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Keywords: *supply chain management, maturity, concept, framework.*

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Maturity and Conceptual Dimensions of Supply Chain Management: Establishing a Structural Model

Jeanfrank T. D. Sartori [α] & Guilherme F. Frederico [σ]

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I. Introduction

Interest in the concept of supply chain and its management emerged from the 1980s by a few researchers and companies, although some of its fundamental assumptions are even older. In the second half of the 1990s the issue became the focus for various publications and was also the time in which more shimmered companies could get benefits of collaborative relationships within and beyond its internal limits (LUMMUS; VOKURKA, 1999; COOPER; LAMBERT; PAGH, 1997).

Since then, the importance of researches focused on the Supply Chain Management (SCM) have grown significantly due to the increasing comprehension by companies of its potential to generate value adding opportunities to their businesses and competitive advantage gains, which are critical in today's global market.

Jashnsadeh and Fard (2016) have demonstrated that the relationship between supply chain and competitive advantage is significant with 99% of confident, what is proven by the data collected by their research. It is needless to say how important competitive advantage is crucial on nowadays global market.

According Lockamy and McCormack (2004), as the organizations are no longer being viewed as a collection of functional areas and the prospect of integrated processes in a horizontal manner along them have become a strategy, it is necessary to evolve the concept of process maturity for supply chain management.

However, Lockamy and McCormack (2004) claim there are still few studies related to the concept of maturity. According to Oliveira (2009), the existing models for chain management supplies still are in an embryonic stage and some adjustments are needed to improve its explanatory power on this field.

There are various models developed by several authors among which stand out Stevens (1989), Ayers and Malmberg (2002), Lockamy III and McCormack (2004), Daozhi et al. (2006), Performance Measurement (2007), Oliveira (2009) and Frederico (2012)because they are more specific to the Supply Chain Management.

These various models present different dimensions to the analysis of maturity as well as different scales to it. There are also some variables that are repeated in different models, sometimes with alternative nomenclatures but similar meaning.

Frederico (2012) proposed a unique set comprising all dimensions presented by these different authors, as well as one single maturity scale. However, despite this author claims that "As these dimensions evolve over time, the greater becomes the level of integration and skills of supply chain management"), there are still gaps to be better understood since the relationship between the dimensions and SCM's maturity was not the object of that study. One of deployed and opened research question from Frederico (2012) study is about the relationship between SCM maturity dimensions and concepts.

Thus, the aim of this article is to propose a single theoretical model that inter-relates the eleven dimensions identified at the literature and enable a greater understanding of how the maturity of each impacts the resulting maturity of the entire chain.

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II. Methodology

According to Hodgkinson, Herriot and Anderson (2001), applied social science can be divided in four groups (Popularist Science, Pedantic Science, Puerile Science and Pragmatic Science) of which only the 'Pragmatic Science' balances both rigour and relevance. In that type of science resides the systematic literature reviews, serving both for the academic and practice purposes.

Tranfield, Denyer and Smart (2003) states that the systematic literature review is in relative infancy state although there is some consensus about its methodological characteristics. Based on other authors, they make reference of three main stages of the method: planning the review, conducting the review and reporting and dissemination.

The present paper is mainly the result of stage three of a developed systematic literature review and, therefore, aims to produce a pragmatic science. A relative large number of articles have been reviewed, using main electronic databases as major source, aiming to present the SCM conceptual and maturity dimensions and, based on it, a propose have been made for a collection of relationships between those conceptual dimensions of supply chain management and it's maturity, stablishing a potential framework that represents e describes those relations.

III. Supply Chain Management Concepts

Basically, the concepts of Supply Chain found on the literature can be divided in two main groups: (1) supply chain as a set of activities and processes; (2) supply chain as a set of entities. In terms of this article, the concept adopted is a set of organizations involved, working in activities towards the upstream and downstream chain, existing company-focus with the central role within the supply chain, as proposed by Christopher (2005) and Pires (2009).

The dissemination of the notion of supply chain management (SCM) has been promoted by many different areas and it's specifics origins are unclear, although likely emerged from within physical distribution and transport (CHEN;PAULRAJ, 2004).For Chen and Paulraj (2004), SCM has three main groups: driving forces (Environmental uncertainty, Customer Focus and Information Technology), critical elements (Strategic Purchasing, Supply Network Coordination, Logistics Integration and Supply Management) and performance (supplier performance and buyer performance).

According to La Londe and Masters (1994), supply chain management is the major logistics strategy that will endure in the 21th century. Cooper, Lambert and Pagh (1997), states that SCM is the integration of end customers to suppliers, business processes that generate products, services and information, adding value to customers.

Thus, Cooper, Lambert and Pagh (1997) propose a conceptual model for supply chain management, based on three major and related elements: business processes, management components and supply chain structure, as shown in Figure 1.

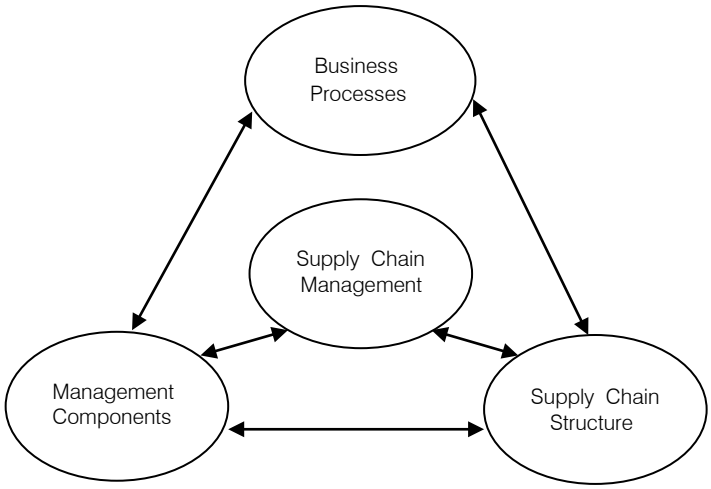


Figure 1: Elements in the Framework of Supply Chain Management. Cooper, Lambert e Pagh., 1997, p.6.

According to these authors, business processes are activities that produce a specific resulted value to the client. The management components are those by which business processes are structured and managed. Finally, the supply chain structure is the setting in which companies form within it.

Lummus & Vokurka (1999) understand that the SCM is the coordination and integration of existing activities in this chain. A key point management is the need to see the whole process as a single system.

Mentzer et al. (2001) understand that the concept has three lines of thought: supply chain management as a philosophy of management, supply

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chain management as a set of activities to implement a philosophy of management and supply chain management as a set of management processes.

On the first conceptual row, Mentzer et al. (2001) stateit comprises three main features. They are: (1) systemic approach to the supply chain view as a whole and not as a set of parts; (2) the strategic orientation toward cooperative efforts in search of an optimization of the entire chain; and (3) focus on customer value generation to the relationship in the entire chain. In the case of conceptual line related to supply chain management as the implementation of a philosophy, these authors point out that it is linked to a set of activities that transforms philosophy into practice. These activities are related to integrated practices, information sharing to, the risks and rewards, the cooperation, the uniform focus to the customer along the chain and long-term relationships between partners.

With regard to the conceptual line related to the supply chain management as a set of processes according to Mentzer et al. (2001), some authors have adopted this approach, in which the supply chain management is carried out through key processes, from the initial point of the chain, related to the integration of the chain of entities, the information flows and the material flow, seeking the service to the end customer with added value.

Mentzer et al. (2001), justifying that there are many definitions on supply chain management, propose a single definition aligned with a conceptual framework presented in Figure 2.

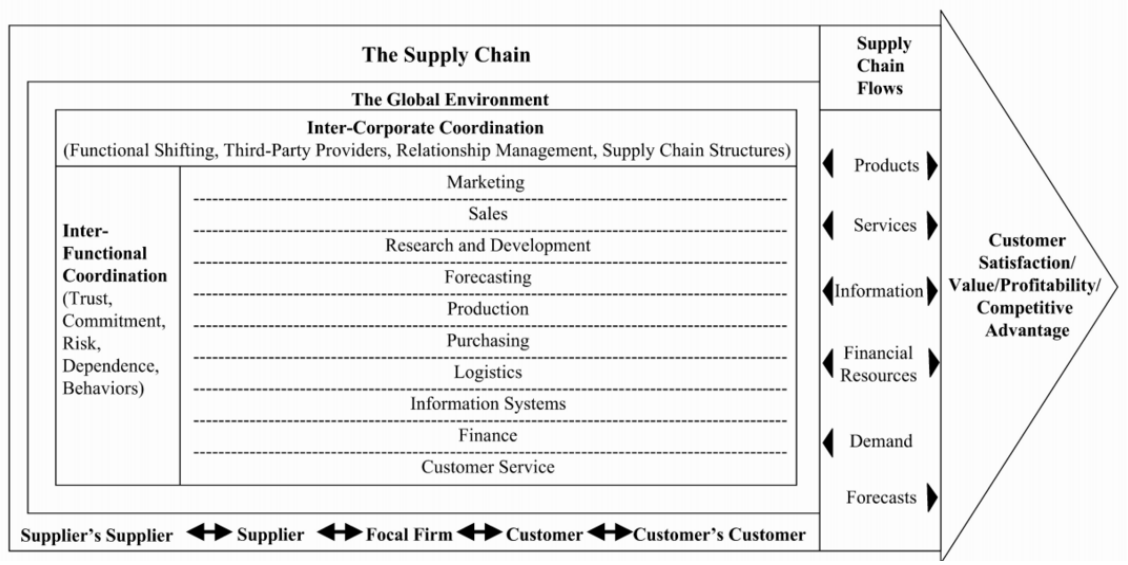


Figure 2: A Model of Supply Chain Management. Mentzer*et.al*.2001, p. 19.

According to these authors, the supply chain management is defined as the strategic and systemic coordination of traditional business functions and the tactics across these functions within a company and own chain in order to improve performance in the long term throughout the supply chain, as well as each company that composes.

For Simchi, Kaminsky and Simchi (2003), SCM is the set of approaches used to efficiently integrate suppliers, factories, warehouses and retail, so that the goods are produced and distributed in the right quantities in the right places at the right time in order to minimize the costs of the entire system and satisfy service levels required by customers.

According to Christopher (2005), supply chain management deals with the company's relationships with suppliers and customers before and after the process of transforming raw materials into products, seeking to generate more value for those customers with the lowest cost for the chain as a whole.

The Council of Supply Chain Management Professionals - CSCMP (2009) defines supply chain management as the planning and management of all activities involved with purchases of resources and raw materials, processing into final products and all activities of logistics management. In this management also would include the coordination and collaboration with channel partners, which can be suppliers, intermediaries, logistics and customer service providers. According to this organization, logistics management is within the supply chain management, and its management comes down to planning, implementation and control of goods and storage of goods flows, services and information between the point of origin to the destination point to bring together all customer requirements.

Stock and Boyer (2009) states that there is a difficulty in havinga single definition for supply chain management. For these authors, some definitions focus on the participating members of the chain and activities,

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while other settings, the physical flow and interorganizational collaboration within the chain.

Stock and Boyer (2009) conducted a study identifying all existing supply chain management on definitions in the literature since 1995. They found that most definitions occurred between 1995-2000.

Identifying the approaches mentioned by all these definitions in literature, Stock and Boyer (2009) proposed a definition, seeking to reach a consensus by the management concept of proposed supply chain of several authors.

According to Stock and Boyer (2009) supply chain management is the management of a network of relationships within an organization and between organizations and interdependent business units composed of suppliers, shopping area, manufacturing facilities, logistics, marketing and systems related to flow downstream and upstream materials, services, financial and information from the original supplier to the end customer, aiming to add value, maximize profitability and meet customers' need.

According to Ballou (2001), supply chain management is a term that encompasses the essence of integrated logistics and even surpasses it, since it highlights the logistical interactions that occur between marketing, logistics and production functions within the framework of an organization.

Therefore, with regard to the concept of supply chain management, the understandings presented in the literature, are that it can be seen as:

- The integration of business processes that generate products and services from suppliers to end customers;
- The coordination and integration of existing activities in the chain;
- The relationship management within an organization and between interdependent organizations;
- The strategic and systemic coordination of the traditional functions of business and tactics of these functions along the chain;
- The set of approaches used to efficiently integrate the entities present in the chain;
- The planning and management of all activities involved in chain;
- A management model that seeks to obtain synergies through integrating processes along the chain.

IV. Maturity in Management

Maturity is a theme extensively explored in recent by researchers in business management area, focusing on a wide variety of areas. Maturity is by definition the state achieved in a process, in which it is better developed and its most advanced state (OXFORD, 2011). The concept of maturity emerged in quality management area, when Crosby (1979) proposed the improvement of quality through five levels of maturity in a model called the maturity grid. The levels are: (1) Uncertainty; (2) Awakening; (3) Enlightenment; (4) Wisdom; and (5) Certainty.

Harter, Krishnan and Slaughter (2000) proposed, based on the Capability Maturity Model - CMM, a model for software development. Kwak and Ibbs (2002) present a model for project management. Attadia and Martins (2003) propose a study suiting performance measurement systems to the stages of evolution of the continuous improvement process, using as a basis the model developed by Bessant et al. (2001).

Venkatraman and Henderson (1998) propose a maturity model that seeks to demonstrate the stages for an organization to reach a level of organization and virtual integration in three dimensions: customer interaction (virtual meeting), asset configuration (search for virtual integration) and (leverage knowledge) virtual excellence.

For each of these dimensions the same authors propose three stages of development, in which the virtual meeting evolves from a remote experience for a fully integrated environment with customers, the configuration of assets, which seeks virtual integration, evolving from separate modules for a total of resources coalition and the monitoring and increased knowledge evolves from a concentration of intellectual capital in work units isolated to an intellectual capital formed throughout the organization.

Another model of well-known and widespread maturity is the Software Engineering Institute (SEI) of Carnegie Mellon University (Vaidyanathan and HOWELL, 2007; HARTER, Krishnan and SLAUGHTER, 2000), which since 1991 started the development of the Capability Maturity Model (CMM) focused on software development.

Currently there are other models, involving a version integrated as software engineering, integrated product development and search for suppliers and a newer version (version 1.2 -Capability Maturity Model for Services). This version is the process of providing services (SEI, 2009).

Regarding organizational processes, Hammer (2007) proposes a maturity model based on two elements: facilitators of organizational processes and skills. According to this author, so that processes become more mature and allow better performance is achieved the following facilitators are needed: project (process design), executors, owner (responsible), infrastructure (information and management system to support) and metrics.

Likewise Hammer (2007) also lists as required to assess the maturity organizational skills that are: leadership (which allows you to create and deploy processes), culture (related to customer focus, teamwork and enthusiasm for change), experience (skill

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and method in relation to the processes) and governance (mechanism to manage complex projects and change initiatives).

With regard to studies involving maturity models, stands out among these, the work of Harter, Krishnan and Slaughter (2000) applied the CMM to product development, specifically software. Another study about maturity models was developed by Kwak and Ibbs (2002) presenting a model for project management. According to these authors the maturity of project management is the level of sophistication that evaluates the practices and processes of project management at the time in which this management is. For these authors, each maturity level comprises the main features, factors and processes of project management.

As shown, the same as in other areas, some studies involving the presentation of maturity models in supply chain management have been developed, which will be presented in the next section of this chapter.

V. Maturity on Supply Chain Management

Specifically for the area of supply chain management, about six major models were found in the literature. Stevens (1989) presented an approach to the concept of supply chain maturity, consisting of a four-stage evolution in relation to its level of integration. According to the author, a supply chain gains greater competitive advantage as its level of integration increases driven by business needs.

Ayers and Malmberg (2002) proposes a maturity model that consists of five stages of evolution in supply chain management. According to these authors, to achieve the stages higher, new skills are required, considering the current stage that the organization is in terms of practices of supply chain management. The stages that make up the model with their respective features are: Dysfunctional, Infrastructure Cost Reduction, Collaboration and Strategic Contribution.

According to these authors, maturity takes into account a process has a life cycle and is measured by the extent to which it is explicitly defined, managed, measured and controlled. Based on these five stages of maturity and relating them with the four basic areas of the SCOR model (plan, source, make and deliver), Lockamy and McCormack (2004) built a model for supply chain management, which has the following characteristics, which are associated with the maturity of process as predictability, competence, control, effectiveness and efficiency: Ad Hoc, Defined, Linked, Integrated and Extended.

Lockamy and McCormack (2004) present a modelof maturity on supply chain management that seeks to find the correlation between the evolutionary stages with the four areas of performance of the Supply Chain Operations Reference model (SCOR). In this study, the authors found a strong correlation between the levels of maturity and performance achieved in the studied supply chains. Their work was based on BPO (Business Process Orientation) maturity model, which was developed from the process maturity concepts, CMM proposed by the Software Engineering Institute (SEI) and SCOR structure.

According to Daozhi et al. (2006), a maturity model allows to support a supply chain in terms of innovation and continuous improvement based on the evaluation of the elements of maturity that compose it. The maturity model of these authors is based on three dimensions: a) Maturity of the management; B) Maturity of the environment, which is related to credit issues in the chain, communication platform; And c) Maturity of resources.

The Performance Measurement Group (PMMG) (2007) belonging to consultancy Pittiglio Rabin Todd & McGrath (PRTM) proposes a model of maturity for supply chain management based on four development levels, starting from a level with functional focus to a level of collaboration between the companies in the chain, with the composite model four maturity levels: functional focus, internal integration, external integration and collaboration.

Oliveira (2009) built the model in three steps. Are they: (1) Use of an international database generated by a survey with professionals working in companies in the areas of supply chain management, in which several variables in relation to this management were related and manipulated statistically; (2) Evaluation and adjustments by a group of experts in the field; and (3) - Final validation through confirmatory analysis and correlation, whereby it was possible to determine the final maturity model. The model, in addition to having maturity levels with their certain characteristics, also has the precedence relationships between the different levels of maturity.

Frederico and Martin (2012) proposed a unique set comprising all dimensions presented by all different authors then found on the literature (therefore considered the then state-of-art on the field), as well as one single maturity scale. However, despite those authors claims that "As these dimensions evolve over time, the greater becomes the level of integration and skills of supply chain management" (Frederico and Martins, 2012), there are still gaps to be better understood since the relationship between the dimensions and SCM's maturity was not the object of that study.

There are other publications associated to maturity in supply chain management which the authors in fact don´t present a framework with dimensions and characteristics of maturity levels but use a maturity model already proposed to verify or test the model in any specific research object as in Childerhouse et al.

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(2011), Netland and Alfnes (2011), Aryee, Naim and Lalwani (2008), McCormack, Ladeira and Oliveira (2008), Okongwu, Morimoto and Lauras (2013), Dellana and Kros (2013) and Zanoni, Pinnheiro de Lima and Gouvea da Costa (2008).

VI. Dimensions of Supply Chain Management Maturity

Regarding maturity models of supply chain management eleven different dimensions for its maturity were proposed by Frederico (2012), whose work presents the wider collection of dimension, as it's list was produced based on those dimensions present by other authors and collected through a systematic literature review. As previously stated, the present paper aims to propose a unique model based on them. For that purpose, Table 1 presents the models of maturity on supply chain management crossed with those eleven maturity dimensions, presenting which of them are considered in each model.

Frederico(2012) observed that the model Lockamy and McCormack (2004) is the one with the highest number of dimensions identified among all the models studied. However there are dimensions that these authors did not take into consideration, although being considered by other authors in the literature. Therefore, the adoption of this comprehensive model proposed by Frederico (2012) is justified by the fact that when adopting one or other existing model some dimensions could be left aside by the study.

According to Frederico (2012) the characteristics of each of the dimensions are:

- Costs are associated with the level of costs and inventory in the supply chain;
- Customers are associated with focus given to customers within the chain management as well as the level of customer satisfaction;
- Processes concerns the formalization, integration, structuring of processes within the chain;
- Technology and tools are linked to the existence of information and tools to support supply chain management systems, such as statistical tools for demand forecasting among others;
- Collaboration refers to the sharing of information, earnings and resources among members of the chain, communication and other joint initiatives within the chain such as product development and planning;
- Management is associated with excellence in project management within the supply chain, risk management and also the level of awareness and training of supply chain management;
- Performance Measurement is associated with the extent of the measurement of supply chain management performance;
- Strategic Focus refers to the strategic goals which are given to the supply chain management by the chain's focused company and by its members;
- Responsiveness is linked to the speed with which the supply chain responds to environmental changes, also in terms of volume and mix of products supplied;
- Resources are linked to the types of resources used in the supply chain, being they common (needed for execution of processes within the chain) and competitive (generate competitive advantage and are difficult to be employed by competing chains due to their differential);
- Environment refers to regulatory issues and credit incentives that favor the best performance of the supply chain.

Table 1: Maturity dimensions mentioned on the literature – Adapted from Frederico (2017)

Dimensions	Stevens (1989)	Ayers e Maimberg (2002)	Lockamy e McComack (2004)	PMG (2007)	Daozhi et. Al. (2006)	Oliveira (2009)	Reyes andGiaghetti (2010)
Collaboration	x	X	x	x	x	X	X
Costs	x	X	x		x		
Customers	x		x			x	X
Environment			x		x		
Management	x	X	x	x	x	x	X
PerformanceMeasurement			x	x		x	X
Processes	x	X	x	x		x	X
Resource					x		X

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Responsiveness	x			x	x	x	
Strategic Focus	x	X	x	x		x	
Technology and Tools	x	X	x	x		x	X

Frederico (2012) considered three maturity stages: Beginner, Intermediate and Advanced. Alignment on three levels was necessary due to the difference of the amount of levels between existing models of maturity of supply chain management. For each level, the eleven dimensions of the maturity of supply chain management have different characteristics, that are:

- Initial: prevalence of high costs in the supply chain, low customer satisfaction, unstructured and disintegrated processes, lack of collaboration among members, absence of technologies and tools for demand forecasting and other activities, lack of strategic focus in the chain, little active project management in the supply chain, absence of risk management, performance measurement absence along the chain, lack of regulation and credit lines as support elements for the chain and use of basic and common resources;
- Intermediate: efforts to reduce costs in the chain, average customer satisfaction, documented processes and defined starting a more horizontal focus along the chain, cooperation between related functions at the supply chain management, use of technologies and statistical tools for demand forecasting and other activities, chain as a strategic focus, awareness, vision and competence in managing the supply chain by employees, good project management practices, basic level of risk management, existence of measurement performance, early regulations and lines of credit to assist the supply chain and use of resources, but still without differential in the supply chain;
- Advanced: chain with excellence in costs, overall customer focus and high level of satisfaction, fully integrated processes and structured along the chain, extensive use of information systems, profit sharing and information between the members of the chain, management excellence in projects and risks, wide performance measurement, supply chain seen as a factor of competitiveness in other chains, responsive action before the demand variations caused by customers, comprehensive regulation and credit lines for development of the supply chain.

It is conceivable that a given chain will be classified in the maturity level at which are classified the largest share of its variables, although it is possible to elaborate better this assumption in future research. It is noteworthy that the maturity classification, either for the purpose of dimensions or for the whole chain, can't be established statically since it is fundamentally dynamic, as there is the need of comparison between different chains, potential results and new challenges posed by environmental changes or new strategic objectives.

VII. The Inter-relationship between the Dimensions of Supply Chain Maturity

In order to build a model that reflects the interrelations between the dimensions of supply chain maturity, first there must be established the criteria on the basis of which this analysis will be made.

a) Classification of Dimensions of the Supply Chain Management Maturity

Using as a basis the definitions of the models Cooper, Lambert and Pagh (1997) and Mentzer (2000) and the model proposed by Frederico (2012), it was designed a conceptual model that integrates both constructs into a single system.

It is understood, however, that any model or system is a simplification of the reality and, as such, is unable to describe the fullness of a phenomenon, representing what is considered relevant by the observer's perspective which, in the concrete case, is an overview of the interrelations between the dimensions of supply chain maturity.

When studied in a greater detail a particular dimension may contain traces of different classifications within the proposed model and, for the objectives of this study, we sought to analyze the predominant characteristics of each dimension.

Starting from these prerogatives, it was drawn in Figure 3, which graphically represents the model proposed by this study to the relationship between the dimensions of the SCM maturity and SCM concepts.

Thus, it is proposed the classification of the dimensions as follows:

i. *Management Components*

In this group they are classified the dimensions that constitute the administrative elements themselves or tools / data supporting this management.

Thus, among the dimensions of the maturity of the supply chain, are classified in this group: process management, technology/tools, performance measurement and risk management and project.

ii. *Chain Structure*

This group is made up of elements that form the characteristics of a given supply chain, namely: collaboration, strategic focus, responsiveness, environment and resources.

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iii. *Business Process*

Business processes according Cooper, Lambert and Pagh (1997), are activities that produce a specific value to the consumer. In other words, it can be said that are the main activities of its chain, not fitting, therefore, the inclusion of any dimension on the maters of maturity.

iv. *Results*

In this group are the expected results for the supply chain management, materialized by the dimensions of costs and customers (satisfaction).

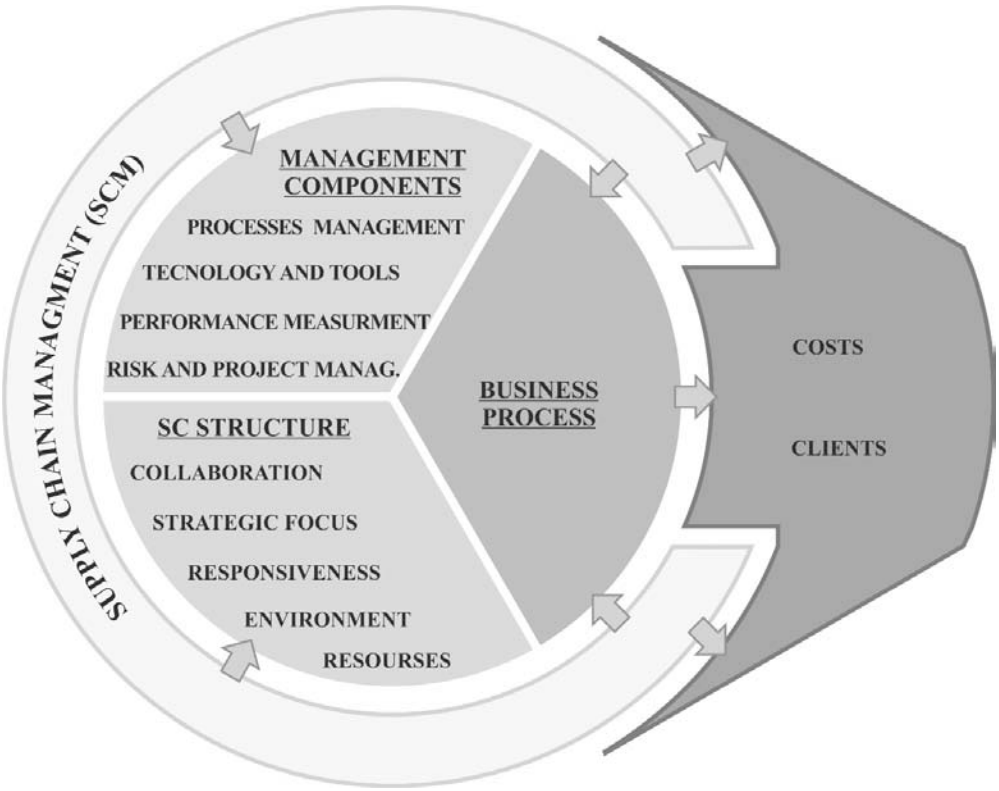


Figure 3: Graphic representation of the Model Inter-relation of Supply Chain Management Maturity dimensions.

Dimensions pertaining to the management and supply chain structure components are the basis for business processes that in turn will determine the resulting dimensions levels (client satisfaction and costs). The higher the maturity level of each of those support dimensions, the greater the potential of the business processes to generate satisfied customers and optimized costs.

Collaboration of information among the entities of a chain contributes to the business processes as it, for example, enables a better forecast of demand, consequently a better accuracy in the sizing of inventories and production planning in the chain, providing, directly and indirectly, greater customer focus and cost savings.

The strategic focus of the chain determines how much the efforts of the various entities are converging towards the same objectives and the level of synergy established. The greater the level of maturity of this dimension, the more concentrated the efforts are and the smaller the waste, generating greater customer satisfaction and lower costs.

The level of responsiveness expresses how fast the chain responds to variations in demand and other changes in the environment. Thus, the more responsive a chain is, the more it will be able to keep its operations close to the optimal level, impacting on customer satisfaction and costs

The environment in which a chain is embedded is critical to it's business processes, since they impact operations in a variety of ways. Organizations generally have little capability to intervene and change aspects of the environmental dimension, but their characteristics impact customer satisfaction and the level of costs that the chain will be able to achieve.

In terms of resources, their availability, quality and costs, among other aspects, have a direct impact on business processes, since they represent the raw material and inputs of the production processes, thus impacting indirectly on levels that can be reached of customer satisfaction and costs.

Process management is closely linked to business processes, since it expresses how entities (internally and with each other) have mapped, organized and optimized processes. The greater the maturity of

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this dimension, the more appropriate will be the business processes with the potential to obtain higher levels of customer satisfaction and cost reduction.

Technologies and tools are increasingly indispensable for us to tackle and analyze a growing universe of data and information. In this way, it is clear that this dimension has a direct impact on business performance and consequently on customer satisfaction and cost reduction.

Performance measurement is a key process by which the organization and the chain can assess how much planning is being accomplished as well as identify problems to be solved. As a result, the higher the maturity level of performance measurement, the better business processes are expected and thus higher customer satisfaction and a lower level of costs.

Finally, the better the level and maturity of risk and project management, the more potential threats will be mitigated or more adequately addressed when they occur. The impact of this dimension is not always visible (although present) in organizations' daily lives, but it is widely noticed when some of the mapped risks are manifested, occasion where negative impacts on business processes are reduced, preserving to the maximum the satisfaction of the Customers and the level of costs.

VIII. Final Considerations

This study proposes a model that integrates the eleven dimensions of maturity of the management of the supply chain in a single inter-relationship model.

As a result of this model, it is expected that the capacity to understand the phenomenon of SCM and its maturity is expanded, with consequences for theory and practice. It remains necessary, however, the development of future field research like surveys and case studies that could prove or disprove the grip of this model to the reality and context of supply chain management.

To this end, it is recommended that those future empirical researches are explored in as much different contexts as possible in order to observe or question the real ability of generalization of this model to any supply chain.

It is also proposed that future research study a deeper understanding on how the performance of each dimension determines the maturity level of the supply chain management as a hole on a giving supply chain.

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