Performance and Maturity Models:
A theoretical approach of relationships between performance measurement systems and maturity models for logistical processes.

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Summary

The paper aims to discuss the development and application of maturity models in the planning and management of logistics processes. Stemming from a bibliographic research effort on the subject, this article approaches the evolution of performance measurement systems in a theoretical and exploratory manner, embarking from a traditional vision and changing into a more innovatory perspective, reporting the origins of maturity models and presenting its main empirical contributions. The concepts of Business Process Reengineering and PMS are explored, as well as the SCOR metrics, which are of utmost importance for the early development of maturity models applied to supply chains.

Keywords: Maturity, Integration, Performance.

Educator & Practitioner Summary

The study contributes for the existing literature by demonstrating the impact of maturity models over supply chain performance. It can be useful for managers and researchers engaged in improving the design of maturity models and performance of logistics, as well by pointing out complex relations between logistical planning and performance.

Introduction

In recent years, a growing amount of research, much of which is still preliminary, has been dedicated to investigating maturity models development and performance measurements for the strategic management of logistical processes in companies and supply chains. (Chan and Qi, 2003; Gunasekaran *et al.*, 2001; Coyle *et al.*, 2003).

The concept of process maturity, including logistics process, derives from the understanding that they have life cycles or developmental stages that can be clearly defined, managed, measured and controlled throughout time. A higher level of maturity, in any business process, can possibly be achieved if three conditions are respected: (1) better control of the results; (2) greater forecast of goals costs and performance; (3) greater effectiveness in reaching defined goals and the management ability to propose new and higher targets for performance (LOCKAMY and MCCORMACK, 2004; POIRIER and QUINN, 2004).

In order to meet the performance levels desired by customers in terms of quantitative and qualitative flexibility of service in demand fulfillment, deadlines consistency and reduction of lead times related to fulfilling orders, firms have developed repertoires of abilities and knowledge that are used in their organizational process (Day, 1994 *apud* Lockamy *and* McCormack, 2004).

In two past decades, logistics management processes has evolved, also because of these new demands, from a departmental perspective, extremely functional and vertical, to an organic arrangement of integrated processes, horizontal and definitely oriented to providing value to intermediate and final costumers (Mentzer *et al.*, 2001). This new pattern of logistical process management has been based towards the development and application of different maturity models and performance metrics useful as support tools to help define a strategy and to face trade-offs, as well as to identify items that are considered critical to quality improvement of logistical services rendered to the client.

The purpose of this article is to explore the concept of Performance Measurement System as base for the development of maturity models and to propose a reflection on its use in the management of supply chains. This article is divided into three sections including this brief introduction. In section two, it is discussed the origin of the Performance Measurement System concept, and references are made about the CSC Framework Maturity Model and the Business Process Orientation Maturity Model. In section three, the conclusions are presented, exploring the common characteristics and the main differences between the models, synthesizing the contributions of this article and suggesting hypothesis that should be investigated in future research about the theme in the field of corporate logistics.

Theoretical Framework

Brief considerations about Performance Measurement Systems - PMS

Performance measurement, according to Neely *et al*. (1995), is an often-discussed topic but rarely defined. They present the following definitions: (1) Performance measurement – process of quantifying the efficiency and effectiveness of an action; (2) Performance measure – metric used to quantify the efficiency and/or effectiveness of an action; (3) Performance measurement system – a set of metrics used to quantify the efficiency and effectiveness of actions.

For Bititci *et al.* (1997), PMS can be seen as an information system that allows the performance management processes to work in an effective and efficient way. To be effective in the fulfillment of its goals, environmental factors and strategies related to business must be considered, as well as the organizational structure, its processes, functions and relationships.

According to Neely *et al.* (1995), one of the problems about performance measurement literature concerns its diversity. It means that each author has a tendency to focus different aspects of the performance measurement system design. In spite of such diversity, in the field of operations management, a significant part of the literature tends to corroborate the hypothesis that the metrics of performance should come from the firm production strategies, being used to reinforce the importance of some strategic variables and the adequate management of trade-offs in manufacturing.

Beamon (1999) highlights the characteristics found in an effective PMS, which can be used as a reference in evaluating the measurements systems including: inclusiveness – the possibility of measuring all relevant aspects; universality – the possibility of allowing comparison under many different operational conditions; measurability – the possibility of measuring required data; and consistency – the possibility to consider that the measurements are consistent with the organization goals.

According to De Toni and Tonchia (2001), performance measurement systems are evolving from a system based on measurement and cost control to a system based on the measurement and creation of value by means of non-cost performances; it means those whose nature is not economic or financial explicitly (Table I).

Table I – Evolution of PMS

TRADITIONAL PMS	INNOVATIVE PMS
Based on cost/efficiency.	Based on value.
Trade-off between performances.	Compatibility of performances.
Profit oriented.	Client oriented.
Short term orientation.	Long term orientation.
Individual metrics prevail.	Team metrics prevail.
Functional metrics prevail.	Transversal metrics prevail.
Comparison with the Standard.	Monitoring of improvement.
Aimed at evaluation.	Aimed at evaluation and involvement.

Source: De Toni and Tonchia, 2001, 47p.

The environmental factors that lead to the development of measurements related to non-costs are, on one hand, linked to the environment turbulence concerning the frequency and unpredictability of changes, and on the other hand, to the managerial complexity, due to the change from strategies based on leadership of costs to strategies based on differentiation and customization, what can easily be assumed as flexibility, in production and in logistics processes (De Toni and Tonchia, 2001).

Alternatively Bititci *et al*. (1997) proposes a reference model for performance measurement systems based on 4 (four) levels: (1) corporate, (2) business unity, (3) business processes, (4) activities. On each level, there are five key factors: stakeholders, control measures, location, improvement goals and inside performance measurement. As the PMS, it has a connection with strategies that are linked to environmental forces. It is needed to guarantee a kind of dynamism for the PMS, with the aim of following the environmental changes where the company is active. According to Bititci *et al*. (2000), the main barriers for a company to adopt a more dynamic PMS are: (1) the impossibility in distinguishing between improvement measures and control measures; (2) difficulty in developing causal relationships between the competitive objectives and strategies for processes and activities, and vice versa; (3) lack of a flexible structure that allows effective management of dynamic PMS; and (4) lack of ability in quantifying the relationship between measures in a system.

Within the recent developments of performance measurement systems mainly related to the logistical process in the context of supply chains, SCOR (supply chain operation references) has gained great visibility in business and academic community over the last few years. Due to contribution made by SCOR to the evolution of different maturity models developed for supply chains, succinct information about some of its characteristics and functionality will be presented in the next section of this article.

SCOR Performance Metrics

The Supply Chain Council, a non-profit independent institution, in 1996, joined a group of 66 companies that aimed the development of an implementing supply chains model. This initiative gave birth to the SCOR model – Supply Chain Operations Reference (Bolstrorff and Rosenbaum, 2003; SCC, 2004).

SCOR integrates planning processes, supply, manufacturing, deliveries and returns, arranging the elements of business processes, metrics, best practices and technology. Those integrations are approached from a "supplier's supplier" to a "customer's customer" perspective, considering the whole supply chain.

In the integrated SCOR processes, it is necessary to distinguish between planning, execution and enabling. The planning process aligns resources and organizational actions to reach specific goals, contributing to an improvement in supply chain response time. The execution process is influenced by the planned or current demand and includes scheduling and sequencing, transformation of materials and services, and the movement of products. The qualification process maintains and manages the information or the relations that make up the planning and execution processes.

The SCOR model prioritizes the orientation to process and not to the organizational functions. It means that the model focuses on the activity involved and not on the professional group or organizational element that will execute such activity. The implementation guide indicates five basic phases of the SCOR project: support education; opportunity discovery; analysis; design; and development and implementation.

The Supply Chain Operations Reference was designed and maintained to assist supply chains of diverse complexity coming from several business areas. The purpose was not to determine how a group should manage its business or adjust its systems and information flows. According to Bolstroff and Rosembaum (2003, pg 6) "...SCOR can tell you where to go but it will never teach you how to drive the car". Every organization that implements improvements using the SCOR model will need to adapt it to their specific process, practices and systems.

SCOR does not include a genuine attention to Human Resources, Training and Quality Certification areas, among others. It happens because such horizontal activities are implicit within the model and there are other models that are specifically concerned with identifying how companies train, maintain, organize and conduct their quality programs. The SCOR implementation brings about a return of investments (ROI) within twelve months of two or six times the total amount invested (Bolstorff and Rosenbaum, 2003; SCC, 2004).

Maturity models and *logistical processes management*

The maturity model represents a methodology which applications are related to definition, measurement, management and business processes control that have been shown to be very similar management approaches concepts by BPR (Business Process Reengineering), attracting a growing interest not only of companies but also of researchers, directly involved in this area (Chan and Qi, 2003; Gunasekaran *et al*, 2001). Although its origins are not directly linked to logistics, it has been seen a growing number of reports in recent years that represent the use of maturity models based on KPI – Key Performance Indicators - to analyze the activities from logistical supply cycles to manufacturing and distribution support itself. Those exploratory experiments are expected to consolidate in order to define an agenda of research in the field of logistics, mainly the *supply chain management* (Chan and Qi, 2003; Gunasekaran *et al.*, 2001).

In the following section, it will be presented the main maturity models currently used by companies to analyze the performance of their logistical processes. There will be shown references about the SCOR measurements (Supply Chain Operations Reference Model), the CSC Framework model, developed by CSC – Computer Sciences Corporation and the Business

Process Orientation Maturity Model, developed by a group of researches at University of Alabama.

CSC Framework

The CSC Framework was developed by CSC (Computer Sciences Corporation) and tested in 2003 for the first time, through a research involving 142 people in charge of supply chain management. Supply Chain Management Review readers and CSC clients composed this sample. Among the 142 components, 71 came from companies and independent consulting firms, while the other 71 came from groups, divisions, business strategic units or subsidiaries. The work's main objective was to identify the logistics function's development stage in the surveyed companies, considering their levels of excellence in the five maturity stages in supply chain, which are presented below (Poirier and Quinn, 2003; 2004).

At the model's first level, the company prioritizes the improvement of its functional processes. At this stage, there are made internal efforts that aim the integration of different functional areas of each company that integrates the supply chain. The SCOR model is used with a great effect in the initial stage, where the logistics and supply areas are more emphasized. The benefits normally include a drastic reduction in suppliers and logistics service providers, rationalizing of offered product mix in markets and a greater volume of purchases. At level 1, the main inefficiencies faced by many companies concern the results of low inter-organization integration process, the barriers in businesses works, and the no-happening or no-expressive sharing between information systems and agents in the expanded value chain.

At the second level, there is a great attention given to logistics gains, focusing more on the use of actives and the effectiveness of its physical distribution. Demand management becomes a critical factor, and the preciseness of predictions can be the main driving force for more acuity on company's operations in the planning, programming and production control areas. The supply chain orientation gains more importance, with a more strategic and divided management of the organization's immediate supplier and client bases.

According to Poirier and Quinn (2004), the company's dominant "logistical culture" inhibits, many times, the progress of its actions towards superior excellence levels, given some premises shared by companies that find themselves on this development stage: (i) all good ideas need to be internally built; (ii) if external help is needed, it means that the internal team is not doing its job. (iii) if external information can be used, we will do so but will not sharing it with anybody. The company can only expand its efficiency levels when its leadership, especially the one linked to the operation areas, decides to break with these premises and dissipate the restrictions that they impose.

At the third level, the company develops or redesigns its inter-organizational processes and starts to create a business network with few and carefully selected allies. During this stage, important suppliers are invited to participate in planning, operations, and sales sessions (S&OP – Sales and Operation Planning), bringing supply and demand closer to each other. Global relationships are established with logistical service suppliers, qualified in relation to transport functions, logistics and storage, and clients are encouraged to give feedback regarding current and desired products. Business allies, at this level, work together, using various tools and collaborative techniques to reduce, through mutual initiatives and shared results, cycle times, especially time-to-market, using their actives more efficiently.

The fourth level is characterized by collaborative initiatives. Companies start using methodologies such as ABC (Activity Based Costing) and the Balanced Score Card to transform the supply into a value network of partners, who work towards the same strategic goals. Information is shared electronically, and inter-company teams are formed to find solutions for specific client problems. E-commerce technologies are considered crucial for this level, guaranteeing real-time sharing of all relevant information at each point of the value chain. Development and using of models and methodologies for implementation in design, planning and collaborative replenishment are crucial at this stage of the inter-organizational relationship evolution.

The fifth and most advanced stage in the supply chain is the most difficult goal to achieve. It is a developmental stage characterized by a complete join between agents throughout the whole supply chain. According to Pourier and Quinn (2003; 2004), only a few organizations in a few sectors reach this stage. It is a stage of complete collaboration throughout the network and of strategic use of technology information to achieve position and status in the market. At this stage, companies usually reach extraordinary order prediction levels as well as a reduction in the cycle time throughout networks connected completely electronically.

The Business Process Orientation Maturity Model

The concept of Business Process Orientation suggests that the companies may increase their overall performance by adopting a strategic view of their processes. According to Lockamy and McCormack (2004), companies with great guidance for their business processes reach greater levels of performance and have better work environment that is based on much more cooperation and less conflicts.

A very important aspect of this model is the use of SCOR to identify the processes maturity (Lockamy *and* McCormack, 2004; SCC, 2003). The SCOR measurements were adopted by their process orientation characteristics and their growing use among professionals and academics who are directly involved in logistic matters. The five stages of the model maturity show a progress of activities when the supply chain is efficiently managed. Each level contains characteristics associated with factors such as predictability, capability, control, effectiveness and efficiency.

Figure I

Ad Hoc, the model's first level, is characterized by poorly defined and bad structured practices. Process measurements are not applied and work and organizational structures are not based on the horizontal process at the supply chain. Performance is unpredictable and costs are high. Functional cooperation and client satisfaction levels are low.

At the second level, **defined**, SCM's basic processes are defined and documented. There is neither work nor organizational structure alteration. However, performance is more predictable. In order to overcome company problems, considerable effort is required, and costs remain high. Client satisfaction levels improve but still remain low if compared to levels reached by competitors.

At the third level, **linked**, the application of SCM principles occurs (Supply Chain Management). The organizational structures become more horizontally prepared through the creation of authorities that overlooks functional units. Cooperation among intra-organizational functions, assistants and clients transform into teams that share measures common with SCM, and into

objectives of horizontal scope in the supply chain. There happen efforts for continuous improvement aiming to stop early problems and so reach better performance improvement. Cost efficiency grows and clientsstarts to directly get involved in the improvement efforts of intra-organizational processes.

At the fourth level, **integrated**, the company, suppliers, and clients strategically cooperate in the processes' levels. Organizational structures and activities are based on the SCM principles and traditional tasks; related to the expanded value chain processes, start to disappear. Performance measurements for the supply chain are used, with the advent of advanced practices, based on collaboration. The process improvement objectives are geared towards teams and well reached. Costs are drastically reduced, and client satisfaction, as well as team spirit, becomes a competitive advantage.

At the final level, **extended**, competition is based in multi-organizational supply chains. Multi-organizational SCM teams appear with expanded processes, recognized authority persons and objectives throughout the chain. Trust and auto-dependence build the support base of the extended supply chain. Process performance and trust in the extended system are measured. The supply chain is taken by a client-focused horizontal culture. Investments in the system's improvement are shared, as well as the investments return.

Conclusions

Logistical processes, as well as other kinds of processes, demand management models geared towards results measurements, and constant actions resulting in improvement. It can be easily understood: it is impossible for a company to develop efficient activities management without having its logistical performance measured and controlled throughout time. The companies' effort to quantify its logistical operations' efficiency levels represents, thus, an opportunity for them to solidify an alignment of its performance measurements to its competitive strategies. The results of this alignments, however, give the organizations an opportunity to evaluate not only the degree of application of strategies defined in the scope of its logistical planning but also if the decisions made and the later managerial actions are coherent with its broader policies of strategic planning.

Measurement and performance systems, developed from a traditional to an innovative perspective, considering not only financial forecasts, bring, in this sense, a great contribution to the supply chain management. As for logistical processes, coherently with the premises that lead to the new models and to performance evaluation systems adopted by companies, it can be noticed that the maturity models, supported by a complete or partial SCOR (Supply chain Operations Reference) performance measurement, represent an important trend.

Some PMS's are geared towards aspects directly linked to cost efficiency and to exclusively financial measures in order to provide functional performance measurements as well as short term operational results. On the other hand, the main maturity models currently applied to the supply chain context, use SCOR as a way of favoring an evaluation system committed with the value management to the client, with multifunctional process measurements, focusing on the continuous improvement and strong commitment with long-term results for the companies. The maturity models supported by the SCOR infra-structure conversely represent a managerial tool that fulfills a fundamental principle that is necessary to business process management: you cannot control what cannot be measured and it is not possible to measure a process which is not

adequately defined in its scope, as well as its interfaces with multiple organizational tasks. Maturity models supported by SCOR enable, thus, access to a complete measurement system very useful to the analysis of companies' logistical process performance and supply chain (Huan, Sheoran and Wang, 2004; De Toni and Tonchia, 2001).

The success of current PMS's, including the SCOR, is mainly due to the developments that took place in IT, and to the direct impact of such innovations in planning, implementation, and control of actions over logistical processes. It is necessary to recognize that important IT advancements have yielded very positive effects over processes of collection, analysis, and treatment of information related to the logistical function, assuring companies the accessibility and current information for taking decisions in real time in relation to events. Aside from promoting activity integration much important to different logistical processes (such as buying, stock, transport, storing, and order processing), the new technologies have the potential to favor logistical flexibility, for they contribute to companies' quick reaction when facing unpredicted changes and non-routine or not programmed situations.

The fact that the maturity models applied to logistical processes emphasize the performance measurement and the continuous improvement of other processes, it favors from the point of view of corporative leadership goals, that might be understood as a group of responsibilities and practices that the board of directors and executives have. The following stand out as primary purposes: keeping the definition of strategies that are more appropriate for some competitive cases and certifying that those goals are being reached, the risks are being managed properly and the resources – including the logistic ones- are being used in a responsible and effective manner. The maturity models are presented as support tools for the corporative leadership, specifically to leadership of the logistical processes, as long as they help, in terms of goal, determining the actual stage of maturity and identifying the items considered more critical so that the companies can evolve and improve the quality of their logistical processes.

Considering the content briefly developed in this article, some questions may be explored in future research into the theme:

- What are the main restrictions that must be overcome by companies when they decide to apply any maturity model oriented to the control and improvement of logistical process?
- Which are the demands for developing a maturity model that can be used as a standard to analyze different companies from the same branch or from the same supply chain?
- What are the costs involved in the planning and implementation of maturity models in the supply chain?

Answers to such questions can contribute in many different ways for a new theme that involves such complexity. There is a point in asking if discussing maturity models would be appropriate if there is no evidence that the concept of SCM itself is being effectively applied by a representative number of supply chains in any market. At the present time, there isn't a model able to properly synthesize all the complexities typically encountered in the management of logistical processes in the wider context of supply chains, although efforts are being aimed at improving the individual performance evaluation systems of the companies.

Therefore, continuous research is being formulated to develop new and improved maturity models that can contribute to the principle of continuous improvement in a supply chain that is truly integrated. To do so, it is necessary to reach points extremely clear, concerning the application of those models and the development and availability of evaluating methods and

certification programs to the market. It is possible to state that in the future, certifying companies level of maturity, according to the level of their logistics process maturity, will gain relevance, similar to what, in over the past few years, have been applied related to standards of total quality and certifying professional and services of IT.

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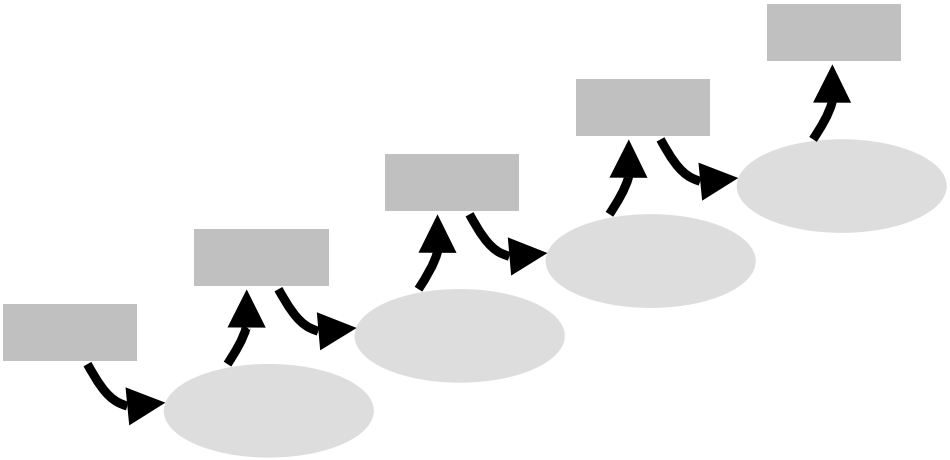

FIGURE I – Process development stages.
Source: adapted from SEI, 2000.