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Shpëtim ÇERRI
Faculty of Economics, University "Aleksander Xhuvani"
Elbasan, Albania

A STRUCTURAL APPROACH TO SUPPLY CHAIN INTEGRATION PROCESS

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Abstract

The competitiveness and dynamics of business environment today expose firms to many challenges. They are part of a whole chain of entities and activities that create goods and services and make them available to customers, which is called supply chain. Implementation of supply chain management techniques requires thorough integration of processes between supply chain partners in all functional areas, including sourcing, manufacturing, and distribution. This study uses a structural approach to measure supply chain integration of Albanian companies. Based on an extensive relevant literature review and interviews with field specialists, a supply – chain integration scale was developed. Then an exploratory factor analysis was conducted to test the applicability of the items developed. Structural equation modeling was used to test the convergent validity through confirmatory factor analysis (performed using LISREL 8.80). The hypothesized research model also exhibited good fit indicators. The study is finalized with a structural model of supply chain integration. The proposed model demonstrates the relative importance of several dimensions that comprise supply chain integration. The result produces a validated integration scale that can help in diagnosing supply chain problems and possibilities.

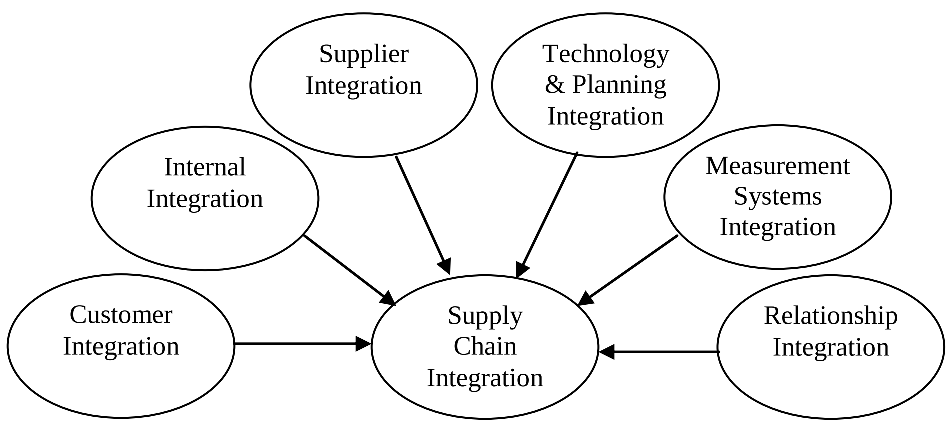
Keywords: Supply chain integration, structural equations modeling,

JEL Classification: M31

1. Introduction

For many companies, the supply chain (SC) strategy plays a crucial role in generating and maintaining competitive advantage (Mentzer et al., 2001, Shankar 2001). In today's business environment, characterized by fierce competitiveness and highly dynamic events, gaining and maintaining competitive advantage requires a continuous collaboration and coordination with external resources and partners. Supply chain management has a favorite position in acting as a coordinator of information and decisions for all companies engaged in a supply chain, prioritizing those resources combination that lead to competitive advantage. Metzer et al. (2001, pp. 2) define supply chain as "three or more companies directly linked through one or more upstream and downstream flows of products, services, finances and information, from the source to the customer. Focusing more on supply chain integration (SCI) has happened due to the increased awareness among managers that performance maximization for a single firm can lead to non-optimal performance for the supply chain as a whole (Monczka et al., 1998). An integrated supply chain includes functional integration within the firm and outside the firm with other partners of supply chain, as well as with customers (Cooper et al., 1997). It is an interconnected network of customers and suppliers who work together to optimize their joint performance in creating, distributing and supporting an end product or service.

Figure 1 The conceptual model of the study



Bowersox et al. (1999) have identified six areas whose integration lead to the integration of supply chain. They are namely customer integration, internal integration, supplier integration, technology and planning integration, measurement integration and relationship integration. This supply chain conceptualization has been used in many studies (De Martino and Marasco, 2007; Fugate, et al., 2010; Morash, 2001; Stank, et al., 2005; Töyli et al., 2008; Zhao, et al., 2011, etc.). The framework introduced by Bowerox et al. (1999) served as a basis for conceptualizing supply chain integration in this study.

The general model proposed in this paper conceptualizes the SCI as a second order latent construct, whose antecedents are the six constructs mentioned above. The six antecedents of SCI are supossed to fully capture the essence of SCI. The model proposed is presented at Figure 1. The study of SCI focused on retail sector in Albania, aiming subjects with two or more outlets. The study follows the approach proposed by Dunn et al. (1994) on developing and validating latent variables in business logistics research. First, constructs were defined and potential items were developed. Then, content validity was checked and initial scale was developed. The next step was conducting exploratory factor analysis and confirmatory factor analysis, in order to purify the instrument proposed and check reliability, convergent and discriminant validity of the scale. Finally, structural equation modeling was used to test the whole proposed model and to investigate the relationships between the proposed constructs.

2. Literature review and hypotheses development

Today, supply chains and networks composed of multiple companies are becoming primary elements of competitive analysis (Chen and Paulraj, 2004). The supply chain ability to fulfill consumer demands and needs in an efficient and effective manner has become a strategic ability, which leads to competitive advantage (Ireland and Webb, 2007). Today there are not firms who compete against each other, but the network of interdependent firms where they belong compete with other networks (Christopher, 2005). Thus, the new challenge today is designing and effectively managing these supply chains or networks (Chen and Paulraj, 2004; Christopher, 2005). Integrating supply chains is a very effective tool to face this contemporary challenge (De Martino and Marasco, 2007).

Several authors, like Bowersox and Morash (1989) and Hammer (2001) suggest that SCI means integrating relationships, activities, functions, processes and locations across all the members of supply chain. Naylor et al. (1999) showed that the objective of SCI is eliminating all the boundaries between companies and enabling a seamless flow of materials, money, resources and information. Lee and Whang (2001) suggested that SCI can be defined as a managerial approach which aims towards a greater coordination and collaboration between SC partners, in order to sustain competitiveness.

Bowersox et al. (1999) have conceptualized SCI as comprised of six types of integration: customer integration, internal integration, supplier integration, technology and planning integration, measuring systems integration, and relationship integration.

Customer integration means creating distinct activities with selected customers. Since few firms can satisfy every customer or customer segment, firm's management should decide on pursuing those activities that better fit customer needs (Bowersox et al., 1999).
Internal integration is a core competency which means linking internal activities to comply with customers' requests, at the lowest total system costs (Bowersox et al., 2002). This competency asks for process excellence of the whole company, in order to achieve

synergies which lead to higher performance in fulfilling customers' demands (Bowersox et al., 1999)

Supplier integration refers to the degree a firm could create partnerships with key members of its SC, in order to structure the strategies, practices, procedures and inter – organizational behaviors into collaborative processes, synchronized and managed to fulfill end customers' demands (Stank et al., 2001).

Technology and planning integration means structuring firm's strategic objectives and goals, as well as sharing resources, rewards and risk across SC members in a contractual and consensual agreement in order to achieve and maintain competitiveness (Fuchs et al., 2000). Due to its strategic importance, technology and planning integration can be considered as a key pre – condition towards SCI.

Measuring systems integration is very necessary to manage coordinated operations of SC. The integration of measuring systems refers to the degree a company could structure measuring systems and manage measuring activities with key members of its SC, in order to evaluate integrative strategies of SC (Bowersox et al., 1999).

Relationship integration is a key prerequisite for SCI. From a strategic perspective, the integration between members of a SC starts when the relationships between firms are considered as strategic assets (Anderson et al., 1994). Relationship integration is achieved when a firm can structure the creating, commitment, maintaining, and terminating a relationship with its partners through consensual and contractual agreements (Bowersox et al., 1999; Stank, et al., 2001).

The model proposed in this study conceptualizes SCI as a reflective construct. Six antecedents, latent construct themselves, lead to SCI. Thus, the hypotheses derived from the model proposed in the study are:
H_1: Customer integration is a significant driver of SCI.
H_2: Internal integration is a significant driver of SCI.
H_3: Supplier integration is a significant driver of SCI.
H_4: Technology and planning integration is a significant driver of SCI.
H_5: Measurement systems integration is a significant driver of SCI.
H_6: Relationship integration is a significant driver of SCI.

3. Initial scale construction

In order to identify the initial items of measurement scales for SCI, three sessions of focus groups were conducted. Members of these focus groups were supply chain and logistics researchers as well as supply chain professionals. Focus groups discussed the original study of Bowersox et al. (1999), which contains in total 100 items for measuring six types of integration. From this pool of indicators, finally 45 items were chosen to construct the initial scales of SCI. The selection criteria were their adaptability and suitability to

Albanian economy context. Some of the indicators were modified and adapted to suit the study context.

In order to evaluate content validity for each of the initial items of six antecedents of SCI, the approach proposed by Lawshe (1975) was used. This approach measures the level of harmony between the specialist evaluators about how much essential a particular item is in explaining a construct or phenomenon (Lawshe, 1975). After examining each initial item, harmony was achieved for 45 of the items representing SCI. These items were then used to build the measurement scale for SCI antecedents and SCI itself. Table 1 presents the items used for measuring each construct.

Table 1 Constructs of the study and respective items

Construct	Item
Customer integration (CI)	- Having unique logistics service strategy for different customers. (CI1) - Continuously integrating and facilitating individual customer requests across strategic business units. (CI2) - Focusing logistic operations on key customers' success. (CI3) - Periodically reviewing customer service offers in order to ensure compliance with customers' logistical requests. (CI4) - Continuously fulfilling special requests of selected key customers. (C5) - Synchronizing logistical operations with customer's operations. (CI6) - Building communication lines with customers which enable last minute changes without loss of planned efficiency. (CI7) - Fulfilling a wide range of unique customer demands through implementing pre – planned solutions. (CI8)
Internal integration (II)	- Reducing formal organizational structure to fully integrate firm's operations. (II1) - Moving the focus of the company from managing functions to managing processes. (II2) - Actively encouraging the implementing of best practices. (II3) - Actively engaging in standardizing the practices and operations of SC. (II4) - Continuously reducing facility and operational complexity. (II5) - Developing performance incentives based on process improvement. (II6) - Using real time logistical solutions. (II7) - Reducing order – to – delivery cycle time. (II8)
Supplier integration (SI)	- Successfully integrating operations with customers and/or suppliers through developing interlinking activities. (SI1) - Believing that strategic management, the role and performance of SC partners are critical for firm's success. (SI2) - Using logistical capacities as criteria for choosing firm's suppliers. (SI3)

	- Significantly reducing the number of suppliers in order to achieve operational integration. (SI4) - Enjoying performance improvement through integrating operations with SC partners. (SI5) - Sharing technical sources with key suppliers in order to facilitate operations. (SI6) - Willingness to enter into long – term relationships with suppliers. (SI7) - Using innovative methods to facilitate the coordination through performance monitoring. (SI8)
Technology and planning integration (TI)	- Being able to internally share standardized and customized information. (TI1) - Moving toward integrated planning. (TI2) - Continuously investing in technology to increase inter – organizational information exchange. (TI3) - Developing a common set of expectations with SC partners. (TI4) - Being involved in joint planning and forecasting with suppliers and/or customers. (TI5)
Measuring systems integration (MI)	- Measuring functional performance comprehensively. (MI1) - Being committed to zero defections. (MI2) - Developing and applying measures that extends across the SC relationships. (MI3) - Implementing and using a formal program to measure customer satisfaction. (MI4) - Using benchmarking as a measurement indicator. (MI5) - Management being able to determine the impact of enhanced SC on incomes and revenues. (MI6)
Relationship integration (RI)	- Clearly determining roles and responsibilities together with SC partners. (RI1) - Creating acceptable practices for cooperation with suppliers and customers. (RI2) - Management being able to understand that engaging in a SC means substantial empowerment. (RI3) - Having clear orientations for developing, maintaining, monitoring and terminating SC relationships. (RI4) - Effectively sharing operational information between departments. (RI5) - Effectively sharing operational information with suppliers and/or selected customers. (RI6)
Supply chain integration (SCI)	- Company having a high level of SCI. (SCI1) - Company having a high integration level with suppliers. (SCI2) - Company having a high internal inter – functional integration level. (SCI3) - Company having a high integration level with customers. (SCI4)

4. Research methodology and variable measurement

The sample of the study comprised of retail businesses with two or more outlets. The sample was drawn from retail businesses population in the seven largest cities in Albania. Data were collected through face to face interviews. Ten qualified students were engaged in the field work of data gathering, during a three week period in spring of 2012. From 300 questionnaires distributed, 289 were returned fully completed, and from those 8 were excluded because of possible unrealistic responses. Thus, only 281 questionnaires were considered valid for further analysis. A seven point Likert scale was used for all the items of the measurement instrument, where 1 = Totally disagree and 7 = Totally agree. Managers of the retail businesses, part of the sample, were asked to express their level of agreement with each of the statements in the questionnaire.

4.1 Exploratory Factor Analysis (EFA)

The main objective of EFA is to determine the underlying structure between variables in an analysis (Hair et al., 2009). EFA was conducted using Principal Axle Factoring – PAF extraction method, with oblimin rotation, in order to identify the factor structure for the seven proposed constructs. PAF was chosen because the objective of the analysis was to obtain parameters reflecting latent constructs (Garson, 2012). Oblimin rotation was chosen because it was supposed that inter – correlations existed between dimensions (Dunteman, 1989, Stevens, 2002; Hair et al., 2009). The objective of these examinations was to evaluate the dimensionality of the scales used in this study.

EFA and scale purification process were conducted step by step. The items with low factor loadings (lower than 0.05), high cross – loadings (greater than 0.4), and/or high item-to-total correlation were excluded from the factor matrix. The items who didn't meet these criteria, thus excluded from factor matrix, were CI8, SI2, SI6, MI3, and RI3.

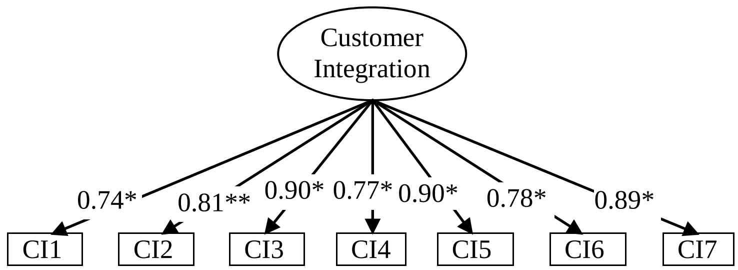
Because some elements were excluded and the resulting total number of factor was reduced, it was necessary to re – calculate item-to-total correlations as well as to re – examine the factor structure of the reduced items set. This iterative process concluded in a final set of 40 items representing six antecedents of SCI and SCI itself. The final factor solution had good loadings patterns and explained 77.308 per cent of the variance.

4.2 Confirmatory Factor Analysis (CFA)

In order to evaluate the dimensionality, reliability, and validity of the generated structure of constructs, CFA was conducted. CFA seeks to determine if the number of factors and the loadings of measured variables are consistent with what is expected from the existing theory (Brown, 2006).

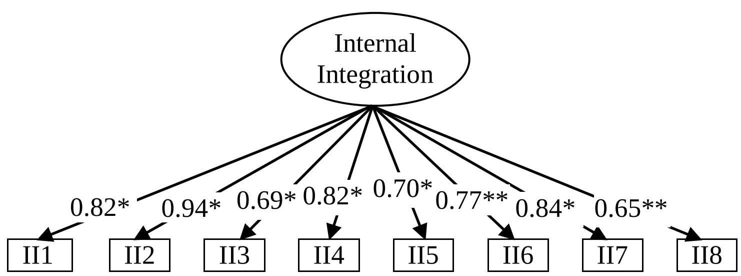
In order to confirm the unidimensionality of the scale, LISREL 8.80 software was used. Correlations between items and fit statistics were assessed. Standard errors and *t*-values, which indicated the degree of significance of each element in explaining their respective factor, were within acceptable limits. The R^2, which indicate the strength of relationship between the item and latent construct it is supposed to measure, were all significant. Path coefficients estimates for unidimensional hypothesized factors are presented in figures 2 to 8.

Figure 2 Path coefficients estimation for Customer Integration



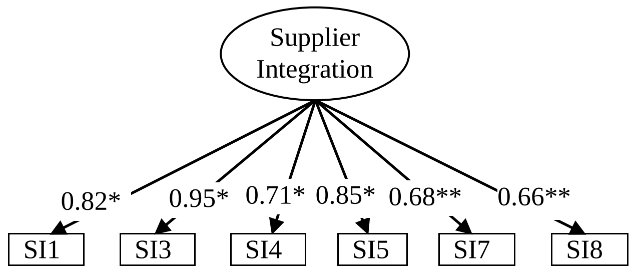
* *p<0.01*
** *p<0.05*

Figure 3 Path coefficients estimation for Internal Integration



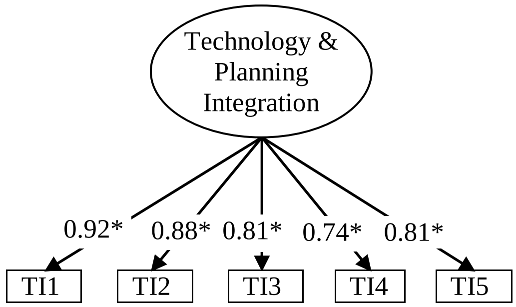
* *p<0.01*
** *p<0.05*

Figure 4 Path coefficients estimation for Supplier Integration



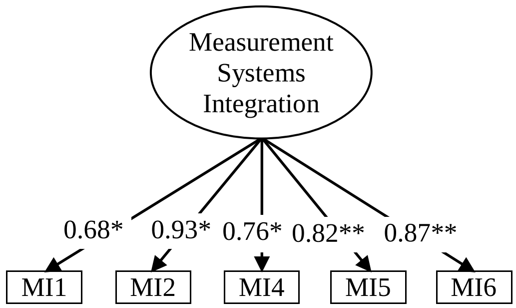
** p<0.01*
*** p<0.05*

Figure 5 Path coefficients estimation for Technology and Planning Integration



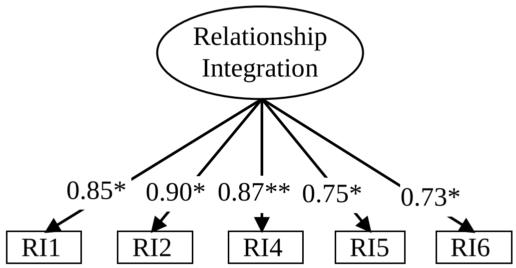
** p<0.01*
*** p<0.05*

Figure 6 Path coefficients estimation for Measurement Systems Integration



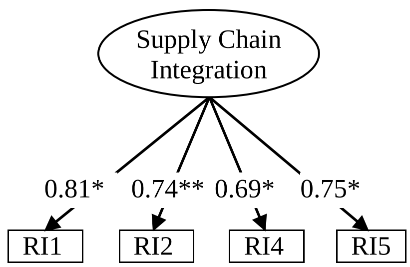
** p<0.01*
*** p<0.05*

Figure 7 Path coefficients estimation for Relationship Integration



* *p<0.01*
** *p<0.05*

Figure 8 Path coefficients estimation for Supply Chain Integration



* *p<0.01*
** *p<0.05*

Then, scale reliability was assessed, through standardized Cronbach alpha coefficient (Cronbach, 1951). Nunnally (1978) and Churchill (1979) suggest that a scale with Cronbach alpha larger than 0.7 is considered reliable. Final Cronbach alphas (item-to-total corrected alphas) varied from 0.715 to 0.908, suggesting a good internal consistency between items within each construct and reliability for the constructs. Furthermore, combined reliability for all items of the scale was 0.957, indicating that reliability as well as convergent validity was met (Hair et al., 2009). Factor structure was considered stable because the alphas for the combined scales would not increase significantly if any of the items was removed.

Composite reliabilities for extracted factors were computed in order to provide further evidence on reliability and convergent validity. Construct reliability and convergent validity are evaluated using *rho* (*ρ*) coefficient (Croteau and Li, 2003), a coefficient which measures how well a set of items measure a single latent construct (Churchill, 1979). Nunnally (1978) suggest that each construct which have a *rho* value equal or greater than

0.70 is reliable and should be kept in the model. As presented in Table 3, *rho* coefficients vary from 0.874 to 0.951 for the seven constructs, further confirming their reliability and convergent validity.

Table 2 Composite reliability and validity indexes for model constructs

Construct	Number of items	Composite reliability (ρ or r_p)
Customer Integration	7	0.874
Internal Integration	8	0.914
Supplier Integration	6	0.922
Technology & Planning Integration	5	0.937
Measurement Systems Integration	5	0.887
Relationship Integration	5	0.913
Supply Chain Integration	4	0.951

Finally, discriminant validity was checked using the approach proposed by Anderson and Gerbing (1988). They suggested conducting a series of paired chi – square difference tests based on models of confirmatory factor analysis. First, a constrained CFA model for each possible pair of construct is build, in which the correlations between paired constructs are fixed to 1. Then, the difference of chi-square values for constrained and unconstrained CFA model is computed. Discriminant validity exists when the unconstrained model has a significantly lower chi-square value than the constrained model (Anderson and Gerbing, 1988). All the chi-square differences between constrained and unconstrained models are significantly high ($p<0.001$), providing sufficient evidence on discriminant validity of the scale (Table 4).

Table 3 Discriminant validity check through chi-square difference test

	CI	**II**	**SI**	**TI**	**MI**	**RI**
CI						
II	247.61					
SI	325.79	340.12				
TI	406.15	154.64	168.97			
MI	224.49	358.01	213.81	257.66		
RI	184.47	114.78	149.64	167.95	184.67	
SCI	431.26	347.32	248.32	314.22	189.67	225.98
All differences significant at p<0.001						

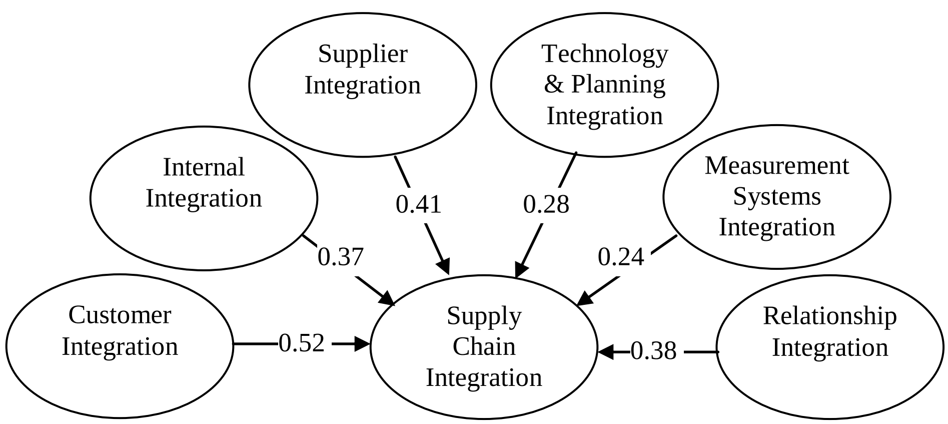
5. Hypotheses testing results and discussion

The proposed model and hypotheses were tested using Structural Equation Modeling (SEM) approach, using maximum likelihood estimation in LISRES 8.80. Fit indices were all significant and greater than the threshold for which it can be concluded than the model results in a good fit. Figure 9 shows the standardized coefficient for each hypothesized path, together with fit statistics indices. All the paths are significant, indicating that they represent meaningful relationships. The results provide support for the proposed model.

H_1: Customer integration is a significant driver of SCI: path coefficient 0.52, p<0.01, thus this hypotheses is confirmed. By successfully being integrated with its customers, a company is able to use its resources in activities that really create value for them. A strong focus on customer is achieved also by integrating individual customer’s request across the strategic business units, where each unit receives relevant information on these requests and does its best to fulfill them.

H_2: Internal integration is a significant driver of SCI: path coefficient 0.37, p<0.01, the second hypotheses is confirmed too. This confirmation comes natural, taking into account the benefits derived from coordinating internal activities and operations of the firm. By coordinating the processes of marketing and sales, procuring, manufacturing and assembling, and distribution of products and services, the company can achieve a core competency which becomes a strong competitive advantage.

Figure 9 Structural equation model with resulting path coefficient and fit statistics indices



χ^2 = 570.94; degrees of freedom = 550; GFI = 0.98, AGFI = 0.97, CFI = 0.97, NNFI = 0.97, RMSEA = 0.07.

H_3: Supplier integration is a significant driver of SCI: path coefficient 0.41, p<0.001, indicating support for this hypothesis. Although achieving supplier integration is difficult, benefits from this are evident for companies. By closely collaborating with their partners of

SC, companies can have access to their expertise, can reduce operational duplications and improve the quality and relevance of services they offer to each other and to end customers.

H_4: Technology and planning integration is a significant driver of SCI: path coefficient 0.28, $p<0.01$, concluding that this hypothesis is supported too. Focusing on the development of information systems capable of supporting a wide range of operational configurations necessary to create SC solutions for specific customers, a firm contributes in achieving high levels of SCI. Technology and planning integration is also crucial in achieving significant benefits that steam from efficient and effective use of resources.
H_5: Measurement systems integration is a significant driver of SCI: path coefficient 0.24, $p<0.01$; this hypothesis is also confirmed by test results. The company, by structuring its measurement systems and managing its measurement activities with key members of its SC, can appropriately evaluate the integrative strategies of SC. Integrated performance measures ensure a basis for calibrating the multiple parts of SC engine.

H_6: Relationship integration is a significant driver of SCI: path coefficient 0.38, $p<0.01$, this hypothesis is also confirmed. Relationship integration demands readiness from SC partners to create necessary structures, framework and metrics that encourage inter – organizational behavior. Then, all SC partners can enjoy the benefits of successful relationship where all parties are winners. This collaborative perspective is substantial in developing effective structures of SC and achieving successful SC integration.

Nomological validity
Nomological validity exists when a construct relates to other research constructs in a way that is consistent with the underlying theory (Gerbing and Anderson, 1988; Dunn et al., 1994). All the findings on the relationships between constructs strongly confirm previous studies and theory on respective relationships, like Chen et al., 2011; Radhakrishnan et al., 2011; Clements, 2007; Trkman et al., 2007; Wamba, 2012; Baofeng, 2012, etc., providing evidence that nomological validity for the constructs is achieved in this study.

6. Conclusions

This study created a measurement scale for SCI, as well as offered a comprehensive model for understanding and examining SCI. Following an innovative approach, it conceptualized SCI as a latent construct with 6 other latent constructs serving as its antecedents, namely customer integration, internal integration, supplier integration, technology and planning integration, measurement systems integration and relationship integration. Further studies may give evidence on the validity of this model, replicating it in different environments or contexts. The model also confirmed previous relevant theory on SC and SCI, contributing in the development of SC field of study.

The proposed instrument was tested and refined, achieving good reliability and validity. It may be beneficial for managers to measure the level of SCI for their companies. The proposed model reveals the relative importance of each antecedent in achieving overall

SCI, thus serving as good guidelines for reaching overall SCI. Retailers should understand, comprehensively, the critical factors and areas which lead to SCI. In this way they can better formulate and implement their SC strategies, in collaboration with their SC partners and customers.

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