http://www.ijmp.jor.br
ISSN: 2236-269X
DOI: 10.14807/ijmp.v9i1.664
v. 9, n. 1, January - March 2018

MULTIDIMENSIONALITY EVALUATION OF SUPPLY CHAIN MANAGEMENT INTEGRATION

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Submission: 25/04/2017
Revision: 16/05/2017
Accept: 13/07/2017

ABSTRACT

Integration is constantly reported in the literature as an essential feature of SCM. However, it is as difficult to define as to operationalize it, resulting in a lack of information on how to increase the level of integration among members. Characteristics such as trust, sharing of information, partnership, cooperation, collaboration and coordination are constantly associated to the definition of SCM. However, further studies are needed relating the contribution of each characteristic separately, neglecting the multidimensional aspect of SCM. Thus, this research aims to evaluate the dimensionality of SCI, to check alignment with the features identified in the literature using multivariate statistical analysis. The methodology used was based on a questionnaire to assess the level of companies integration with suppliers of its supply chain, obtaining 205 answers. Full-information item factor analysis and principal component analysis on the correlation matrix tetrachoric were used for the instrument dimensionality analysis.

http://www.ijmp.jor.br v. 9, n. 1, January - March 2018
ISSN: 2236-269X
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They are appropriate procedures for analysis of dichotomous variables. The results of this analysis enabled grouping the questionnaire items in the following underlying factors: trust, information sharing, partnership, collaboration or cooperation, and coordination. The identification of such factors such as dimensions of SCI allows improving the recognition of SCM as a multidimensional concept, allowing a greater understanding on how to raise the level of integration among the members of a supply chain. In addition, to think on every dimension separately may make the planning of future actions easier as the individual aspects of each characteritic may be discussed.

Keywords: supply chain integration; characeristics; multidimensionality

1. INTRODUCTION

Integration is constantly reported in the literature as an essential feature of the Supply Chain Management (SCM) (NÄSLUND; HULTHEN, 2012; PEARCY; GIUNIPERO, 2008; RICHEY JUNIOR et al., 2009). However, it is as difficult to define integration as operationalize it, resulting in a lack of information on how to increase the level of SCI (Supply Chain Integration) (NÄSLUND; HULTHEN 2012).

The literature defines SCI as the alignment of internal and external flows of a supply chain through collaboration and coordination among members, seeking effective and efficient flow of goods, services, information and financial, to generate value for the end customer (JÜTTNER et al., 2007; FABBE-COSTES; JAHRE, 2008; FLYNN et al.; 2010, THUN, 2010; NÄSLUND; HULTHEN, 2012).

Associated to this definition, many authors include characteristics such as trust, sharing of information, partnership, cooperation, collaboration and coordination as part of an integration (WU et al., 2004; VAN DONK; VAN DER VAART, 2005; TRKMAN et al., 2007; ZHAO et al., 2008; YEUNG et al., 2009; ZHAO et al., 2011; VAN DER VAART et al., 2012; BASNET, 2013; XU et al., 2014; HE et al., 2014; JACOBS et al., 2016).

The constant association between such characteristics to the definition of SCM reveals a consensus on such an association. (JÜTTNER et al., 2007; RICHEY JR et al., 2009; FLYNN et al., 2010; THUN, 2010; NÄSLUND; HULTHEN, 2012). However, further studies are needed aiming to relate the contribution of each

http://www.ijmp.jor.br v. 9, n. 1, January - March 2018
ISSN: 2236-269X
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characteristic separately in the development of an integration between members of a supply chain.

Part of the difficulty in addressing individual aspects of each characteristic may be ascribed to a lack of clarity in the definitions found in the literature. They generally occur as synonyms, alternating the terms that refer to the same behaviors. This collaboration is addressed by Aryee et al. (2008) as a synonym of SCM.

Danese (2013) uses collaboration and partnership as synonyms. Many other examples may be found in the literature. Thus, an analysis of the definitions separately is necessary, addressing them as dimensions of SCM because each exerts diferente functions in integrating the members.

The understanding of SCM as a multidimensional concept is still scarce in the literature. However, it is of utmost importance so that the integration be increased simultaneously according to different practices (DANESE; BORTOLOTTI, 2014). Trust consists in believing in the partner's integrity (MORGAN; HUNT, 1994).

Communication, or sharing of information, is essential to a close understanding and cooperation with suppliers and clientes, allowing a broad identification of the clients' requirements (ZHAO et al., 2011). Partnership demands from companies a structural change in how they relate to each other (MALONI; BENTON, 1997).

Cooperation, or collaboration, consists in mutual understanding interactions between partners (SPEKMAN et al., 1998; WEI et al., 2012; FAWCETT et al., 2008). Coordination encompasses all efforts in aligning decisions to achieve the global objectives of the system (CAO et al., 2008). The identification of how each characteristic is related to an increase in the integration level between the members of the supply chain will allow managers to better plan their actions, working each characteristic according to its specific traits.

This study aims to evaluate the multidimensionality of SCM to allow a better planning of future actions. Thus, a set of SCM indicators was established and applied, as a questionnaire, to a sample of 205 company-supplier relationships. The answers were analyzed based on multivariate statistical analysis, associating indicators with predominant dimensions.

2. BACKGROUND LITERATURE

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ISSN: 2236-269X
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The SCI has been seen as a way to develop competitive advantage from the management of the relationships, because it reduces the response time to market changes (SEZEN, 2008; KIM, 2009), enabling cost savings by streamlining processes and eliminating redundancies (CHEN et al., 2009; ROSENZWEIG et al., 2003).

However, it is still common to see companies ignoring the value of investing in internal and external relationships to create competitive advantage. Hence, Souza et al. (2004) believe that knowledge of practices that add value lacks to companies, therefore, they seek immediate and one-off solutions, leading to under-utilization of their potential.

The benefits of integration are often translated into aspects valued by customers, such as product quality, delivery reliability, process flexibility and cost leadership (ROSENZWEIG et al., 2003). However, since the market has customers increasingly demanding and companies, it can no longer overcome on its own. In order to achieve integration, the members of the chain should see each other as partners, working together in the development of strategic planning, demand forecasts and setting of targets (KIM; LEE, 2010). However, to achieve SCI, some characteristics must be identified in the relationship between members, they are: trust, information sharing, partnership, cooperation, collaboration and coordination (ARANTES et al. 2014).

Trust is a basic feature for SCI because, when working together, the actions of one reflect on others (MAYER et al., 1995; CHOPRA; MEINDL, 2003; KWON; SUH, 2005; JONES et al., 2010; LAEEQUDDIN et al., 2012; TEJPAL et al., 2013).

This concept applied to the management of relationships between businesses is the basis for the construction of SCI, since, , joint work involves interdependence and therefore it is necessary to depend on the other to achieve their goals (MAYER et al. 1995).

Thus, confidence in the integrity of the partners leads companies to cooperate, since the current relationships provide resources, opportunities and superior benefits to its competitors, with exchange standard at the same level, strategic information sharing and lack of opportunist behavior (MORGAN; HUNT 1994).

The performance of trust can be classified by the fulfillment of high performance promises (JONES et al. 2010), by the existence of standard procedures

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to perform as promised (FAWCETT et al. 2012), by the quality of interpersonal relations (CAI et al. 2010).

It is defined as the accomplishment of actions that benefit the other, hoping that this is not used for their own benefit, but as best for both (ARANTES et al. 2014). Some steps to building a relationship based on trust are: consider the relationship value, stipulate operational tasks and decision rights for each party, create effective contracts and design effective solutions to conflicts (CHOPRA; MEINDL, 2003).

The wants and needs of consumers are constantly changing and companies need to adapt to in order to remain competitive. The best way to do it is by establishing a close relationship between customers and suppliers through accurate flow of information demand, which will reduce the time spent in production planning, decrease inventory and make more business sensitive to customer needs (FLYNN et al., 2010; CHOPRA; MEINDL, 2003).

Information sharing can happen at various levels, ranging from complete absence to full information sharing, being an essential factor in reducing the bullwhip effect, which is the distortion of demand information the further the member is from information in the chain (SAHIN; ROBINSON, 2002).

Some of the key information shared are: performance measures (LEE; WHANG, 1998; LI et al., 2006), production information and order status (LEE; WHANG, 1998; SAHIN; ROBINSON, 2002), cost information (SAHIN; ROBINSON 2002, LI et al. 2006), availability of production capacity, inventory levels and demand forecasts (LEE; WHANG, 1998; SAHIN; ROBINSON, 2002; LI et al., 2006; DING et al., 2011).

In order to increase efficiency in sharing information, members of the chain can adopt compatible information systems, facilitating problem solving and strategic decision making in a collaborative way (ZHOU; BENTON 2007, HA et al. 2011). Thus, information sharing in the supply chain, aiming to increase the level of integration among members, is the exchange of strategic information that favor the creation of competitive advantage for the chain as a whole (ARANTES et al. 2014).

The relationship between the members of a supply chain can be considered partnership where the parties interact both in the short and long term, with common goals and shared benefits (RYU et al., 2009; MALONI; BENTON, 1997; CHEN; WU,

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2010; SINGLETON; CORMICAN, 2013). It is essential, though, to deal with the problems of supply chain (SINGLETON; CORMICAN, 2013).

The partnership requires, from companies, a structural change in the way of relating, encouraging mutual planning and solving problems together (MALONI; BENTON, 1997). It also requires members to be open to make adjustments in the relationship (CHEN; WU, 2010; MOTWANI et al., 1998), that they share capacity, risks, losses and gains (Vieira 2006), have availability and flexibility to adapt to changes (CHEN; WU 2010), in addition to work with fewer suppliers so that it is possible to develop a close relationship with each of its partners (MALONI; BENTON, 1997; MAHESHWARI ET AL. 2006, CHRISTOPHER; JÜTTNER 2000, LAMBERT; COOPER 2000).

Cooperating is "a mean to achieve a certain goal and not an end in itself". It refers to a way of working together that generates benefits for all parts involved in the process. Cooperation occurs when two or more entities come together to obtain benefits that can't be achieved individually, sharing resources such as confidential information, infrastructure, defining standards that improve the interoperability of their systems, optimizing the tactical and operational planning of logistics activities (AUDY et al. 2010).

Collaboration can be defined as the ability to work beyond organizational boundaries to build higher value-added and increase the ability to meet customer needs. It's not only about managing transactions, but developing and implementing new approaches to problem solving considering trust as a basic principle. Collaboration can be governed by contracts or informally (FAWCETT et al., 2008).

Supply chain processes coordination consists on the intensity in which a company can structure its operational processes, the sharing of resources, rewards and risks in the organizations, in order to become more competitive in the market in which it operates (YEUNG et al., 2009; SIMATUPANG et al., 2002). Coordination creates understanding among members, shapes human behavior and improves competitiveness (MISHRA; SHARMA, 2015). In other words, coordination is to organize the activities of two or more groups so that they are aware of one another's activities and can work together efficiently (SINGH, 2011).

Consequently, it can be concluded that, as part of SCI, cooperation and collaboration can be seen as carrying out activities together, seeking greater gains

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for the chain as a whole; and coordination is necessary to organize such joint actions, ensuring the best possible result.

From the raised features, SCI indicators that are related to each finding disagreement in the literature about the relationship of the indicators with the characteristics of SCI were identified, (Table 1). Part of this difference is justified because there is a dependency relationship between some characteristics, since trust is cited as information sharing prerequisite (LAAKSONEN et al. 2009; CHENG et al., 2010), partnership (WEI et al., 2012; LAAKSONEN et al. 2009), collaboration (SPEKMAN et al., 1998; FAWCETT et al., 2008) and cooperation (MORGAN; HUNT, 1994); as well as information sharing is cited as a prerequisite for partnership (SPEKMAN et al.; 1998; DU et al., 2012), collaboration (WIENGARTEN et al., 2010; HA et al., 2011) and cooperation (MORGAN; HUNT, 1994; WEI et al., 2012; JÜTTNER et al. 2007).

Trying to find a consensus among these opinions, this research brings together the SCI indicators using full-information item factor analysis, and lists the factors obtained with the features identified in the literature. This allows the understanding of what the characteristics that have the greatest influence on each share of integration between company and suppliers are.

3. METHODS

The selection of the research method is one of the key decisions to be taken in its construction process, since the collection of data requires a careful and systematic planning when it comes to scientific research (LUDKE; ANDRÉ, 1986). Thus, for the identification of SCI characteristics review of the literature method proposed by Ensslin et al. (2010) was used, named ProKnow-C Knowledge Development Process-Constructivist.

Table 1: SCI indicators related to the characteristics

Indicators	**Trust**	**Information sharing**	**Partnership**	**Collaboration**	**Cooperation**	**Coordination**
Interdependence	Mayer et al. (1995)					
Consideration of the impact of each action under the other members of the supply chain	Chopra and Meindl (2003)	Ding et al. (2011)			SPEKMAN et al. (1998) Wei et al. (2012)	Sahin and Robinson (2002) Chopra and Meindl (2003)

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Interaction in the short and long term	He et al. (2014)		Ryu et al. (2009)			
Open communication	(Kwon and Suh (2005), Laeequddin et al. (2012)		Motwani et al. (1998)			
Greater willingness to take risks						
Quality of interpersonal relationships	Cai et al. (2010)	Cai et al. (2010)		Cai et al. (2010)		
Jointly troubleshooting	Fawcett et al. (2012)		Maloni and Benton (1997)	Vieira (2006)		
Exchange of strategic information at different levels		Lee and Whang (1998) Sahin and Robinson (2002) Li et al. (2006)				SPEKMAN et al. (1998)
Use of compatible information systems		Ha et al. (2011) Hsu et al. (2008)		Ha et al. (2011) Näslund and Hulthen (2012) Kim and Lee (2010)		
Closer relations reducing the number of suppliers			Christopher and Jüttner (2000), MAHESHWARI et al. (2006)		SPEKMAN et al. (1998)	
Benefits not individually achieved			Singleton and Cormican (2013)	Audy et al. (2010)		

This method makes possible the information systematization in a simple way through the bibliometric techniques and the researcher judgment as to what is relevant, following the steps as shown in Figure 1.

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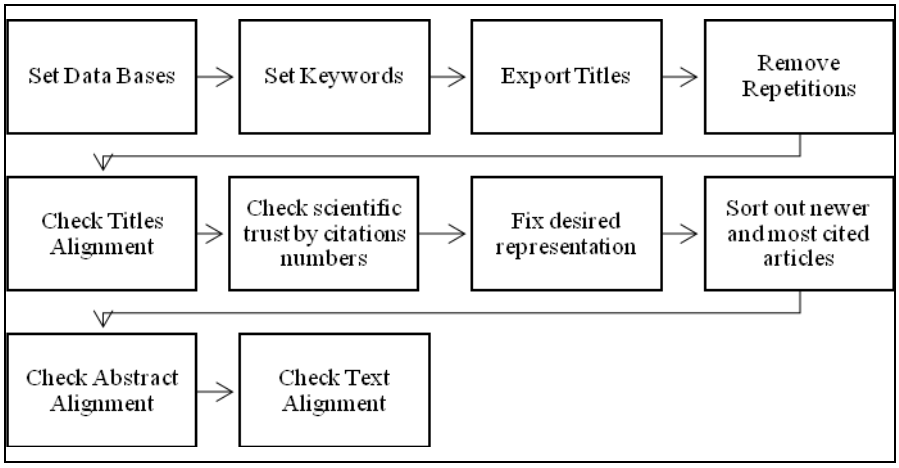

Figure 1: ProKnow-C Article Process Selection

Initially a general review of SCI was carried out in order to identify its characteristics, since they are not all identified together on the same work; given the lack of consensus in the literature. Using the databases ISI Web of Knowledge and Scopus, 1085 references were identified in the search by combining the keywords "Supply Chain" in the title, and integration, in the abstract. Of this total, 390 titles were repeated and were eliminated, leaving 695 references remaining.

Then it was verified the alignment of titles, eliminating over 222. The next step to get to the group of articles that are more closely related to the subject of this research is to evaluate them as to their scientific recognition, this is done by checking the number of times each one has been cited in other works. ProKnow-C suggests using Google Scholar for this check.

The number of citations of the 473 articles was verified using this feature and the results were organized in a descending order spreadsheet. The relevant considered citations number is determined by the author of the research, considering that the selection of the most cited articles is able to represent the majority of this scientific knowledge on current database (LACERDA et al., 2012).

Therefore, considering that there is still a high set of articles, the group representing 80% of the total number of citations was determined as the cutoff point. The 473 articles total 6,992 citations; considering the cutoff point; the texts that are part of the most cited set are the ones that add up to 80% of this amount. Hence, the articles that make up this group, in this research, are those who received 14 citations or more; which resulted in 126 titles.

From the confirmation of scientific articles recognition by the number of citations, their abstracts are read and then it is defined who will be part of the final

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repository. Among the 126 most cited; 64 abstracts were considered aligned to the research topic, but five of them had the complete text available on the accessed basis, remaining than 59 articles with relevant volume of citations; with abstract aligned with the theme and full text available.

The 347 articles that have been cited a few times or that have not been cited are not discarded; they are divided into two groups and analyzed separately: more recent articles (published after 2011) and older articles. Whereas the newest texts had not enough time to receive a significant number of citations, it is necessary to read their abstracts to identify those which would make the final portfolio of articles, given its alignment with the theme. From 347 articles, 182 were published in the last two years, and 109 were discarded for not presenting abstract alignment with the subject of research, 20 were discarded for not having the full text is available in basis and 53 were selected to compose the articles portfolio by abstract alignment. After reading the complete texts; we came up to a final set of 46 articles that led to the identification of the SCI characteristics cited. From that, the search process shown in Figure 1 was repeated for each one of the identified features as shown in Table 2, always combined with the term "supply chain" located in the abstract.

Table2: Complementary-literature selection

Keyword / **Step selection**	***Trust***	***"Information sharing"***	***Partnership***	***Collaboration and coordination and cooperation***
Keyword location	title	title	title	abstract
Total titles	302	743	405	71
Total titles eliminating repetitions	195	449	262	43
Aligned titles	73	196	136	18
BAB	33	72	83	18
Aligned abstracts	22	17	30	4
Aligned texts	10	9	10	2

3.1. Sample and data collection

From SCI characteristics, a questionnaire was designed to assess the level of companies' integration with suppliers of their supply chain. This instrument consisted of 21 items, presented in Table 3, with response options: yes, no or not applicable.

Table3: Questionnaire to assess the level of SCI

N	**Item**
I1	Is the quality of products consistent with the expected?
I2	Do good personal relationships help maintain this relationship?
I3	Is there a standard procedure to replace damaged goods at delivery?
I4	Is there a standard procedure to exchange products under warranty?

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I5	Does he inform you if there is a delay in sending the request?
I6	Does he use a formal system to share information? Which one?
I7	Does this supplier know your stock?
I8	Do you know his stock?
I9	Do you have information on the costs of this supplier?
I10	Do you talk with your supplier about market conditions; their predictions or expectations?
I11	Does your supplier know your demand forecast?
I12	Does he have access to your order production information?
I13	Long-term relationship?
I14	Do you give preference to this supplier because of the quality?
I15	How is the communication with this supplier? Is it open?
I16	Do you exchange information with him seeking to improve the product or process?
I17	Is this supplier tolerant to any delay of payment?
I18	Are there meetings for troubleshooting in conjunction with this supplier?
I19	Does this relationship give you some benefit that would not be achieved individually?
I20	Does he guarantee you a lower price?
I21	Does he inform you in advance of a price increase?

One of the issues to be taken into account in the evaluation of supply chains is the varying need for managing and the integration level between relationships. It depends on the relevance of each member to the chain (LAMBERT; COOPER 2000). In order to evaluate the integration of the supply chain, an instrument must be used alowing observing the relationships individually (CASTRO et al., 2015; VAN DER VAART; VAN DONK, 2008). Thus, the questionnaire was applied analyzing the company-supplier relationships.

The answers were collected by a structured interview with managers of 41 companies. The question were about the integration with some of the companies' suppliers using the questionnaire shown in Table 3. The application of the questionnaire using interviews obtains a higher accuracy of answers, minimizing mistakes in the interpretation of questions and ensuring a greater return rate, different from questionnaires sent by e-mail (Bêrni et al., 2012). Each company answered on average 5 questionnaires, resulting in a sample of 205 relationships. The number of questionnaires answered by each company varies according to the number of suppliers and the availability of each respondent.

The questionnaires application was concentrated in the city of Joao Pessoa, State of Paraiba, Brazil, 77% of the responses were collected in this city; 20% in nearby cities and the remaining 3% in other states. The respondents sample comprises basically micro and small businesses, which represent over 25% of the

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Brazilian GDP. They were selected at random according to the availability of their managers. Most of the sample is concentrated in the sectors of trade, food, construction and manufacturing industry with 44%, 20%, 17% and 10% share respectively.

3.2. Data analysis

SCI is not well defined in the literature; it is important performing tests proving the relationship of the proposed features in the explanation of integration. In this sense, multivariate statistics allows reducing and grouping the data, relating the variables, even in the absence of a structured theoretical model (BAKKE et al., 2008).

An important tool of multivariate analysis is the factor analysis. It consists of a class of multivariate statistical methods, in order to define an underlying structure in a data matrix (HAIR Jr et al., 2006). Besides being an objective technique to identify common variability dimensions in a set of variables (CORRAR et al., 2006).

It can be applied when there is a large number of correlated variables in order to identify a lower number of new alternative variables, which somehow, summarize key information of the original variables in factors or latent variables.

This data summarization enables better information management generating more significant variables, easy to work with (COSTA, 2007). In summarizing the data in this way, the factor analysis captures the latent dimensions that represent the data set on fewer concepts than the original individual variables (COOPER; SCHINDLER, 2003). It is therefore an interdependence technique that evaluates all variables simultaneously, each one connected with the other, using the concept of statistical variable.

Factor analysis is often used when a determination of dependent and independent variables is not previously identified (COOPER; SCHINDLER, 2003), since this method makes it possible to relate the variables based on their correlation, forming groups of highly interrelated variables (BAKKE et al., 2008). These groups represent dimensions that, together, can explain the integration (HAIR JR et al., 2006). Thus, the variables are combined in accordance with the latent integration feature that they represent.

Factor analysis assumes that the variables are continuous and it is based on the correlation matrix of those variables. For dichotomous variables, it is possible to

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adjust the factor analysis by adopting the matrix of tetrachoric correlation (BARTHOLOMEW; KNOTT, 1999). A more recent approach is called full-information item factor analysis, that uses the respondents answers standards adjusting the response theory models to the multidimensional item (WIRTH; EDWARDS, 2007; BOCK; GIBBONS, 1988).

4. RESULTS AND DISCUSSION

The different latent features that compose the SCI can be seen through the graph of eigenvalues of tetrachoric matrix correlation, consisting of the variance explained by each factor shown in Figure 2. This graph is the result of principal component analysis, and factor analysis, it reduces the number of the original set variables in main components, generating new coordinates, simpler to be analyzed. The analysis of this graph indicates that the set of items used to assess the SCI can be grouped in approximately 4 factors.

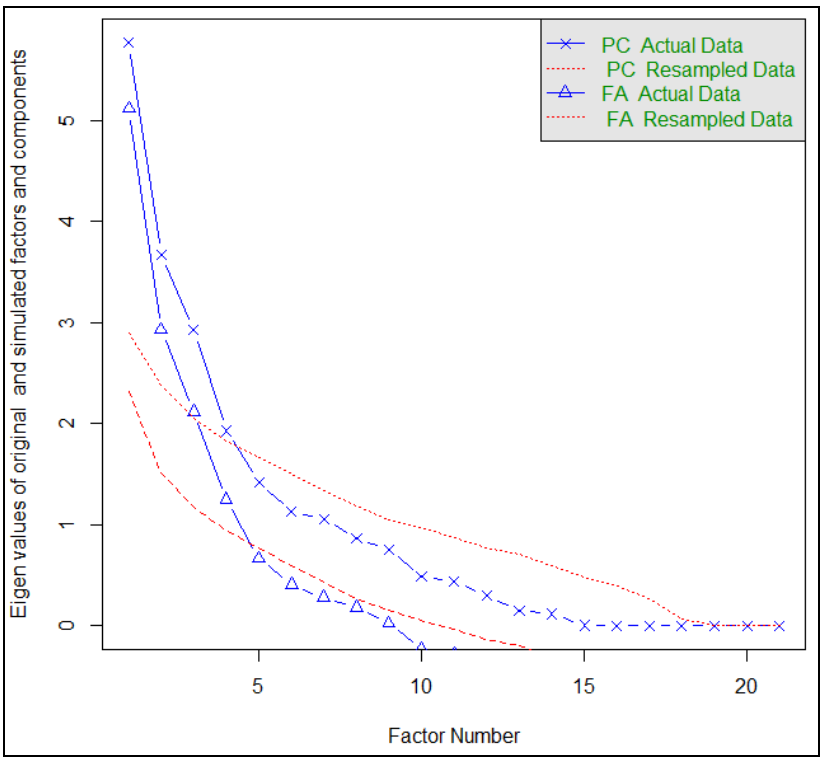

Figure 2 - Eigen values of tetrachoric matrix

The percentage of variance explained by the full-information item factor analysis model (Table 4) indicates that 72% of the model change can be explained with 4 factors, and 79% if 5 factors are considered. By this criterion, it is reasonable to consider the number of factors that exceeds 70% of variance explained by the model, and, according to Reckase (2009), the aim of factor analysis is to find the

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smallest number of factors that explain the latent variable. However, it is important to note the information gain by adding another factor, in addition to observing the theoretical coherence of the proposed pool.

Table4: Percentage of variance explained by the model

	Factors					
Dimensions	**F1**	**F2**	**F3**	**F4**	**F5**	**Total**
1	35%	-	-	-	-	35%
2	34%	14%	-	-	-	48%
3	23%	22%	16%	-	-	61%
4	19%	19%	15%	18%	-	72%
5	19%	18%	14%	14%	14%	79%

A way to verify the information gain with an increase in the number of dimensions is to observe the Akaike (AIC) and Bayesian (BIC) information criterion shown in Table 5, based on the response theory models to the item of different sizes. They are criteria used for selecting the most appropriate model to the data, calculating the increase in information of a model while the number of dimensions based on the value of the maximum likelihood and the number of degrees of freedom increases (TEZZA, 2012). The smaller the AIC and BIC value, the more appropriate is the model.

Table5: Analysis of information gain with increasing number of dimensions

N. of factors	**AIC**	**BIC**
1	3.730.038	3.869.604
2	3.583.755	3.789.782
3	3.512.975	3.782.139
4	3.438.426	3.767.404
5	3.352.603	3.738.072

Based on principal component analysis and the percentage of variance explained by the model, the observed set of variables could be grouped into 4 factors. However, indicators of AIC and BIC suggest that 5 dimensions best explain the SCI. Therefore, adjustment of factorial analysis models for different numbers of dimensions was verified, noting that the 5-dimensional model adequately adjusts the SCI features identified in the literature.

In order to obtain better estimates of the factor loadings, a template was adjusted restricting the positioning of the items on the scale proposed by the previous model, obtaining the results shown in Table 6. Thus were defined as dimensions of SCI: information sharing, trust, partnership, cooperation or

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collaboration and coordination. The results reinforce the idea according to which integration is a multidimensional concept (VALLET-BELLMUNT; RIVERA-TORRES, 2013) and that such aspect must be taken into account to improve the integration level in their different practices (DANESE; BORTOLOTTI, 2014).

The feature that should be seen as the basis for constructing the integration in a supply chain is trust among members. Feature that involves maintaining the quality standard of the product supplied (JONES et al., 2010), the existence of standard procedure to replace damaged goods on delivery or within warranty (CHOPRA; MEINDL, 2003; FAWCETT ET AL., 2012) and good personal relations between the parties (CAI et al., 2010), which will favor the development of the business relationships.

Table6: Factor loadings in the dimensions of SCI obtained with the restricted model of Full-Information Item Factor Analysis

N	Item	F1	F2	F3	F4	F5
Information Sharing						
I5	Does he inform you if there is a delay in sending the order?	0.561				
I8	Do you know his inventory?	0.397				
I12	Do you have access to his order production information?	0.617				
I15	How is the communication with this supplier? Is it open?	0.587				
I16	Do you exchange information with him seeking to improve the product or process?	0.538				
I21	Does he inform you in advance of a price increase?	0.542				
Trust						
I1	Is the quality of products consistent with the expected?		0.473			
I2	Do good personal relationships help maintain this relationship?		0.748			
I3	Is there a standard procedure to replace damaged goods on delivery?		0.602			
I4	Is there a standard procedure to exchange products under warranty?		0.724			
Partnership						
I13	Long-term relationship?			0.542		
I19	Does this relationship give you some benefit that would not be achieved individually?			0.536		
I20	Does he guarantee you a lower price?			0.841		
Collaboration/Cooperation						
I11	Does your supplier know your demand forecast?				0.782	
I14	Do you give preference to this supplier because of the quality?				0.733	

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I17	Is this supplier tolerant to any delay of payment?	0.728	
I7	Does this supplier know your stock?	0.786	
Coordination			
I6	Do you use any formal system to share information? Which one?		0.524
I9	Do you have information on the costs of this supplier?		0.663
I18	Are there meetings for troubleshooting in conjunction with this supplier?		1.534
I10	Do you talk with your supplier about market conditions, their predictions or expectations?		1.153

Reporting to customer order status, warning about possible delays in the delivery of future price increases and inventory levels are part in the dimension of sharing information (LEE; WHANG, 1998; SAHIN; ROBINSON, 2002; LI et al., 2006). In addition, it is expected that communication between partners in the supply chain is open, allowing the exchange of ideas and suggestions seeking to improve the product or production process.

To the latter, the result differs from that found in the literature. An open communication was initially related to trust (KWON; SUH, 2005; LAEEQUDDIN et al., 2012) and to partnership (MOTWANI et al. 1998). Exchange of information to suggest changes in the processes was associated with partnership (MOTWANI et al. 1998; CHEN; WU, 2010). Although such elements are related to the characteristics mentioned, the statistical analysis suggests that these indicators are more related to sharing of information.

The aspects of these two characteristics develop over time and the success on the basis of the construction of SCI leads companies to a long-term relationship, signaling the formation of a partnership (CHRISTOPHER; JÜTTNER, 2000; MAHESHWARI et al., 2006; RYU et al., 2009). This partnership provides benefits for companies that would not be achieved working individually, for example, supply with greater discount due to time and other characteristics of the relationship (VIEIRA, 2006; SINGLETON; CORMICAN, 2013).

The joint work, developed over time, leads to collaboration and cooperation between companies, transferring the demand and inventory information for members the amount to increase accuracy in decision-making (VIEIRA, 2006; SPEKMAN et al., 1998), reducing the bullwhip effect. Collaboration and cooperation also means

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being tolerant to any delay in payment and providing a quality product that meets the needs of the end customer.

Although information sharing is considered as a basic feature of SCI, certain information is shared only when companies already have a high level of integration also influencing on how this information is shared among members of the supply chain. These aspects of SCI can be defined as coordination with companies making decisions and solving problems together, sharing cost information with supplier and facilitating access to their information using information systems compatible (CAO et al., 2008; SINGH, 2011; ZHAO et al., 2011).

Some of the values shown in Table 6 deserve attention, as the factor load in item 8, which seeks to know if the company receives updated information from the supplier of the inventory involved. This item presents problems of interpretation, which generated a lower result than expected. On the other hand, the last two items on the coordination had factor loadings higher than 1, which according to Jöreskog (1999), may occur when the factors are related, indicating that the greater the load factor, the greater the ratio between factor and items.

This variables reduction, provided by factor analysis, allows us to better understand how to increase the level of integration among the members of a supply chain, since we can work with less complex variables. Based on it, we can individually study each of the identified features, combining their individual ways to increase the level of SCI.

However, it is noteworthy that some actions are more complex than others. This implies that the SCI must be installed in a gradual way and its evolution depends on how relationships with partners in the supply chain are conducted. As trust among members increases, and more joint actions are developed, the performance of the supply chain increases, generating higher earnings for the most integrated members.

5. CONCLUSION

The SCI is a very broad topic, covering different characteristics and this has led the authors to have different definitions that vary according to the approach used in their analysis, limiting planning the construction of an integrated supply chain. The evaluation of SCM muldimensionality allowed separating different practices according to a predominant characteristic. To acknowledge one of these

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characteristic as part of SCM allows improving to a better definition, facilitating planning inside organizations.

SCM is a multidimensional concept. To find ways to improve integration in supply chains, it must be seen as such. This is an aspect little studied by the existing literature on this topic. This study is a small step in that direction. However, much must still be discussed on this topic.

One limitation found in studies on companies is representative samples because of the lack of availability to participate in academic research (BORTOLOTTI, 2010). Thus, assessing the dimensionality of the instrument in another sample is needed to determine the generalizability of the results (Immekus and Imbrie 2014).

As further research, we suggest the broadening of each characteristic related to SCM. In addition to deciding whether an instrument for measuring the SCI level is expected to generate a total score for all items or if scores are generated for each dimension.

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