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How to measure Innovative Supply Chain Strategies (ISCS) in the context of SCM? - Construct development and measurement validation

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How to measure *Innovative Supply Chain Strategies* (ISCS) in the context of SCM? - Construct development and measurement validation -

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Abstract:

Nowadays, organizations have to innovate either in product or in management (Damanpour and Aravind, 2012). If innovations in product are largely studied (Garcia and Calantone, 2002), managerial innovations are seldom studied (Soosay *et al.*, 2008; Arlbjørn *et al.*, 2011). Simultaneously, organizations develop Supply Chain Management (SCM) to manage their inter-organizational relationships with their partners (Chen and Paulraj, 2004). SCM “constitutes an interesting potential area for creating competitive advantages through innovations” (Pralhad and Krishnan, 2008, p.14) e.g. VMI, CPFR and supply Kanban systems.

Our interest is to underline and discuss the key dimensions explaining the performance of inter-organizational managerial innovations in the context of SCM. From a large literature review, three dimensions emerge to measure these innovations: (1) the conditions and context for their deployment, (2) the involved organization’s capacity for innovation and (3) the performance of these innovations. Nevertheless, no pertinent measurement scale exists to evaluate these three dimensions. In this perspective, the aim of this research is to develop and validate a scale measurement for each of them.

The supporting methodology is quantitative. A structural equation modeling is applied to the data from a questionnaire to 170 inter-organizational managerial innovations in the context of SCM in France. The three measurement scales resulting from this research represent major methodological and theoretical contributions to the field. Consequently, supply chain managers are able to identify the main issues and factors to perform inter-organizational managerial innovations in the context of SCM.

Key words: Supply Chain Management, Innovation, Innovative Supply Chain Strategies (ISCS), Scale development, measurement validation.

1. Introduction

In an increasingly turbulent and complex competitive environment, companies are facing new constraints, such as reducing the life cycle of products, unpredictable demand, pressure on costs, on time and on quality of products and services (Chen and Paulraj, 2004 ; Hult *et al.*, 2006 ; Craighead *et al.*, 2009). To meet these new requirements, companies must constantly seek to do better, invent new products and to improve their processes internally and with their industry partners to satisfy their customers.

Multiple researches have focused on product innovations (Garcia and Calantone, 2002), and few focused on innovations in supply chain strategies, even though they are real sources of value creation and performance for businesses (Mol and Birkinshaw, 2009). In this perspective, Damanpour and Aravind (2012) “recommend the investigation of external conditions and internal processes that facilitate the introduction of compositions of innovation types across organizational units and over time” (p.447). Considering inter-organizational aspect of innovation is an important issue because of the increasing attention on supply chain management by businesses (Chen and Paulraj, 2004). It compels companies to consider the coordination and the collaboration of their supply chain as essential in their innovative strategies. Indeed, the management of these upstream and downstream partners and of the whole supply chain support value creation for customers. The recent emergence of SC strategies such as VMI (Vendor Managed Inventory), CPFR (Collaborative Planning, forecasting and Replenishment), or the

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Supplier Kanban reflect the managerial enthusiasm for this type of innovations and should therefore push researches in this domain.

The literature on this topic remains relatively scarce and fragmented (Arlbjørn *et al.*, 2011; Soosay *et al.*, 2008) and some authors even deplore the fact that researches in logistics and SCM ignore largely the concept of innovation (Flint *et al.*, 2008). In this regard, some authors recommend conducting complementary researches on innovations in inter-organizational strategies, specifically on key factors such as information systems (Bello *et al.*, 2004), collaborative relationships between SC partners and expected benefits (Roy *et al.*, 2004; Soosay *et al.*, 2008). Nevertheless, they seldom propose and develop scales to measure these innovative strategies in SCM.

The importance of scales development on innovation (and SCM) outlines the growing interest of researchers to measure this phenomenon. However, these studies seem to be fragmented to cover such a complex and large phenomenon. These scales are parsimonious covering only one aspect of SC (upstream or downstream), a single feature of innovation (information systems or physical flows), or a very specific industry (automotive or chemical). A unifying conceptual framework covering the entire SC is missing and the necessity to propose a comprehensive vision of innovative strategies in SCM and an associated measurement instrument is essential. Our research seeks to fill these two gaps by proposing and developing an instrument to measure the performance of these strategies.

After the introduction in this section 1, we position our research and the constructs studied in the current literature. The design of the research is described in Section 3, and follows the recommendations of the development of measures in organizations studies. The results are presented in section 4 and discussed in section 5. Finally, we conclude by discussing the contributions, limitations and future directions of this research.

2. Literature background

The literature review highlights that innovation in SCM is multifaceted and has to include an analysis of main motivations and barriers, actors concerned with the innovation and the expected gains.

2.1. Innovation in SCM and the ISCS concept

Van de Ven (1986) defines innovation as “a new idea, which may be a recombination of old ideas, a scheme that challenges the present order, a formula, or a unique approach which is perceived as new by the individuals involved. As long as the idea is perceived as new to the people involved, it is an “innovation”, even though it may appear to others to be an “imitation” of something that exists elsewhere” (Van de Ven, 1986, p.591). In the vein of Mol and Birkinshaw (2009, p. 1269), we propose the following definition of innovation, namely the introduction of strategies that are new in the business and that are deployed to increase the performance of the company. Thus, innovation is not necessarily something new and did not exist at all before, but it consists of something that the organization did not and now she decides to deploy and apply. We exclude from our analysis the field of innovation research products (or service).

Based on a literature review on Innovation in Supply Chain Management, Arlbjørn *et al.* (2011) highlight that only 29 articles deal with this domain. Bello *et al.* (2004) focused on technological innovations between foreign partners and studied the context of these innovations. Roy *et al.* (2004) were interested in the customer-supplier inter-organizational relations in the SCM and were concentrated on the generation of incremental and radical innovations. They indicated that two factors influence innovations in SC: internal factors (commitment, adoption of inter-

organizational information systems, confidence) and external factors (stable demand, network connections). Soosay *et al.* (2008) studied how the collaborative relationships encourage continuous innovation in the supply chain. They observed that these relationships involve common planning, knowledge and logistical process sharing or joint investment. Taking a downstream approach, Flint *et al.* (2008) observed that innovation supposes from companies anticipation and identification of customer needs and expectations.

We define Innovative Supply Chain Strategy (ISCS) as a set of strategies, technologies, techniques and methods that are previously inexistent in companies and/or their subsidiaries that will be generated, developed and deployed within supply chains to tackle different supply chain issues such as quality, costs and lead-time (Ageron *et al.*, 2013). These innovations can rely on logistics network reconfiguration (co-packing), stock outsourcing (VOI, VMI), information systems development (Advanced Planning System) and collaborative strategies (CPFR, supplier Kanban, ECR) and they all aim to increase collaborative relationships between supply chain partners. Thanks to these innovative supply chain strategies, companies can create value for their customers and improve their competitiveness and the performance of the whole supply chain.

From the previous literature review on innovation and SCM (on the premise of the above literature review) and from our qualitative study (exposed in section 3), we highlight that ISCS performance depends on two major elements: the innovative capacity of the firm and the context of deployment of the ISCS. Innovative capacity refers to the firms' "ability [...] to adopt or implement new ideas, processes, or products successfully" (Hurley and Hult, 1998, p.44). This capacity is based on organisational knowledge and competencies that produce innovations (Siguaw *et al.* 2006). The study of the deployment context of ISCS is essential as innovation depends on the business in which it is deployed. Many authors emphasized the importance of context in innovation, particularly the interactions and the relationships between customers and suppliers (Becheikh *et al.*, 2006). The evaluation of ISCS performance is related to the value created (Panayides and Venus Lun, 2009) and its distribution between all the participants (Lin *et al.*, 2010). These ISCS can generate quantitative and qualitative gains. However, one should notice that even if these two key elements are essential, they don't cover all the characteristics of ISCS performance. Indeed, other factors seem to be important such as the maturity of SCM, the business of the company, the structure and culture of the organization, the competitive and technological environment. Nevertheless, these factors did not emerge from our qualitative phase during interviews with experts.

Li *et al.* (2005) examined SCM practices and developed scales measurement that capture almost the whole concept of SC as it covers downstream and upstream side of SC and internal business processes. In order to examine the impact of outsources activities on performance in SCM context, Wallenburg *et al.* (2010) proposed a scale measurement based on costs and services performance factors. Flint *et al.* (2008) measured logistics innovation in the downstream side of SC. Panayides and Venus Lun, 2009). The increasing literature on innovation measurement outlines the importance of these issues for researchers. Nevertheless, these researches are fragmented and failed to study this multifaceted and multidimensionality phenomenon. These scales appear to be parsimonious and focus on a specific aspect of SC, on a type of innovations, or on a specific industry sector. A unified framework covering all aspects of SCM is missing. Such framework should integrate a comprehensive vision of innovative strategies in SCM and rely on a measurement instrument. The objective of our study is to propose and to develop scales to measure the performance of these ISCS.

2.2. The main characteristics of ISCS performance

Based on our scale development process (see section 3), we propose the three following scales: the context and the conditions of deployment is associated with collaboration, gains expectations, the process and the surrounding environment. The collaborative capacity of the organization is measured by the expertise and experience, the internal structure or a joint structure with partners. The performance of the ISCS relies on expectations, the extent of success, and knowledge creation.

Among the different criteria discussed in the literature and outlined in the qualitative phase, we propose a discussion of the keys elements related to our scales in the next section.

2.2.1. Conditions and context of the deployment

Many reasons compels companies to innovate including competitive pressure (Yalabik and Fairchild, 2011), because of their network and industrial partners, thanks to acquisition of new technologies (Becheikh *et al.*, 2006). Thus, every firm that innovates needs to understand the context and the conditions under which innovation deployment takes place through the innovation process, the hope of earnings and collaboration.

Collaboration - Today all companies are part of collaborative networks of diverse partners that work toward competitive excellence. The success of inter-organizational innovation depends upon the capacity of companies to mobilize their partners in profitable ways (Pohle and Chapman, 2006). Partner collaboration should also permit companies to increase performance by accessing to essential internally lacking resources and competencies to achieve their desired goals (Cao and Zhang, 2011).

Hope for earnings (Return on investments: ROI) - Because innovation frequently requires significant financial and organizational investment many companies hesitate before undertaking such projects. Estimation of potential gains has to do with the relationship maintained with partners. Many companies mention that the success of their innovation is impacted by the degree of participation and transparency of their partners (Faems *et al.*, 2005; Lin *et al.*, 2010). The estimation of earnings is also associated with short, medium and long term.

Process - In order to use innovation as a lever to increase their performance, certain companies aware of these new stakes, have turned innovation into a competitive advantage, by a formalized innovation strategy. Other companies find this much more difficult and only seem to innovate when forced to (Wynstra *et al.*, 2010). Whatever the innovation process, it is delicate to undertake the evaluation of the context of innovation because it is not always easy to determine whether innovation is a voluntary or an imposed process.

2.2.2. Organization's capacity for innovation

Three dimensions are used in the creation of our innovation capacity measurement scale: the project's internal structure, the project's external structure and the experience and expertise available.

Internal structure - The capacity for innovation is contingent upon essential factors such as tools, methods and physical and financial resources available (Adams *et al.*, 2006). Concerning the individuals implicated in innovation, individuals with diverse experiences and competencies are extremely valuable in the context of innovation. Making individuals from different departments or diverse teams work together creates also opportunities from the complementary skills and knowledge of the participants and encourage companies to create multi-dimensional organizational structures (O'Connor and McDermott, 2004 ; Brettel *et al.*, 2011).

Joint structure - Today more and more innovations are crossing company boundaries and are being realized in networks or alliances developed with clients, suppliers or other partners (Musiolik and Markard, 2011). Companies are seeking in their partners sources of innovation that they do not always possess internally. The increasing weight of partners in innovation creates a new worry for companies, namely that of coordination. Peterson *et al.* (2005) insist on

the importance of establishing joint project teams that enhance rapid decision making, allow fixing realistic objectives and support functioning in a cooperative and unified manner.

Experience and expertise - Undertaking innovation demands that the companies involved are audacious in their choices and that they dare to risk failure. This position can be explained by previous experience and expertise developed in innovative projects. On this subject, O'Connor and McDermott (2004) insist on the importance of continuity within innovative projects, but also between innovative projects, notably in regard to the project team. They state that the accumulated experience of those individuals who regularly participate in driving innovative projects is a source of expertise in innovative project management (Fawcett *et al.*, 2008).

2.2.3. Innovative Supply Chain Strategies (ISCS) performance

Innovative supply chain strategies can be directed upstream, downstream or internally. These ISCS can be either incremental or radical innovations (Panayides and Venus Lun, 2009) and their performance depends on the three following aspects:

Scope of the success - Some researchers indicate that innovation in the supply chain is positively correlated with global SC performance (Panayides and Venus Lun, 2009). This inter-organizational performance in innovation should concern all the SC partners and can rely upon technical, organizational or collaborative aspects. The knowledge developed and acquired over the course of different inter-organizational innovations can thus be capitalized upon and mobilized in other projects to improve its performance (Van Echtelt *et al.*, 2008).

Knowledge creation - Knowledge creation has been extensively addressed in the literature about innovation. In the context of SCM, Hult *et al.* (2006) observe that knowledge constitutes an important strategic resource if all the companies implicated in the supply chain are “capable of continually creating “actionable” knowledge that helps them develop the foundations for their future competitiveness” (p460). Craighead *et al.* (2009) study the capacity for knowledge creation and observe that knowledge permits, by its use and re-use to solve problems and to improve situations.

Fitting expectations - A number of studies evaluate criteria for performance of product innovation (Zhou and Wu, 2010). In the context of SCM, it seems that innovation should be evaluated according to other criteria like cost, quality, flexibility and delay. Concerning the financial aspect, by innovating, companies seek to create value and earn money, while simultaneously trying to reduce and control the costs associated with. Ultimately, fit with company expectations in terms of profits has a significant place in evaluating the success of innovative inter-organizational strategies.

Thanks to this literature review and our qualitative research, we propose the following conceptual model to evaluate ISCS performance (figure 1).

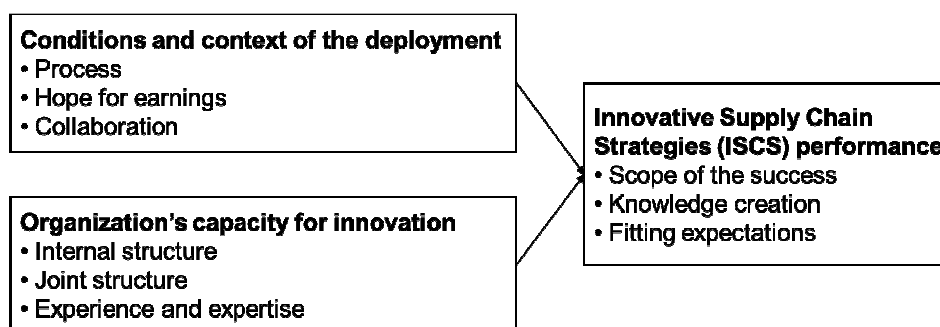


Figure 1: Conceptual model

3. Research design

Several scholars studied construct measurement and validation procedures in different domains: Churchill (1979) in marketing, Dunn *et al.* (1994) in logistics, Hinkin (1998) in organizational behaviour, Hensley (1999) in operations management and MacKenzie *et al.* (2011) in Management of Information System. All of them propose a scale development process relying on different steps which can be grouped in three major stages (Churchill, 1979, p.66; Dunn *et al.*, 1994, p.156; Hinkin, 1998, p.106; Hensley, 1999, p.355; MacKensie *et al.*, 2011, p.297): 1 - Scale **development** with conceptualization and generation of items; 2 - Scale evaluation and **purification**; 3 - Scale **validation**.

These different phases are iterative, as well as sequential and bring, if they are scrupulously followed, to the development of scales measurement. Figure 2 describes our scales development and validation process.

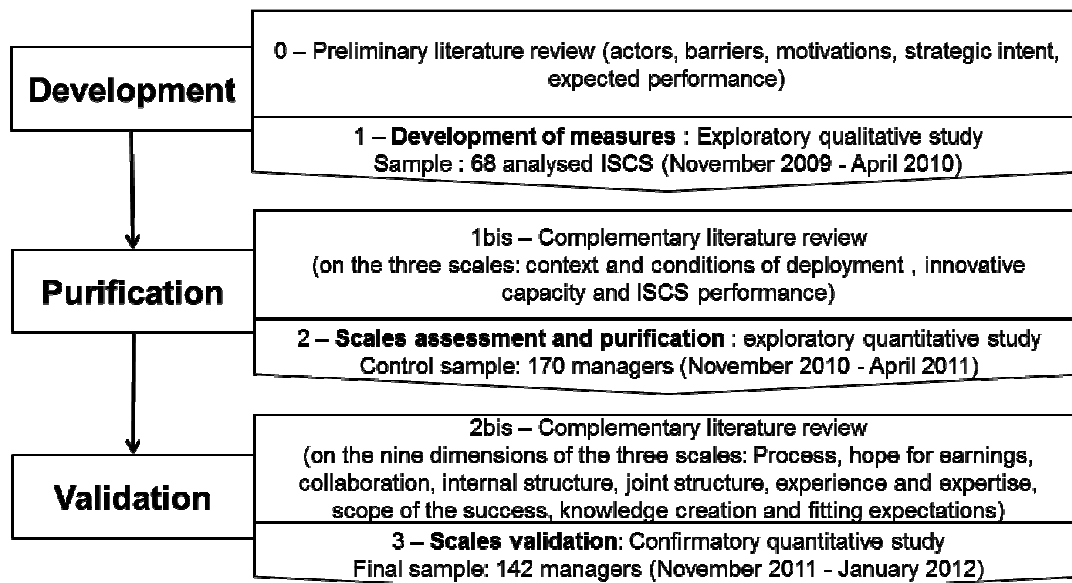


Figure 2: Scales development and validation process

This research is a long term study conducted in three different stages during three years with three different samples (table 1 and table 2). Each phases of the process corresponds to a specific objective.

The first step is the **development and construction of the measuring scales**. This stage began with a qualitative study which was conducted by semi-structured face-face interviews. The objective was to better understand the concept of innovative strategies in the field of SCM and to generate items that represent the construct. The themes discussed in the interviews emerged from the literature review; we first carried and are classics in the field of SCM like motivations, strategic intent, actors, barriers, and expected performance. This preliminary work was based on interviews. From these interviews and the associated codes, several items emerged, forming three elements: the conditions and the context in which innovations in SCM are deployed, innovative capacity of an organization involved in innovation and performance of an ISCS.

To prepare the second step of our scales development process, we conduct a complementary review of the literature on these three elements. This was very helpful to better define and understand them according to past and current academic researches and to clarify some items emerged during the interviews. Indeed, as pointed by Menor and Roth (2007, p.830) “good measurement is a prerequisite for good empirical science; however, multi-item measurement and scale development must be preceded by sound conceptual development of the theoretically important construct(s) being defined”.

Once the generation of items made, some of them were reworked until a consensus emerged among the evaluators. An initial questionnaire was then pre-tested with five supply chain managers (working in industrial companies in France) to assess and test the manner in which the items were written. “Generally speaking, each item should be written so that its wording is as simple and precise as possible” (MacKenzie *et al.*, 2011, p.304). Thanks to this work, some were clarified to be unambiguous and with familiar terms (for example, the type of partners with whom ISCS were deployed), others were simplified and reformulated to be more specific and precise (for example, items about the performance of ISCS). This step helped to generate items that represent ISCS and that can be understood by all the stakeholders of the innovation process whatever the business considered.

Through this qualitative phase and the literature review, we structured our exploratory quantitative survey. The objective of this step is to evaluate, **purify and refine our measuring instrument**, by administrating the questionnaire to a sample of control. We assess the validity and the reliability of the scales.

After this phase, we complement the literature review for two reasons: On one hand, we discuss the new dimensions of our measurement scales: expectancy gains, the extent of success, etc. This was helpful to precise and to understand each of these dimensions as well as their relations. On the other hand, we were able to justify and explain why certain items which emerged from the qualitative analysis were omitted and disappeared in this exploratory quantitative analysis.

Once the measurement scale evaluated and purified and the complementary literature review done, we conducted a second quantitative study. Its objective was confirmatory to examine our scales properties and **validate our measurement instrument**. A questionnaire was administered, using the scales evaluated and purified in the previous phase, with a new sample, different and independent of the previous one.

To synthetize, during these past three years of research to understand and measure ISCS, nearly 380 participants were interviewed. The following sections will detail the results of this process.

Table 1: Characteristics of the sample for the qualitative phase

| Date of collection : from nov. 2009 to april 2010 | | <i>Activity sector</i> | <i>Percentage</i> |
|---|-------------------|--|-------------------|
| Type of collection : semi-structured interview | | Pharmacy | 25% |
| Number of respondants | 50 | Automotive | 25% |
| Number of ISCS | 68 | Production and distribution of Gas and electricity | 22% |
| <i>Function of respondant</i> | <i>Percentage</i> | Electronics and Microelectronics | 13% |
| Supply Chain Management | 57% | Distribution | 7% |
| Industrial management | 15% | Other (construction, food, ...) | 8% |
| Purchasing / Procurement | 13% | <i>Company Size</i> | <i>Percentage</i> |
| CEO | 9% | More than 1000 employees | 41% |
| Information system | 3% | Between 251 and 999 employees | 37% |
| Commercial | 3% | Fewer than 250 employees | 22% |

Table 2: Characteristics of the sample for the quantitative phases

| | Exploratory | Confirmatory | <i>Activity sector</i> | Exploratory | Confirmatory |
|---|------------------------|--------------------------|--|-------------------|-------------------|
| | Nov. 2010 à avril 2011 | Nov. 2011 à janvier 2012 | | <i>Percentage</i> | <i>Percentage</i> |
| Date of collection | | | | | |
| Type of collection : questionnaire face to face | | | Production and distribution of Gas and electricity | 28% | 34% |
| Number of respondants | 170 | 142 | Pharmacy | 14% | 10% |
| Number of firms | 64 | 52 | Production and distribution of Gas and electricity | 11% | 12% |
| <i>Function of respondant</i> | <i>Percentage</i> | <i>Percentage</i> | Distribution | 10% | 15% |
| Supply Chain Management | 59% | 61% | Automotive | 9% | 11% |
| Purchasing / Procurement | 14% | 11% | Other (construction, food, ...) | 28% | 18% |
| Industrial management | 14% | 9% | <i>Company Size</i> | <i>Percentage</i> | <i>Percentage</i> |
| Méthodist/ingénieur | 6% | 11% | More than 1000 employees | 44% | 35% |
| CEO | 4% | 3% | Between 251 and 999 employees | 26% | 32% |
| Commercial | 3% | 5% | Fewer than 250 employees | 30% | 33% |

4. Results

In this section, we present the results from our different statistical analyses. To test the reliability and the stability of the three measurement scales, we conduct principal components analysis using SPSS and Confirmatory Factor Analysis (CFA) using AMOS as suggested by Dunn *et al.* (1994).

4.1 Measurement scales reliability

To check the factorability of the data, we use two complementary tests that are usually run to verify factorability: the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) and the Bartlett's test of sphericity. With a KMO superior to 0.7 for the innovation performance and superior to 0.65 for deployment's condition and context and for organization's capacity of innovation, we conclude to the factorability of the data. In the framework of this research, the principal components analysis of each of the measurement scales shows that the group of communities observed is satisfactory and greater than .5 as recommended by Fornell and Larcker (1981). To determine the optimal number of factors that should be retained for the different scales, we examine the percentage of variance explained by the different factors. We observe for each scale, three dimensions and we also note that all the factors linked to them are reliable with a Cronbach's alpha greater than .75 (in the case of "conditions and context of deployment" and "organization's capacity for innovation") and .65 for the scale relative to the "ISCS performance". Thus all the results attest the coherence and the reliability of the developed measurement scales.

4.2. Stability of the measurement scales structures

To verify the stability and the robustness of the factor structure put forward during the exploratory analysis phase, we conduct a confirmatory factor analysis (CFA) as suggested by Dunn *et al.* (1994). Three goodness of fit indexes were used: RMSEA, GFI and CFI. The CFA measure of the three scales "context and condition of deployment", "organization's capacity for innovation" and "ISCS Performance" confirm the structure suggested by the exploratory analysis and enabled us to ensure the quality of the model adjustment to data. Even if RMSEA of the scale "context and condition of deployment" is upper 0.08, results suggest that the measurement scales are reliable and valid for this study according to their good fit indices.

Table 3: Test and validation of scales

| Scales | Items | Exploratory | | Confirmatory | | | |
|--|--|-------------|------------------|--------------|--------------|---------------------|---------------------------------|
| | | λ | Cronbach's Alpha | T Value | Jöreskog Rhó | Convergent validity | Model index and indicators |
| Conditions and context of the deployment | Collaboration | | 0,801 | | 0,794 | 0,505 | |
| | Part1 – Partners with whom we already have established long term relationships | 0,787 | | 8,80 | | | GFI 0,918 |
| | Part2 – Partners with whom we collaborate regularly | 0,801 | | 10,40 | | | |
| | Part3 – Partners in whom we have confidence | 0,694 | | 5,79 | | | CFI 0,914 |
| | Part4 – Strategic partners for our activity | 0,721 | | 5,08 | | | |
| | Part5 – Partners with whom we have lots of activities | 0,715 | | 6,73 | | | RMSEA 0,086 |
| | Hope for earnings (return on investments) | | 0,812 | | 0,825 | 0,619 | |
| | D1e1 – short term (from 6 months to 1 year) | 0,696 | | 13,20 | | | |
| | D1e2 – mid-term (from 1 to 3 years) | 0,869 | | 7,52 | | | Khi²/dl 2,549 |
| | D1e3 – long term (more than 3 years) | 0,854 | | 14,05 | | | |
| | Process | | 0,755 | | 0,784 | 0,661 | |
| | D1vi1 – Imposed | 0,771 | | 3,16 | | | |
| D1vi2 – Voluntary | 0,852 | | 3,02 | | | | |

| | | | | | | | |
|---|--|-------|--------------|-------|--------------|--------------|---------------------------|
| Organization's capacity for innovation | Internal structure | | 0,813 | | 0,861 | 0,760 | |
| | DIint1 – Change management was a condition of the success/failure of this ISCS | 0,907 | | 2,65 | | | |
| | DIint2 – Establishing an internal organizational structure dedicated to this ISCS was important to the project's success/failure | 0,862 | | 2,74 | | | GFI |
| | Joint structure | | 0,914 | | 0,940 | 0,886 | 0,944 |
| | DIext1 – Establishing a joint organizational structure dedicated to this ISCS was important to the project's success/failure | 0,948 | | 5,07 | | | CFI |
| | DIext2 – With your partner you established a joint organizational structure dedicated to this ISCS | 0,931 | | 4,07 | | | 0,958 |
| | Experience and expertise | | 0,759 | | 0,767 | 0,507 | RMSEA |
| | DIcap1 – We are used to deploying ISCSs. | 0,772 | | 12,45 | | | 0,076 |
| | DIcap2 – We innovate often in our supply chain strategies | 0,807 | | 14,58 | | | Khi²/dl |
| | DIcap3 – We are satisfied with the performance of the already deployed ISCSs | 0,689 | | 8,57 | | | 1,986 |
| | DIcap4 – We do lots of innovating | 0,681 | | 6,58 | | | |
| DIcap5 – We have structured tools and methods to accompany deployment of a ISCS | 0,624 | | 6,53 | | | | |
| ISCS Performance | Scope of the success | | 0,799 | | 0,807 | 0,678 | |
| | PIre1 – An organizational success | 0,862 | | 7,63 | | | GFI |
| | PIre2 – A success at the supply chain level | 0,863 | | 4,69 | | | 0,941 |
| | Knowledge creation | | 0,764 | | 0,753 | 0,508 | CFI |
| | Deployment of this ISCS allowed us to create | | | | | | 0,938 |
| | PIK1 – internal knowledge | 0,860 | | 7,76 | | | RMSE |
| | PIK2 – external knowledge | 0,863 | | 10,53 | | | 0,067 |
| | PIK3 – external knowledge with the whole supply chain | 0,675 | | 5,29 | | | Khi²/dl |
| | Fitting expectations- | | 0,655 | | 0,696 | 0,498 | 2,047 |
| | Once ISCS was deployed, it responded to our need in terms of | | | | | | |
| | PID1 – respecting budgetary constraints | 0,598 | | 6,24 | | | |
| PID2 – satisfying our management | 0,751 | | 10,47 | | | | |
| PID3 – client satisfaction | 0,706 | | 3,50 | | | | |
| PID4 – expected gains | 0,699 | | 6,24 | | | | |

5. Discussion

In this section we will discuss each of the three scales of our conceptual research model.

5.1. Discussion of the scale “Conditions and context of the deployment”

Following the initial exploratory factor analysis, four dimensions emerged: collaboration, hope for earnings, process and environment of ISCS. According to Faems *et al.* (2005), inter-organizational collaboration is essential for the development and the success of innovations. In this regards, the choice of partners is crucial and can be influenced by different internal or external variables such as the capacity of supplier to innovate or the capacity of the organization to transfer and to appropriate knowledge (Wynstra *et al.*, 2010). Moreover, the origin of an ISCS can be either voluntary or compulsory and can have positive or negative effect on performance. In this perspective, Panayides and Venus Lun (2009) observe that voluntary innovation has a positive effect on the performance. ISCS can be constrained by supplier, customer, concurrent or top management (Wynstra *et al.*, 2010). Whatever the origin of innovation, organization has to evaluate its hope of earnings related to the deployed ISCS. This evaluation refers to the necessary period for ROI that can be short-term, middle-term or long-term (Pohle and Chapman, 2006). Finally, concerning the “environment”, this dimension was rejected during the purification phase. This rejection outlines that the environmental context doesn't affect the deployment of ISCS. Indeed, whatever the characteristics of their environment, companies must innovate in order to create value creation thanks to innovations (Prahalad and Krishnan, 2008; Panayides and Venus Lun, 2009).

5.2. Discussion concerning the scale “Organization's capacity for innovation”

ISCS often need the creation of a group or a team responsible for their deployment (Brettel *et al.*, 2011). This group can be either internal to the organization or joint with the partner and must be supported by the top management. Besides, this joint organizational structure creates a

positive framework for innovation, thanks to the resources dedicated (Musiolik and Markard, 2011). Nevertheless, the ability to innovate in product doesn't influence the organization's capacity for innovation in ISCS. Becheikh *et al.* (2006) argue that product and managerial innovations don't follow the same trajectories and don't have the same determinants. Finally, expertise and experience result from previous ISCS deployments, structured tools and methodologies. Supply Chain managers, thanks to their qualifications and past experiences, are able to manage the changes consecutive to ISCS deployment. Moreover, lack of resources (human, technological or organizational) constitutes an important barrier to innovate.

5.3 - Discussion concerning the scale “ISCS performance”

According to our measurement scale, the success of ISCS depends on the organization but also on the whole Supply Chain. To be successful at the SC level, partners involved in the innovation must be conscious of the value created by their collaboration and the associated gains. To be beneficial to all partners, this value creation has to be equally shared according to the resources engaged (Lin *et al.*, 2010), even if it is difficult to estimate this created value and its distribution. The creation of knowledge is a condition for the success of ISCS and more generally to the performance of the Supply Chain Management (Hult *et al.*, 2006). The knowledge comes from internal (Chesbrough, 2010) or external (Craighead *et al.*, 2009) skills to the organization and is materialized by transverse processes and routines between partners. Performance of ISCS relies also on quantitative and qualitative indicators such as the adequacy expectations concerning customer and direction satisfaction, budget constraint and expected gains. Following statistical analysis, the respect of the delay doesn't seem to be a priority. Indeed, if the gains of innovation can be observed, ISCS are more beneficial (Skipper *et al.*, 2009).

6. Contribution, limits and research perspectives

Contributions - Our main contribution is methodological by developing and validating three measurement scales for ISCS. It clarifies the multidimensional construct of Innovation in SCM and opens the way for new researches on this topic. Managers can better understand ISCS, by identifying the key elements and the specific actions that help to build and succeed with partners. Moreover, our article presents theoretical contributions. It addresses innovations in supply chain management and proposes a research model to understand and measure these innovations, while limited researches are concerned with this domain.

Limits - Our article presents mainly methodological limits, common to research based on individual's perception and quantitative researches. Furthermore, we only questioned a single respondent of ISCS. This unique vision to interpret ISCS can generate a lack of clarity and stronger biases due to its multidimensionality (Cao and Zhang, 2011). Finally, our research did not take into account the size of company, the business sector or the supply chain maturity.

Research perspectives - In future researches, we will test and validate our research model using these measurement scales. Our scales could be enriched by introducing additional dimensions, such as characteristics of the organization (strategy, structure, culture, SCM maturity), characteristics of the supply chain (competitive situation, supply chain length). In the present study, we focused only on a single ISCS respondent. Performing a crossed study of a single strategies in each organization involved would allow us to better understand how to deploy an ISCS between supply chain partners.

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