10.1007/s10796-008-9089-0

Liu, H., Wei, S., Ke, W., Wei, K. K., & Hua, Z. (2016). The configuration between supply chain integration and information technology competency: A resource orchestration perspective. *Journal of Operations Management*, *44*(1), 13-29. https://doi.org/10.1016/j.jom.2016.03.009

Lockamy, A., & McCormack, K. (2004a). Linking SCOR planning practices to supply chain performance: An exploratory study. *International Journal of Operations and Production Management*, *24*(12), 1192-1218. https://doi.org/10.1108/01443570410569010

Lockamy, A., & McCormack, K. (2004b). The development of a supply chain management process maturity model using the concepts of business process orientation. *Supply Chain Management: An International Journal*, *9*(4), 272-278. https://doi.org/10.1108/13598540410550019

Marconi, M. D. A., & Lakatos, E. M. (2010). *Técnicas de pesquisa* (7th ed.). Atlas.

McCormack, K., Ladeira, M. B., & Oliveira, M. P. V. (2008). Supply chain maturity and performance in Brazil. *Supply Chain Management*, *13*(4), 272-282. https://doi.org/10.1108/13598540810882161

Mentzer, J. T., Keebler, J. S., Nix, N. W., Smith, C. D., & Zacharia, Z. G. (2001). Defining supply chain management. *Journal of Business Logistics*, *22*(2), 1-25.

Panahifar, F., Byrne, P., Salam, M. A., & Heavey, C. (2018). Supply chain collaboration and firm performance: The critical role of information sharing and trust. *Journal of Enterprise Information Management*, *31*(3), 358-379.

Panahifar, F., Heavey, C., Byrne, P. J., & Fazlollahtabar, H. (2015). A framework for Collaborative Planning, Forecasting and Replenishment (CPFR): State of the Art. *Journal of Enterprise Information Management Article Information*, *28*(6), 838-871.

Qi, Y., Huo, B., Wang, Z., & Yeung, H. Y. J. (2017). The impact of operations and supply chain strategies on integration and performance. *International Journal of Production Economics*, *185*, 162-174. https://doi.org/10.1016/j.ijpe.2016.12.028

Rai, A., Patnayakuni, R., & Seth, N. (2006). Firm performance impacts of digitally enabled supply chain integration capabilities. *MIS Quarterly*, *30*(2), 225-246. https://doi.org/10.2307/25148729

Rea, L. M., & Parker, R. A. (2000). Projetando questionários eficientes. In *Metodologia de pesquisa: Do planejamento a execução* (pp. 39-75). Pioneira.

Ringle, C. M., Wende, S., & Becker, J.-M. (2015). SmartPLS 3. http://www.smartpls.com

Rosenzweig, E. D. (2009). A contingent view of e-collaboration and performance in manufacturing. *Journal of Operations Management*, *27*(6), 462-478. https://doi.org/10.1016/j.jom.2009.03.001

Sirmon, D. G., Hitt, M. A., Ireland, R. D., & Gilbert, B. A. (2011). Resource orchestration to create competitive advantage: Breadth, depth, and life cycle effects. *Journal of Management*, *37*(5), 1390-1412. https://doi.org/10.1177/0149206310385695

Sirmon, D. G., Hitt, M. A., Ireland, R. D., & Texas, A. (2007). Managing firm resources in dynamic environments to create value: Looking inside the black box. *Academy of Management Review*, *32*(1), 273-292.

Sundram, V. P. K., Chandran, V. G. R., & Bhatti, M. A. (2016). Supply chain practices and performance: The indirect effects of supply chain integration. *Benchmarking: An International Journal*, *23*(6), 1463-5771. https://doi.org/10.1108/BIJ-03-2015-0023

Trkman, P., McCormack, K., De Oliveira, M. P. V., & Ladeira, M. B. (2010). The impact of business analytics on supply chain performance. *Decision Support Systems*, *49*(3), 318-327. https://doi.org/10.1016/j.dss.2010.03.007

Wang, G., Huang, S. H., & Dismukes, J. P. (2004). Product-driven supply chain selection using integrated multi-criteria decision-making methodology. *International Journal of Production Economics*, *91*(1), 1–15. https://doi.org/10.1016/S0925-5273(03)00221-4

Wiengarten, F., Bhakoo, V., & Gimenez, C. (2015). The impact of host country regulatory quality on the value creation process in e-business supply chains. *International Journal of Production Research*, *53*(16), 4963-4978. https://doi.org/10.1080/00207543.2015.1008108

Wiengarten, F., Humphreys, P., McKittrick, A., & Fynes, B. (2013). Investigating the impact of e-business applications on supply chain collaboration in the German automotive industry. *International Journal of Operations and Production Management*, *33*(1), 25-48. https://doi.org/10.1108/01443571311288039

NON CONFLICT OF INTEREST STATEMENT

The authors have no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest in the subject matter or materials discussed in this manuscript.

AUTHORS' CONTRIBUTIONS:

Author 1 - Definition of the research design, considering the problem issue and the conceptual model, elaboration of the literature review and the data collection instrument, and conducting the analysis of the results and conclusions.
Author 2 - Advising and review of the research, as well as the theoretical framework, and validation of the conceptual model and hypotheses. General review of the article, with an emphasis on analyzing the results and identifying theoretical and practical contributions.