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ABSTRACT TITLE: Supply chain management and its impact on operational performance:
an empirical analysis of Brazilian companies

Authors:

Ms. Priscila L. Miguel - Fundação Getúlio Vargas – e-mail: plsmiguel@gmail.com – Phone:
55-11-55433880

Dr. Luiz A. Brito - Fundação Getúlio Vargas – e-mail: Luiz.brito@fgv.br – Phone: 55-11-
32550858

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ABSTRACT

Integrating two main areas of operations management, operations strategy and supply chain management, this paper empirically confirmed a positive relationship between the level of SCM adoption and several dimensions of operational performance. Reviewing the conceptual and empirical literature of SCM and interpreting it under the theoretical streams of transaction costs, resource-based and relational views of strategy, we developed a measurement model of the SCM construct, with excellent fit that can be used as a starting point for a scale for other studies. Operational performance was conceptualized inspired in the competitive priorities literature with four dimensions: cost, quality, flexibility and delivery. Using structural equation modeling, we empirically tested hypothesized relationships between SCM and these four performance dimensions based on a sample of 103 companies, operating in Brazil. The results provide evidence that the SCM has positive effects on the operational performance as a multidimensional construct and also on its different dimensions: quality, cost, flexibility and delivery. The simultaneous positive effect of SCM in all dimensions offers further support for the cumulative capabilities perspective. We also found empirical evidence of the existence of an operational competence construct as a result of SCM and mediating its effect in the different performance dimensions, supported conceptually by the resource-based and relational views of strategy

Keywords: supply chain management, performance, competitive priorities, empirical research, structural equation modeling.

1 Introduction

The supply chain management concept assumes that firms establish alliances with members of the same chain, through process integration, long term relationship, cooperation and

information sharing aiming to improve its competitive advantage manifested by superior operational performance including inventory reduction, customer satisfaction, cost reduction and lead time (COOPER; LAMBERT; PAGH, 1997; COOPER; ELLRAM, 1993; BECHTEL; JAYARAM; 1997; MENTZER *et al.*, 2001). However, despite its origins in the 1980s and its academic and practitioners debate, the SCM area still faces two important challenges: its theoretical development is still in its early stages and it lacks empirical evidence of its benefits. Harland *et al.* (2006) argue that the SCM is an emerging discipline: there is still no consensus or coherence about its definition or its constructs (BURGESS; SINGH; KOROGLU, 2006; CHEN; PAULRAJ, 2004; MENTZER *et al.*, 2001; GIBSON; MENTZER; COOK, 2005). The lack of a commonly accepted framework and clear constructs' definitions results in a fragmented literature, impairing knowledge advancement (BURGESS; SINGH; KOROGLU, 2006; CHEN; PAULRAJ, 2004; COUSINS; LAWSON; SQUIRE, 2006; HARLAND *et al.*, 2006) and creating additional difficulties to find empirical confirmations of its positive effect on firm performance (COUSINS; LAWSON; SQUIRE, 2006).

A great proportion to the literature reporting advantages of the SCM are anecdotal, in nature. Only recently, the empirical research has been trying to measure the SCM constructs and to define its measurement scales (CHEN; PAULRAJ, 2004; MIN; MENTZER, 2004), or to test the causal relationship between SCM and performance (SHIN; COLLIER; WILSON, 2000; MIN; MENTZER, 2004; WISNER, 2003; HARLAND *et al.*, 2006; GIMENEZ; VENTURA, 2005). The results are not conclusive yet, especially due to important differences in research design. While some researches refer to SCM as a multidimensional construct (e.g., CHEN; PAULRAJ, 2004; MENTZER *et al.*, 2004), some papers consider only some particular dimension of the strategy, like cooperation or long term relationship or assume SCM is an unidimensional construct (WISNER, 2003). Another key difference in the published studies

is the unit of analysis: the whole chain (MIN; MENTZER, 2004; WISNER, 2003), the buyer-seller relationship (CARR; PEARSON, 1999; NARASIMHAM; DAS, 2001) or manufacturing and distributor dyad (GRIFFITH; HARVEY; LUSCH, 2006). Additionally, most studies used non probabilistic samples, limiting generalizability.

Finally, there is no consensus on how to define and measure performance. Although there is an agreement that performance is a multidimensional construct that should reflect the firm strategy (VENKATRAMAN; RAMANUJAM, 1986; KAPLAN; NORTON, 1992; WARD *et al.*, 1998; BEAMON, 1999; GUNASEKARAN; PATEL ; TIRTIROGLU, 2001; NEELY; GREGORY; PLATTS, 2005; COMBS; CROOK; SHOOK, 2005), there is no evidence how it should be considered in empirical researches. Ray, Barney and Muhanna (2004) affirm that a specific strategy should be analyzed and empirically tested only in terms of operational results, as an antecedent of the financial performance. As they state, the firm performance is a combination of different processes of the firm and this makes it difficult to analyze the particular effect of the strategy. Combs, Crook and Shook (2005) add that it is mandatory to analyze the operational performance in its different dimensions (cost, delivery, quality and flexibility) to understand the nature of the effect and evaluate possible conflicts between them.

This paper, then, aims to answer the following research question: “Does the SCM has a positive effect on the operational performance for companies?” A survey with 103 respondents representing Brazilian companies was investigated and a positive relationship between SCM adoption and operational performance could be identified. The paper has specific contributions in its development. First, it offers a parsimonious, yet integrative method to measure the SCM construct. The measurement model based on a comprehensive literature review of the SCM literature interpreted by the theoretical perspectives of transaction-cost analysis (WILLIAMSON, 1991), resource based view (BARNEY, 1986;

DIERICKX; COOL, 1989; BARNEY, 1991, GRANT, 1991) and relational view (DYER; SINGH, 1998). This resulted in a model of SCM as a second order construct with four dimensions that can be used as a scale. Second, it measured operational performance using the competitive priorities and cumulative capabilities literature integrating two important streams of operations management: operations strategy and supply chain management. This approach covers performance in a much broader perspective than most studies and also allows an evaluation of the existence or non-existence of trade-offs in the impacts of supply chain. The results offered further support for the cumulative capabilities perspective. Third, building on the operations strategy literature it found support for the existence of a general operational competence mediating the relationship between supply chain management and improvement in performance in the several dimensions of competitive priorities.

This paper is structured as follows. In section 2, we present a literature review of SCM, its relationship to performance based on theoretical perspective and operational performance and competitive priorities. In section 3, we present the research framework and hypotheses. Section 4 presents the research methodology and data collection procedures. In section 5, results are analyzed and discussed and section 6 concludes with important implications of research, its limitations and new opportunities.

2. Literature review

2.1 Supply chain management

Since the term “supply chain management” was first used in the 1980s, the term has evolved from a process integration perspective (COOPER, LAMBERT, PAGH, 1997) to a more recent systemic and strategic view (MENTZER *et al.*, 2001). Probably due to its general boundaries and because it is still a discipline under development (Harland *et al.*, 2006), there

is no consensus of the SCM definition or its constructs yet (BURGESS; SINGH; KOROGLU, 2006; CHEN; PAULRAJ, 2004; MENTZER *et al.*, 2001; GIBSON; MENTZER; COOK, 2005).

Mentzer *et al.* (2001) define supply chain management 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(MENTZER *et al.*, 2001, p. 18).

Although it's not the unique definition, we decide to adopt it as it was developed based on an extended literature review and due to its broad conceptual definition. It means that two or more organizations assign efforts to implement a global strategy in order to improve competitive advantage.

As mentioned before, there is also no agreement on the SCM constructs. Following Burgess, Singh and Koroglu (2006), we consolidated the constructs proposed by researchers as Chen and Paulraj (2004) and Mentzer *et al.* (2004) by focusing on the commonalities amongst these lists, resulting in six main aspects of the supply chain management (information sharing, long term relationships, cooperation, process integration, risk and return sharing and agreed vision and goals). Based on the number of recent empirical researches published in the most important journals of operations (JOM; IJOPM and POM), this list was reduced with the main purpose of parsimonious (The appendix I presents a list of recent empirical papers reviewed). The final outcome was a list of four constructs: information sharing, long time relationship, cooperation and process integration. Information sharing is the continuous flow of communications between partners that occurs in a formal or informal way (CHEN; PAULRAJ, 2004; COOPER; LAMBERT; PAGH, 1997; MENTZER *et al.*, 2001). Long term

relationship assumes that the members of the supply chain are committed to the relationship investing in equipments and efforts in order to maintain the strategy (COOPER; ELLRAM, 1993; DYER; SINGH, 1998; GANESAN, 1994; DWYER; SCHURR; OH, 1987); Cooperation means that all organizations are assigning complementary resources in order to develop and implement strategic projects or processes and to solve conflicts (MENTZER *et al.*, 2001; COOPER; LAMBERT; PAGH, 1997; CHEN; PAULRAJ, 2004). Process integration considers that organizations will work together in order to have a continuous and efficient flow of materials and resources (COOPER; LAMBERT; PAGH, 1997; CHEN; PAULRAJ, 2004; MENTZER *et al.*, 2001). Table I summarizes the dimensions analyzed, its definitions and the recent empirical studies for the mentioned aspects.

Table I – Summary of constructs of SCM

Construct	Definition	Empirical papers
Information sharing	Continuous and frequent communication between partners that occurs in a formal or informal way	STUART; McCUTCHEON, 1996; CARR; PEARSON, 1999; SALVADOR <i>et al.</i> , 2001; NARASIMHAM; KIM, 2002; WISNER, 2003; CHEN; PAULRAJ, 2004; CHEN; PAULRAJ; LADO, 2004; MIN; MENTZER, 2004; GIMENEZ; VENTURA, 2005; COUSINS; MENGUC, 2006; KAUFMANN; CARTER, 2006; VEREECKE; MUYLLE, 2006; CARR; KAYNAK, 2007; KRAUSE; HANDFIELD; TYLER, 2007.
Long term relationship	Assumes that the members of the supply chain are committed to the relationship investing in equipments and efforts in order to maintain the strategy	CARR; PEARSON, 1999; SHIN; COLLIER; WILSON, 2000; NARASIMHAM; DAS, 2001; SALVADOR <i>et al.</i> , 2001; WISNER, 2003; CHEN; PAULRAJ, 2004; CHEN; PAULRAJ; LADO, 2004; MIN; MENTZER, 2004; CARR; KAYNAK, 2007; KRAUSE; HANDFIELD; TYLER, 2007.
Cooperation	All organizations are assigning complementary resources in order to develop and implement strategic projects or processes and to solve conflicts	STUART; McCUTCHEON, 1996; KRAUSE; HANDFIELD; SCANELL, 1998; COMBS; KETCHEN, 1999; SHIN; COLLIER; WILSON, 2000; NARASIMHAM; DAS, 2001; NARASIMHAM; KIM, 2002; VICKERY <i>et al.</i> , 2003; WISNER, 2003; CHEN; PAULRAJ, 2004; DROGE; JAYARAM; VICKERY, 2004; JOHNSTON <i>et al.</i> 2004; MIN; MENTZER, 2004; FYNES; VOSS; BÜRCA, 2005; GIMENEZ; VENTURA, 2005; VEREECKE; MUYLLE, 2006.
Process integration	Continuous flow of material across the chain, including supply, manufacturing and distribution activities	SALVADOR <i>et al.</i> 2001; NARASIMHAM; KIM, 2002; WISNER, 2003; CHEN; PAULRAJ, 2004; DROGE; JAYARAM; VICKERY, 2004; MIN; MENTZER, 2004; GIMENEZ; VENTURA, 2005; COUSINS; MENGUC, 2006.

2.2 Supply chain management and performance

The SCM concept and its impact on performance can be explained based on theoretical perspective, although few authors has been grounding their research on organizational theories (BURGESS; SINGH; KOROGLU, 2006; KETCHEN; HULT, 2007).

The transaction cost analysis (TCA), developed based on the concept that the transaction cost is an explanation for the existence of the firms proposed by Coase (1937), states that firms should adopt efficient governance mechanisms as a way to minimize the transaction costs, mainly caused by two behavioral assumptions: bounded rationalism, that makes difficult to decision makers to take decisions especially under uncertainty and opportunism, that considers self-interest behaviors (WILLIAMSON, 1991; GROVER; MALHOTRA, 2003).

The TCT is used to explain SCM aspects such as buyer-seller relationship or outsourcing decisions (SKJOETT-LARSEN, 1999; HOLCOMB; HITT, 2007), but it cannot give an overall explanation of the phenomenon. It assumes that companies will act in the same manner, under similar conditions, what cannot explain competitive advantage (HOLCOMB; HITT, 2007). Besides that, it does not consider social and psychological aspects such trust (SKJOETT-LARSEN, 1999) or value creation by the relationship (ZAJAC; OLSEN, 1993).

The SCM can also be explained by the resource-based view (RBV), that considers that firms are heterogeneous and achieve competitive advantage due to rare, valuable, inimitable and not substitutable resources and capabilities (BARNEY, 1986; DIERICKX; COOL, 1989; BARNEY, 1991; GRANT, 1991; PETERAF, 1993). Because firms should focus on their primary resources and capabilities, the RBV enhances the strategic alliances and outsourcing (SKJOETT-LARSEN, 1999; JARILLO, 1988). The information and knowledge sharing with partners also fosters innovation and cost reduction internally (MILES; SNOW; 2007). The RBV, however, should be broadened to consider the relationship as a source of competitive advantage (DYER, 1996; DYER; SINGH, 1998; RUNGTUSANATHAM *et al.*, 2003; HOLCOMB; HITT, 2007; KETCHEN; HULT, 2007).

The limitations of the TCT and the RBV to explain completely the SCM as a source of rents were surpassed by the development of the relational view – RV. The RV is an extension of the RBV that considers the relationship as a potential source of superior performance and also includes economic perspective (DYER; SINGH, 1998; RUNGTUSANATHAM *et al.*, 2003; HOLCOMB; HITT, 2007; KETCHEN; HULT, 2007). It states that there are four different sources of relational rents: 1. investments in relation specific assets, 2. substantial knowledge exchange, 3. complementary, but scarce resources and 4. lower transaction costs owing to more effective governance mechanisms, based on informal safeguards, such as trust and reputation (DYER, 1996; DYER, 1997; DYER; SINGH, 1998; HOLCOMB; HITT, 2007; RUNGTUSANATHAM *et al.*, 2003). As in the RBV perspective, the relational resources and capabilities should be rare, valuable, hard to imitate or to substitute in order to provide sustained competitive advantage.

2.2 Operational performance and competitive priorities

The competitive priorities literature (FERDOWS; DE MEYER, 1990; WARD *et al.*, 1998) in Operations Strategy can offer a useful approach to evaluate the operational impact of supply chain management on operational performance.

The idea of competitive priorities has its roots in the trade-off approach (SKINNER, 1969, 1974) according to which a manufacturing operation cannot perform in all dimensions and has to define priorities, hence the term competitive and the concept of focused factory proposed by Skinner (1974). The most basic competitive priorities were cost, quality, flexibility and delivery (BOYER; LEWIS, 2002; WARD *et al.*, 1998), but Leong, Snyder and Ward (1990) acknowledge the conceptual justification of a fifth, innovativeness, less explored in empirical studies with few exceptions (VICKERY; DROGE; MARKLAND, 1997).

The relationship between these competitive priorities is still subjected to debate within the operations management literature. Three approaches can be identified as indicated by

(BOYER; LEWIS, 2002): the trade-off, cumulative, and integrative models. The trade-off perspective takes the position that often a better performance in one dimension comes at the expense of another dimension where the operation will inherently have a lower performance. Since resources are scarce, management would need to prioritize and choose where to focus time and energy. This would inevitably cause a somewhat lower performance in dimensions not so critically prioritized. The trade-off concept and the related focused factory solution to it were originally proposed by the seminal papers of Skinner (SKINNER, 1969; 1974) and found some support in recent empirical papers (BOYER; LEWIS, 2002). The cumulative perspective considers the competitive priorities complementary rather than mutually exclusive. With intense and global competition with the help of advanced manufacturing technologies companies need to excel in all dimensions, breaking the trade-offs (CORBETT; WASSENHOVE, 1993). In fact, a stream of this literature attempts to identify a specific sequence of development of these capabilities like the “sand cone model” (FERDOWS; DE MEYER, 1990), but there is considerable debate about this sequence (FLYNN; FLYNN, 2004; NOBLE; 1995; ROSENZWEIG; ROTH, 2004). The integrative perspective attempts to explain the existence of both models. Hayes and Pisano (1996), drawing from the then emergent resource-based view of strategy, differentiated between first-order effects (those that affect the firm today) and second-order ones that relate to the consequence of capabilities the firm will develop dynamically. The trade off does not need to be present when this dynamic approach is considered since simultaneous improvement in several priorities is possible over time due to the development of capabilities. Schmenner and Swink (1998) added the concepts of operating and asset frontiers arguing that while trade off might exist for companies that are operating at the asset frontier, for plants where the operating frontier did not reach yet the limits of the asset frontier simultaneous improvement in priorities was perfectly possible.

The competitive priorities framework can also be thought as way to conceptualize and measure operational performance, or even competitiveness. Improvements in performance can manifest themselves in different aspects like inventory reduction, lead time reduction or different aspects of quality improvement. Grouping these types of improvements under the broader classes of competitive priorities as cost, quality, delivery and time can be a useful measurement approach allowing comparability, comprehensiveness and theoretical underpinning. The different priorities can be taken as different performance dimensions. Vickery *et al.* (1997) used a similar approach, but called these as dimensions of manufacturing strength. If the performance in each dimension is driven by a specific capability associated with this dimension the question whether what is being measured is the performance or the level of the capability is more semantic than practical.

This paper, attempted to measure the operational performance in each priority by asking respondents how they compare their performance in the aspects of the corresponding in each competitive priority. Each of these competitive priorities was treated as latent construct and several items were used to tap this construct.

The effect of supply chain management was then evaluated in each of these operational performance dimensions. Simultaneous positive effect in several dimensions is an indication of the lack of trade offs and further evidence in support for the cumulative capabilities perspective.

At conceptual level, one can ask whether the performance in these different operational dimensions is caused by the development of a generic, encompassing operational capability. This second order construct would manifest itself in each of the operational dimensions or specific operational capabilities associated to the priorities. Vickery (1991) suggested a similar construct, but as a formative construct where the several dimensions would be combined into this second order construct. In this research this construct is being proposed as

a reflexive one. The performance in each dimension is a consequence of its existence and the correlations between these dimensions are explained by the second order construct. In the formative model there is no need to have positive correlations between the dimensions. The existence of this second order construct was supported by data and it offers further support for the cumulative model.

3. Conceptual framework and hypothesis

The proposed frameworks are presented in figure 1. It assumes that the SCM is a multidimensional construct, that has a positive influence on the different dimensions of operational performance or competitive priorities (fig. 1.a). It also tests this relationship mediated by another construct, called operational competence (fig. 1.b).

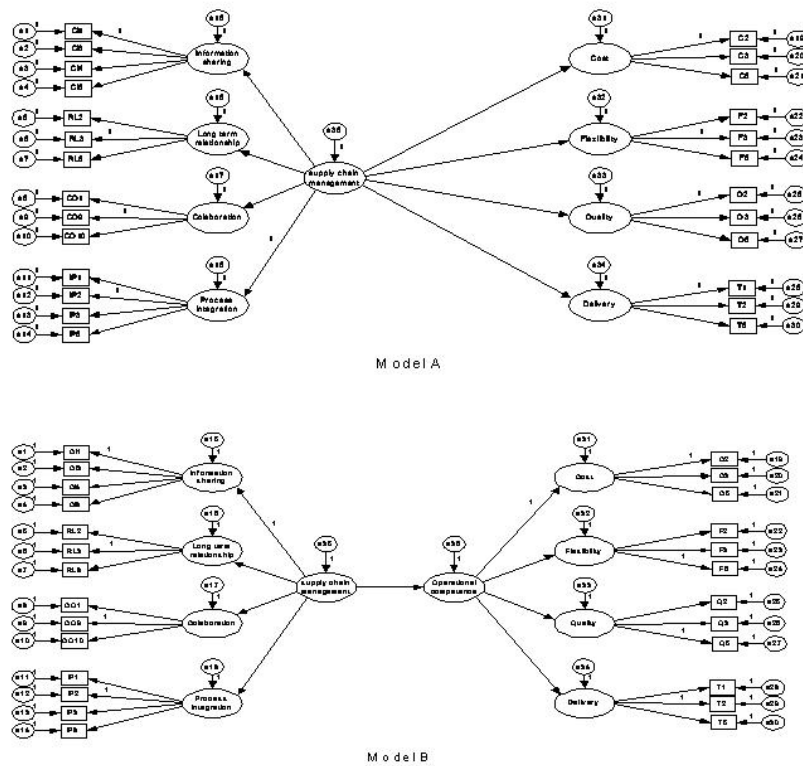


Figure 1 – Proposed research model

Each of the first order construct was measured through four indicators, in order to enhance the measurement instrument reliability (MALHOTRA; GROVER, 1998; FORZA, 2002). The relationship between SCM and operational performance is detailed as follows.

3.1 Supply chain management and operational performance.

The supply chain management can be a source of competitive advantage for companies, because cooperation, process integration, long term relationship, information sharing allow processes improvement and inventories and leadtime reduction (COOPER; LAMBERT ; PUGH, 1997; COOPER; ELLRAM, 1993; BECHTEL; JAYARAM, 1997; MENTZER *et al.*, 2001). The information sharing reduces uncertainty in the whole chain, resulting in better planning and control processes (LEE; PADMANABHAM; WHANG, 1997). Cooperation and processes integration between members of the same chain result in cost and time reduction and quality and flexibility improvements, as each organization can focus on its core competencies (JARILLO, 1988) and an effective governance mechanism is chosen (GROVER; MALHOTRA, 2003). Additionally, valuable, rare, non imitable and non substitutable resources are source of competitive advantage.

Empirically, it was shown that cooperation and long term relationship have positive effect on quality and delivery (SHIN; COLLIER; WILSON, 2000; DYER, 1996), as well as in time reduction (SALVADOR *et al.*, 2001; VICKERY *et al.*, 2003). External integration also results in time improvements, as processes design, development and improvements are developed simultaneously (DROGE; JAYARAM; VICKERY, 2004). Min and Mentzer (2004) also concluded that SCM as a multidimensional construct impacts the firm performance as a whole.

Therefore, our researches hypotheses are:

H1: The supply chain management is positively related to cost performance.

H2: The supply chain management is positively related to quality performance.

H3: The supply chain management is positively related to delivery performance.

H4: The supply chain management is positively related to flexibility performance..

Because at conceptual level, the performance in these different operational dimensions is caused by the development of a generic, encompassing operational capability, a fifth hypothesis is added:

H5: The operational competence mediates the relationship between supply chain management and the different competitive priorities.

The proposed model (Fig. 1) shows the hypothesized relationships among the independent variable *supply chain management* (SCM) and the five dependent variables: *cost* (C), *quality* (Q), *flexibility* (F) and *delivery* (T) in model **a** and *operational competence* (O.C.) in model **b**.

4. Methodology

The main purpose of this study was to test the relationship between SCM and operational performance, developing a measurement scale for each of those constructs. A survey research design was then used to collect data for the scale development. The items tapping the theoretical constructs were developed based on extensive literature review of the recent empirical studies in the area of supply chain management and were reviewed with academics in order to reduce the list to four to six questions per construct. Each construct was measured using multiple questions, in order to increase the scale reliability (MALHOTRA; GROVER, 1998; FORZA, 2002). The constructs related to SCM were measured on a five-point Likert scale with anchors ranging from strongly disagree (1) to strongly agree (5). Regarding the dependent variables, the respondents were asked to indicate their performance compared to their competitors, classifying it from much worse (1) to much better (5).

Prior to sending the questionnaire to the final sample, a pre-test was performed to identify problems of questions understanding, clarity and ambiguity and to assess measurement reliability (FORZA, 2002). Final instrument was then refined and questionnaire was sent to final samples (Appendix II).

4.1 Data collection

The target firms were not limited to a specific industry, but open to different firms. Therefore, the questionnaire was sent to three different samples: companies drawn from the CEBRALOG directory (aprox. 6950 firms), respondents in the personal network of the researchers (193 companies) and students of executive logistics courses of FGV (another 167 contacts). The samples answers were compared using ANOVA with results showing no evidence of bias being a problem.

A cover letter of the research was sent by e-mail to respondents, inviting them to access the on-line questionnaire. For safety purposes, a password was requested and only one answer per computer was allowed. To assure that there was only one respondent per firm, IP was also controlled. In order to increase the return rate of the survey, a reminder of the research was sent two weeks after the first wave (FORZA, 2002). 140 responses were received, 33 were discarded due to incomplete information or repeated firms, resulting in an effective return rate of 1,4 % (103 valid responses). Despite the low number of responses, it was considered satisfactory for a statistical treatment of the data. The respondents were directors (15%), managers (47%), supervisors (21%) and others (18%). The final sample was constituted for firms of more than 20 industries, with different range of employees, but with revenues predominantly above US 30 million.

5. Data analysis

Structural equation modeling (SEM) was used as the main statistical analysis tool in two stages: first for the measurement model, using confirmatory factor analysis and, secondly, to test the hypothesized relationships using path analysis (ANDERSON; GERBING, 1988).

The first analysis consisted of a descriptive analysis of the variables, performed for an examination of mean, minimum and maximum values, standard deviation and normality tests (kurtosis and skewness). No indication of serious violations was detected.

5.1 Measurement models

To carry out the structural equation modeling, we used the statistical software package AMOS 7.0. In the present stage, the data were first examined to check unidimensionality, reliability and validity (convergent and discriminant) of measurement scales in the analysis of SCM and operational performance individually, as presented in figure 2.

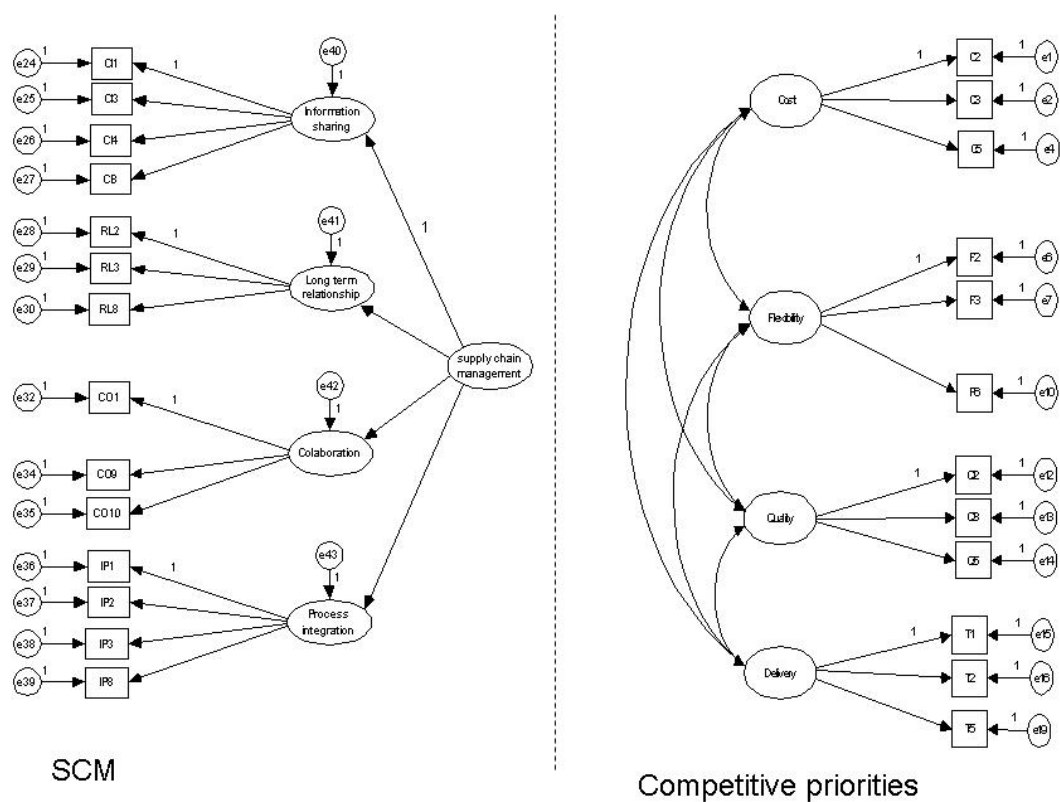


Figure 2 – Measurement models for SCM and competitive priorities

Unidimensionality was ensured by the literature review and item generation process and confirmed by the confirmatory factor analysis. Reliability was assessed using Cronbach alpha values, which were all above 0.7 (NUNALLY; BERNSTEIN, 1994; CHEN; PAULRAJ, 2004; DEVELLIS, 2003).

Convergent validity can be assessed through the individual item loadings, while the discriminant validity can be assessed comparing these loadings with the average shared variance between two constructs. According to Hair *et al.*, 2005, an evidence of convergent validity is provided by individual loadings higher than 0.5. All individual loadings varied from 0,45 to 0,88 and were considered appropriate, as they were strongly based on literature. The results for the discriminant validity showed that some of the constructs were highly correlated (information sharing and cooperation; information sharing and long term relationship and cooperation and process integration; cost and flexibility and cost and time). However, because they are related to multidimensional constructs of second order, the discriminant validity is more difficult to access and is particularly critical when an investigator develops a measure of new construct that may be redundant (SCHWAB, 2005, p. 28, 34). Therefore, the results, presented in tables II and III were considered satisfactory.

Table II – Reliability and construct validity results for SCM

	Cronbach alpha values	Individual item loadings	Average shared variance			
			CI	LTR	CO	IP
Information sharing (CI)	0,88	0,65	1,00	0,93	0,90	0,72
Long term relationship (LTR)	0,86	0,63	0,93	1,00	0,76	0,60
Cooperation (CO)	0,84	0,58	0,90	0,76	1,00	0,75
Process integration (IP)	0,93	0,78	0,72	0,60	0,75	1,00

The method chosen for estimation was the maximum likelihood ratio (ML) and the models were compared using multiple fit indexes in order to have a better understanding of the results (ANDERSON; GERBING, 1988; LOEHLIN, 2004; HAIR *et al.*, 2005; SHAH; GOLDSTEIN, 2006).

Table III – Reliability and construct validity results for operational performance

	Cronbach alpha values	Individual item loadings	Average shared variance			
			C	F	Q	T
Cost (C)	0,77	0,46	1,00	0,40	0,45	0,57
Flexibility (F)	0,87	0,58	0,40	1,00	0,19	0,44
Quality (Q)	0,86	0,61	0,45	0,19	1,00	0,63
Delivery (T)	0,85	0,55	0,57	0,44	0,63	1,00

The overall model fit was analyzed through the use of the Chi-square test (χ^2) and the ratio of χ^2 and the degrees of freedom – DF (CMIN/DF). CMIN/DF lower than 2 suggests an acceptable fit for the hypothetical model, when used for samples between 100 and 200 data. A CMIN/DF between 2 and 3 is considered satisfactory. An alternative model fit, Tucker Lewis index – TLI, was used to compare alternative models. A value close to 0,95 reflects a good model fit (SCHUMACKER; 2004). The comparative fit index (CFI) was used to compare the proposed model to baseline models. CFI values near or higher than 0,9 represent a good indicator of model fit (HAIR *et al.*, 2005). Goodness-of-fit index (GFI) and adjusted goodness-of-fit index (AGFI) were used to evaluate the parsimony of the proposed model. GFI is less than or equal to 1.00 A value of 1.00 indicates a perfect fit, while the AGFI is bounded above by 1.00 (SCHUMACKER, 2004). Root-mean-square error of approximation (RMSEA) was used to assess the model fit based on the population discrepancy. RMSEA between 0,05 and 0,08 are considered appropriate, but values of RMSEA lower than 0,1 are considered satisfactory (HAIR *et al.*, 2005). Shumacker (2004) defines that an acceptable level of RMSEA is bellow 0,05. Results are presented in table IV.

Table IV – Measurement models fit for SCM and competitive priorities

	CMIN	DF	CMIN/DF	TLI	CFI	GFI	AGFI	RMSEA	LO 90	HI 90
SCM	88,07	73	1,207	0,984	0,987	0,897	0,852	0,045	0,000	0,076
Competitive priorities	62,74	48	1,307	0,959	0,970	0,908	0,851	0,055	0,000	0,090

Both models presented very good fits and were considered satisfactory as measurement models.

5.2 Relationship between SCM and operational performance

The causal relationship between SCM and operational performance was tested using path analysis for the two different models (A and B). The results are presented in table V and we will comment first model A, and later model B. All indexes are acceptable for both models, with model b presenting better fit.

Table V – Path analysis fit

	CMIN	DF	CMIN/DF	TLI	CFI	GFI	AGFI	RMSEA	LO 90	HI 90
Model A	473,62	291	1,628	0,886	0,898	0,747	0,695	0,078	0,065	0,091
Model B	414,37	290	1,429	0,922	0,930	0,771	0,722	0,065	0,050	0,079
Model A – Model B										
CMIN(A)–CMIN(B)	59,25									
DF(A) – DF(B)	1									

The results suggest that hypotheses 1 to 4 are supported, loads linking supply chain management to the four competitive priorities were all statistically significant ($p < 0.001$) and in the expected directions as presented in Figure 3. This can be seen as an empirical evidence of the simultaneous positive impact of SCM in all operational performance dimensions, offering further support for the cumulative capabilities perspective of operational strategy.

The findings also reinforce the results obtained in other studies (SHIN; COLLIER; WILSON, 2000; NARASIMHAM; DAS, 2001; SALVADOR et al., 2001; VICKERY et al., 2003; WISNER, 2003; DROGE; JAYARAM; VICKERY, 2004, JOHNSTON et al., 2004; CHEN; PAULRAJ; LADO, 2004; FYNES; VOSS; BÚRCA, 2005; GIMENEZ; VENTURA, 2005; KAUFMANN; CARTER, 2006; COUSINS; MENGUC, 2006; CARR, KAYNAK, 2007), what increases the chances of generalizations of empirical research on the subject of supply chain management.

The main contribution of the present study, however, is on the integrative tested model. While some researches studied the effect of specific practices in a particular dimension of operational performance, such as time (DROGE; JAYARAM; VICKERY, 2004), quality (CARR; KAYNAK, 2007, customer service level (VICKERY et al. , 2003; CHEN; PAULRAJ, LADO, 2004) or logistics performance (GERMAIN; IYER; 2006), others considered operational performance as a first order construct (PRAHINSKI; BENTON, 2004,

JOHNSTON et al., 2004; GIMENEZ, VENTURA, 2005; GRIFFITH; HARVEY; LUSCH, 2006; KRAUSE; HANDFIELD; TYLER, 2007). The literature review of the recent empirical researches identified only two that consider the various aspects of operational performance (SHIN; COLLIER; WILSON, 2000; FYNES; VOSS; BÚRCA, 2005). While Fines, Voss and Búrca (2005) analyzed the impact of the supply chain dynamics on the manufacturing performance, Shin, Collier and Wilson (2000) measured supply chain management as a first order construct.

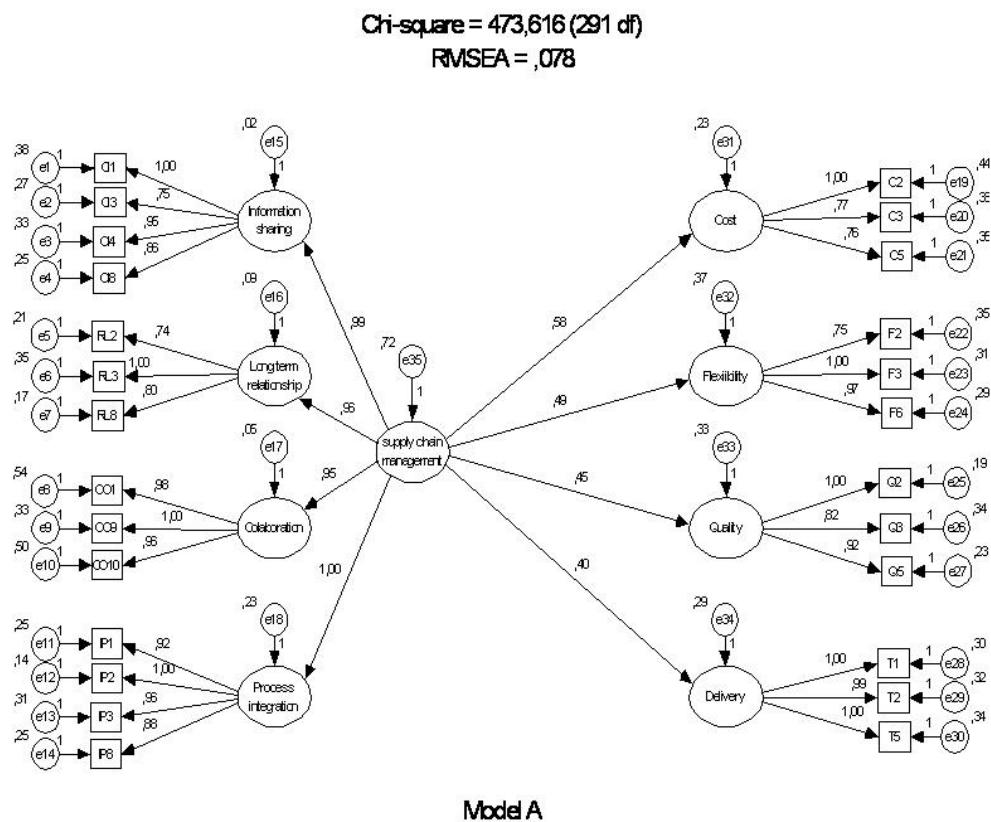


Figure 3 – Path analysis coefficients related to the proposed model A (standardized results)

Model B results are presented in Figure 4 where a new mediating construct, named operational competence, was introduced. This construct could be considered as the overall impact for the company involved of the adoption of the SCM concept. Following Ketchen, Hult and Thomas (2007) and drawing from the resource-based literature (BARNEY, 1991; PETERAF, 1993) and relational-view (DYER; SINGH, 1998) this competence would be a

resource that has a positive impact in the several dimensions of operational performance. All loads presented in Figure 5, linking SCM with operational competence and the latter with the operational performance dimensions of cost, flexibility, quality and delivery were significant ($p < 0.001$) and positive. Hypothesis 5 was thus confirmed. This model can be compared with model A, since the two can be considered nested and the chi-square difference is a statistical test that can be used to compare the fit of the two solutions. Model B has a statistically significant superior fit since the chi-square difference is 59.25 exceeds 10.83 that corresponds to the chi-square distribution with one degree of freedom and $p = 0.001$.

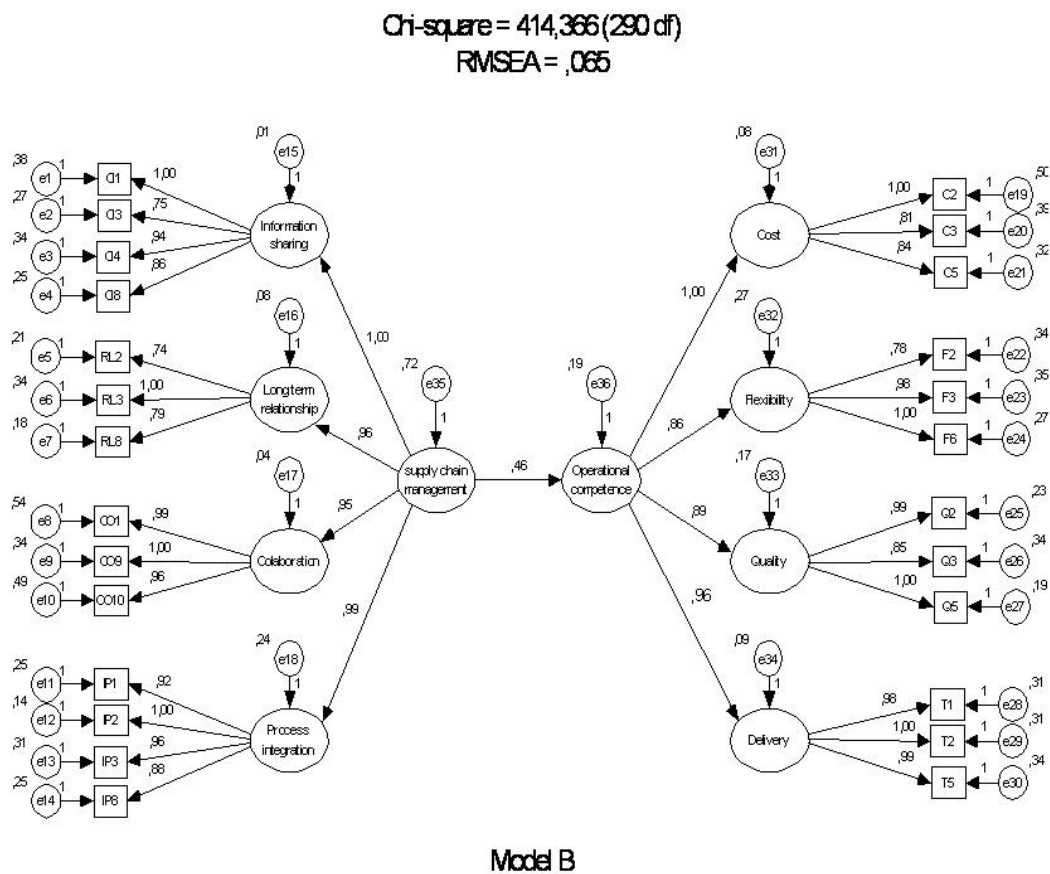


Figure 4 – Path analysis coefficients related to the proposed model B (standardized results)

6. Conclusions and directions for future research

This study contributes to and extends a growing research stream related to the strategic role of supply chain management in the operational performance. Specifically, we investigated the

impact of the supply chain management as a multidimensional construct (information sharing, long term relationship, cooperation and process integration) on the operational performance as a second order construct and on the different competitive priorities (cost, flexibility, quality and time).

The empirical study provided evidences of a positive impact of the SCM on the operational performance, reinforcing the results of other empirical researches (SHIN; COLLIER; WILSON, 2000; NARASIMHAM; DAS, 2001; SALVADOR *et al.*, 2001; VICKERY *et al.* 2003; WISNER, 2003; DROGE; JAYARAM; VICKERY, 2004; JOHNSTON *et al.*, 2004; CHEN; PAULRAJ; LADO, 2004; FYNES; VOSS; BÚRCA, 2005; GIMENEZ; VENTURA, 2005; KAUFMANN; CARTER, 2006; COUSINS; MENGUC, 2006; CARR, KAYNAK, 2007) and increasing the generalization possibilities.

The main contribution of the present study, however, resides on the integrative model that tested SCM and operational performance as multidimensional constructs. The previous researches has been studying only partially this relationship, as they tested the impact of SCM as a unidimensional construct on a multidimensional operational performance (SHIN; COLLIER; WILSON, 2000; FYNES; VOSS; BÚRCA, 2005) or the impact of the SCM on different competitive priorities (DROGE; JAYARAM; VICKERY, 2004; CARR; KAYNAK, 2007; VICKERY *et al.*, 2003; CHEN; PAULRAJ, LADO, 2004; GERMAIN; IYER; 2006). The findings of this study suggested that SCM impacts positively the operational performance as a whole and also all the competitive priorities, providing support for the cumulative capabilities perspective.

This research provides new insights for the SCM program. From a managerial perspective, it reinforces the importance of a set of practices that enhances the competitive advantage. They can use the measurement scale to evaluate their relationship with suppliers and identify possible gaps in their operations. It also support the cumulative capabilities perspective by

showing that the strategy has a positive impact in all competitive priorities and lack of trade offs.

It's important to highlight the limitations of this research. The small size of the sample and the use of non probabilistic sample do not allow to generalize the results beyond the respondents. Additionally, some constructs of supply chain management were not considered in the proposed model due to the complexity of the questionnaire. New researches should include aspects such as risk and return sharing or common vision and goals to broad the SCM concept. New research should consider the whole chain as the unit of analysis and should consider the performance of the whole chain to evaluate the main benefits of SCM.

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Appendix I – Empirical researches

Carr, Amelia S.; Kaynak, Hale, 2007. "Communication methods, information sharing, supplier development and performance." *International Journal of Operations and Production Management*, v. 27, p. 346-370. Carr, Amelia S.; Pearson, John N., 1999. "Strategically managed buyer-supplier relationships and performance outcomes." *Journal of Operations Management*, v. 17, p. 497-519. Chen, Injazz J.; Pauraj, Antony; Lado, Augustine A., 2004. "Strategic purchasing, supply management and firm performance." *Journal of Operations Management*, v. 22, p. 505-523. Combs, J.G.; Ketchen, D.J., 1999. "Explaining interfirm cooperation and performance: toward a reconciliation of predictions from the resource-based view and organizational economics." *Strategic Management Journal*, v. 20, n. 9, p.867-888. Cousins, Paul D.; Menguc, Bulent, 2006. "The implications of socialization and integration in supply chain management.", *Journal of Operations Management*, v. 24, p. 604-620. Droge, Cornelia; Jayaram, Jayanth; Vickery, Schawnee K., 2004. "The effects of internal versus external integration practices on time-based performance and overall firm performance.", *Journal of Operations Management*, v. 22, p. 557-573. Fynes, Brian; Voss, Chris; Búrca, Seán de, 2005. "The impact of supply chain relationship dynamics on manufacturing performance.", *International Journal of Operations and Production Management*, v. 25, n. 1, p. 6-19. Gimenez, Cristina; Ventura, Eva, 2005. "Logistics-production, logistics-marketing and external integration. Their impact on performance." *International Journal of Operations and Production Management*, v. 25, n. 1, p. 20-38. Johnston, David A. *et al.*, 2004. "Effects of supplier trust on performance of cooperative supplier relationships", *Journal of Operations Management*, v. 22, p. 23-38. Kaufmann, Lutz; Carter, Craig R., 2006. "International supply chain relationships and non financial performance – A comparison of US and German practices.", *Journal of Operations Management*, v. 24, p. 653-675. Krause, Daniel R.; Handfield, Robert B.; Scanell, Thomas V., 1998. "An empirical investigation of supplier development:

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Appendix II

Information sharing

- CI1 We share information (financial, production, design, etc.) with our suppliers.
 CI3 Exchange of information with our supplier (formal or informally) is frequent.
 Any event or change that might affect the other party is immediately communicated to
 CI4 other.
 CI8 Any information that might help the other party is provided for them.

Long term relationship

- RL2 The suppliers see our relationship as a long term alliance.
 RL3 The relationship with this supplier is based on a long term project.
 Both parties (this firm and its suppliers) foster the long term relationship based on
 RL8 cooperation.
 RL9^a We expect our relationship with this supplier to last a long time.

Cooperation

- CO1 Our key suppliers are involved in new processes and product development
 CO5^a There are meetings / conferences with our suppliers to discuss sales forecast and planning.
 CO9 Both parties (this firm and its supplier) establish jointly objectives.
 CO10 There are cross-functional teams with our suppliers for continuous improvement

Process integration

- IP1 Interorganizational logistics activities are closely coordinated.
 IP2 Our logistics activities are well integrated with the logisitcs activities of our suppliers.
 Our distribution, warehousing and transport processes are integrated with our suppliers’
 IP3 processes.
 IP8 The materials flow between organizations is effective.

Cost

C2	Production cost
C3	Inventory turnover
C4 ^a	Capacity utilization
C5	Productivity

Flexibility

F1 ^a	Volume flexibility
F2	Process flexibility
F3	Customization flexibility
F4 ^a	New products into production flexibility
F5 ^a	Product <i>mix</i>
F6	Rapid capacity adjustments

Quality

Q1 ^a	Product performance
Q2	Number of defects
Q3	Conformance to design specs
Q4	Number of customer's complaints

Delivery

T1	Delivery time
T2	On-time delivery
T3 ^a	Production cycle time
T4 ^a	New products time to market
T5	Time to solve customers complaints
T6 ^a	Customer order processing time

^aDiscarded in the measurement model process

NOTE: The indicators scales kept the original indexes prior to scale refinement and academics reviewers.

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