

Study of Performance Measurement Practices in Supply Chain Management

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Abstract

Supply chain management creates value for companies, customers and stakeholders interacting throughout a supply chain. The strategic dimension of supply chains makes it paramount that their performances are measured. In today's performance evaluation processes, companies tend to refer to several models that will differ in terms of corporate organization, the distribution of responsibilities and supply chain maturity. The present article analyzes various models used to assess supply chains by highlighting their specific characteristics and applicability in different contexts. It also offers an analytical grid breaking these models down into seven layers. This grid will help managers evolve towards a model that is more suitable for their needs.

Keywords

Supply chain management; Logistic; Supply chain maturity; Performance measurement; Evaluation model

1. Introduction

Business organizations need to capitalize on Supply Chain (SC) capabilities and resources to bring products and services to the market faster, at the lowest possible cost, with the appropriate product and service features and the best overall value (Gunasekaran et al., 2001). Performance measures are important to the effectiveness of SC. Companies can no longer focus on optimizing their own operations to the exclusion of their suppliers' and customers' operations. Supply Chain Performance Measures (SCPM) serve as an indicator of how well the SC system is functioning. Measuring SC performance can facilitate a greater understanding of the SC and improve its overall performance (Charan et al., 2008). There is an emerging requirement to focus on the performance measurement of the SC in which company is a partner (Charan et al., 2008). Interest on performance measurement has notably increased in the last 20 years (Taticchi et al., 2010). Companies have understood that for competing in continuously changing environment, it is necessary to monitor and understand firm performances. Measurement has been recognized as a crucial element to improve business performance (Taticchi et al., 2010). Various performance metrics are in place for measuring effectiveness of SC. Different perspectives of Supply Chain Performance Measures (SCPM) are cost and non-cost perspective; strategic, tactical or operational focus (Gunasekaran *et al.*, 2001); business process perspective and financial perspective (Beamon, 1999). The earlier focus of performance measurement was on financial perspective which is gradually changing to non-financial perspectives. Most of the models have gone through some empirical testing and some have only theoretical developments (Taticchi et al., 2010). Very little guidance is available in the literature examined for the actual selection and implementation of Supply Chain Performance Measurement System (SCPMS). The present research objectives are as follows:

- To review the literature in the SCPMS areas.
- Identify strengths and limitations of existing frameworks of SCPMS.
- Identify SCPM success factors as well as reasons for failures.
- To identify the gaps and suggest the future research.

The paper has been organised as follows: Definition and characteristics of SCPMS are given at Section 1 and 2 respectively; Section 3 gives an overview of evolution of SCPMS; Classification of PMS literature is attempted at Section 5; Structure and classification of metrics and measures in SCPMS is given at Section 6; Some of the most cited PMS frameworks and models are described at section 7; Success factors, selection and implementation of SCPMS are brought out at Section 8 and results of this study is discussed at Section 9.

2. Definition and Objectives of SCPMS

Neely et al. (2002) defined Performance Measurement System (PMS) as a balanced and dynamic system that enables support of decision-making processes by gathering, elaborating and analyzing information. Taticchi et al. (2010) further elaborated this definition by commenting on the concept of 'balance' and 'dynamicity'. 'Balance' refers to the need of using different measures and perspectives that tied together give a holistic view of the organization. The concept of 'dynamicity' refers instead to the need of developing a system that continuously monitors the internal and external context and reviews objectives and priorities. Bititci et al. (1997) defined SCPMS as the reporting process that gives feedback to employees on the outcome of actions. Stefan Tangen (2004) proposed that performance be defined as the efficiency and effectiveness of action, which leads to the following definitions: (i). Performance measurement is defined as the process of quantifying the efficiency and effectiveness of action; (ii). A performance measure is defined as a metric used to quantify the efficiency and/or effectiveness of an action; and (iii). Performance Management System is defined as the set of metrics used to quantify the efficiency and effectiveness of an action. Effective supply chain management (SCM) has been associated with a variety of advantages including increased customer value, increased profitability, reduced cycle times and average inventory levels and even better product design (William et al., 2007). The objective of SCPM therefore has to facilitate and enhance the efficiency and effectiveness of SCM. The main goal of SCPM models and frameworks is to support management by helping them to measure business performance, analyze and improve business operational efficiency through better decision-making processes (Tangen, 2005). An effective, integrated and balanced SCPMS can engage the organisation's performance measurement system as a vehicle for organizational change. SCPM can facilitate inter-understanding and integration among the SC members. It makes an indispensable contribution to decision making in SCM, particularly in re-designing business goals and strategies, and re-engineering processes (Charan et al., 2008).

3. Desirable Characteristics of SCPMS

A number of suggestions have been offered by various experts on the subject of designing PMS. Beamon (1999) presents a number of characteristics that are found in effective performance measurement systems, which include the following.

- Inclusiveness (measurement of all pertinent aspects)
- Universality (allow for comparison under various operating conditions)
- Measurability (data required are measurable) and
- Consistency (measures consistent with organization goals)

According to Gunasekaran et al. (2001), for effective management in a SC, measurement goals must consider the overall SC goals and the metrics to be used. These should represent a balanced approach and should be classified at strategic, tactical and operational levels, and be financial and nonfinancial measures, as well. Below is a list of desirable characteristics of SCPM derived from different sources (Beamon, 1999; Gunasekaran et al., 2001; Gomes et al., 2004; Tangen, 2005; and Thakkar et al., 2009). Some of these apply to all measures and some apply to a limited number of a firm's measures. It is also very difficult to fulfil all requirements suggested in literature when designing a PMS (Tangen, 2005). A firm's performance measures should:

- Be simple and easy to use.
- Have a clear purpose.
- Provide fast feedback.
- Relate to performance improvement, not just monitoring.
- Reinforce the firm's strategy.
- Relate to both long-term and short-term objectives of the organization.
- Match the firm's organization culture.
- Not conflict with one another.
- Be integrated both horizontally and vertically in the corporate structure.
- Be consistent with the firm's existing recognition and reward system.
- Focus on what is important to customers.
- Focus on what the competition is doing.
- Lead to identification and elimination of waste.
- Help accelerate organizational learning.
- Evaluate groups not individuals for performance to schedule.
- Establish specific numeric standards for most goals.
- It must reflect relevant non-financial information based on key success factors of each business.
- It must make a link to reward systems the financial and non-financial measures must be aligned and fit within a strategic framework.
- Minimum deviations should exist between the organizational goals and measurement goals;

4. Evolution of SCPMS

Performance measurement has its roots in early accounting systems. According to Gomes et al. (2004), performance measurement evolved through two phases. The first phase was started in the late 1880s, while the second phase in the late 1980s. The first phase was characterized by its cost accounting orientation. This orientation aimed at aiding managers in evaluating the relevant costs of operating their firms. It incorporated financial measures such as profit and return on investment. A study has indicated that by 1941 about half of US companies were using budgetary control in one form or other and by 1958, over 95 % of the companies, budgets were used for overall control of company performance (Bourne et al., 2003). These accounting based performance measures were financially based, internally focused, backward looking and more concerned with local departmental performance than with the overall health or performance of the business (Bourne et al., 2003). These traditional financially-based performance measurement systems failed to measure and integrate all the relevant factors critical to business success. By the 1980s, traditional accounting measures were being criticised as inappropriate for managing businesses of the day. The mid-1980 was a turning point in the performance measurement literature, as it marked the beginning of the second phase. This phase was associated with the growth of global business activities and the changes brought about by such growth. In the late 1980s, some frameworks, which attempted to present a broader view of performance measurement started to appear (Gomes et al., 2004). They underscored the need for the alignment of financial and non-financial measures in order to be in accordance with business strategy. The emphasis was on the development of better integrated performance measurement systems. The structure of the business organization also evolved during this period. The early 19th century saw the birth of systematic large organizations. During the 1980's the business organizations became global and 1990's were significant with automation of business processes. The 2000's saw the emergence of e-commerce and borderless business activities. PMS also changed with this evolution of business organization from cost accounting system (before 1980s), mixed financial and non-financial systems (1990's) to balanced integrated approach (2000's). **Table 1** summarises the evolution of SCPM in an organizational context.

Table 1. Evolution of PMS in an organizational context (Gomes et al., 2004 and Morgan, 2007)

Period	Characteristics of business organisation	Characteristics of PMS
Before 1980	Systematic large organizations	(i). Cost Accounting orientation. (ii).Retroactive approach and results used to promote organizational efficiency, facilitate budgeting and attract capital from external entities (iii).Performance measurement dominated by transaction costs and profit Determination
1980 - 1990	Business organizations became global	(i). Cost Accounting orientation (ii).Retroactive approach and results used to promote organizational efficiency. (iii).Enhanced to include operations and value adding perspectives
1990 – 2000	Automation of business processes	(i).A mixed financial and non-financial orientation. (ii).A mixed retroactive and proactive approach. (iii).Results are used to manage the entire organization. (iv).PMS enhanced to include process, quality & customer focus
2000 – 2010	e-Commerce and borderless business activities	(i).A balanced and integrated orientation. (ii).A more proactive approach. (iii).Results are used to enhance organizational responsiveness. (iv).Performance measurement enhanced to give a balanced view of the organization and included the SC & inter-process activities.

Table 2. List of Performance Measurement Models (Taticchi et al., 2010 and Morgan, 2007)

Name of the model	Period
The ROI, ROE, ROCE and derivatives	Before 1980s
The economic value added model (EVA) The activity based costing (ABC) – the activity based management (ABM,1988) The strategic measurement analysis and reporting technique (SMART,1988) The supportive performance measures (SPA,1989) The customer value analysis (CVA,1990)	1980-1990

The performance measurement questionnaire (PMQ,1990)	
The results and determinants framework (RDF,1991) The balanced scorecard (BSC,1992) The service-profit chain (SPC,1994) The return on quality approach (ROQ,1995)	1991-1995
The Cambridge performance measurement framework (CPMF,1996) The consistent performance measurement system (CPMS,1996) The integrated performance measurement system (IPMS,1997) The comparative business scorecard (CBS) The integrated performance measurement framework (IPMF,1998) The business excellence model (BEM,1999) The dynamic performance measurement system (DPMS,2000)	1996-2000
The action-profit linkage model (APL,2001) The manufacturing system design decomposition (MSDD,2001) The performance prism (PP,2001) The performance planning value chain (PPVC,2004) The capability economic value of intangible and tangible assets model (CEVITA,2004)	2001-2004
The performance, development, growth benchmarking system (PDGBS,2006) The unused capacity decomposition framework (UCDF,2007)	2006-2007

Literature survey indicates development of a number of Performance Measurement Models since 1980s. Most of the models have gone through some empirical testing and some have only theoretical developments. The most widely cited performance measurement systems are the SMART (1988), the performance measurement matrix (1989), the Balanced Scorecard (1992), and the integrated dynamic PMS (1997). In the Indian context, there have been many attempts to measure the performance at the organizational level, but very few attempts have been made to measure the performance at inter-organizational level (Saad and Patel, 2006). Table 2 lists the major Performance Measurement Models based on literature survey.

5. Classification of Performance Management Literature

The literature related to SCPMS belongs to two major orientations. They are: (i). Conceptual articles and (ii). Empirical articles. The conceptual works tend to focus on measurement constructs and prescriptive methodologies. Topics normally covered in conceptual articles are related to performance definition, theoretical evaluation criteria, models and issues with measures. The empirical works tend to focus more on performance content than on measurement process. Empirical articles include descriptive studies, methods, taxonomies, benchmarking and prescriptive performance improvement activities. (Keebler, 2001) Performance measurement literature of the past twenty years can be classified into five general phases of evolution. This classification of PMS literature is related to evolution of PMS. Table 3 shows the five phases in Performance Measurement literature.

Table 3. Phases in Performance Measurement Literature (Neely, 2005)

Category	Period	Characteristics
Phase 1	1980 -1990	Dominant theme was a discussion of the problems of performance measurement systems; recognising and discussing the weaknesses of measurement systems and their organisational impact.
Phase 2	1990 -1995	Potential solutions – e.g. measurement frameworks such as the BSC were being proposed; search for “frameworks” that might provide useful ways of addressing the previously identified problems.
Phase 3	1996 - 2000	The search for ways in which the proposed frameworks could be used; processes and methodologies for populating measurement frameworks were being developed and discussed.
Phase 4	2000 - 2005	Robust empirical and theoretical analysis of performance measurement frameworks and methodologies; analysis of impact of PMS on organisations
Phase 5	2005 onwards	Theoretical verification of frameworks; application and impact on supply chains; focus on multi-firm performance.

6. Performance Measures and Metrics in SCPMS

Fundamental processes of performance measurement according to Neely (2004) are the following.

- Measurement system design.
- Implementation.
- Managing through measurement and

- “Refreshing” the measurement system.

In ‘Measurement system design’, the challenge lies in choosing the right measures; it is identifying what you need to measure so as to concentrate on what is absolutely vital. ‘Implementation’ involves ensuring access to the right data, and the political and cultural issues, notably people’s fear of measurement and the games they consequently play to try to manipulate target-setting to ensure targets are achievable and no blame can be attributed. To combat this, people inside organizations need to be educated to understand the purpose and use of the measurement system. The challenge in managing through measures requires a cultural shift in many organizations. “Refreshing” is to ensure that, as the organization changes the measurement system keeps pace. Sambasivan (2009) defines measure as a more objective or concrete attribute that is observed and measured and metric as an abstract, higher-level latent attribute that can have many measures. Because SC is a network of firms that includes material suppliers, production facilities, distribution services and customers linked together via the flows of materials, information and funds (Gunasekaran et al., 2001), the measures have been classified as follows: fund flow (cost and profitability), internal process flow (production level flexibility, order fulfilment and quality), material flow (inventory and internal time performance), sales and services flow (delivery performance, customer responsiveness and customer satisfaction), information flow and partner relationship process flow (supplier evaluation and sharing of information with suppliers and customers). Figure 1 shows measures and metrics at four basic links in a SC: plan, source, make/assemble, and deliver. However, according to Bourne et al. (2003), frameworks on their own are not a complete solution. Frameworks provide different perspectives for categorising performance measures, allowing one to consider the balance between the demands on the business. According to Beamon (1999), a supply chain measurement system must place emphasis on three separate types of performance measures: 1. Resource measures (generally costs); 2. Output measures (generally customer responsiveness); and 3. Flexibility measures (Ability to respond to a changing environment). Each of these three types of performance measures has different goals and purpose. Resource measures include: inventory levels, personnel requirements, equipment utilization, energy usage, and cost. Output measures include: customer responsiveness, quality, and the quantity of final product produced. Flexibility measure a system's ability to accommodate volume and schedule fluctuations from suppliers, manufacturers, and customers (Beamon, 1999). Categorization of measures - The Table 4 lists the various measures that are presented in the literature. The abbreviations used for categorizing is as shown below Quality (Q) Cost (C) Delivery(D) Flexibility (F) Agility (A) Responsiveness(R) Non-financial (NF) Qualitative (QL) Quantitative (QN)

Table 4. Supply Chain Measures from Literature

Author	Framework / Performance measures / Performance Measurement System	Category of measures	Author	Framework / Performance measures / Performance Measurement System	Category of measures
Beamon(1999)	Resources, output and flexibility	QN	Changrui Ren, Yueting Chai, Yi Liu, (2004)	Active performance management system	QN, QL
Holmberg.S.(2000)	Performance model with system perspective, cost,speed and customer service level, agility	C, A, Q	Archie Lockamy Kevin L. Payette, (2004)	SCOR model	QN, QL
Suwignjo, U.S Bititici and AS Came, (2000)	Quantitative model	QN	David J. Parsons, Robin J. Clark, Kevin L. Payette, (2004)	Relationship between productions run lengths and overall supply chain performance	QN, Q
Gunaskaran. A, Patel C and Tittiroglu E (2001)	Strategic, operational and tactical focus	QN, QL	Schonsleben (2004)	Quality, cost, delivery and flexibility	Q, C, D, F
Stephens, (2001)	Measures based on process	C,R, QN	Gunaskaran A, Williams, H.J. (2005)	framework for measuring and costs performance	C, NF
De Toni and Tonchia (2001)	Cost and non-cost	C, NF	Li, S, Rao, S. Ragu Nathan T. S. & Ragu Nathan, B.(2005)	Strategic supplier partnership, CRM, information sharing, quality, internal lean practices and postponement	QL, QN, Q, C
Hieber(2002)	Supply chain collaboration efficiency, coordination efficiency and configuration	Q, QN	Liwen Wu, Yutao Song (2005)	Finance business process,customer environment, core enterprise ability	C,QN
Chan(2003)	Cost, quality, resource utilization flexibility, visibility trust and innovativeness	C, Q, QN, F, A	Fynes,B, Voss,C., Burca, S.D,(2005)	Quality, framework incorporating dimensions of SC relationship and quality performance	Q, QN
Chan and Qi (2003)	Input, output and composite measures, process of supply	QN, QL	Abhijeet K. Digalwar, Bhimaraya A. Metri	Theoretical framework for the performance measures of	QN, Q, C

	chain		(2005)	World Class Manufacturing	
Chunhua Tian, Yeuting Chai, Yi Liu, Shouju Ren (2003)	Quality, cost, delivery and flexibility perspective performance measures at department, enterprise and supply chain level	C, Q, QN, F, A	MAO Zhaofang et al.(2006)	Supporting evaluation level (HITS- Human, Institution, Technology) and operational evaluation level	QL, T, Q, C
Felix T S Chan, H J Qi, H K Chan, Henry C W Lau, (2003)	Innpvative performance measures method	Q, QN, QL	Z, Li, X. Xu, & Arun kumar (2007)	Approach which evaluates a supply chain from both structural and operational levels	QN, C, Q
Stefan Tangen, (2003)	Financial, time based measures	C, T, NF	Tong Ren, (2008)	Supply Chain Performance Measurment Based on SCOR Model	QN

7. Characterisation of different supply chain performance evaluation models

There is a significant corpus summarizing different studies on the performance evaluation models applied in a corporate framework (Bititci, 1995; Neely et al., 1995; Bititcietal., 2005; Folanand Browne, 2005). Identifying performance evaluation systems was a key concern in the 1990s, the aim having mainly been to devise measurement systems whose dimensions would be broadly aligned with the corporate strategy (Neely et al., 1995). There have been a huge variety of measurement systems, starting with the best known ones such as the Balanced Scorecard (Kaplan and Norton, 1996) or the EFQM Excellence Model (EFQM, 2010). Mainly geared towards measuring autonomous entities (companies, subsidiaries, business units, etc.), these models did not take the complexity of value-creating company chains into account. A number of measurement models was then defined in the 2000s and helped to analyse supply chains in terms of some or all of their components (collaboration, human resource management, sustainability, etc.) (Beamon, 1998, 1999; Gunasekaram et al., 2001, 2004). Supply chain performance measurement models developed in recent years include Supply Chain Operation (SCOR) (Lockamy and McCormack, 2004), Global Supply Chain Forum (GSF) (Cooper et al., 1997) and Efficient Consumer Response (ECR) (ECR, 2010). We present 16 well-known supply chain performance measurement models and their particularities.

7.1 ABC: Activity-Based Costing

It has been created in the 1980s. It aims to analyze costs and margin, but goes beyond the simple calculation of return costs. It necessitates a deep knowledge of the company. It groups activities by their process logic and interweaves accounting data into this concept.

7.2 FLR: Framework for Logistics Research

It has been developed in the 1990s. It describes dependency between the level of performance achieved, logistics organization and competitive strategy. It can be applied at organizational and strategic level. It structures logistics function into several dimensions (centralization, formalization, integration and areas of control).

7.3 BSC: Balanced Score Card

It has been developed in the 1990s. It seeks balanced measures to buttress company strategy. This principle proposes four analytical axes: customers, finance, internal processes and innovation-growth and it incorporates a human dimension for the performance measurement. It is specifically geared towards general management and can be applied from the strategic through the organizational level. It aims to establish causalities between the performance of each analytical axis.

7.4 SCOR: Supply Chain Operation Reference model

It has been developed in 1996 by the Supply Chain Council (SCC). It aims to analyse four dimensions: reliability of commercial performance, flexibility/ responsiveness, cost of supply chain and turnover of committed capital. It can be applied to all industrial and service sector companies, at tactical and operational level for an implementation of decisions relating to the company's strategic planning. Its indicators' definitions are explained using calculation modes and giving association of indicators for each process.

7.5 GSCF framework

It has been created by Ohio State University in 1994. It describes three levels (strategic, tactical and operational) and highlights links between supply chain process and structure. It focuses on seven processes: customer relationship management, customer service management, demand management, order fulfillment, manufacturing flow management, supplier relationship management, product development and commercialization, and returns management.

7.6 ASLOG audit

It has been created in 1997 by ASLOG, based on models used in the automobile sector. It assesses logistics procedures by analyzing strengths and weaknesses. It is a transversal tool, which aims to implement good practice dedicated to companies with low or medium levels of maturity. It analyses the following areas: management, strategy and planning, design and projects, sourcing, production, transportation, stocks, sales, returns and after sales, piloting and permanent progress indicator.

7.7 SASC: Strategic Audit Supply Chain

It has been developed in 1999. It analyzes supply chain in terms of processes, information technologies and organization at an organizational level. Its principle is to break logistics chain down into six competencies: customer orientation, distribution, sales planning, lean production, supplier partnerships and integrated management of chain and to link competencies to information technology and organization of chain.

7.8 Global EVALOG (Global MMOG/LE)

It has been created in 1999 with Odette International Limited and Automobile Industry Action Group. It assesses partner site processes and performance, pursues continuous improvement approach. Although it has been developed for an automobile industry, it can be used for associated sectors (metal works, chemicals). It is structured in to six areas: strategy and improvement, work organization, production planning, customer interface, process control and supplier interface.

7.9 WCL: World Class Logistics model

It has been developed by Michigan State University in the 1990s. It evaluates the company's performance in terms of its ability to account for inter organizational relationships through a model comprised of 68 questions. It can be applied at strategic and organizational level. It revolves around four areas of competency: positioning, integration, agility and performance measurement.

7.10 AFNOR FDX50-605

It has been developed in 2008. It offers general framework for strategic reflection and defines different logistics processes. It identifies performance levers associated with each process. Its model features six area: identification of needs and setting of objectives, logistics system design and development, production, sales and distribution, logistics support and control over global logistics process.

7.11 SCM/SME

It has been developed in 2007 within an SME context. It is composed by a questionnaire featuring 25 modules: corporate strategy, organization and logistic competencies development, performance processes and measurements, information system. Its targets are mainly industrial SMEs in fast moving consumer goods sector. It is structured around demand management, distribution, import/export flows, stocks, production, sourcing, returns, after sales support and traceability.

7.12 APICS: Association for Operations Management

It has been developed by professional association APICS in 2000. It analyzes innovation and customer service management, efficiency drivers, agility, risk control and sustainability. It mainly applies to industrial firms. Its processes are structured via model that is mainly geared towards production planning.

7.13 ECR: Efficient Customer Response

It has been created in 1994 by an ECR Association of manufacturers and retailers. It evaluates good inter organizational practices and uses maturity based evaluation tool: global mapping. It focuses on collaboration between industrialists and distributors in fast moving consumer goods sector. It establishes common language based on joint evaluation of performance by act or sin the chain. It is based on 45 criteria structured into four areas: consumer demand management, supply chain management, technological platforms and integration.

7.14 EFQM: Excellence model

It has been in traduced in 1992. It starts by a questionnaire with 50 questions; respondents positioned along the scale of excellence. It covers areas relating to process efficiency, continuous improvement in products and services, personnel management and progression. It is suitable for all types of companies. It is based on eight principles: customer focus, leadership, definition of objectives, process-based management, staff involvement, continuous innovation process, development of partnerships and civic responsibility.

7.15 SCALE: Supply Chain Advisor Level Evaluation

It has been created in the early 2000s by the Institute for Supply Chain Excellence (ISLI) for all sectors of activity. It revolves around questionnaire that assesses strategic and tactical dimensions, elements of value creation. It is based on 58 processes classified into seven categories of activities: definition of strategic objectives, establishment of procedures, needs planning, coordination of phases, performance evaluation and monitoring and supply chain optimization.

7.16 SPM: Strategic Profit Model

It has been created in 2002, derived from the DuPont model. It displays existing interactions between strategic and operational levels by means of financial ratios. It proposes strategic and financial implementation based on cost drivers using returns on asset or returns on net value measurements. We have chosen to develop essential characteristics that are useful in understanding each model: (1) the model's origin; (2) the type of analysis involved; (3) implementation conditions and constraints; (4) the degree of conceptualization; and (5) the quantitative or qualitative indicators being used. This table illustrates how hard it can be to understand different supply chain performance evaluation models' roles and uses, whether in terms of the perspectives characterizing particular decision-making levels ("strategic, tactical or operational"), the typology of flows and processes in question or the areas of activity under study.

8. Analysis of different model

Table 5 tries to present differences and similarities between the various evaluation models based on a number of criteria that we considered crucial to any such comparison. We have suggested eight levels of analysis that are clearly inter dependent and enable an identification of each model's characteristics. We have defined our criteria in a way that will allow companies to start with their own positioning, before going on to ascertain which of the models should be applied in case the supply chain has to be changed.

8.1 Decisional level affected by the evaluation benchmarks

The levels' characteristics derive from time and space studies (horizon and period of decision-making) and hierarchy analysis. They have helped to identify strategic decisions that are mainly geared toward long-term resource management (investments, contract frameworks, etc.) along with tactical decisions based on medium-term resource programme planning followed by short-term, operational flows piloting decisions (Vernadat, 1996; Ducq et al., 2001).

8.2 Types of flows under analysis (physical, informational and financial)

In its commonly accepted definition, logistics distinguishes between physical and information flows. Originally, the optimization of physical flows dominate deficient logistics management efforts, with performance measurement tools being entirely devoted to this one area (Fabbe Costes and Colin, 2007). Controlling materials via information systems achieved saving sat the level of two traditional performance levers: costs and service levels (Cooper et al., 1997; Beamon, 1999; Lee et al., 2000). Financial flows piloting has also enabled the assessment of value creation with supply chains (Mentzer et al., 2001).

8.3 Supply chain maturity levels

When comparing performance evaluation models, it is important to specify whether their basic construction includes a tool for assessing a company's level of maturity. Within our analytical framework, we have chosen Pache´ and Spalanzani (2007) approach, which enables company evaluations through the use of a broader analytical matrix involving a five level maturity grid focused on inter organizational relations within the supply chain plus a number of societal aspects.

8.4 Type of benchmarking

Benchmarking constitutes an attempt to ensure the superiority of a particular activity through the adoption of top performance methods (Camp, 1989). This involves a continuous comparison of processes, products and services featuring similar activities that are all deemed to be best -in-class. The goal is to determine improvement objectives and actions that are demanding but realistic, so as to become and remain the best of the best within a reasonable period of time (Balm, 1992; Dattakumar and Jagadeesh, 2003).

8.5 Contextualisation (sector of activity, organizational typology)

Bazire and Brezillon (2005) have written that contexts are tantamount to constraints restricting the behavior of a given system. Thus, performance evaluation must be viewed in the context of a given supply chain's sector of activity or an organizational environment. In turn, this should help the model in question to be appropriated more quickly. At the same time, when evaluation models of this kind have been implemented, it becomes harder

both to validate any comparisons or else to make any references to the kinds of practices that other organizations are pursuing, and which might lead to sudden shifts or significant improvements.

8.6 Quality factors

Quality impacts on organization and performance, the end effect being that companies will start to inject quality management approaches in to their logistics vision. Today's management systems tend to seek total quality based on customer and employee satisfaction principles. This involves the development of a quality mindset shared by then tire staff. Note that companies strive not only to achieve quality, but also to achieve excellence, based on an expanded quality vision including the notion of continuous improvement. Given wide spread interest in this area, it is worth trying to ascertain which supply chain evaluation models in corporate quality and excellence dimensions in their supply chain performance evaluation measurements.

8.7 Human capital

This factor plays a crucial role in supply chain organization and performance, combining the value of knowledge with the kind of competencies that come from the accumulation of experience. Human resource management has become an increasingly important resource for companies, with several models offering very precise descriptions there of (Shub and Stonebraker, 2009; Becker et al., 2001). Hence, our decision to use this comparative exercise to present those supply chain evaluation models that have become today's benchmarks and whose performance evaluation approaches rely heavily on the human factor. The idea here is to evaluate supply chain performance via indicators related to human resource and competency management. One outcome has been the growing significance attributed to the management of staff members, construed as a corporate resource. Hence our efforts to present, through this comparative analysis, those supply chain evaluation models that have become today's benchmarks and whose performance evaluation approaches highlight human factors.

8.8 Sustainability

Environmental issues have become a key concern for companies, most of whom integrate a sustainability approach in to their activities and strategies nowadays. The focus here is on protecting the environment and overall economic and social developments. A sustainable supply chain—including any return flows—will improve the social, environmental and economic impacts of the raw materials and service flows that link suppliers, manufacturers and end users(NZBCSD, 2001).

Models	FLR	GSCF	SASC	WCL	ASLOG	EVALO G	AFNO R	SCM/ SME	BSC	SPM	ABC	SCO R	SCAL E	APIC S	ECR	EFQ M
Decision level																
Strategic level	✓	✓	✓	✓			✓	✓	✓	✓			✓	✓	✓	✓
Tactical level	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
Operational level	✓	✓			✓	✓					✓	✓		✓		
Type of flows																
Physical flow		✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓
Informational level	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
Financial flow				✓			✓		✓	✓	✓	✓	✓			
Level of supply chain maturity																
Intra-organizational	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	□	✓
Inter-organizational		✓	✓	✓		✓	✓	✓		✓	✓	✓			✓	
Extended inter-organizational										✓		✓	✓		✓	
Multi-chain										✓		✓				
Social							✓	✓	✓			✓	✓			✓
Type of bench- marking																
Internal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
External				✓		✓				✓		✓	✓		✓	
Contextualization																
SME								✓								
Retailer															✓	

Models	FLR	GSCF	SASC	WCL	ASLOG	EVALOG	AFNOR	SCM/SME	BSC	SPM	ABC	SCOR	SCALE	APICS	ECR	EFQM
Industry						✓								✓	✓	
Service																
All sectors	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓			✓
Quality factors				✓			✓					✓				✓
Human capital				✓					✓			✓				✓
Sustainability							✓	✓	✓			✓		✓		✓

9. Conclusion

The literature review shows that performance measurement is growing in its scope and importance. The academicians and practitioners have been increasingly paying attention on how to design and implement performance measurement systems. However, there are continuous changes in its nature and context. There is a shift for example, from the traditional performance measures that focused on financial data (i.e. ROI, ROA), to non-traditional performance measures that focused on non-financial data (i.e. quality, flexibility). The paper initially provides definitions of performance measurement. It discusses the importance of performance measurement systems. It is also seen from the literature survey that both traditional and non-traditional performance measures are necessary for an organization to compete. The paper explores performance dimensions and its measures. The literature review leads to a conclusion that a study is needed to reliably and accurately measure activities in which the flow of material, information and cash, through transformation processes, to finished product. Performance measurement is a power tool that assists firms or organizations to evaluate resource utilization so that they can strategically manage and continuously control to achieve their objectives and goals.

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