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# **Causal linkages between supply chain management practices and performance: a balanced scorecard strategy map perspective**

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## **Abstract**

**Purpose** – The purpose of this paper is to empirically investigate, from a balanced scorecard strategy map perspective, the types of linkages – sequential, non-sequential, intra-dependent, and reverse – through which supply chain management practices (SCMP) impact on financial and non-financial performance, and consequently lead to the achievement of the firm's strategic objectives.

**Design/methodology/approach** – This study is carried out in two stages. Firstly, based on the survey data collected from 450 French industrial firms (with a return rate of 20.2%), structural equation modelling (SEM) is used to test eight hypotheses that are formulated through the discussion of previous theoretical and empirical findings in extant literature. Then, based on the framework of the balanced scorecard strategy map, the SEM results are used to discuss the linkages between SCMP and firm performance.

**Findings** – After confirming some of the relationships already observed in extant literature, our results show that there are many strategic paths (of different nature) that link supply chain management practices and other intangible assets to financial performance.

**Practical implications** – The results of our study constitute a practical contribution that would guide managers in the strategic alignment of their firm's supply chain initiatives with corporate strategy. We argue that when implementing SCM initiatives, managers should pay particular attention to how intangible assets act as mediating factors in the achievement of the

firm's financial objectives. The BSC framework that we propose can also be used by researchers to investigate causal linkages between intangible and tangible assets.

**Originality/value** – There are few studies that adopt an extensive multi-dimensional approach by looking simultaneously at both upstream and downstream linkages of the supply chain while taking into account many performance measures. Using the balanced scorecard strategic map framework, this paper proposes eight types of linkages that could lead to the achievement of the firm's strategic goals.

**Keywords:** Supply chain management practices; Balanced scorecard strategy map; Supplier partnership; Customer orientation; Information sharing; Structural equation modelling.

**Paper type:** Research paper

## Introduction

Thanks to a collaborative management of relationships between the organizations that constitute the value chain and to an integrated coordination of processes, from the ultimate supplier to the ultimate customer, supply chain management (SCM) aims to create more value for customers, as well as for the supply chain partners (Mentzer et al., 2001), thus improving performance not only within each organization, but also across the whole chain. A SCM system entails the implementation of a set of practices that can be defined as activities deployed in an organization in order to enhance the effective management of its supply chain (Li et al., 2005). Despite the constantly growing attention given to research on SCM, contributions on the link between supply chain management practices (SCMP) and performance are very diverse in scope and nature, and most often remain dispersed and incomplete (Li et al., 2005). The existence of many SCMPs and many performance measures implies that both theoretical and empirical research can be focused on two fundamental questions:

- 1) Which SCMPs impact individually or collectively on which performance measures?
  - 2) What is the nature of the linkages between the SCMPs and the performance measures?
- The nature of the linkage could be on the one hand direct or indirect, and on the other hand, sequential, non-sequential, intra-dependent or reverse (based on the balanced scorecard framework).

Regarding the first fundamental question, most studies often focus on only one or few aspects (or parts) of the supply chain such as the upstream network (Chen and Paulraj, 2004), the internal relationships (Williams et al., 2013) or the downstream network (Tan et al., 2002). There are just a few studies that adopt a global approach by looking simultaneously at both internal and external linkages of the supply chain (Li et al., 2005). Moreover, most authors limit their study of performance to the use of partial or one-dimensional indicators, which are quite often financial (Vickery et al., 2003). We can therefore say that in this field, two research streams can be distinguished: 1) Studies that aim to establish a link between two variables (a SCMP and a performance measure) based on a unique construct of SCM and performance, and most often by incorporating a mediating performance variable into the model (Li et al., 2006b). For example, Sahin and Robinson Jr. (2005) studied the impact of information sharing on cost reduction in make-to-order supply chains, Zhu and Nakata (2007)

examined the link between customer orientation and business performance, Wong et al. (2013) looked at the effects of supply chain integration on product innovation, and Lotfi et al. (2013) proposed a conceptual model for studying the relationship between supply chain integration and product quality. 2) Studies focusing on the impact of two or more SCMPs (considered separately or collectively) on one or several performance variables (Mohr and Spekman, 1994; Tan et al., 1998; Chen and Paulraj, 2004; Green et al., 2007). Other examples of recent studies in this category are: Ou et al. (2010) who examined the impact of different SCMPs on a handful of financial and non-financial performance and Yu et al. (2013) who investigated the effect of internal and external integration on customer satisfaction and financial performance.

Both in theory and practice, one thing is to study the number of SCMPs that are linked to one or many financial and non-financial performance measures, another thing is to understand the nature of this relationship. This is the second fundamental question. Some researchers have studied and confirmed direct linkages (Chen and Paulraj, 2004; Koçoğlu et al., 2011), some have reported both direct and indirect linkages (Vickery et al., 2003; Kim, 2009) while some others have studied how parameters such as complexity (Gimenez et al., 2012) or risk and environmental uncertainty (Srinivasan et al., 2011) act as mediating factors between SCMPs and performance measures. Also, from the balanced scorecard (BSC) perspective, linkages can be considered to be causal (sequentially or non-sequentially) or interdependent (Nørreklit, 2000). The notion of sequential and interdependent linkages will be defined later in the section on literature review. Nørreklit (2000) and Oriot and Misiaszek (2004) argue that though most authors have claimed causal linkages between the four perspectives of the BSC framework, the relationships between them are rather interdependent. In other words, they are not unidirectional.

Using the balanced scorecard framework, our study aims to simultaneously investigate the two fundamental questions discussed above, by adopting a multidimensional approach that looks at the impact of many SCMPs on many performance variables, with particular emphasis on the nature of the linkages. Through the discussion of the results of this study, these relationships can be linked to business strategy. Given that we did not find in the literature any paper that investigates the relationship between SCMPs and performance from a

comprehensive multidimensional approach, we consider that our methodology constitutes an interesting contribution in this stream of research.

Mentzer et al. (2001) define SCM as “the systemic, strategic coordination of the traditional business functions and the tactics across these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long term performance of the individual companies and the supply chain as a whole”. Based on this definition, supply chain management can be broken into two parts: external and internal (which entails cross-functional coordination and collaboration within the company). External SCM can further be broken into two parts: upstream, which has to do with coordination and collaboration with suppliers, and downstream, which has to do with coordination and collaboration with customers. In the SCM literature, these three parts can be referred to as supplier integration, internal integration and customer integration (Flynn et al., 2010; Barratt and Barratt, 2011; Wong et al., 2013; Yu et al., 2013) or supplier relationship management, internal supply chain management and customer relationship management (Dey and Cheffi, 2013). Given that the aim of this paper is not to review the numerous definitions of supply chain management (SCM) in extant literature, it simply adopts that of Mentzer et al. since it contains the key elements (strategic coordination, collaboration across the whole supply chain and long term performance) that we intend to study. Nevertheless, we note that this paper deliberately investigates only external (supplier and customer) integration.

Though there is abundant literature on the characterization and identification of SCMPs, they remain fragmented. Hence, some authors focus on the integration of logistics systems (Rudberg and Olhager, 2003), while others focus either on the practices related to the management of the upstream linkages (Chen and Paulraj, 2004), or on the management of the downstream linkages (Tan et al., 2002). Table 1 summarizes most of the practices identified by various authors.

Table 1

Summary of supply chain management practices (SCMP) in extant literature

Authors	Supply Chain Management Practices
Shin et al. (2000)	Supplier base reduction, long-term supplier-buyer relationships, Quality focus in selecting suppliers, and supplier involved product development.

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Tan et al. (2002)	Supply chain integration, information sharing, supply chain characteristics, customer service management, geographical proximity, and Just-in-time capability.
Chen and Paulraj (2004)	Supplier base reduction, long-term relationship, communication, cross-functional teams, and supplier involvement.
Min and Mentzer (2004)	Common objectives, information sharing, risk and profit sharing, cooperation, process integration, long-term relationship.
Li et al. (2006b)	Supplier partnership, customer relationship, intensity of shared information, and quality of shared information.
Zhou and Benton (2007)	Supply chain planning, Just-in-time production, and delivery practice.

In this paper, we have deliberately limited our study to three main SCMPs (informationsharing, supplier partnership and customer orientation), for three reasons. Firstly, they are perfectly in line with the definition of SCM that we adopted, with emphasis laid on inter-organizational coordination and close collaboration between the partners of the supply chain, value creation for the customer, communication and synchronization of flows, sharing of risk and benefits, and the establishment of a long term relationship. Secondly, they are broad in nature and cover almost all the facets (dimensions) of SCM that are found in the literature. And thirdly, they are explicitly incorporated in the Balanced Scorecard Strategy Map (BSSM) model, which will constitute the basis of our research construct. The practice of information sharing is defined here as the willingness of a company to provide its partners with complete information that can be operational, tactical and/or strategic in nature (Li et al., 2005). The quality of the information shared is essential to the development of the SCM system; it encompasses the relevance, credibility, accuracy and timeliness of the information (Anderson and Narus, 1990). Supplier partnership is defined as the establishment of a close and cooperative relationship with one's suppliers. Commonly found in the demand chain management literature, customer relationship management could be defined as the development of a long-term relationship with customers through the deployment of measures aimed at improving the quality of the interaction between the company and its customers in order to better satisfy their needs and expectations (Li et al., 2005).

As already mentioned, this paper proceeds in twosteps: 1) to establish and confirm, through a multidimensional approach, some of the relationships that have already been observed in extant literature between SCMPs and both financial and non-financial performance, and 2) based on the results of the first step and using a balanced scorecard strategy map approach, to study the nature of the linkages in order to enable managers to comprehend how supply chain initiatives impact on performance and consequently on corporate strategic objectives. Based on a quick scan literature review, we will start by formulating our research hypotheses, as well as one postulate. Thereafter, we will present our methodology and the test of our research hypotheses using structural equation modelling. We will then present our results and discussion, before finally drawing some conclusion.

## **Literature review, hypotheses and postulate**

In this section, we will carry out a quick-scan literature review that will enable us to establish the links between SCM and performance before formalizing them in the form of eight distinct research hypotheses. Since the aim of this paper is not to carry out a thorough investigation of the relationship between a specific supply chain practice and a specific performance measure, we do not intend to be exhaustive in our literature review. The aim is to identify key relationships that will be sufficient enough to investigate the nature of the linkages.

### *Link between sharing of information and performance*

Transaction cost theory provides a theoretical framework that is relevant to highlight the positive role of information exchange. In fact, an active and intensive communication between the partners of the value chain will tend to reduce informational asymmetry, thus limiting uncertainty and risks of opportunistic behavior (Williamson, 1985). Moreover, if the information that is exchanged between the partners is complete, there is reduction in the risks of divergence of objectives, cheating or inappropriate assessment of the efforts made by each partner, and this reduces the costs related to performance measurement and the risks of misunderstanding and conflicts (Williamson, 1985; Anderson and Weitz, 1992). It follows



that communication increases the benefits that the parties can derive from the relationship (Anderson and Narus, 1990; Anderson and Weitz, 1992; Simpson et al., 2001).

Furthermore, sharing accurate, rich, appropriate and relevant information contributes to a better coordination of partners' actions, thus enabling them to easily achieve their goals (Anderson and Narus, 1990; Mohr and Spekman, 1994; Kulp et al., 2004). By ensuring the synchronization of the partners' operations, information exchange will lead to reduction in inventory levels and costs, and to generating more value for the customer (Lee et al., 2000). Similarly, the intensity of information exchange enables to improve the responsiveness of organizations faced with rapidly-changing markets and customer expectations (Narasimhan and Nair, 2004). The willingness of a company to systematically transmit information concerning decisions or changes in marketing (or production) plans, for example, enables one's partners to better plan and organise their own activities, thereby avoiding contingencies (Leuthesser, 1997; Langfield-Smith and Greenwood, 1998). Information sharing therefore gives companies the opportunity to improve not only their efficiency but also their responsiveness and flexibility. As a result, the relationship between information sharing and firm performance has been studied and established by many authors including recently Hsu et al. (2008), Agus (2011) and Ibrahim & Ogunyemi (2012). Based on this quick scan literature review, we can formulate the following hypotheses:

**H1a.** *The practice of sharing information with supply chain partners impacts positively on the organization's non-financial performance.*

**H1b.** *The practice of sharing information with supply chain partners impacts positively on the organization's financial performance.*

**H2a.** *The quality of information shared with supply chain partners impacts positively on the organization's non-financial performance.*

**H2b.** *The quality of information shared with supply chain partners impacts positively on the organization's financial performance.*

*Link between supplier partnership and performance*

Resource-based theory bases its postulate on the fact that the accumulation of resources, characterized by their value, their scarcity and their inimitability can constitute a competitive advantage, leading to a higher level of profitability (Wernerfelt, 1984; Barney, 1991). Consequently, it is then possible to consider that the specific links between the value chains of companies can lead to the development of capabilities (Srivasta et al., 2001). Often referred to as intangible assets, these capabilities can be a source of competitive advantage (Stalk et al., 1992; Ramsay, 2001). If we adopt the idea of competition based on capabilities (Stalk et al., 1992), the source of competitive advantage lies not in the product itself but rather in the processes underlying its production. Also, success could result from the transformation of the key processes of the firm into strategic capabilities, which can create value for the customer. Supply chain management therefore enables to generate capabilities that create value through the integration of processes, activities and functions across the value chain. It follows that the resource based theory is suitable for explaining the relationship between supply chain linkages and performance (Rungtusanatham et al., 2003).

A supplier relationship management system, based on the use of a close relationship with a limited number of actors to jointly implement coordinated actions, enables to develop a core and unique competence that is difficult or impossible for competitors to imitate (Ramsay, 2001). This competence contributes more and more to the competitiveness of the firm in terms of cost, quality and responsiveness, in response to the ultimate customer's expectations (Koh et al., 2007). Cooperative relationship with suppliers facilitates the understanding of the expectations of each party and enables to identify more easily and faster the potentials for process improvement, as well as the effectiveness of linkages between the value chain of firms (Lambert and Pohlen, 2001). Through early involvement and integration of suppliers in the design and development process, the company boosts its innovation capability and value creation for customers, thereby increasing its prospects for profitability (Wisner, 2003). Strategic partnering in a supply network is therefore considered to constitute a competitive advantage (Khaji and Shafaei, 2011). Moreover, the existence of a close relationship with a limited number of suppliers allows easy access to key critical resources, greater effectiveness in technical choices related to design and industrialization (Monczka et al., 1998), elimination of time wastage, concentration of efforts on other value-creating activities, and increase in product quality (Lambert and Pohlen, 2001). In essence, a

partnership-based management of supplier relationship provides opportunities for creating value for both the customer and the shareholder (Ellram and Liu, 2002; Pressuti, 2003; Chen and Paulraj, 2004). Based on this, we can formulate the following hypotheses:

**H3a.** *Partnership-based practices of managing supplier relationship impact positively on the organization's non-financial performance.*

**H3b.** *Partnership-based practices of managing supplier relationship impact positively on the organization's financial performance.*

#### *Link between customer relationship and performance*

Also from the perspective of resource based theory, the existence of a close relationship with the customer can be considered a core competency of the firm and can constitute a source of sustainable competitive advantage. In fact, developing a relationship of intimacy with the customer seems to be relatively rare and difficult to replicate for competitors and is therefore likely to generate higher performance for the company and its shareholders (Srivasta et al., 2001). Cultivating trust between the parties and their respective commitments, this type of relationship reduces the uncertainty attached to the transaction and improves the customer's loyalty, which in turn leads to higher profitability (Kumar and Shah, 2004). Managing the relationship with the customer enables to achieve higher performance not only in the short term, but also in the long term by generating an increase in the volume of business induced by the relationship, as well as the reputation related to the customer's prescription action (Li et al., 2005). The intimacy developed with the customer provides the organization the opportunity to capture and analyse market responses to its products and/or services, thus enabling it to develop its capacity to adapt to changing expectations and even to better anticipate these possible changes (Kohli and Jaworski, 1990). In other words, collaborating and integrating with customers enhance firm performance (Koçoğlu et al., 2011; Yu et al., 2013). Based on this, we formulate the following hypotheses:

**H4a.** *The practice of customer relationship management impacts positively on the organization's non-financial performance.*

**H4b.** *The practice of customer relationship management impacts positively on the organization's financial performance.*

### *Nature of linkages between supply chain management practices and performance measures*

The definition of SCM by Mentzer et al. (2001) emphasises the strategic coordination of processes in order to create value for the organisation, as well as for its stakeholders. This implies that a firm's supply chain management practices should be aligned with its strategic goals. Though Kaplan and Norton's (2004a, 2006) balanced scorecard and strategy maps provide a very good framework for achieving this alignment from a theoretical perspective, it is yet to be confirmed by empirical research (Nørreklit, 2000; Cohen et al., 2008; Chareonsuk and Chansa-ngavej, 2010).

The four perspectives of the balanced scorecard are financial, customer, internal process, and learning & growth. One of the main strategic goals of a firm is to achieve profitable growth and this goal can be met by increasing financial performance. The customer perspective entails creating value for the customer and this can be achieved through customer satisfaction and higher quality of products and services. For a supply chain, improving internal processes can be achieved through various supply chain practices and initiatives Kaplan and Norton (2004b, 2006):

- developing and improving partnership with suppliers
- developing and improving relationship with customers
- improving organisational processes through collaborative information sharing and higher information quality
- improving delivery service through higher responsiveness and dependability
- improving products and services by developing innovation capabilities
- reducing waste by controlling cost

The learning and growth perspective includes how supply-chain-relation resources (human capital, information capital and organisational capital) are developed and managed. In this paper, we will be considering only how social performance is improved through employee satisfaction. Table 2 shows the strategic goals and scorecard performance measures (or capabilities) presented as a balanced scorecard strategy map.

Table 2

## Balanced Scorecard Strategy Map

Strategy map		Scorecard performance measures / capabilities
Financial perspective	Achieve profitable growth	Financial performance
Customer perspective	Create value for customer	Customer satisfaction Quality of products and services
Internal processes	Develop and improve partnership with suppliers	Strong supplier partnership
	Develop and improve relationship with customers	Close customer relationship
	Improve organizational processes	Collaborative information exchange Information quality
	Improve delivery service	Responsiveness Dependability
	Improve products and services	Innovation capability
	Reduce wastes	Cost control
Learning and Growth	Improve human capital	Employee satisfaction

In the field of supply chain management, the balanced scorecard has been explored by some authors: Brewer and Speh (2000) and Bullinger et al. (2002) used it to analyse supply chain performance; Bhagwat and Sharma (2007) used it to establish a set of performance measures as they apply to supply chain management. Hult et al. (2008) looked at the link between supply chain orientation and balanced scorecard performance; Chang (2009) used it to evaluate supply chain management integration; and Khaji and Shafaei (2011) used it to study strategic partnering in supply networks. Without using the balanced scorecard framework, Koh et al. (2007) studied the relationship between supply chain management practices and operational (and organisational) performance, but did not relate these relationships to the strategic goals of the firm. However, these studies have not successfully established the alignment of SCMPs with the strategic goals of the firm. It follows that the nature of the linkages should first be understood before this strategic alignment can be empirically affirmed. This is why this paper aims to study the nature of the linkages between SCMPs and performance measures.

The first three levels (learning and growth, internal process, and customer perspectives) of the balanced scorecard are generally considered to be intangible assets or non-financial performance measures while the fourth level (financial perspective) is regarded as tangible

asset or financial performance measure (Kaplan and Norton, 1992). While some researchers try to lay emphasis on the causal (sequential or non-sequential) linkages between the BSC components, others (Nørreklit, 2000; Bryant et al., 2004; Bento et al., 2013) argue that these linkages are rather interdependent. A sequential causal linkage exists when one or more components of one BSC level have a cause-and-effect relationship with one or more components of the immediate level in the upward direction (for example, a causal upward relationship between the learning & growth perspective and the internal process perspective or between the internal process perspective and the customer perspective). A non-sequential causal linkage exists when one or more components of one BSC level have a cause-and-effect relationship with one or more components of any level beyond the immediate level in the upward direction (for example, a cause-and-effect relationship between the learning & growth perspective and the customer or the financial perspective). We note that sequential and non-sequential causal linkages are unidirectional and upward; this is why their existence will culminate in the achievement of the financial objectives (Bryant et al., 2004). An interdependent linkage exists when the relationship between the components of two BSC levels (whether or not they are adjacent) are in any of the two (upward and downward) directions. In order to clearly distinguish between the upward interdependent linkage and the sequential (or non-sequential) linkage, we will for the purpose of this paper use the terminology “reverse linkage” to denote the downward linkage between the components of any two BSC levels, whether or not they are adjacent. In order to complete this spectrum of relationships, we will use the terminology “intra-dependency” to denote the linkage between any two components within the same BSC level (perspective). By combining these four types of linkages with the notion of direct and indirect impact, we obtain eight possible types of linkages:

1. Direct Sequential Linkage(DSL)
2. Indirect Sequential Linkage(ISL)
3. Direct Non-Sequential Linkage(DNSL)
4. Indirect Non-Sequential (INSL)
5. Direct Intra-Dependent Linkage (DIDL)
6. Indirect Intra-Dependent Linkage (IIDL)
7. Direct Reverse Linkage (DRL)

## 8. Indirect Reverse Linkage(IRL)

These eight types of linkages are clearly defined in Table 3. Based on the results of our structural equation modelling, this paper aims to investigate how the relationships between supply chain management practices and financial and non-financial performance measures fit into these eight types of linkages.

Table 3

Types of linkages in a balanced scorecard

	<b>Direct</b>	<b>Indirect</b>
	<u>DSL</u>	<u>ISL</u>
<b>Sequential</b>	Linkages where a component of one BSC level has a direct upward cause-and-effect relationship with a component of the immediate level.	Linkages where a component of one BSC level has an upward causal relationship with a component of the immediate level, but via another component in any level.
	<u>DNSL</u>	<u>INSL</u>
<b>Non-sequential</b>	Linkages where a component of one BSC level has a direct upward cause-and-effect relationship with a component of any other level beyond the immediate level.	Linkages where a component of one BSC level has an upward cause-and-effect relationship with a component of any other level beyond the immediate level, but via another component in any level.
	<u>DIDL</u>	<u>IIDL</u>
<b>Intra-dependent</b>	Linkages where there is a causal relationship between components within the same BSC level.	Linkages where there is a causal relationship between components within the same BSC level, but via another component.
	<u>DRL</u>	<u>IRL</u>
<b>Reverse</b>	Linkages where there is a downward cause-and-effect relationship between the components of two BSC levels, whether or not they are adjacent.	Linkages where there is a downward cause-and-effect relationship between the components of two BSC levels, whether or not they are adjacent, but via another component in any level.

A strategy is a set of hypotheses about cause and effect (Kaplan and Norton, 1996). The balanced scorecard strategy map provides a framework that enables to link together the four balanced scorecard perspectives by cause-and-effect relationships. With reference to Kaplan and Norton (1996), Bryant et al. (2004) noted that although the BSC is designed to translate the firm's strategy and mission into measures that managers can use to manage the organisation, BSCs contain both generic measures (such as return on investment, customer satisfaction, customer loyalty, market share and new product introduction) that are common across organisation and unique measures that are tailored to the firm's competitive strategy.

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Bryant et al. (2004) also observed that a significant stream of literature provides evidence that even when managers collect and track unique measures, they still place primary reliance on traditional generic measures. We can therefore argue that if a significant majority of linkages between the generic components of the various BSC levels are sequential or non-sequential in nature (whether they are direct or indirect), then the BSC perspectives have a cause-and-effect relationship that would culminate in the achievement of the firm's strategic (financial and non-financial) objectives, especially when the components of the BSC perspectives were formulated based on the firm's vision and mission statements. In the case of supply chain management, we can formulate the following postulate:

*When using the balanced scorecard as a framework for strategic alignment, if there is a significant number of sequential, non-sequential, intra-dependent and reverse causal linkages (whether they are direct or indirect) in the relationships between supply chain management practices (SCMPs), non-financial performance measures and financial performance measures, then these SCMPs will most likely impact positively on the firm's strategic goals.*

As discussed previously in this section, many authors have studied the impact of supply chain management practices on performance, but to our knowledge, none has empirically investigated the alignment with the firm's strategy based on the nature of the linkages between the BSC components. In this regard, we consider that this constitutes an interesting and original contribution of this paper.

## **Methodology**

### *Unit of Analysis and Data Collection*

This research was conducted on a population of 450 supply chain managers, logistics managers and purchasing managers of major industrial French firms. A convenience sample was established based on the directory of ASLOG (a French Association for Logistics). Each respondent was contacted by telephone in order to obtain their acceptance to participate in the survey and also to ensure that they possess the necessary skills and information (from a global supply chain perspective). Thereafter, electronic questionnaires were addressed to them. The



450 managers contacted enabled to validate and process 91 questionnaires. This represents a return rate of 20.2%.

### *Measures*

Within the framework of this study, we relied on previous measurements drawn from extant literature. All the variables in the model resulted in a multi-items measure, estimated on a seven-point bipolar scale. Besides, we tested the convergent validity, the discriminant validity and the reliability of the scales used. To do this, we first conducted an exploratory factorial analysis (Principal Component Analysis or PCA) on all the items constituting the variables involved in the analysis. This was followed by a confirmatory factorial analysis.

We first checked the relevance of the PCA using successively Bartlett's sphericity test and Kaiser-Meyer-Olkin (KMO) test, completed with MSA (Measure of Sampling Adequacy). After a Varimax rotation, we purified the scales. Finally, using the measure of Cronbach's alpha ( $\alpha$ ), we looked at the reliability of factors resulting from the factorial analysis.

Then, we used the structural equation modelling (done with the software AMOS 18) to conduct a confirmatory factorial analysis. First, we checked the overall adjustment of the measurement model (by applying at the same time absolute adjustment indicators of the model:  $\chi^2/\text{d.f.}$  (*Normed*  $\chi^2$ ), goodness of fit index (GFI), adjusted goodness of fit index (AGFI), standardized root mean squared residual (SRMR); comparison indicators: normed fit index (NFI), relative fit index (RFI); and a parsimony indicator of the model: consistent Akaike information criterion (CAIC)). Once the measurement model had stabilized, we were able to estimate the reliability, the convergent validity and the discriminant validity of the constructs. To do this, we first applied Joreskog  $\rho$  ( $\phi$ )—composite reliability, which, if greater than 0.7, allows to conclude that the scale is reliable—construct reliability (Bagozzi and Yi, 1988).

Then, we tested the convergent validity of the constructs by verifying three conditions: the level of significance of the t-test associated with each factorial contribution (critical ratio greater than 1.96), the square of the factorial contribution of each item greater than 0.5 (in order to make sure that each indicator shares more variance with its construct than with the measurement error associated with it), and the indicator of the average variance extracted or the  $\rho$  ( $\phi$ ) of convergent validity greater than 0.5.

Finally, we tested the discriminant validity of the constructs by making sure that the  $\rho$  of convergent validity of each construct was greater than the percentage of variance shared by the construct with the other constructs (correlation between constructs).

### *Exogenous variables*

The measure of supplier partnership (see appendix A) was derived from a combination of measures developed within the framework of vertical alliances [through the contributions of Krause and Ellram (1997) and Mohr and Spekman (1994)] and scales developed within the specific framework of the SCM concept (Chen and Paulraj, 2004; Li et al., 2005). The measure of the customer relationship management was developed on the basis of the conventional measures of this concept such as proposed by Kohli and Jaworski (1990), and on the basis of scales specifically tested within the framework of the SCM concept (Tan et al., 1999; Li et al., 2005, 2006b). For the information sharing variable, we adopted the measure developed by Krause and Ellram (1997), as well as by Li et al. (2005). The information quality variable was adapted from Closs and Goldsby (1997) and Li et al. (2005).

In the end, the measurement model comprising the explanatory variables presents a good adjustment both in terms of absolute indicators (NC=1.423, GFI=0.905, AGFI=0.861, SRMR=0.06) and of comparison indicators (NFI=0.937, RFI=0.885). Also, the parsimony indicators of the model (CAIC) present a value lower than that of the saturated model. Besides, all the constructs present values of Cronbach's  $\alpha$  greater than 0.8, as well as values of Joreskog's  $\rho$  (reliability composite) also greater than 0.8. This allows us to conclude that the scales are very reliable. Furthermore, regarding the convergent validity of the scales, we observe that the t test associated with each factorial contribution is significant, that the square of the factorial contribution of each item is greater than 0.5 and that the average extracted variance is greater than 0.5. Finally, the  $\rho$  of the convergent validity of each construct being greater than the correlation of the construct with the others, we were able to conclude the discriminant validity of the scales.

### *Performance variables*

Regarding performance measurement, we chose perceptual measures. On the one hand, the use of perceptual measures allows to overcome the reluctance of some respondents to provide objective data related to performance, especially financial (Zou et al., 1998). Consequently, the use of such a measure enables to minimize the "no response" phenomenon and to improve the overall return rate (Zou et al., 1998).

For the financial performance, we went for measures of profitability (commercial profitability, economic profitability and financial profitability). These measures of profitability are combined with indicators that track the evolution of the critical variables related to the competitive position or to the financial health of the company (traditionally used in this type of research): sales growth (Wisner, 2003), average profit (Green et al., 2007), improvement of cash flow or working capital (Wisner, 2003; Koh et al., 2007). Following the exploratory factorial analysis, we purified this scale before collapsing it to only one comprehensive variable.

Regarding non-financial performance, we initially adapted the scales developed for four categories of variables. The first category is related to the creation of value for the customer (Kaplan and Norton, 1992; Vickery et al., 2003; Li et al., 2006b; Green et al., 2007). The second category concerns the innovative capacity of the company (Kaplan and Norton, 1992; Li et al., 2005, 2006b). The third category is related to cost control (Kaplan and Norton, 1992; Li et al., 2005; Koh et al., 2007). And, the fourth category is related to the performance of the company in terms of social responsibility (Kaplan and Norton, 1992), viewed from the perspective of employee satisfaction. Following the exploratory factorial analysis, our non-financial performance indicators were decomposed into seven categories: social performance, cost control, innovation capability, dependability, responsiveness, service and product quality, and customer satisfaction (see Appendix B).

In the end, the combination of financial and non-financial indicators allows us to test the hypotheses on eight categories of performance measures by introducing the possibility of a mediating role of the non-financial performance measures between SCMPs and financial performance. To our knowledge, no similar study in extent literature has mobilized such a wide variety of performance variables.

### *Control variables*

Several control variables that could affect the firm's performance were also taken into consideration in our study. We thus integrated into the research model four categories of variables in order to avoid any excessive interpretation in relation to the presence of these uncontrolled active factors and also to test their explanatory power. The first control variable is relative to the size of the company and is measured by the turnover. The second concerns the business sector and is integrated in the form of dummy variables, which assure that the company belongs to one of seven industrial sectors concerned by our study (machines and mechanical materials, electrical and electronic materials, automobile, aeronautical materials, rubber and plastic materials, computer hardware, and other manufacturing industries). The third, which is also integrated in the form of a dummy variable, is relative to the function of the respondent. Finally, the fourth control variable considers the complexity of the supply chain (Bozarth et al., 2009), which is taken into account by the integration of two variables measured respectively by the number of customers and the number of products. For each of the seven models presented, we compared the quality of adjustment obtained with and without the integration of these control variables. In all the models, these control variables do not show any significant influence. Besides, their integration contributes to lowering the quality of adjustment of the models. This is why the models integrating the control variables are not presented.

### *Hypothesis Testing*

To test our research hypotheses, we used the AMOS 18 software that is based on the structural equation technique. Considering the good results of the measurement model, we used aggregated scores to measure the latent constructs, and this allowed to reduce the complexity of the model, as well as the specification problem (Calantone et al., 1996).

Though our hypotheses have been formulated in a generic manner as shown in Figure 1, we want to study independently the influence of each of the constitutive SCMP on each of the shortlisted components of performance. Moreover, we also intend to consider the possible mediating role of certain SCMPs in the relationship between SCMPs and performance, as well as the possible mediating role of the non-financial performance in the relationship between SCMPs and financial performance. In this perspective we tested, for each performance variable, the impact of the four explanatory variables identified in several successive models,

including each time one of the seven non-financial performance variables and the financial performance variable. This enables to identify the direct and indirect effects of the SCMPs on financial and non-financial performance.

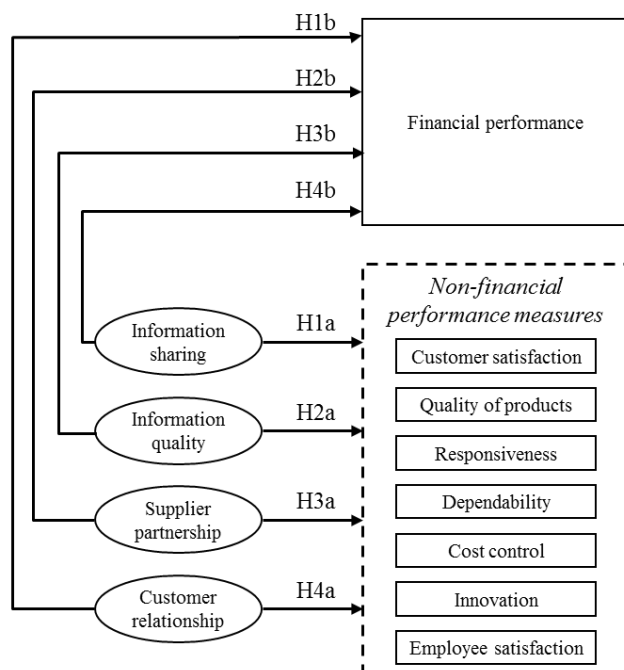


Figure 1. Research construct with links between SCM practices and firm performance.

In order to develop a framework that will be used to validate the postulate that we formulated in the section on literature review, we have grouped the balanced scorecard components (in Table 2) into three categories (see Figure 2). Starting from the financial perspective at the top, we have the financial performance measure which constitutes a strategic objective. Then, we have the non-financial performance measures with customer satisfaction and quality of products constituting strategic objectives at the customer perspective level, while four non-financial measures (responsiveness, dependability, cost control and innovation) constitute operational objectives at the internal processes perspective level, and the last non-financial measure (employee satisfaction) constitute an operational objective at the learning and growth perspective level. Finally, information sharing, information quality, supplier partnership and customer orientation are the supply chain management practices at the internal process perspective level. Examples of the eight types of linkages are shown in Figure 2.

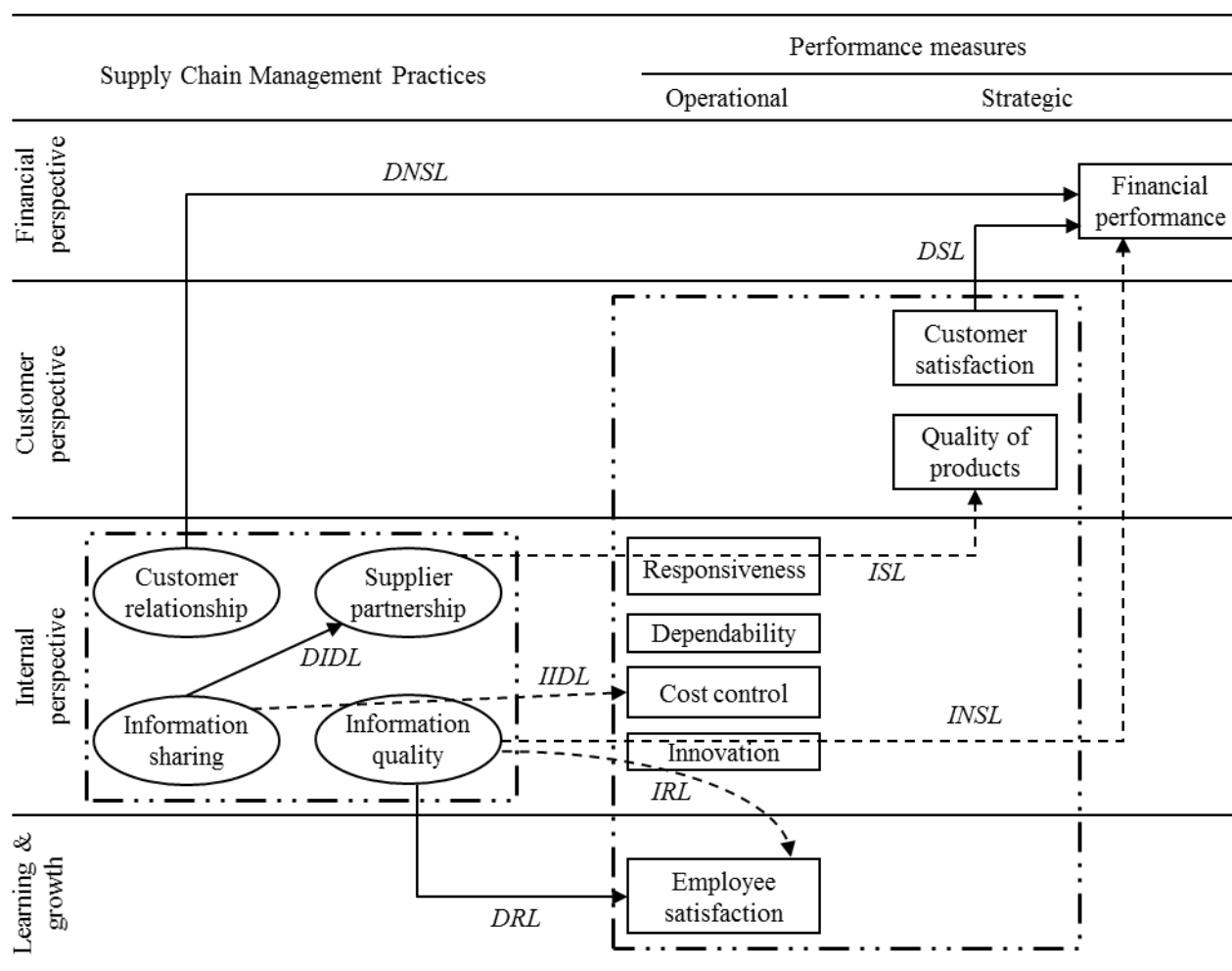


Figure 2. Research construct showing causal linkages between balanced scorecard perspectives.

Figure 2 will be used to study how the inter- and intra-linkages between the components of the four BSC perspectives fit into the eight types of linkages proposed in the section on literature review.

As it is recommended in structural equations, we compared, for each performance variable considered, several alternative models in order to determine the model that would allow the best adjustment. For the sake of conciseness, we report only the models leading to the best adjustment.

## Results and discussions

We will first use the results of the structural equation modelling to discuss the direct and indirect impacts of SCMPs on performance measures. Then, we will discuss the nature of linkages by combining these direct and indirect impacts with the sequential, non-sequential and intra-dependent linkages in the BSC framework.

Our results show that SCMPs actually impact on the performance of the organization to varying degrees, both directly and indirectly. All the models show a good adjustment from the point of view of absolute indicators ( $NC < 2$ ,  $GFI > 0.95$ ,  $AGFI > 0.945$  and  $SRMR < 0.065$  for all the models, and  $SRMR < 0.05$  for 5 of the 7 models presented), as well as from the point of view of comparison indicators ( $NFI > 0.9$  for all the models,  $NFI > 0.95$  for 5 of the 7 models presented and  $RFI > 0.85$  for 6 of the 7 models presented). They also show a good adjustment from the point of view of parsimony indicators (the values of CAIC are systematically lower than the values of the saturated model). Table 4 summarizes the direct and indirect effects of the SCMP on performance. The numerical value of the indirect impact is obtaining by subtracting the direct impact value from the total value.

Table 4 : Standardized direct and total effects of SCMP on performance

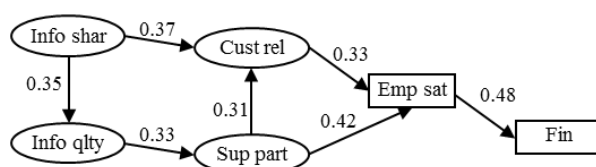
		Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7	
Non-financial performance		Employee satisfaction		Cost control		Innovation capability		Delivery dependability		Responsiveness		Quality of products		Customer satisfaction	
		Direct	Total	Direct	Total	Direct	Total	Direct	Total	Direct	Total	Direct	Total	Direct	Total
H1a	Information sharing	0	0.18	0	0.12	0	0.16	0	0.05	0	0.16	0.27	0.27	0	0.21
H2a	Information quality	0	0.17	0	0.16	0.20	0.22	0	0.16	0.18	0.20	0	0	0	0.15
H3a	Supplier partnership	0.41	0.52	0.43	0.49	0	0.07	0.48	0.48	0	0.07	0	0	0.33	0.46
H4a	Customer relationship	0.33	0.33	0.17	0.17	0.22	0.22	0	0	0.24	0.24	0	0	0.42	0.42
Financial performance		Financial		Financial		Financial		Financial		Financial		Financial		Financial	
		Direct	Total	Direct	Total	Direct	Total	Direct	Total	Direct	Total	Direct	Total	Direct	Total
H1b	Information sharing	0	0.08	0	0.12	0	0.14	0	0.11	0	0.12	0	0.18	0	0.10
H2b	Information quality	0	0.08	0	0.09	0	0.15	0	0.08	0	0.11	0	0.11	0	0.11
H3b	Supplier partnership	0	0.25	0	0.27	0.21	0.29	0	0.24	0.27	0.34	0.26	0.32	0.17	0.34
H4b	Customer relationship	0	0.15	0.17	0.25	0.17	0.23	0.23	0.23	0.22	0.22	0.24	0.24	0	0.16

The primary objective in this paper is to investigate, using the balanced scorecard strategy map framework, the linkages between supply chain management practices (SCMPs) and

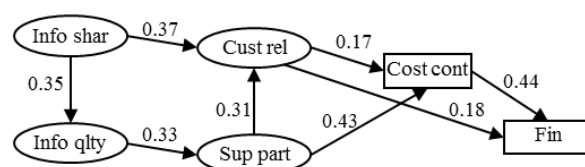
performance measures (both financial and non-financial) which contribute to achieving the firm's performance objectives. But, we will first discuss the validation of our hypotheses individually before using the results of the structural equation modelling to discuss the paper's research objective, which will enable to validate the research postulate.

The seven models of our structural equation modelling (the results of which are summarized in appendix C) show not only the direct relationships between SCMPs and financial performance, but also the interplay between non-financial and financial measures. Employee satisfaction, cost control, innovation capability, delivery dependability, product quality and customer satisfaction impact on financial performance in models 1, 2, 3, 4, 6 and 7 respectively. In order to visualize all the relationships, a graphical representation of the seven models is shown in Figure 3.

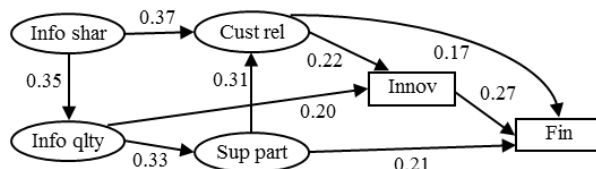
**Model 1:** Financial performance via employee satisfaction



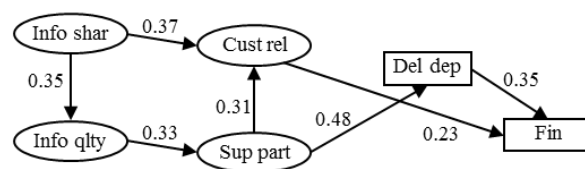
**Model 2:** Financial performance via cost control



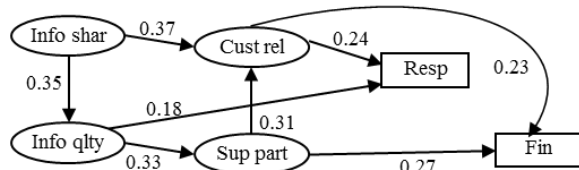
**Model 3:** Financial performance via innovation capability



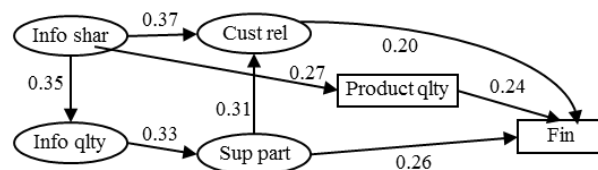
**Model 4:** Financial performance via delivery dependability



**Model 5:** Financial performance via responsiveness



**Model 6:** Financial performance via product quality



**Model 7:** Financial performance via customer satisfaction

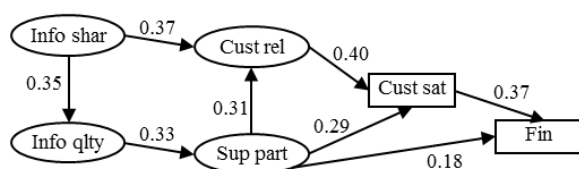


Figure 3. Graphical representation of the results of our structural equation modelling.



### *Impact of information sharing on performance*

Regarding information sharing, our results show that it has a direct impact only on one non-financial performance measure (service and product quality) and none on financial performance. The indirect impact of this variable (information sharing) on the other non-financial performance measures, as well as on financial performance could be explained by its influence on customer relationship. This indirect impact could be further explained by the fact that information sharing also acts on supplier partnership through its action on information quality. Based on this indirect impact on all the financial and non-financial performance measures (see Table 4), we can claim the validation of hypotheses H1a and H1b. Our results confirm and enrich the contributions of Mohr and Spekman (1994).

### *Impact of information quality on performance*

In Table 4 we can see that information quality has a direct impact only on two non-financial performance measures (innovation capability and responsiveness) and none on financial performance. Here again, the effects on the other non-financial performance measures and on all the financial performance measures are indirect. This indirect effect could be explained by its influence on supplier partnership. Given the direct and indirect impacts on almost all the non-financial performance measures, as well as the indirect impact on all the financial measures (see Table 4), we claim the validation of hypotheses H2a and H2b. However, this hypothesis is not validated as regards the impact of information quality on service and product quality. Generally speaking, our results confirm and enrich the contribution of Mohr and Spekman (1994).

### *Impact of supplier partnership on performance*

In 4 (models 1, 2, 4, 7) of the 7 models presented, we observe a significant and strong direct positive impact on non-financial performance (employee satisfaction, cost control, delivery dependability and customer satisfaction (see Table 4). Besides, in two of the three models left, supplier partnership has an indirect impact on non-financial performance

(innovation capability and responsiveness) through its action on customer relationship. In essence, it is only service and product quality that is not impacted by supplier partnership. Furthermore, in 4 (models 3, 5, 6 and 7) of the 7 models presented, supplier partnership has a direct impact on financial performance. Also, in all the models presented, as well as through the non-financial performance measures in models 1, 2, 4 and 7, it impacts indirectly on financial performance through its influence on customer relationship. These observations lead to the validation of hypotheses H3a and H3b.

Our results confirm the contributions of Tan et al. (1998) and Chen and Paulraj (2004) who argue that the establishment of a long-term relationship with suppliers improves financial performance and the creation of value for the shareholder. They also confirm the contributions of Tracey and Tan (2001), who claim that supplier partnership impacts positively on delivery dependability, timeliness and customer satisfaction, the contributions of Li et al. (2006b) who established the positive impact on responsiveness, as well as the contributions of Cetindamar and Ulusoy (2008) who observed that partnership between companies impacts on their innovation performance.

However, just as in the case of information quality, H3a is not validated as regards the impact of supplier partnership on service and product quality. This is not totally surprising since partnership with suppliers could entail collaboration in many diverse areas such as product development, joint planning, inventory management and lead time reduction. If some authors (Hoegl and Wagner, 2005) have reported the positive impact of supplier partnership on service and product quality in the first area (product development) where there is early involvement of the supplier in new product development, there is no evidence of its impact in the other areas mentioned above.

#### *Impact of customer relationship on performance*

In 5 (models 1, 2, 3, 5 and 7) of the 7 models, as can be seen in Table 4, we observe a significant and strong direct positive impact on five non-financial performance measures (employee satisfaction, cost control, innovation capability, responsiveness and customer satisfaction). Though we do not observe any direct or indirect effect on two non-financial performance measures (delivery dependability and service & product quality), we can

nevertheless conclude that H4a is validated in almost all the cases. Hypothesis H4b is also validated since there is not only a direct impact on financial performance in 5 models (2, 3, 4, 5 and 6), but also an indirect impact in 4 models (1, 2, 3 and 7) through its influence on non-financial performance measures (employeesatisfaction, cost control, innovation capability and customer satisfaction). Our results not only confirm contributions of Vickery et al. (2003) and Zhu and Nakata (2007), but also enrich them by extending the scope to a wider spectrum of non-financial performance measures. Moreover, our results are consistent with the contributions of Chen et al. (2004) that show the positive role of integrating the customer (into the value chain) on responsiveness and customer service level.

We do not observe any direct or indirect impact of customer relationship on service and product quality. A possible explanation of the non-existence of an impact could come from the very broad definition of customer relationship as “an array of practices that are employed for the purpose of managing customer complaints, building long-term relations with customers, and improving customer satisfaction” (Li et al., 2005). Therefore, if our respondents understood it as practices geared towards managing customer complaints, then its impact would rather be on responsiveness, as confirmed by our results. This is especially true given that responsiveness is defined as “the ability to minimize the time it takes to cater to customer needs by processing and solving their complaints...” (Vickery et al., 2003). If however, our respondents looked at customer relationship as building long-term relations with customers, then a more appropriate terminology could be customer integration. In this case, Flynn et al. (2010) argue that it has an impact on product quality. We note also that the absence of a link could partly be due to the fact that after purification, we dropped the question that refers specifically to a follow-up feedback on quality of products and services, with the customers.

Also, our results do not show any direct or indirect impact of customer relationship on delivery dependability. In total disagreement with the contributions of Li et al. (2006b) and Green et al. (2007), this result is more surprising given the fact that delivery dependability is a typical logistic performance measure. Once again, this divergence could have resulted from the various definitions used in formulating survey questions. For example, there are two dimensions to fulfilling a customer's order: (1) the ability to minimize the time between receipt and delivery of the order, and (2) the ability to deliver on or before the promised due

date. Vickery et al. (2003) referred to the former as delivery speed and to the latter as delivery dependability. While Li et al. (2005) kept only to the dependability dimension, we lumped together both speed and dependability.

### *Balanced scorecard linkages leading to the achievement of financial objectives*

Having validated the impact of SCMPs on both financial and non-financial performance, we will now use our proposed balanced scorecard linkage model (see Table 3) to discuss the paths through which the eight types of linkages (derived from the results of the structural equation modelling and presented in Table 5) could lead to the achievement of the firm's performance objectives. Given that in the balanced scorecard strategy map framework, the financial perspective is the BSC level that leads directly to the achievement of the firm's strategic goals, we will discuss the eight types of linkages with respect to the finance performance. With reference to the BSC framework, we will refer to the learning and growth perspective as level 1, the internal process perspective as level 2, the customer perspective as level 3 and the finance perspective as level 4.

Table 5: Balanced scorecard causal linkages resulting from our structural equation modelling

	Direct	Indirect
<b>Sequential</b>	<u>DSL</u> Info shar => Product qlty Sup part => Cust sat Cust rel => Cust sat Product qlty => Finance Cust sat => Finance	<u>ISL</u> Info shar => Cust rel => Cust sat Info shar => info qlty => Sup part => Cust sat Info shar => Info qlty => Sup part => Cust rel => Cust sat
<b>Non-sequential</b>	<u>DNSL</u> Empl sat => Finance Sup part => Finance Cust rel => Finance Cost control => Finance Innov => Finance Del dep => Finance	<u>INSL</u> Info shar => Product qlty => Finance Info shar => Cust rel => Finance Info shar => Cust rel => Cust sat => Finance Info shar => Cust rel => Innov => Finance Info shar => Cust rel => Cost control => Finance Info shar => Cust rel => Empl sat => Finance Info shar => Info qlty => Innov => Finance Info shar => Info qlty => Sup part => Finance Info shar => info qlty => Sup part => Cust sat => Finance Info shar => Info qlty => Sup part => Del dep => Finance Info shar => Info qlty => Sup part => Cost control => Finance Info shar => Info qlty => Sup part => Empl sat => Finance Info shar => Info qlty => Sup part => Cust rel => Finance Info shar => Info qlty => Sup part => Cust rel => Cust sat => Finance Info shar => Info qlty => Sup part => Cust rel => Innov => Finance Info shar => Info qlty => Sup part => Cust rel => Cost cont => Finance

		Info shar => Info qlty => Sup part => Cust rel => Empl sat => Finance
<b>Intra-dependent</b>	<u>DIDL</u>	<u>IIDL</u>
	Info shar => Cust rel	Info shar => Cust rel => Innov
	Info shar => Info qlty	Info shar => Cust rel => Resp
	Info qlty => Sup part	Info shar => Info qlty => Innov
	Info qlty => Innov	Info shar => Info qlty => Resp
	Info qlty => Resp	Info shar => Info qlty => Sup part => Cust rel => Innov
	Sup part => Cust rel	Info shar => Info qlty => Sup part => Cust rel => Resp
	Sup part => Del dep	
	Sup part => Cost control	
	Cust rel => Cost control	
	Cust rel => Innov	
	Cust rel => Resp	
<b>Reverse</b>	<u>DRL</u>	<u>IRL</u>
	Sup part =>Empl sat	Info shar => Cust rel =>Empl sat
	Cust rel => Empl sat	Info shar => Info qlty => Sup part =>Empl sat
		Info shar => Info qlty => Sup part => Cust rel =>Empl sat

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Firstly, based on our research construct in Figure 2 and the BSC linkages in Table 5, it can be seen that out of the two direct sequential linkages (DSL) and the six direct non-sequential linkages (DNSL) that lead to finance performance, two are at level 3 (customer satisfaction and product quality), five are at level 2 (two SCMPs - supplier partnership and customer relationship; and three operational non-financial performance measures – innovation capability, cost control and delivery dependability) and one is at level 1 (employee satisfaction). It follows that the financial objectives of a firm cannot be achieved only through sequential linkages as initially assumed by Kaplan and Norton (2004a, 2006) and tested by Chareonsuk and Chansa-ngavej (2010), but also through non-sequential linkages as argued by other authors such as Nørreklit (2000) and Oriot and Misiaszek (2004) and tested by Bryant et al. (2004) and Bento et al. (2013). We observe that even though they did not use the BSC framework, some other authors have report results that are in line with our results. For example, Thornhill (2006) found a positive and significant relationship between innovation (a BSC level 2 component) and revenue growth especially in high technology firms. Waddock and Graves (1997) argued that a positive consumer perception of service and product quality would likely enable firms to achieve increased sales and eventually improve profitability. Extending this argument, we can suggest that high delivery dependability and product innovation will not only increase the loyalty of existing customers, but will also attract new customers, thereby leading to sales growth and eventually higher return on sales. Based on marketing theories, Rust and Zahorik (1993) suggest that customer satisfaction implies lower

marketing costs, less price elasticity, and higher customer loyalty, which in turn lead to improvements in financial performance measures such as sales revenue and market share.

Secondly, the achievement of the firm's financial objectives (and consequently its strategic goals) is reinforced by the direct sequential impact of three BSC level 2 components (information sharing, supplier partnership and customer relationship) on two level 3 components (product quality and customer satisfaction), which in turn impact directly on financial performance as mentioned above.

Thirdly, Table 5 shows so many (seventeen) indirect non-sequential linkages (INSL) that lead to the achievement of financial performance. We note that sequential linkages are imbedded in most of these INSLs and this is in line with the initial assumption by Kaplan and Norton (2004a, 2006) and as tested by Chareonsuk and Chansa-ngavej (2010). Also, all these INSLs start with information sharing and therefore deserve to be discussed. We had earlier mentioned that our two hypotheses on the impact of information sharing on performance (H1a and H1b) are only partially validated. The possible inexistence of a direct impact was implied by Ibrahim and Ogunyemi (2012), who having observed that supply chain linkages have more impact on performance than information sharing, noted that what matters is not what you know but rather what you do with that knowledge. We could deduce from this that the impact of information sharing will depend on the quality and use of the information shared. This could explain why eleven of the seventeen INSLs lead to financial performance through the direct impact of information sharing on information quality. Five of the remaining six INSLs lead to financial performance through the direct impact of information sharing on customer relationship. Though it is generally believed that sharing as much information as possible would increase benefits, Yu et al. (2010) argue that the most efficient scenario is sharing demand information. If we assume that managing customer relationship includes sharing demand information, then, the argument of Yu et al. (2010) is in line with our results where information sharing impacts on financial performance through customer relationship.

Fourthly, the three indirect sequential linkages (ISL) that are shown in Table 5 lead to the achievement of only customer satisfaction through various SCMPs. But since customer satisfaction has a direct impact on financial performance, we can assume that these three ISLs would lead to financial performance.

Fifthly, in line with the argument developed by Nørreklit (2000), Oriot and Misiaszek (2004), Bryant et al. (2004) and Bento et al. (2013), that BSC linkages are rather interdependent than sequentially causal, Table 5 shows many direct intra-dependent linkages (DIDL) and indirect intra-dependent linkages (IIDL). With the exception of five of them, which concern one and the same non-financial performance measure (responsibility), all the DIDLs and IIDLs can be assumed to lead to the achievement of financial performance since they are imbedded in the INSLs. Based on the two DIDLs and three IIDLs (concerning responsibility) that do not lead to financial performance, we argue that some SCMPs could impact on non-financial performance measures without ultimately leading to the achievement of the firm's financial objectives.

Finally, Table 5 shows two direct reverse linkages (DRL) and three indirect reverse linkages (IRL). Based on Kaplan and Norton's (2004a, 2006) initial assumption that the firm's financial objectives can only be achieved through upward sequential causal linkages, one would expect that a reverse linkage in the BSC framework would not lead to financial performance. However, given that employee satisfaction (a component of BSC level 1) has a direct non-sequential impact on finance performance, it can be argued that the two DRLs and three IRLs also lead to the achievement of the firm's financial performance. We note that the direct impact of a BSC level 1 component on a level 4 component has already been tested but not confirmed by Chareonsuk and Chansa-ngavej (2010).

Though interplays in a balanced scorecard framework between intangible assets (non-financial) and tangible assets(financial)have been investigated in extant literature (Bryant et al., 2004; Cohen et al., 2008; Chareonsuk and Chansa-ngavej, 2010; Bento et al., 2013), this paper goes a step further to empirically demonstrate that financial performance can be achieved through many different types of linkages: direct sequential, direct non-sequential, indirect sequential, indirect non-sequential, direct intra-dependent, indirect intra-dependent and even reverse linkages. This can be considered a major contribution.

Figure 4 summarises all the paths that link learning& growth perspective and internal process perspective (supply chain management practices and some operational non-financial performance measures) to the customer and financial perspectives(customer satisfaction, product quality and financial performance), which constitute a firm's strategic objectives.

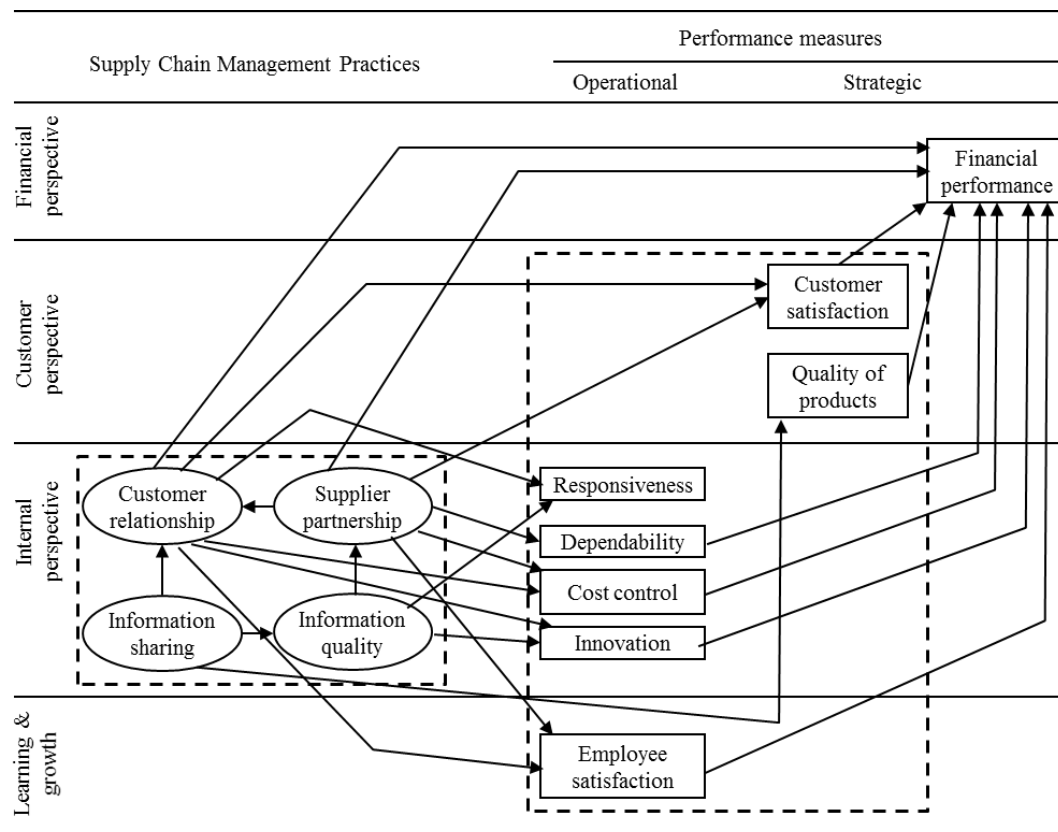


Figure 4. Balanced scorecard strategy map causal linkages resulting from our SEM.

As discussed in the section on Literature review, BSCs contain both generic measures that are common across organisations and unique measures that are tailored to the firm's competitive strategy. Based on the observation that a signification stream of literature provides evidence that even when managers collect and track unique measures, they still place primary reliance on traditional generic measures (Bryant et al., 2004), we can argue (by having a close look at Figure 4) that this paper has, at least from a theoretical standpoint, successfully demonstrated that the four BSC perspectives have a multitude of cause-and-effect linkages that would culminate in the achievement of the firm's strategic (financial and non-financial) objectives. This validates our postulate which states that when using the balanced scorecard as a framework for strategic alignment, if there is a significant number of sequential, non-sequential, intra-dependent and reverse causal linkages (whether they are direct or indirect) in the relationships between supply chain management practices (SCMPs), non-financial performance measures and financial performance measures, then these SCMPs will most likely impact positively on the firm's strategic goals. This will especially be true if the



components of the BSC perspectives were formulated based on the firm's vision and mission statements.

## Conclusion

By adopting a multidimensional approach, this paper has succeeded in empirically confirming some of the relationships between supply chain management practices (SCMP) and performance, which have been reported in extant literature in a dispersed manner. It also discussed some relationships which were not observed as expected (according to the findings of previous authors). In other words, it aimed to contribute to broadening the awareness of top managers looking for ways to improve the performance of their supply chains.

Going beyond the confirmation of some of the direct and indirect relationships that are already established by other authors, we have succeeded in using the balanced scorecard strategy map approach to empirically demonstrate how supply chain management practices can be aligned with strategic objectives through a multitude of different types of linkages. This constitutes the major contribution of this paper. Our empirically built strategy map framework would enable operations and supply chain managers to constantly check the alignment of their supply chain management initiatives with the strategic goals of the company. Also, the BSC framework that we propose can be used by researchers to investigate causal linkages between intangible and tangible assets.

However, we acknowledge and admit the fact that the practical validation of this postulate will depend on the business characteristics of a firm. Based on the review of extant literature, Hsu et al. (2009) state that information exchange encompasses different types of information (supplier, customer, product, manufacturing procedure, transportation, inventory, sales and market, competition, supply chain processes and performance related information). Therefore, performance outcomes would definitely be different depending on the type of information that is shared. For example, sharing sales and market information would improve responsiveness to customers, while sharing inventory and transportation information would primarily enable to reduce cost and would secondarily improve responsiveness. By conducting a simulation study, Schmidt (2009) showed how sharing aggregated order data contribute to reducing safety stocks and inventories levels. Furthermore, Li et al. (2006a) note that the impact of

information sharing on supply chain performance largely depends on demand patterns, the supply chain structure and the type of information (transactional, operational and strategic) shared. It follows that the impact of information sharing could be direct, indirect or inexistent depending on certain factors imbedded either in the value system or in its environment. Therefore, for the practical validation of our postulate, a case study research method might enable to have a detail description and investigation of a specific situation as done by Chang et al. (2013).

Putting aside the above comment on the research method that we used, this paper has naturally some limitations that constitute avenues for future research. The first limitation is related to the sample chosen to test our hypotheses. This was extracted from the database of ASLOG (a French Association for Logistics), which certainly enabled us to reach respondents who have some knowledge of the concepts that we discussed, but which however limits the external validity of our study and the possibility of extending the conclusions to all firms.

The second limitation has to do with the existence of other variables, which are not considered in this study, but which could influence the performance of the company and play a mediating role in the relation between SCMPs and performance. This is the case of methods of resolution of conflicts between supply chain partners (Mohr and Spekman, 1994) or the existence of resistance strategies (Lapassouse, 1991) within the supply chain. For reasons related to a search for parsimony of the tested model and to a limited size of the administered questionnaire, we were not able to consider these variables. Also, we argue that the linkages between supply chain management practices and firm performance would depend on certain contextual variables such as business sector, market uncertainty, nature of products and services, and the length of the supply chain, as well as on inter-organizational variables such as cultural closeness, power imbalance, level of trust and divergence of strategic goals between supply chain partners. The inclusion of one or more of these variables as mediating factors will definitely constitute a basis for further research and would enable to develop balanced scorecard strategy maps for different supply chain environments.

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## Appendix B. Summary of performance measurement variables\*

Construits	Items
<i>In comparison with your competitors, how would you rate your performance in the following areas (very weak / very strong):</i>	
<b><u>Financial performance</u></b>	<ul style="list-style-type: none"> <li>- Return on assets (ROA)</li> <li>- Return on investment (ROI)</li> <li>- Return on equity (ROE)</li> <li>- Return on sales (ROS)</li> <li>- Improvement on working capital*</li> <li>- Average profit</li> <li>- Sales growth*</li> <li>- Cash flow improvement</li> </ul>
Cronbach $\alpha = 0.79$	
<b><u>Non financial performance</u></b>	
Dependability	<ul style="list-style-type: none"> <li>- Effectiveness in the production of products/services</li> </ul>
Cronbach $\alpha = 0.81$	<ul style="list-style-type: none"> <li>- Timeliness</li> <li>- Speed of delivery</li> </ul>
Responsiveness	<ul style="list-style-type: none"> <li>- Speed of adjustment of resource capabilities *</li> </ul>
Cronbach $\alpha = 0.89$	<ul style="list-style-type: none"> <li>- Speed of responding to changes in production volumes</li> <li>- Speed of responding to changes in product mix</li> <li>- Speed of responding to changes in product design</li> </ul>
Quality of products and services	<ul style="list-style-type: none"> <li>- Quality improvement *</li> </ul>
Cronbach $\alpha = 0.84$	<ul style="list-style-type: none"> <li>- Failure rate</li> <li>- Rate of product returns</li> <li>- Product quality</li> </ul>
Customer satisfaction	<ul style="list-style-type: none"> <li>- Quality of customer service</li> </ul>
Cronbach $\alpha = 0.912$	<ul style="list-style-type: none"> <li>- Customer satisfaction</li> <li>- Treatment of customer complaints*</li> </ul>
Innovation capacity	<ul style="list-style-type: none"> <li>- Development of new processes or technologies</li> </ul>
Cronbach $\alpha = 0.7924$	<ul style="list-style-type: none"> <li>- Development of new products or services</li> <li>- Process improvement</li> </ul>
Cost control	<ul style="list-style-type: none"> <li>- Cost reduction</li> </ul>
Cronbach $\alpha = 0.833$	<ul style="list-style-type: none"> <li>- Productivity</li> </ul>
Social responsibility performance	<ul style="list-style-type: none"> <li>- Employee engagement</li> </ul>
Cronbach $\alpha = 0.740$	<ul style="list-style-type: none"> <li>- Motivation of employees *</li> <li>- Personnel satisfaction</li> <li>- Respect for environment*</li> </ul>

\* The items marked with an \* were eliminated after the purification and scale procedure.

## Appendix C. Results of the modeling by structural equations

<i>Structural paths</i>	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Information sharing → Customer relationship	0.37**	0.37**	0.37**	0.37**	0.37**	0.37**	0.37**
Information sharing → Information quality	0.35**	0.35**	0.35**	0.35**	0.35**	0.35**	0.35**
Information quality → Supplier partnership	0.33**	0.33**	0.33**	0.33**	0.33**	0.33**	0.33**
Supplier partnership → Customer relationship	0.31**	0.31**	0.31**	0.31**	0.31**	0.31**	0.31**
Supplier partnership → Employee satisfaction	0.42**						
Customer relationship → Employeesatisfaction	0.33**						
Employeesatisfaction → Financial performance	0.48**						
Supplier partnership → Cost control		0.43**					
Customer relationship → Cost control		0.17					
Cost control → Financial performance		0.44**					
Customer relationship → Financial performance		0.18					
Information quality → Innovation capability			0.20				
Customer relationship → Innovation capability			0.22*				
Innovation capability → Financial performance			0.27*				
Supplier partnership → Financial performance			0.21*		0.27*	0.26*	0.18
Customer relationship → Financial performance			0.17		0.23*	0.20*	
Supplier partnership → Dependability				0.48**			
Customer relationship → Financial performance				0.23*			
Dependability → Financial performance				0.35**			
Customer relationship → Responsiveness					0.24*		
Information quality → Responsiveness					0.18		
Information sharing → Quality of products						0.27*	
Quality of products → Financial performance						0.24*	
Supplier partnership → Customer satisfaction							0.29**
Customer relationship → Customer satisfaction							0.40**
Customer satisfaction → Financial performance							0.37**
<i>Model fit statistics</i>							
Normed $\chi^2$	0.480	0.307	1.055	0.761	0.327	0.432	0.729
Goodness of Fit Index (GFI)	0.986	0.992	0.977	0.978	0.992	0.989	0.982
Adjusted Goodness of Fit Index (AGFI)	0.962	0.976	0.958	0.942	0.976	0.967	0.945
SRMR	0.041	0.036	0.065	0.054	0.036	0.041	0.047
NFI	0.968	0.980	0.929	0.939	0.971	0.963	0.957
RFI	0.939	0.957	0.822	0.886	0.937	0.920	0.909
CAIC/CAIC saturated model	75/115	79/115	88/115	77/115	79/115	80/115	82/115

\*\* *t*-value significant at  $p < 0,01$  ; \* *t*-value significant at  $p < 0,05$  ; \*  $p < 0,1$