SUPPLY CHAIN INTEGRATION AND PERFORMANCE RELATIONSHIP: A MODERATING EFFECTS REVIEW[1]

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ABSTRACT

Purpose – The purpose of this paper is to interpret the relationship between supply chain integration (SCI) and performance. To find empirical evidence of the moderating factors that affects said relationship, as well as to describe, classify, and discuss the empirical evidence.

Design/methodology/approach – A systematic review of 72 studies published during the period 2001-2015 is offered. A multi-criteria approach is used to sort, structure and classify papers with the purpose of contributing to the discussion.

Findings – The direct relationship between SCI and performance shows mostly positive results, however, the moderating effects analyzed show a clear lack of consistency since their effect and significance vary depending on the measures used, both in SCI and performance.

Research limitations/implications – The use of specific keywords of SCI to select an initial sample of papers may lead to a narrow perspective, although snowballing was used to include relevant papers initially excluded.

Originality/value – The analysis and classification of moderating factors as well as the measure of their tendency help to better understand the questions that remain unsolved regarding SCI and performance. Propositions for further research are suggested.

Keywords: Supply chain integration, moderating effects, uncertainty, internal integration, strategy, performance.

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1. INTRODUCTION

Factors such as increasing global competence and the shortening product life-cycle are the two main factors that encourage organizations to change their focus from competitive rivalry to mutual beneficial relationship and cooperation (Lambert and Cooper, 2000; Wisner and Keah, 2000). In this sense, organizations within supply chains would align their strategy with other supply chain members in an effort to be more responsive to the environment and therefore, remain competitive (Richey *et al.*, 2009). This can be carried out by focusing on a proactive search of efficient linkages, both among internal functions and external agents that comprise the supply chain (Qi *et al.*, 2011; Narasimhan and Kim, 2002). Therefore, those organizations integrating their processes with external suppliers and customers within a single supply chain seem to be more successful (Frohlich and Westbrook, 2001; Zailani and Rajagopal, 2005).

The approach most used for these integrating processes was proposed by Flynn *et al.* (2010), which distinguishes between internal and external integration and where the external dimension can also be split into supplier and customer integration. According to Flynn *et al.* (2010), SCI can be defined as the degree to which a manufacturer strategically collaborates with partners within its supply chain and collaboratively manages inter and intraorganizational processes.

SCI may be considered as one of the managerial tools with the potential to generate competitive advantages for organizations (Flynn *et al.*, 2010; Vickery *et al.*, 2003). This ability allows organizations to complement resources with others and, thus, to improve the performance of both organizations. However, integration does not always imply a balance in the mutual benefits. It might comprise additional coordination and control activities that could eventually increase managerial costs.

Most of the empirical studies that analyze the relationship between SCI and performance show positive results; which is in line with recent literature review and meta-analysis (Leuschner *et al.*, 2013). However, they are quite heterogeneous. They not only show a lack of consensus in their results, but also in measuring both SCI and performance (Huo, 2012; Vickery *et al.* 2003). Nevertheless, SCI construct is measured

considering different instruments (unidimensional, multidimensional construct, and even as a set of practices). Meanwhile, performance measurements show more homogeneity, although mainly focused on operational performance (reliability, delivery time, response capability) and, to a lesser extent, on financial performance (return on assets or on investment). In addition, studies analyzing the relationships among different SCI measures find that internal integration improves external integration (Droge *et al.*, 2004; Huo *et al.*, 2014). Further, some studies suggest the existence of moderating effects among the SCI measures (Danese and Romano, 2011; 2013; Flynn *et al.* 2010; Wiengarten *et al.* 2014).

According to Kim (2013), most of the studies that address the direct relationship between SCI and performance refer to publications from 2000 to 2006. In the same vein, Mackelprang *et al.*, (2014) find that more than half of SCI/performance relationships analyzed are subject to unknown moderating effects. Thus, performance measurements associated with SCI might widely vary.

A deeper study is needed to classify and categorize these moderating factors and their effects. The disparity and diversity of the moderating effects motivate this research in an attempt to systemize and unify them. Thus, and as far as possible, general guidelines about these effects could be provided.

The aim of this study is to carry out a systematic review of the empirical literature considering moderating factors that affect the relationship between SCI and performance. Previous studies concerning SCI and performance use a restrictive criterion to select the sample, usually limited to publications with a certain impact factor (Fabbe-Costes and Jahre, 2008; Kim, 2013; van der Vaart and van Donk, 2008). Besides, results of effects vary when they are combined with different integration and performance dimensions. This has led to some confusion that this study tries to clarify. Although the importance of the moderating effect has been recognized (Mackelprang *et al.*, 2014), the literature on the subject is scattered. Therefore, this study intends to develop and analyze them and propose a classification.

There three main contributions offered by this study. Firstly, it offers an update and greater understanding in the comprehension of the relationship between SCI and performance. Secondly, an analysis is given of the main moderating factors affecting this relationship. Thirdly, a delimitation and classification of moderating factors is provided that can foster or restrict the effect of SCI over performance.

The reminder of this paper is structured as follows. Section 2 introduces the theoretical background of the SCI/Performance relationship. Section 3 presents the research methodology of the systematic literature review and resumes the empirical papers selected for analysis. Thereafter, Section 4 provides the definitions used in the papers selected previously for SCI, both theoretically and operationally, and for performance. Section 5 presents an analysis and classification of the main moderating factors. Finally, the conclusions and implications as well as limitations and future research are presented.

2. THEORETICAL BACKGROUND

The concept of integrative relationships in the supply chain has been widely studied under different concepts. Although integration has been the most commonly used, other concepts such as coordination or collaboration are usually used to describe integrative efforts along the supply chain (Ellinger *et al.*, 2000; Pagell, 2004; Singh and Power, 2009). However, the latter are also used to describe some elements of SCI (Leuschner *et al.*, 2013). Thus, coordination comprises synchronization, planning and alignment of activities while collaboration includes shared actions to improve processes and exploit resources (Wiengarten *et al.*, 2014).

Although most of the expected benefits of SCI are cost savings (Madhok and Tallman, 1998), integrative processes may increase these for a time. Also, the increase in performance due to integration might not be sufficient to recover the high costs (Leuschner *et al.*, 2013). Therefore, the fact of carrying out SCI practices does not ensure organizations attain superior performance (Rosenzweig *et al.*, 2003). As a consequence, the statement that SCI involves a positive effect in performance can be questioned.

Therefore, the concept of SCI, when referred to its link with performance, is complex and can be approached from different perspectives and theoretical fundaments.

In general, a strategic view of SCI is thought of as one of the managerial tools with the potential to generate competitive advantages in organizations (Flynn *et al.*, 2010; Vickery *et al.*, 2003). According to Porter's perspective of competitive advantage (1985), an organization is able to create a defensible position over its competitors. Under this perspective, individual rent-seeking behaviors are encouraged to maximize

the firm's benefits (Lavie, 2006). However, SCI involves taking into account the objective of other firms in a joint decision-making process. This implies a consideration of the advantage at an integrative level, where relational rents are fostered to produce common benefits for bilateral rent-seeking behaviors (Cao and Zhan, 2011).

In this way, the roots of competitive advantage in interorganizational arrangements can be approached mainly through three perspectives: (1) resource based view, (2) relational view, and (3) transaction cost economics.

Resource based view

Resource based view (RBV) posits that firms are a collection of resources, within which some of them can be considered to be strategic (Wernerfelt, 1984). Thus, firms that want to achieve a competitive advantage must combine resources in a unique and different way from other firms that might not be able to do it (Dyer and Singh, 1998). At the same time, they need to be concerned with the heterogeneous distribution of resources across firms involved in the integration processes (Barney, 1991). Therefore, the incentives for integration are laid on the acquisition of scarce and specific resources to protect and maintain the competitive advantage. In this way, the establishment of integrative links lead firms to leverage, as much as possible, the resources and knowledge of their suppliers and customers (Fawcett and Magnan, 2002) and, especially, to maintain this over time. This would allow them to maintain efficiency and be responsive to dynamic market needs.

Relational view

The relational view (RV) can be seen as a complement of the RBV. Thus, while the unit of analysis in RBV is focused on the resources or capabilities of the firm, in the RV the unit of analysis is the relationship between firms. That is, critical resources may reach beyond firm boundaries (Dyer and Singh, 1998). Elements such as trust, frequency of interaction or commitment are characteristics that help to understand these relationships. In this manner, firms can attain relational rents, that is, attaining performances jointly which are above the average and that could not be achieved in isolation and can be only created through the combined contributions of integrated partners (Dyer and Sing, 1998; Lavie, 2006). Also, as SCI offers barriers to imitation, mainly derived from inimitable

specialized assets, skills and information, it may help to attain a sustainable competitive advantage. Therefore, the ability of firms to create relational rents by using complementary resources is tied to elements such as prior integration experience, investment in their internal capability to the search for partners, and the ability to occupy information-rich positions within networks (Ritala and Ellonen, 2010). Thus, relational rents may condition the mechanism of governance, leading to a network governance mechanism that is based on a dynamic process of organizing, rather than on a static entity (Jones *et al.*, 1997).

Transaction cost economics

In considering SCI, transaction cost economics (TCE) states that firms should perform better if they appropriately adjust their governance mechanisms to underlying transactions (Williamson, 1979). In this regards, the integration of the supply chain may be an intermediate form of hybrid governance (Cao and Zhan, 2011). This is partially because relational integration implies the adoption of a strategic connection among firms characterized by trust, commitment, long-term orientation and goodwill that can help to avoid opportunistic behavior.

3. METHODOLOGY

A systematic review of the available evidence on the moderating effects in SCI was performed. Such a literature review establishes the state of current knowledge in a field (Tranfield *et al.* 2003). This process has been successfully carried out in medical fields as it helps to synthesize empirical evidence from a large number of studies. Thus, according to Perkmann *et al.* (2013), the implementation of this process in social science is due to its utility to identify areas of consensus and disagreement between researchers. For the current article, a simplified version of the process outlined by Tranfield *et al.* (2003), was followed as detailed below:

Planning the process

The first phase of this literature review was to analyze empirical studies about SCI, focusing on identifying those moderating factors that affect the relationship between SCI and performance.

The review was conducted by searching in the main management databases: Emerald Insight, Science Direct and ABI/Inform. The reason for choosing them is that they cover many of the peer-reviewed journals focused on management. This makes it possible to locate a substantial amount of papers on SCI issues.

Keywords were selected considering the wide range of concepts related to integrative efforts. Thus, the words chosen were "supply chain", "integration", "collaboration", "practices" and "performance". The search was also limited to title and/or abstract to ensure a minimal level of relevance.

As the objective was to focus on empirical studies, theoretical papers were excluded. To focus on enhancing quality control, only published peer-reviewed journal articles were considered. Additionally, it was decided to select only those articles published before 2016.

Conducting the review process

This section reports the steps of the process of searching for relevant studies in the chosen databases based on the proposed criteria (it was carried out in late April 2016):

- The keywords were entered into each of the databases using an excluding syntax for concepts related to integration [("supply chain" AND (integration OR collaboration OR practices)) AND performance]. Introducing the keywords resulted in a total of 481 publications, of which 61 remained as relevant after considering the exclusion gauges.
- To maximize the search, the snowball effect was used. Thus, firstly, the references of the studies selected were reviewed (backward snowballing). Secondly, article citing the selected keywords were also reviewed (forward snowballing). To do the latter, Google Scholar was selected because of its suitability to measure formal scholarly patterns (Kousha and Thelwall, 2007). Here, the purpose was to locate high quality studies that may have been initially hidden from the keywords used. As a result, 11 new articles were taken into account. Therefore, a total of 72 studies were considered for further research.
- A title and abstract analysis was then conducted to split the sample into two groups: those papers carrying out moderating factor analysis over the SCI/performance relationship, and those that did not.

- Data synthesis. Of the total of 72 studies, 34 of them analyzed moderating factors, whilst the remaining 38 did not (Table 1).

Table 1 here

Preliminary findings

Figure 1 shows the evolution in publications, comparing the total number of papers with those analyzing moderators. It can be seen that there has been an increase in the number of studies analyzing moderating factors over SCI/performance relationships. This is consistent with the total number. The largest number of studies recorded were for 2011 and 2014 (with seven and six respectively). In 2011, seven out of eight studies dealt with moderators. Despite some fluctuations, there is a clear increasing trend in the number of publications on this topic. A slight decline is noticed in 2015, perhaps because of delays in the introduction of the references in databases or the citing in the snowballing. Despite this, this increasing trend highlights the importance and awareness of this topic among researchers. Thus, more than 50% of the studies analyzed were concentrated between 2011 and 2015.

Figure 1 here

Most of the studies' samples are from the USA or Asian countries (China, Taiwan, and Thailand), while minority studies focused on European countries (Finland, UK, and Switzerland) or on a multi-country sample. Meanwhile, the average sample was between 150 and 200 cases for analysis in the USA and Europe, over 250 for multi-country studies and 260 for samples focused on Asian countries.

Most of the studies based their research in the manufacturing sector. However, 38% of them do not specify the sector analyzed. Among the studies that specify the sector, 76% carried out an analysis that encompassed more than one sector. The preferred sectors were electronical/electrical, machinery/mechanical, chemical, metal and transport equipment. Among the less studied sectors were furniture, wood, textile and food and beverage.

The 34 selected studies analyzed a total of 74 effects by means of 27 different moderators (Table 2). These effects were tested in 147 hypotheses. Most of these hypotheses were formulated considering whether or not the moderator had an impact on the relationships. However, some of them directly specified a positive or negative impact in the hypothesis according to a particular organizational theory.

The number of effects increased because the studies tended to analyze an effect for every combination of SCI and performance dimensions. Most of the studies analyzed several moderating factors over the SCI/performance relationship within the same sample, however there could be different versions of one single effect (e.g. technological and demand uncertainty or leadership cost and differentiation strategy). Likewise, most of the studies have considered supplier integration as a dimension of SCI in the direct relationship, although customer integration also had a relevant position.

Table 2 here

Regarding publications, most of the studies were concentrated in four main high-impact journals: International Journal of Operations and Productions Management (5), International Journal of Physical Distribution and Logistics Management (3), Journal of Operations Management (9), and Supply Chain Management: An International Journal (4). The rest of the studies (13) were distributed among 10 different journals of which Transportation Research-Part E, Journal of Supply Chain Management or International Journal of Production Economics can be highlighted.

Tables 3 and 4 show the main results of the literature review. For each paper, the sample, the characteristics and different dimensions used to measure both SCI and performance, as well as the direct effect of SCI over performance were identified. Additionally, in accordance to one of the main purposes of this literature review, the moderating variable used was highlighted in each study and the sense of each moderating effect, whether positive, negative or non-significant. To classify them, the ability of firms to influence the moderating factors as a criterion was used. Table 3 shows the studies that analyze moderating factors that can be controlled by firms, whilst Table 4 shows those not controlled by firms. However, it is recognized that the

classification of some of the moderating factors as "controllable" could be controversial, such as the strategy followed by firms. On the one hand, every firm decides which strategy it wants to carry out. On the other hand, firms have to adapt to their surrounding and therefore, consider the strategy that best fits their needs. Despite this lack of control, firms can always choose an alternative, albeit more risky strategy. Therefore, environmental conditions can be considered to be the framework while firms are ultimately responsible for the decision-making process.

Table 3 here

Table 4 here

4. ANALYSIS OF THE DEFINITION AND MEASUREMENT OF SUPPLY CHAIN INTEGRATION.

The definition of SCI is an issue of great relevance that goes back to Porter's (1985) value chain model and its notion of linkages within and among firms in the value chain. Likewise, Stevens (1989) and Frohlich and Westbrook (2001) set the foundation for what would be a fairly extensive development of relationships between organizations, beyond simple transactions, with the purpose of achieving joint objectives. However, it was not until the early 2000s that the number of studies considering the topic increases. As a consequence, different approaches arose to deal with the issue of integration. This in turn led to the use of a greater number of dimensions to measure SCI that eventually brought more inconsistent results (Abdallah *et al.*, 2014; Chan *et al.*, 2012; Germain *et al.*, 2008; Wong *et al.*, 2011).

Integrative efforts in the supply chain are mainly understood as integration (Vickery *et al.*, 2003; Germain *et al.*, 2008; Zhao *et al.*, 2013; Wong *et al.*, 2015), although there are some relevant studies that consider them as collaboration (Simatupang and Sridharan, 2004; Rosenzweig, 2009; Wiengarten *et al.*, 2010). Despite this disparity, these two concepts set the general trend in the field of definitions. The main difference between them is that definitions of integration mostly use the expression "strategically collaborate with" whereas those for collaboration use "getting involved in". This highlights the difficulty in telling them apart because both definitions have elements in

common. However, it should be stressed that the concept of integration might be closer to property approach, while collaboration is more linked to a relational approach.

A classification of the studies is also hampered by the imbalance in the number of studies using both integration and collaboration as well as by the underlying approach of each definition. To deal with this, a multidimensional framework developed by Fabbe-Costes and Jahre (2008) was followed. This includes three dimensions: layers, scopes and degree. Layers are related to the aspects that are or have to be integrated; scopes comprise the number of organizations or participants included in the integrated supply chain, and degree refers to the multidimensionality of SCI.

The use of a framework helps to find differences in the conceptualization of integration regarding what is defined and what is measured. As the objective was to analyze the concept of SCI and, in order to cover the largest possible number of studies, all the empirical studies resulting from the literature review were used, regardless of whether or not they analyzed moderating effects. This represents the total sample of 72 studies.

Fabbe-Costes and Jahre (2008) considered four different kinds of layers: flows, process/activities, technology/systems and actors. Under this approach, Table 5 summarizes the number of layers that each study uses both definitions and measurements of SCI. The purpose was to compare the balance in definitions and measurement. Thus, most of the studies (56) used more than two layers to theoretically define SCI. This number is a bit higher (66) than the number of studies using the same number of layers to operationally measure SCI. In general, it can be said that there is awareness about the complexity of SCI, and that academics tend to use several elements for its definition and measurement. However, the analysis of the studies shows that 52 of them use more than three layers to measure SCI whereas only 27 studies use more than two to define it. This trend reveals the great importance that is given to measurement.

Table 5 here

Moreover eight studies were found that either used no layers to define SCI or no information was given. However, these studies used between three and four layers to measure SCI, even using the same kind of layers. This represents a partial discrepancy

as it may be due to a strong empirical approach or the implicit assumption of the definition of SCI.

Only eight studies used one layer in their definition. Among the possible layers, only one of the studies included flows of information (Germain *et al.*, 2008). The remaining seven used actors as a preferred layer. Most of them used between two and three layers to measure SCI, however one study (Zailani and Rajagopal, 2005) did not use any layer to measure SCI because it is an exploratory analysis of two large geographical areas.

A large number of studies (29) included two layers in their definitions. Although all of them included actors, eight of them combined it with flows, while only one combined it with systems and technology (Beheshti *et al.*, 2014). One study gives no information about measures (Lotfi *et al.*, 2013). At the same time, they range almost evenly between two, three and four layers to measure SCI.

Meanwhile, those studies that included three layers in their theoretical definition (25) use the same layers: flows, activities and actors. Almost all of them consider between three and four layers in their measurements. Such homogeneity is possible because most of them base their definitions on the same authors, Flynn *et al.*, 2010 and Zhao *et al.*, 2015.

With regards to the studies that included four layers, only 2 were found. However, Kim and Cavusgil, (2009) used three layers to measure SCI whereas Zolait *et al.* (2010) used one.

Additionally, it can be stated that a reasonable usage of SCI would require the adoption of a certain number of layers to define it, and also to be consistent with the number of layers used to measure it. Additionally, it is expected that these would not only match in number, but also in the layers themselves. However, after the analysis, it was realized that the use of this theoretical balance of layers is less frequent than expected as only 19 out of 72 studies fulfill it. Of these studies, 12 use the same layers to define and measure SCI, which shows the maximum soundness. Despite this, no study reached equilibrium in four layers as this only happens for two and three layers both in definition as in measurement.

To analyze the scope, 71 of the 72 studies were considered as one of the studies (Germain *et al.*, 2008) only considered internal integration and does not fall under the scope of the criterion previously outlined. Thus, as shown in Table 6, most of the

studies (32 out of 71) take under consideration a limited dyadic relationship when considering the scope of integration. Despite this frequency, a substantial number of studies, 17 out of 71, consider an extended scope of the integration. This reflects the latent concern to extend the study of integration beyond first tier suppliers and customers.

Despite the fact that some studies consider internal integration of great importance for the proper development of external relationships (Abdallah *et al.*, 2014; Flynn *et al.*, 2010; Zhao *et al.*, 2015), only 28 out of 71 studies analyzed consider it as a separate dimension.

Table 6 here

The consideration of internal integration should be connected to the use of a greater number of participants in the integrated supply chain. However, when an extended scope is considered, studies usually do not take into account internal integration with the exception of three studies by Huo *et al.* (2014), Kocoglu *et al.* (2011) and Nakano, (2009). The same pattern can be found in those studies using others scopes (e.g. dyadic upstream, dyadic downstream and triadic) with the exception of Wiengarten *et al.* (2010) and Sanders and Premus (2005). On the contrary, the consideration of a dyadic scope makes studies take into account internal integration more frequently (23 out of 71 studies analyzed) than those considering others scopes.

According to the analysis of the degree of integration, this is less relevant in moderator relationship analysis because, implicitly, moderating variables assume a contingent use of the SCI. Even so, it seems to also offer variability. More than half of the studies (46) approach their analysis under a multidimensional perspective of SCI. However, seven studies follow a unidimensional one. In addition, two studies use different elements to measure SCI as a single construct (Huang *et al.*, 2014 and Narayanan *et al.*, 2015). Nevertheless, other studies use those same elements to measure SCI as a multidimensional concept (Abdallah *et al.*, 2014; Cao and Zhang, 2011; Cook *et al.*, 2011 and Liu *et al.*, 2013).

5. ANALYSIS OF MODERATING EFFECTS IN THE SUPPLY CHAIN INTEGRATION AND PERFORMANCE RELATIONSHIP

The relationship between SCI and performance shows a great variety of results. Differences in results may partially arise as a consequence of the strategic adjustment among the organization and its environment, where organizations must adapt their structures and processes to different contingencies to optimize their performance (Donaldson, 2001; Stonebraker and Liao, 2006). This also may be due to different elements such as the perspective adopted by researchers, the context of the study, the approach followed, the methodology or the measures used (Najafi Tavani *et al.*, 2014).

Although there may be many factors acting as modifiers of the relationship between SCI and performance, this literature review finds 27 moderating factors that are grouped into five homogeneous categories: SCI measurement, environment, strategy, element of the relationship and others, all of which are summarized in Table 2.

5.1. SCI measurement

According to Fabbe-Costes and Jahre (2008), SCI may be considered as a composite of layers and scope. At the same time, these authors agreed on considering the degree of SCI through dimensionality. Eventually, the degree of SCI tries to capture the essence of being more or less integrated and how to measure it.

The measurement of SCI is usually approached as a multidimensional construct (e.g. 27 out of 34 studies use different SCI measures in their analysis), which basically distinguishes between supply chain internal and external integration. These dimensions of SCI are usually used in two ways: as part of the direct relationship and also as moderators.

The use of different SCI measures as moderators is based on their complementary nature. In this sense, it is argued that internal integration has a key role in fostering external integration. Also, when considering supplier and customer integration, each one allows for the fostering effect of the other.

In the case of a dual use of the SCI, external integration (both jointly and considering supplier and customer integration) has no significant moderating effect on the relationship between internal integration and performance (Flynn *et al.* 2010). However,

under similar conditions, Schoenherr and Swink (2012) found that this effect was positive, depending on what measure of performance was used.

However, Danese and Romano (2011; 2013) find that supplier integration as a moderating effect over the relationship customer integration and performance had a positive effect. Likewise, the use of an international supplier network positively moderates the relationship between SCI and performance only when external integration is considered jointly (Danese *et al.*, 2013).

Alternatively, under certain scenarios supplier integration can comprise the whole supply process within a country. This can be considered as logistical capabilities and act as a moderating factor. Thus, Wiengarten *et al.* (2014) find that logistical capabilities have a positive moderating effect over the relationship between customer partnering and performance.

5.2. Environment: uncertainty and competence

The environment can be considered as a key element when trying to improve both supply chain management and its performance (Davis, 1993). Thus, environment has become one of the most studied factors in literature because ignoring the context where organizations work in would imply restrictions in the study of supply chain and performance (Ho *et al.*, 2002).

This classification gathers 14 of the total studies analyzed, which is considerably higher than others. This group comprises a wide variety of factors despite sharing environment as core.

Uncertainty, present in 10 of the 34 studies, is the most frequent moderating factor. Besides, its contingent effect over the relationship between SCI and performance is so broad that it is studied both globally (Koufteros *et al*, 2005; Wong *et al.*, 2011), and through different dimensions, mainly represented by technological and demand uncertainty (Bonn-itt and Wong, 2011; Germain *et al.*, 2008; Huang *et al.*, 2014; Iyer, 2014; Iyer *et al.*, 2009; Rosenweizg, 2009; Wu, 2013).

Environmental uncertainty

The effect of environmental uncertainty as a moderator may be positive or negative, depending on the performance measure considered (Wong *et al.*, 2011). Nevertheless, it

may have no effect over the SCI/performance relationship depending on the combination of SCI and performance dimensions (e.g. supplier integration and product quality or customer integration and production cost).

Also, uncertainty may foster diverse and conflicting interpretations about the same phenomenon. In this sense, integration with customers and suppliers would help to unify criteria and reduce the loss of sense and meaning information. However, uncertainty only has a positive moderating effect when the relationship is between external integration and product innovation as a performance measure (Koufteros *et al.*, 2005).

Technological uncertainty

With a mild presence in just six studies of the 34 analyzed, technological uncertainty may produce diverse results. Thus, its moderating effect is positive when considering customer integration and performance as direct relationship (Boon-itt and Wong, 2011; Iyer, 2014). It is also positive when integration practices, such as sharing information or interdependence among partners, are involved (Huang *et al.*, 2014). However, while Bonn-itt and Wong (2011) find a negative moderating effect when internal integration is related, Wong *et al.*, (2015) show that this effect is positive considering the integration of information. Wu (2013) also finds a negative effect, but only when the integrative efforts are intended to improve environmental performance. However, Rosenzweig, (2009) finds that uncertainty may have no moderating effect over SCI and performance.

Demand uncertainty

Demand uncertainty comprises the unpredictability shown by customer demands and needs (Chang *et al.*, 2002). The empirical evidence analyzed (eight of the 34 studies) supports the idea that demand uncertainty may have diverse effects. Thus, while both Germain *et al.*, (2008) and Iyer (2014) find a positive effect, Iyer *et al.*, (2009) and Wong *et al.*, (2015) find a negative effect. Likewise, Huang *et al.*, (2014), Rosenzweig, (2009) and Wu (2013) find a non-significant effect. Meanwhile, Boon-itt and Wong (2011) find both negative and non-significant results. Apparently, the explanation to such variety of results seems to be that both SCI and performance dimensions were considered in the analysis.

Supply complexity

The presence of supply complexity is a problem for organizations because it is directly related to the proper delivery of goods in accordance with customers' expectations. In this regard, Giménez *et al.* (2012) state that supply complexity has a positive effect on the relationship between SCI and performance when it is high, and no effect when it is low. Although van der Vaart *et al.*, (2012) support the idea of no effect when supply complexity is low, they also find positive and non-significant effects under the presence of high levels of supply complexity. However, Narayanan *et al.* (2015) find no effect whatsoever. Because of the lack of studies on the same topic there are limitations in the generalization of results.

Competitive intensity

When competitive intensity is considered as a moderating effect between SCI and performance, different effects arise. Thus, from the three studies that analyze it, it was found that this effect is positive when considering internal or supplier integration (Abdallah *et al.*, 2014), but it may be either positive or negative when considering customer integration regardless of the performance measure (Abdallah *et al.*, 2014; Chan *et al.*, 2012). However, Rosenzweig (2009) finds that its effect is positive under a high competitive intensity and negative under a low intensity. Thus variation may depend on the consideration of other similar factors such as munificence.

5.3. Strategy

Business strategy is an element only moderately studied as a moderating factor (five of the 34 studies). It has been analyzed from diverse perspectives: market orientation; (Liu *et al.*, 2013) cost leadership and differentiation strategies (Huo *et al.*, 2014). Other authors consider additional resources and capabilities: absorptive capability (Najafi Tavani *et al.*, 2014), modular design competencies (Salvador and Villena, 2013) and export experience (Lorentz, 2008).

Market orientation

Market orientation reflects the orientation of an organization to create superior value to customers effectively and efficiently (Li *et al.*, 2010; Min *et al.*, 2007). This is achieved through two perspectives: (1) customer orientation, where organizations try to emphasize both comprehension and satisfaction of their customers demand (Zhou *et al.*, 2009); and (2) competitor orientation, where organizations try to know the strengths and

weakness of their current and potential competitors (Narver and Slater, 1990). This strategy allows firms to remain in contact with the reality that surrounds them.

In this manner, a market orientation strategy would make integration practices have a greater impact on performance. Thus, Liu *et al.* (2013) find that market orientation (both with customers and competitors) has a positive moderating effect on the relationship between SCI and performance. Since there is only one study analyzing this factor, its result is difficult to generalize.

Competitive strategy

The basis of competitive strategy distinguishes between leadership cost and differentiation (Porter, 1980). Therefore, when carrying out an integration process, the actions implemented with every strategy would offer different levels of performance because they do not utilize the same resources. Thus, Huo *et al.* (2014) find that competitive strategy has a positive effect on the relationship between SCI and performance. If organizations decide to carry out a cost leadership strategy, internal integration will provide them higher performance. However, if organizations decide to carry out a differentiation strategy, supplier integration will provide them higher performance.

Likewise, when making use of the different resources and capabilities to develop the organizational strategy, the results may be opposed. Thus, while Najafi Tavani *et al* (2014) find that in the presence of higher absorptive capacity and a closer relationship with suppliers would generate lower performance; Salvador and Villena (2013) find that modular design competencies have a positive effect over the relationships; and Lorentz (2008) finds that export experience has no moderating effect. Although they, respectively, find a negative, positive and non-significant moderating effect, it may change regarding other performance dimensions (e.g. agile product innovation).

5.4. Elements of the relationship

Relationships within supply chains must meet certain requirements beyond being maintained over time and mutually beneficial. Thus, in two of the 24 studies reviewed, it was found that three requirements operate as moderating effects: trust, dependence generated between partners, and cultural distance.

Although it seems that high levels of trust can improve relationships, Corsten and Felde (2005) find that it has a negative effect on the relationship between SCI and performance. Conversely, they state that dependence has a positive moderating effect, especially when performance measures are based on innovation. However, too much dependence would generate an instability that will make partners seek alternatives to that relationship; they might even be willing to change when other opportunities arise.

When organizations from different countries get involved in a relationship, cultural distance must be considered as an essential characteristic of the relationship. In this regard, Parente *et al.* (2011) find that cultural distance has a negative effect on the SCI/performance relationship.

5.5. Others

Although large organizations may have greater capacity and access to resources in comparison with smaller ones, this does not mean they are in a better state to easily make integrative efforts. Although this apparently seems to be clear, Koufteros *et al.* (2007) find that organizational size has no moderating effect over the SCI/performance relationship while Cao and Zhang (2011) find a positive effect and Jayaram *et al.*, (2011) find both positive and non-significant effect.

Information technologies (IT) play a critical role in integration processes. Their purpose is to integrate technological resources with others, which affects the strategy of the firm. Thus, Li (2015) finds a positive and non-significant effect over the SCI/performance relationship depending on the SCI dimension used.

When an integration relationship is developing, both parts must commit some physical investment. This leads to a situation of asset specificity. Narayanan *et al.*, (2015) find that asset specificity has a negative moderating effect, weakening the effect of SCI over performance. Likewise, the support of top management becomes essential for the proper development of the integration process as well as for resolving potential conflicts between the parties. Thus, Zhao *et al.*, (2015) show that top management has a moderating effect for any dimension of integration used.

The position of the organization within the supply chain, whether manufacturer, distributor, retail and service provider determines its role. There are some integration practices that best suit each one of these roles. Thus, considering the convenience of the

organizations, they may adopt a different role, in accordance with the practices best suited to their needs. This can be especially important to those organizations deciding to change the role within the supply chain.

In this regard, Cook *et al.* (2011) find that when role is not taken into account, information sharing and distribution network are the practices that contribute the most to explaining improvement in performance. However, these results differ when the role of organizations within the supply chain is considered.

5.6. Homogenization of results

The analysis of the moderating effects highlights a great deal of heterogeneity in their results. In an effort to clarify them, an attempt was made to measure the tendency of the moderating effects analyzed. To do this, the study specifically used criterion sampling under the approach of attaining a sample by means of purposive sampling (Suri, 2011). Accordingly, a reliance was made on the contradictory results shown by these factors, which is to say, if every relationship analyzing a single factor provided the same result. Therefore, all cases were reviewed that met some predetermined criterion of importance (Patton, 2002). This kind of measurement has been used in different disciplines such as environmental strategy (Walls *et al.* 2011) and social media (Haro-de-Rosario *et al.* 2016). To calculate it, a scale from -1 to 1 was allocated to the results of every hypothesis tested. Thus, a value of 1 is given when the effect is positive, -1 when this effect is negative, and 0 stands for a non-significant effect. The final value is obtained by dividing the sum of the scores given by the number of hypotheses analyzing every moderating effect. This gives an idea of the "average tendency", with values ranging from -1 to 1. Therefore, values close to 1 would indicate that the effect tends to be mainly positive; while values close to -1 would indicate a negative effect. Values near to 0 would indicate that, on average, the results show a non-significant tendency (Table 7).

Table 7 here

Most of these factors have been tested in a few hypotheses. To take advantage of this measurement, a number of those hypotheses should be considered. Thus, the greater the number of hypotheses, the easier to generalized their tendency. To confirm this, a calculation was made of the level of its "relative tendency", which would indicate whether or not the trend of the effect arises as a consequence of having been analyzed in a greater number of hypotheses. Therefore, the higher the value, the more reliable the trend.

Following the review, it was found that three of the moderating factors have a value of 0 (absorptive capacity, export experience and munificence). Also, they were tested in just one hypothesis each, so their results cannot be generalized at all. Similarly, nine of the moderating factors have a value lower than 0.5. This shows the tendency of moderating factors to be positive. Here, there is less homogeneity because the deviation of the average tendency differs among them. The largest deviations are found in those moderating factors tested in a greater number of hypotheses (demand uncertainty, technological uncertainty and environmental uncertainty). The rest, despite having a lower deviation, also have a lower average tendency. A total number of nine moderating factors have been given a score higher than 0.5 and lower than 1. This indicates a clear positive tendency. Nonetheless, the deviations are also higher, which would indicate a lack of consistency in their results. Likewise, four of the moderating factors reached a score of 1, although they have been tested in so few hypotheses than the results cannot be generalized. Finally, two out of 27 moderators have clearly been given a score of -1. Even though they are the only ones that show a negative effect, they should be tested in a higher number of hypothesis to confirm this negative tendency on the relationship between SCI and performance.

6. DISCUSSION

Theoretical literature argues that there is a positive relationship between SCI and performance, and empirical literature finds enough evidence regarding this relationship. However, this relationship does not have to be either linear or homogenous. At the same time, every integration process requires an investment in resources and the relationship that it pretends to develop. The relationship between SCI and performance is relationship complex one where there are many factors that may influence or moderate

it (from environment to strategy, including their own SCI implementation). These considerations make it difficult to generalize the theoretical arguments.

The studies analyzed show that non-significant results appear more frequently in certain situations, when variables are expressed in more detail, when there are more factors in the analysis or where an international environment exists. In this regard, some factors exert a moderating effect only when minimum levels are reached (e.g. supply complexity).

Likewise, the information provided by the studies analyzed is so disparate that this prevents a conceptualization and unique measurement of SCI. However, the tendency is to unify the elements that address the definition of SCI because they follow the models proposed by the same authors, mainly Flynn *et al.*, 2010 and Zhao *et al.*, 2015.

The results do not permit an assurance of the existence of clear moderating effects because they are not generalizable. These effects seem to be contingent, as they can appear, or not, depending of the circumstances or the indicator of performance analyzed.

In this sense, SCI can be considered to be a lever with enough potential to positively influence different aspects of performance. However, its usage in this way needs further exploration. For instance, Li (2015) finds positive and non-significant moderating effects of information technology over the SCI/performance relationship depending on the SCI and performance dimensions used.

Despite all this, some highlights can be drawn from the results. One of the most important moderating factors, and also less known, is internal integration. It is considered an essential element for SCI. Thus, if it is carried out in isolation, without external integration, it might be disadvantageous in attaining performance.

Analyzing uncertainty as a moderating factor requires taking different aspects into account. Therefore, as technology becomes more and more multidisciplinary and dynamic, firms need to establish stronger relationships with partners within the supply chain to achieve that technological knowledge. However, demand uncertainty is more difficult to control because it speaks directly to the satisfaction of external agents. That is why firms should carry out integration practices with external agents cautiously because demand uncertainty can offer unexpected results. The same results arise when considering supply complexity as a moderator. In this case, firms use SCI as a means to

control the process from buyer's order to product delivery. Meanwhile, when the environment has the ability to offer diverse opportunities for development, SCI is left behind because firms prefer other options.

Regarding the strategy carried out, firms need to know which strategy will provide better opportunities to increase their expected results from external relationships. Thus, a market orientation may generate specific knowledge that can determine the patterns to develop external relationships. At the same time, these relationships of integration will differ considerably if the firm opts for differentiation or a leadership cost strategy.

7. CONCLUSIONS AND FUTURE RESEARCH

The analysis of SCI has been an issue of great interest both for academics and practitioners in recent years. However, there are different elements or circumstances that make understanding difficult. In order to obtain clear conclusions, this literature review has found certain distortions because of the high level of variability in: (1) SCI measure (both in dimension and practices); (2) performance measures (mainly operational performance); (3) moderating variables analyzed (27 moderating variables are analyzed with only five of them being repeated among different studies); and (4) the context of the analysis (different samples and countries).

The measure of SCI is largely made using different dimensions (including internal and external integration). There is a tendency to increase the level of detail in the constructs. Although this allows firms to monitor actions carried out in each measure, it is also common to use only supplier or customer integration because of their complementarity. This suggests that organizations should consider the whole supply chain when carrying out integration processes, and that different combinations of integration may result in a similar degree of integration. Although the use of diverse dimensions may avoid overlapping and therefore better capture their effect, they prevent making generalization because, in the end, they measure slightly different things.

Although most of the studies consider an operational performance proxy, other dimensions are also analyzed (e.g. financial performance or perceive performance). While the effect on operational performance is undoubtedly short-term, effects of SCI over other performance dimensions, such as financial, would be more evident in the medium and long-term.

The most frequent measures of operational performance are delivery, product quality and process flexibility. In this regard, it is important to consider the possible trade-offs among these different sub-dimensions because of two main reasons (Da Silveira and Slack, 2001). The first one is that they show a clear link to meeting customers' needs and negotiation, thus having an impact on operation competitiveness. This would explain why most of the studies opt for operational measures. The second one is that, each one of those dimensions might have a different degree of sensitivity that will have a greater or lesser effect on the others. Thus, if not properly managed, a change in the target of one dimension could have an unexpected change in others which in turn, could disturb their balance. Therefore, the existence of trade-offs may explain some of the variability or inconsistency of the results of the moderating effect.

The moderating effects analysis shows a high level of heterogeneity; practically all of the studies analyze one single factor. This leads to several factors having a low consistency in their effects. Moreover, when a moderating factor is considered to affect to a high or low level, its effect may be opposite depending on each level. This happens even within the same study (e.g. competitive intensity, uncertainty or absorptive capacity). Both cases hinder generalizations about moderating factors effects; the former is due to a lack of information, while the latter is due to the opposing results.

As with any research, there are limitations that must be pointed out. On the one hand, this study uses its own criteria to select the sample, which led to restrictions in the sample. As a thorough literature search and snowballing was performed to identify all suitable papers, it cannot be ensured that some studies were not missed. Likewise, additional papers could have been omitted because the sample accesses papers published in some of the most visible journals related to Operations Management and Supply Chain Management. However, due to the number of papers analyzed and considering the tendency analyzed, there is confidence that any additional study would not change the results.

On the other hand, the focus of the analysis of moderating factors introduces certain bias in the analysis of the SCI/performance relationship. This bias mainly affects one of the three dimensions of SCI proposed by Fabbe-Costes and Jahre (2008), degree of integration.

Despite these drawbacks, SCI can be considered as a capability. It helps firms to improve the information exchange as well as to create new products and processes. At

the same time, it creates a more stable relationship with their partners, improving their satisfaction. All this generates a particular scenario for every relationships established. In this regard, SCI facilitates obtaining the information needed to optimize internal processes and to face environmental adversities. Firms may obtain the knowledge they did not have previously through the establishment of strategic collaboration with customers and suppliers. In addition, they have the ability to integrate it with existing knowledge. All this indicates that SCI may be one of the most suitable capabilities to properly manage the effects of moderating factors.

However, SCI may increase its effect on performance in certain situations. Moderating factors that are not controlled by firms, are usually a threat. In general, this happens with environmental factors (e.g. technological and demand uncertainty, competitive intensity, munificence, supply complexity, etc.). Thus, it is assumed that the higher the adversity in the environment, the less integrated the supply chain. Nevertheless, and despite that greater integration is not always linked with better performance, the response of firms in these cases is to increase SCI. They may strategically connect different parts of the supply chain and make use of complementary resources. This is based on the essence of relationships that eventually generate stronger links. Therefore, SCI becomes a protector against adversities while generating a positive effect on performance.

Analogously, this happens with those factors that, to some extent, are controlled by firms (dependence, strategy, market orientation, logistical capabilities, etc.). This is a challenge for firms because their results depend on a set of choices. Most of these choices are of a strategic nature so that taking advantage of the presence of SCI can make a difference. These are based on the exchange of resources between firms, where some have access to resources that were previously not available to them. This complementarity of resources helps to define the base upon which build a joint path. Therefore, SCI becomes the best ally to achieve a better performance.

A study like this can help to understand the context in which integration relationships are developed. Likewise, it helps to uncover under what conditions and circumstances SCI might have a higher effect over performance. Also, it helps practitioners understand that SCI may be a good strategy to find competitive advantages as it is based on the specificity of relationships. However, SCI can also be used to manage other capabilities and resources while it is improved by other elements that, a priori, can be seen as

setbacks. In any case, its effect on the performance is not reflected in the short-term. This makes SCI suitable to be included in decision-making processes as it could help in achieving both individual and joint objectives within the supply chain.

Under the premise that most of the SCI/performance relationships are subject to unknown moderating factors (Mackelprang *et al.*, 2014), this research tries to shed some light. In order to achieve this, existing factors were organized and classified in the literature to gradually delimit them. However, the first problem in generalizing the effect of these moderating factors is that there are so many of them with different natures. There is also a lack of consistency in their particular effects because they are only tested in a few studies, using diverse contexts. Nonetheless, an attempt was made to create a base upon which to discover other factors, which leads to further research.

Although the moderating factors described help to explain part of the significant results among SCI and performance, it is not sufficient to uncover all their potential. There are two major challenges for future research: (1) an in depth study of those factors that, in general, have a positive effect over the relationship between SCI and performance (e.g. dependence, supplier integration, supply complexity or strategy); and (2) determine the circumstances leading to certain factors to show positive and negative effect on the SCI/ performance relationship (e.g. technological and demand uncertainty, competitive intensity or absorptive capacity).

Likewise, there are others issues that would be of great interest to develop in further research. Thus, new advances could be found proposing alternative models for measuring SCI that depict its particular multidimensional character. Also, analyzing SCI as a distinct form of governance would be helpful to better understand the new tendencies in interorganizational relationships.

Regarding the measurement of variables, it would be interesting to delimit and specify them in more detail. Since this would generate more non-significant results, this would be an opportunity to explore their causes, based on the idea that there is an optimal level of analysis of variables that could help to obtain clearer and more consistent results. In the case of business performance, trying to explain it through just one dimension would not capture its full scope because of its complexity and the large number of factors affecting it. Among the solutions would be the use of operational performance, much more sensitive to changes in managerial factors, as an intermediate step between SCI and business performance. This would permit making generalizations about the results.

Apart from the factors analyzed, there may be other emerging factors affecting the relationship between SCI and performance (e.g. human resource practices, organizational climate and culture and structure). These new perspectives would help to explain more significant results and to partly reduce non-significant ones. Since factors hardly ever appear in isolation, it would be of great interest to consider the interaction of more than one factor over the same direct relationship and analyze its joint effect. This could be conducted choosing those factors that are more closely related (e.g. technological uncertainty and competitive strategy). This would lead to the establishment of a global framework that would aid decision-making processes about SCI and guiding strategic actions where there is uncertainty.

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Table 1 Summary of methodology used

Research Identification	The most representative moderating factors affecting the relationship between SCI and performance and their effects
Type of analysis	Qualitative
Period of analysis	2001-2015
Search engines	Emerald Insight, Science Direct, ABI/inform
Keywords used	Supply chain, integration, collaboration, practices, performance
Papers analyzing moderating factors	34
Papers not analyzing moderating factors	38
Total number of papers evaluated	72

Figure 1. Total number of papers published and papers analyzing moderators between 2001 and 2015

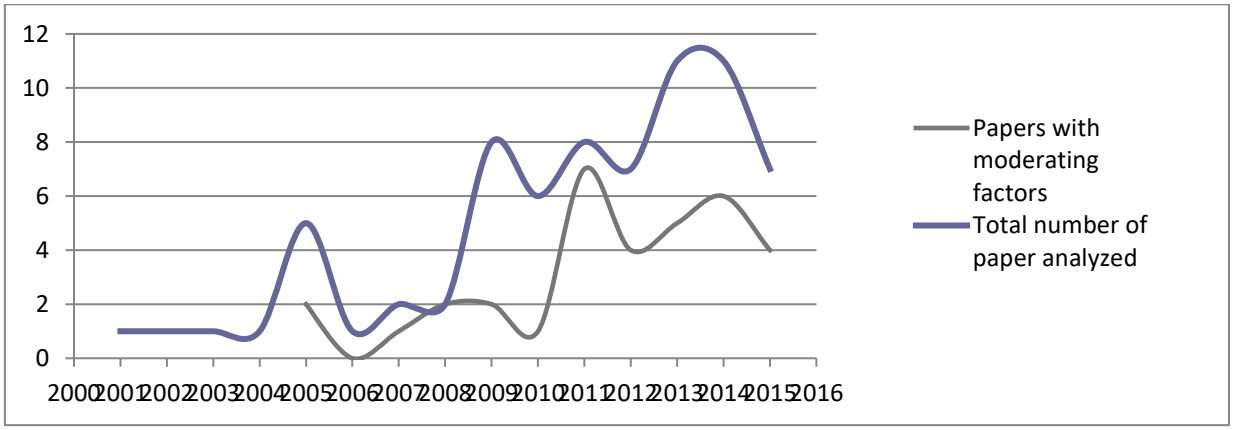

Table 2. Moderating effects and SCI dimensions distribution of the moderating effect analyzed

Moderating Factors	Number of studies	SCI dimension					Number of relationships analyzed
		Internal	External	Customer	Supplier	Practices	
SCI dimensions	**6**						**10**
External integration	1	1					1
Logistic capabilities	1			1	1		2
Internal Integration	1		1				1
Supplier integration	4	2	1	3			6
Environment	**14**						**37**
Competitive intensity	2			1		1	2
Demand uncertainty	7	4	1	3	3	1	12
Environmental uncertainty	2	2		2	2		6
Equivocality	1	1		1	1		3
Munificence	1		1				1
Supply complexity	3					3	3
Technological uncertainty	6	3	1	3	2	1	10
Strategy	**5**						**11**
Absorptive capacity	1				1		1
Competitor orientation	1					1	1
Customer orientation	1					1	1
Differentiation strategy	1	1		1	1		3
Export experience	1				1		1
Leadership cost strategy	1	1		1	1		3
Modular design competencies	1				1		1
Elements of the relationship	**2**						**3**
Cultural distance	1				1		1
Dependence	1				1		1
Trust	1				1		1
Others	**7**						**13**
Clock speed	1			1	1		2
IT Competence	1	1	1				2
Organization size	3			1	2	1	4
Supplier asset specificity	1					1	1
Supply chain role	1					1	1
Top management support	1	1		1	1		3
	34	17	6	**19**	**21**	11	**74**

Tabla 3. Main results of empirical papers with SCI-performance relationship. Controlled moderating effect

Author	Sample	SCI dimension	Performance dimension	Direct effect	Moderating variable	Moderating effect
Flynn et al., (2010)	617 manufacturing companies in China	Internal integration, with customers and with suppliers	Operational	Positive effect	External and with supplier integration	Nonsignificant effect
Danese y Romano (2011)	200 manufacturing companies in different countries	Customer integration	Operational	Nonsignificant effect	Supplier integration	Positive effect
Schoenherr and Swink (2012)	403 executives and managers around the world	External integration	Operational	Positive effect	Internal integration	Positive and nonsignificant effect (depending on dimensions)
Danese y Romano (2013)	200 manufacturing companies in different countries	Customer integration	Operational	Nonsignificant effect	Supplier integration	Positive effect
Danese et al. (2013)	266 manufacturing companies in different countries	External and internal integration	Operational	Positive effect	Supplier integration	Positive and nonsignificant effect (depending on dimensions)
Liu et al., (2013)	246 firms in China	Integration practices	Operational and financial	Positive and nonsignificant effect (depending on dimensions)	Market orientation	Positive effect
Huo et al., (2014)	604 manufacturing companies in China	Internal integration, with customers and with suppliers	Operational and financial	Positive and nonsignificant effect (depending on dimensions)	Competitive strategy	Positive effect (depending on dimensions)
Zhao et al. (2015)	195 manufacturing companies in China	Internal integration, with customers and with suppliers	Financial	Positive and nonsignificant effect (depending on dimensions)	Top management support	Positive effect

Table 4. Main results of empirical papers with SCI-performance relationship. Uncontrolled moderating effect

Author	Sample	SCI dimension	Performance dimension	Direct effect	Moderating variable	Moderating effect
Corsten y Felde (2005)	135 manufacturing companies in Switzerland	Supplier integration	Operational	Positive effect	Trust and dependence	Trust: negative effect. Dependence: positive effect
Koufteros et al., (2005)	244 manufacturing companies in USA	Internal integration, with customers and with suppliers	Operational	Positive, negative and nonsignificant effect (depending on dimensions)	Uncertainty and equivocality	Uncertainty: nonsignificant effect. Equivocality: positive effect (depending on dimensions)
Koufteros et al., (2007)	157 manufacturing companies in USA	Supplier integration	Operational	Positive effect	Organization size	Nonsignificant effect
Germain et al., (2008)	208 manufacturing companies in USA	Integration internal	Financial	Positive and nonsignificant effect (depending on dimensions)	Demand uncertainty	Positive effect
Lorentz (2008)	72 manufacturing companies in Finland	Supplier integration	Perceived performance	Not applicable	Export experience	Nonsignificant effect
Iyer et al., (2009)	152 manufacturing companies in USA	Customer and supplier integration	Operational and financial	Positive effect	Demand uncertainty	Negative effect
Rosenzweig (2009)	50 manufacturing companies in USA	External integration	Operational	Positive effect	Technological and demand uncertainty and munificence	Technological and demand uncertainty: nonsignificant effect. Munificence: only positive effect with operational performance
Cao and Zhang (2011)	211 manufacturing companies in USA	Integration practices	Financial	Positive effect	Organization size	Positive effect

Bonn-itt y Wong (2011)	151 manufacturing companies in Thailand	Internal integration, with customers and with suppliers	Operational	Positive and nonsignificant effect (depending on dimensions)	Technological and demand uncertainty	Technological uncertainty: positive, negative and nonsignificant effect (depending on dimensions).Demand uncertainty: negative and nonsignificant effect (depending on dimensions)
Cook et al., (2011)	145 North American membership of the ISM	Integration practices	Operational	Positive and nonsignificant effect (depending on dimensions)	Role within supply chain	Positive, negative and nonsignificant effect (depending on dimensions)
Jayaram et al. (2011)	197 manufacturing companies in China	Customer and supplier integration	Operational	Positive effect	Organization size and clock speed	Positive and nonsignificant effect (depending on dimensions)
Parente et al., (2011)	111 manufacturing companies in Brazil	Supplier integration	Operational	Negative effect	Cultural distance	Negative effect
Wong et al., (2011)	151 manufacturing companies in Thailand	Internal integration, with customers and with suppliers	Operational	Positive effect	Environmental uncertainty	Positive and negative effect (depending on dimensions)
Chan et al., (2012)	194 foreign invested companies in China	Customer integration	Financial	Positive effect	Competitive intensity	Positive effect
Giménez et al., (2012)	145 manufacturing companies in Spain and The Netherlands	Integration practices	Operational	Positive effect assumed	Supply complexity	Positive effect
van der Vaart et al. (2012)	145 manufacturing companies in Spain and The Netherlands	Integration practices	Operational	Positive and nonsignificant effect (depending on dimensions)	Supply complexity	Positive and negative effect (depending on dimensions)
Salvador y Villena (2013)	165 manufacturing companies in different countries	Supplier integration	Operational	Positive and nonsignificant effect (depending on dimensions)	Modular design competencies	Positive effect

Wu (2013)	211 manufacturing companies in Taiwan	Internal integration, with customers and with suppliers	Operational	Positive effect	Technological and demand uncertainty	Technological uncertainty: positive effect. Demand uncertainty: nonsignificant effect
Abdallah et al., (2014)	104 manufacturing companies in Jordan	Integration practices	Operational	Positive and nonsignificant effect (depending on dimensions)	Competitive intensity	Positive and negative effect (depending on dimensions)
Huang et al., (2014)	164 manufacturing companies in Taiwan	Integration practices (monodimensional)	Perceived performance	Positive effect	Technological and demand uncertainty	Technological uncertainty: positive effect. Demand uncertainty: nonsignificant effect
Iyer (2014)	115 manufacturing companies in USA	Customer integration	Operational	Positive effect	Technological and demand uncertainty	Positive effect
Tavani et al (2014)	233 manufacturing companies in UK	Supplier integration	Operational	Positive and negative effect (depending on dimensions)	Absorptive capacity	Positive and negative effect (depending on dimensions)
Wiengarten et al., (2014)	346 manufacturing companies in different countries	Customer and supplier integration	Operational	Positive and nonsignificant effect (depending on dimensions)	Logistical capabilities	Positive and negative effect (depending on dimensions)
Li (2015)	260 manufacturing companies in different countries	External and internal integration	Operational	Positive and negative effect (depending on dimensions)	IT competence	Positive and negative effect (depending on dimensions)
Narayanan et al. (2015)	177 North American membership of the ISM	Integration practices (monodimensional)	Operational	Positive effect	Supplier asset specificity and requirement certainty	Negative and nonsignificant effect (depending on dimensions)
Wong et al. (2015)	188 wholesale trade companies in Hong Kong	Internal integration	Operational	Positive effect	Technological and demand uncertainty	Positive and nonsignificant effect (depending on dimensions)

Table 5. Differences in layers between definition and measure

	Measure	Four	Three	Two	One	None	Total no of papers
Definition	Four		Kim and Cavusgil (2009)		Zolait et al. (2010)		2
	Three	Boon-itt y Wong (2011), Flynn et al. (2010), Giménez et al. (2012),He et al. (2014),Huo (2012), Lau et al. (2010), Swink et al. (2007),Vereecke et al. (2006),Wong et al. (2011),Xu et al. (2014), Yu et al. (2013), Zhang and Huo (2013), Zhao et al. (2013),Zhao et al. (2015)	Alfalla-Luque et al. (2015), Cao and Zhang (2011), Danese y Romano (2013), Danese et al. (2013), Koufteros et al. (2007),Li et al. (2009),Prajogo and Olhager (2012), Sanders and Premus (2005), Narayanan et al. (2015)			Kocoglu et al. (2011), Leuschner et al. (2013)	25
	Two	Abdallah et al. (2014), Beheshti et al.(2014), Huo et al. (2014), Kannan and Tan (2010), Kim (2009), Liu et al. (2013), Narasimhan and Kim (2002), Stank et al. (2001),Wiengarten and Longoni (2015)	Corsten and Felde (2005), Han et al. (2013), Hong et al. (2010), Iyer (2014), Koufteros et al. (2005), Seo et al. (2014), Wu (2013), Wiengarten et al. (2014)	Bagchi et al. (2005), Jayaram et al. (2011), Parente et al. (2011), Rosenzweig (2009), Salvador and Villena (2013), Schoenherr and Swink (2012),,Simatupang and Sridharan (2004), Vickery et al. (2003), Wong et al. (2015), Zacharia et al. (2009)		Lotfi et al. (2013),Li (2015)	29
	One		Huang et al. (2014), Tseng and Liao (2015), Wiengarten et al. (2010)	Chan et al. (2012), Germain et al. (2008),Squire et al. (2009), Tavani et al. (2014)		Zailani and Rajagopal (2005)	8
	None	Cook et al. (2011), Danese y Romano (2011), Lorentz (2008), van der Vaart et al. (2012)	Alam et al. (2014), Iyer et al. (2009),Nakano (2009),Sun and Ni (2012)				8
	Total no of papers	27	25	14	1	5	

Table 6. Scope of integration and the use of internal integration

Scope	Including internal Integration	No including internal integration	Total no papers
Downstream		Chan et al. (2012), Corsten and Felde (2005), Danese and Romano (2011), Danese and Romano (2013), Iyer (2014),Rosenzweig (2009), Stank et al. (2001),	7
Upstream	Sanders and Premus (2006),Wiengarten et al. (2010)	Alam et al. (2014), Koufteros et al. (2007), Narayanan et al. (2015), Parente et al. (2011), Salvador and Villena (2013), Squire et al. (2009), Najafi Tavani et al. (2014)	9
Limited dyadic	Abdallah et al. (2014), Alfalla-Luque et al. (2015), Boon-itt y Wong (2011), Danese et al. (2013), Flynn et al. (2010), Han et al. (2013), Hong et al. (2010), Huo (2012), Kim (2009), Koufteros et al. (2005), Lau et al. (2010), Leuschner et al. (2013), Li (2015), Lofti et al. (2013), Narasimhan and Kim (2002), Schoenherr and Swink (2012), Seo et al. (2014), Wong et al. (2011), Wu (2013), Yu et al. (2013), Zhang and Huo (2013), Zhao et al. (2013), Zhao et al. (2015)	Giménez et al. (2012),He et al. (2014), Prajogo and Olhager (2012), Sun and Ni (2012), Van der Vaart (2012), Wiengarten et al. (2014), Wiengarten and Longoni (2015), Xu et al. (2014), Zailani and Rajagopal (2005)	32
Limited triadic		Cao and Zhang (2011), Iyer et al. (2009), Jayaram et al. (2011), Lorentz (2008), Swink et al. (2007), Vickery et al. (2003)	6
Extended	Huo et al. (2014), Kocoglu et al. (2001), Nakano (2009)	Bagchi et al. (2005), Beheshti et al. (2014), Cook et al. (2011), Huang et al. (2014), Kannan and Tan (2010), Kim and Cavusgil (2009), Li et al. (2009), Liu et al. (2013), Simatupang and Sridharan (2004),Tseng and Liao (2015), Vereecke et al. (2006), Wong et al. (2015), Zacharia et al. (2009), Zolait et al. (2010)	17
Total no papers	28	43	71*

*Total number of papers analyzed excluding Germain et al. (2008) which studies only internal integration and cannot be consider under the scope criterion.

Table 7. Moderating effects classification according to their tendency

Moderators	Num. relationships	Num. hypotheses	Scores	Average tendency	Deviation	Relative tendency	Firm power over it
Absorptive capacity	1	1	0	0.0000	0.000	0.0000	No controllable
Export experience	1	1	0	0.0000	0.000	0.0000	No controllable
Munificence	1	1	0	0.0000	0.000	0.0000	No controllable
Technological uncertainty	10	17	2	0.1176	0.676	0.2313	No controllable
Dependence	1	6	1	0.1667	0.373	0.0408	No controllable
Differentiation strategy	3	6	1	0.1667	0.373	0.0408	Controllable
IT Competence	2	6	1	0.1667	0.373	0.0408	No controllable
Leadership cost strategy	3	6	1	0.1667	0.373	0.0408	Controllable
Clock speed	2	4	1	0.2500	0.433	0.0272	No controllable
Environmental uncertainty	6	13	5	0.3846	0.487	0.4422	No controllable
Organization size	4	7	3	0.4286	0.495	0.1429	No controllable
Demand uncertainty	12	18	8	0.4444	0.685	0.9796	No controllable
External integration	1	2	1	0.5000	0.500	0.0136	Controllable
Internal Integration	1	4	2	0.5000	0.500	0.0544	Controllable
Logistic capabilities	2	6	3	0.5000	0.500	0.1224	No controllable
Trust	1	6	3	0.5000	0.500	0.1224	No controllable
Competitive intensity	2	9	6	0.6667	0.471	0.3673	No controllable
Equivocality	3	7	5	0.7143	0.452	0.2381	No controllable
Supplier integration	6	4	3	0.7500	0.433	0.0816	Controllable
Supply chain role	1	4	3	0.7500	0.433	0.0816	No controllable
Supply complexity	3	7	6	0.8571	0.350	0.2857	No controllable
Competitor orientation	1	2	2	1.0000	0.000	0.0272	Controllable
Customer orientation	1	2	2	1.0000	0.000	0.0272	Controllable
Modular design competencies	1	2	2	1.0000	0.000	0.0272	No controllable
Top management support	3	3	3	1.0000	0.000	0.0612	Controllable
Supplier asset specificity	1	2	-2	-1.0000	0.000	-0.0272	No controllable
Cultural distance	1	1	-1	-1.0000	0.000	-0.0068	No controllable
Total	74	147					