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A framework for analysing supply chain performance evaluation models

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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 organisation, 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.

1. Introduction

With supply chain now comprising a key element in corporate competitiveness, some firms have come to view this function as the cornerstone of their differentiation strategy (Waters and Waters, 2007). Supply chain performance can be measured both in terms of customers' level of satisfaction – since they remain the ultimate judges of how much value is actually being created at a logistics level – and the costs incurred. Evaluating supply chain performance is a complex undertaking, in part because this is a transversal process involving several actors cooperating to achieve given logistical and strategic objectives. Such evaluations become particularly important in situations, where supply chains are considered a key factor of corporate success.

The purpose of the present article is to analyse the characteristics of different supply chain performance evaluation modes, while providing a decision assistance framework that will allow managers to choose the model that offers the kind of analysis they need. As such, it seeks to identify which model is most useful to a company in terms of helping it to raise performance by incorporating analysis that covers a whole range of criteria, one of which is the supply chain maturity.

The article starts with a definition of logistics and supply chains, with a second section specifying different levels of supply chain maturity within companies and considering the estimation of

supply chain performance. The two sections seek to analyse ways of evaluating supply chain performance. The third section applies an initial analytical table to identify characteristic criteria, while highlighting the dissimilarities between different models used in supply chain evaluations. The fourth section applies a second analytical grid that we have developed to examine the relevancy of each of these models. The purpose of this double characterisation is to enhance researchers and professionals' understanding of different evaluation models' roles, along with their suitability within particular corporate contexts.

2. Logistics and supply chain

Cooper et al. (1997) have pointed out that in 1986, the Council of Logistics Management (CLM) – since renamed the Council Of Supply Chain Management Professional (CSCMP) – defined logistics management as “the process of planning, implementing and controlling the efficient, cost-effective flow and storage of raw materials, in-process inventory, finished goods and related information flow from point-of-origin to point-of-consumption for the purpose of conforming to customer requirement”.

This function, whose main mission is the management of physical, and informational flows, interacts closely with many other corporate functions, including management control, human resources, marketing, finance, engineering, IT, etc. Smooth collaboration between logistics and other corporate functions no longer suffices consider that a company is actually performing well. A much broader range of areas come into play nowadays, calling on a variety of additional parties who might be called business

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partners, ranging from suppliers' suppliers to customers' customers. It is in this sense that people no longer talk about "logistics", but instead about "supply chain management" when defining a network of interdependent partners that are working extremely closely together to fulfill a common goal of customer satisfaction (Mentzer et al., 2001). As such, supply chain management involves integrating all key operational processes at any level between the final users and original suppliers of the products, services and bits of information that offer added value to customers and other stakeholders (Christopher and Ryals, 1999; Cooper and Lambert, 2000).

Combining these multiple aspects, supply chain management can be defined as a systemic and strategic coordination of traditional operational functions both within a given company and also between partners working within a chain, with a view towards improving the long-term performance of each company that is part of the chain and of the whole of the chain itself (Mentzer et al., 2001).

3. Supply chain maturity

Maturity models first appeared in early quality management studies, which tended to identify a number of different levels (Crosby, 1979). Identifying such levels has been one corollary of corporate performance improvement approaches. This vision considers that organising a company on a silo basis (i.e. at the lowest possible level) leads to lesser performance than taking a broad, cross-departmental view.

The best known maturity model derived from these approaches is the Capability Maturity Model Integration (CMMI). This model has been developed by Software Engineering Institute (SEI) (SEI, 2004) since the 1990s to improve the efficiency and effectiveness of product and service development and maintenance activities, while incorporating practices associated with a product or service's total lifecycle, ranging from design to maintenance. This model is mainly used for engineering activities. The maturity model is based on the description of processes that must be implemented to achieve the level of excellence corresponding to the maximum level of maturity. Achieving each level of maturity enables an incremental and lasting improvement in performance. In the CMMI model, there are five maturity levels:

Level 1: initial: the processes are neither defined nor standardized and the performance is not evaluated regularly.

Level 2: managed: the processes being implemented are planned, executed, supervised, controlled, reviewed and assessed. The resources associated with the use of these processes are effective and possess the wherewithal that will allow them to realise the processes in question.

Level 3: defined: the processes are standardised and improved and used by the whole of the organisation—whose own objectives will also be defined.

Level 4: quantitatively managed: the organisation sets performance objectives for the processes. The objectives are linked to organisational, but also customer demands. Outcomes are measured quantitatively.

Level 5: optimizing: the processes are continually improved through an analysis of the causes for any variations in performance.

These quality management-based maturity models are geared toward process implementation and the introduction of good practices enabling an improvement in an organisational performance. Many authors in the field of supply chain management have demonstrated the existence of links between maturity levels and

supply chain performance (Simatupang and Sridharan, 2004; Lockamy and McCormack, 2004; Cohen and Rousset, 2004; Trkman et al., 2007) with others contesting this same linkage (Lapide, 2006) insofar as they consider that supply chain performance derives from an evolutive process involving the implementation of "customised" practices grounded in an understanding of the principles of value creation that actually lead to an improvement in performance. Note that this shift from one level of maturity towards another higher one is usually associated with the implementation of best practices.

The ability to integrate best supply chain management practices is one way of defining maturity levels (Paché and Spalanzani, 2007). Many authors have worked to define supply chain performance-related maturity classifications that are not exclusively tied to the proper implementation of intra-organisational processes (in the same way as quality approaches are), but also rely on a company's ability to integrate such practices into an inter-organisational vision.

The maturity classification proposed in the Supply Chain Operations Reference (SCOR) model relates to companies' ability to manage the full scope of a supply chain (Cohen and Rousset, 2004).

Level 1: functional integration: The goal is to respond to improvements in the performance of a company's internal processes without seeking an optimum with other, ancillary processes.

Level 2: internal integration: The goal is to devise tools to measure transversal performance within the company, thereby validating overall performance by seeking an optimum between the demand for (and the management of) resources.

Level 3: external integration: The goal is to extend performance measurement to the company's key external actors, while associating them with the search for shared performance.

Level 4: inter-company collaboration: Sharing a joint organisational strategy (design, management modes, shared risks, etc.) enables the choice of common performance objectives.

Paché and Spalanzani (2007) have proposed five levels of maturity built around inter-organisational supply chain relationships, including any relevant societal aspects.

Level 1: intra-organisational maturity: the goal is to manage performance by bringing together different corporate functions (design, marketing, production, etc.).

Level 2: inter-organisational maturity: performance is managed at a more global level through the integration of any and all actors operating in proximity to the company (suppliers, service providers, direct customers, etc.).

Level 3: extended inter-organisational maturity: with all of the actors in a chain being involved in the search for better performance, this extended chain approach corresponds to the aforementioned supply chain definitions.

Level 4: multi-chain maturity: the company is integrated into a complex network of relationships, where each member company can be the "pilot" or "fulcrum" of a relationship. The "multi-firm" level enables each company to progress by offering a number of inter-sectorial performance approaches (ECR, 2010).

Level 5: societal maturity: companies belonging to a global network incorporate sustainability-associated performance dimensions (environment, society) and seek a kind of performance that will be valuable in a broader societal context. A prime example is the work done in France by the Déméter club (Déméter, 2010), which has brought together a variety of

industry or distribution sector actors to enhance global and societal performance.

The CMMI model is principally oriented on the processes and do not specify the collaboration aspects in an inter-organisational context. The maturity model proposed by an SCOR is limited to inter-organisational aspect of a specific chain and does not specify multi-chain aspects such as the collaboration processes or resource sharing, neither the social dimension and the necessary collaboration with territories, in which the channels will be stakeholders, including environmental and societal aspects. The model proposed by Paché & Spalanzani includes both societal and multi-chain perspectives.

When measuring supply chain performance, it is important to situate a company in terms of its maturity level given the variations, at different maturity levels, between the strategies that will be adopted, organisational implementation and the approaches used to measure the performance. The supply chain maturity grid describes, at each level, the principles that should be implemented to achieve superior performance. The five levels proposed by Paché and Spalanzani integrate different organisational practices for each level. The transition from one level to another involves the chain actors in organisational changes related to the modes of cooperation, implementation of interrelational processes or adapted performance indicators following the pattern of relationships (Fig. 1).

4. 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; Bititci et al., 2005; Folan and 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).

Table 1 in appendix 1 presents 16 well-known supply chain performance measurement models and their particularities.

- (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.
- (2) **FLR: Framework for Logistics Research:** it has been developed in the 1990s. It describes dependency between the level of performance achieved, logistics organisation and competitive strategy. It can be applied at organisational and strategic level. It structures logistics function into several dimensions (centralisation, formalization, integration and areas of control).
- (3) **BSC: Balanced ScoreCard:** it has been developed in the 1990s. It seeks balanced measures to buttress company strategy. This principle proposes four analytical axes: customers, finance,

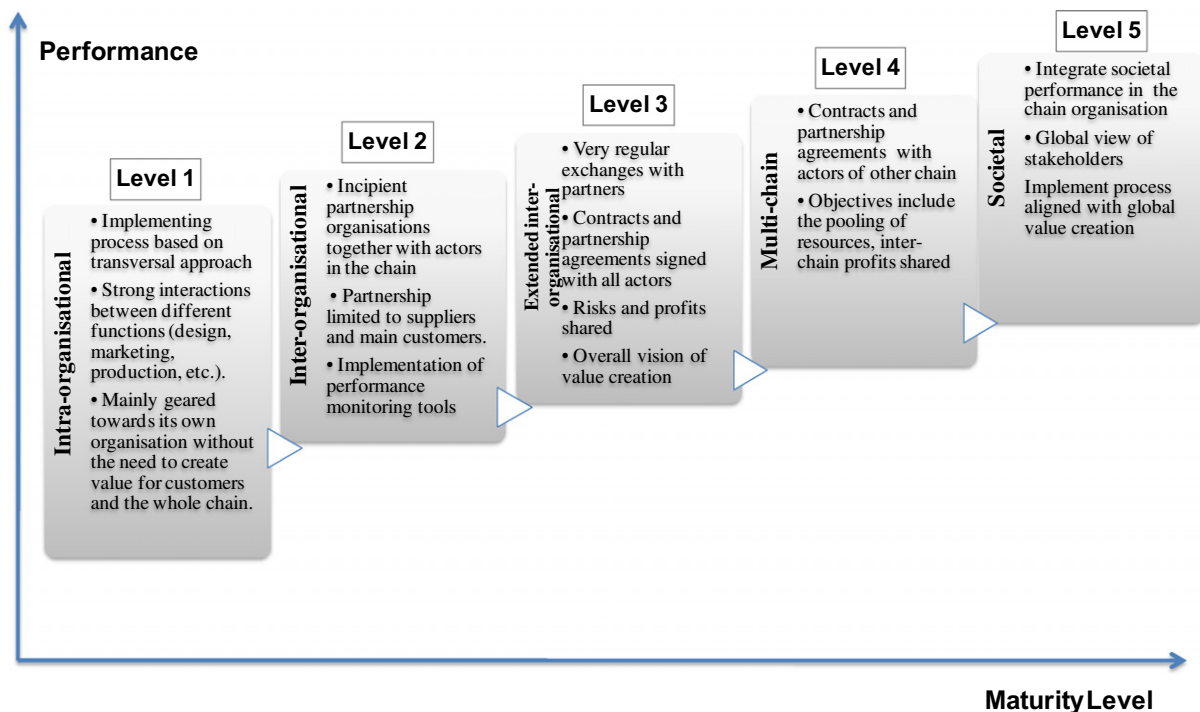


Fig. 1. Supply chain maturity grid.

Table 1
Supply chain performance measurement models.

Models/characteristics	1-ABC: Activity-Based Costing	2-FLR: Framework for Logistics Research	3-BSC: Balanced ScoreCard	4-SCOR: Supply Chain Operation Reference Model
References	(Kaplan and Johnson, 1987; Kaplan, 1983; Comellia et al., 2008)	(Chow et al., 1995)	(Kaplan and Norton, 1996)	(SCOR, 2010)
Origin of model	<ul style="list-style-type: none"> Created in the 1980s 	<ul style="list-style-type: none"> Developed in the 1990s. 	<ul style="list-style-type: none"> Developed in the 1990s. 	<ul style="list-style-type: none"> Developed in 1996 by the Supply Chain Council (SCC).
Type of analysis used	<ul style="list-style-type: none"> Analyzes costs and margins Variant of full costs, but goes beyond simple calculation of return costs 	<ul style="list-style-type: none"> Describes dependency between level of performance achieved, logistics organisation and competitive strategy Emphasizes relative nature of performance evaluation 	<ul style="list-style-type: none"> Seeks balanced measures to buttress company strategy Proposes four analytical axes: customers, finance, internal processes and innovation-growth Incorporates human dimension in performance measurement 	<ul style="list-style-type: none"> Analyzes four dimensions: reliability of commercial performance, flexibility/responsiveness, cost of supply chain and turnover of committed capital
Conditions and constraints	<ul style="list-style-type: none"> In-depth knowledge of company along with its activities and processes 	<ul style="list-style-type: none"> Applies at organisational and strategic levels 	<ul style="list-style-type: none"> Traditional top-down approach Specifically geared towards general management Applies from the strategic through the organisational level 	<ul style="list-style-type: none"> Applies to all industrial and service sector companies Applies at tactical and operational level for implementation of decisions relating to the company's strategic planning Contributes to operations integrating different actors in the chain
Degree of conceptualisation	<ul style="list-style-type: none"> Interweaves accounting data into the concept of "activity" Groups activities by their process logic 	<ul style="list-style-type: none"> Structures logistics function into several dimensions: centralisation, formalisation, integration, and areas of control 	<ul style="list-style-type: none"> Approach establishing causalities between the performance of each analytical axis Details causalities between customers and financial axes 	<ul style="list-style-type: none"> Models processes: planning, sourcing, manufacturing delivery and returns Standardised common language for different actors in the chain Definition of basic concepts: processes, typology of processes, management modes
Established indicators	<ul style="list-style-type: none"> Financial piloting indicators coherent with the strategy Performance improvement internal benchmarking approach 	<ul style="list-style-type: none"> Does not define indicators, but enables internal benchmarking 	<ul style="list-style-type: none"> Indicators chosen depending on the company's objectives Measurements must be balanced to accommodate demands emanating from all internal corporate functions and from external environment 	<ul style="list-style-type: none"> Indicators' definition explained using calculation modes Association of indicators with each process Enables internal and external comparisons of measurements Suggests "best-in-class"

Models/characteristics	5-GSCF framework	6-ASLOG audit	7-SASC: Strategic Audit Supply Chain	8-Global EVALOG (Global MMOG/LE)
References	(Cooper et al., 1997)	(Pimor, 1998)	(Gilmour, 1999)	(Odette, 2010; AIAG, 2010)
Origin of model	<ul style="list-style-type: none"> Created by the Ohio State University in 1994 	<ul style="list-style-type: none"> Created in 1997 by ASLOG Based on models used in the automobile sector 	<ul style="list-style-type: none"> Developed in 1999 	<ul style="list-style-type: none"> Created in 1999 Developed with Odette International Limited and Automobile Industry Action Group
Type of analysis used	<ul style="list-style-type: none"> Describes three levels: strategic, tactical and operational Highlights links between supply chain process and structure 	<ul style="list-style-type: none"> Model comprised of 200 performance measurement questions Assesses logistics procedures by analysing strengths and weaknesses Transversal tool seeking to achieve given level of excellence and implement good practice 	<ul style="list-style-type: none"> Analyses supply chain in terms of processes, information technologies and organisation 	<ul style="list-style-type: none"> Assesses partner site processes and performance, pursues continuous improvement approach
Conditions and constraints	<ul style="list-style-type: none"> Adapted to all types of companies 	<ul style="list-style-type: none"> Model geared towards small companies Targets companies with low or medium levels of maturity 	<ul style="list-style-type: none"> Applied at the organisational level 	<ul style="list-style-type: none"> Developed for automobile industry, but also used for associated sectors (metalworks, chemicals)
Degree of conceptualisation	<ul style="list-style-type: none"> Focuses on seven processes: customer relationship management, customer service management, demand management, order fulfillment, manufacturing flow management, supplier relationship management, product development and commercialisation, returns management 	<ul style="list-style-type: none"> Analyzes range of areas: management, strategy and planning, design and projects, sourcing, production, transportation, stocks, sales, returns and after-sales, piloting and permanent progress indicator 	<ul style="list-style-type: none"> Breaks logistics chain down into six competencies: customer orientation, distribution, sales planning, lean production, supplier partnerships and integrated management of chain Links competencies to information technology and organisation of chain 	<ul style="list-style-type: none"> Structured into six areas: strategy and improvement, work organisation, production planning, customer interface, process control and supplier interface
Established indicators	<ul style="list-style-type: none"> Enables internal benchmarking 	<ul style="list-style-type: none"> Internal benchmarking 	<ul style="list-style-type: none"> Internal benchmarking 	<ul style="list-style-type: none"> Six standard indicators Model assessing operational performance in terms of supplier-customer relationship

Table 1 (continued)

Models/characteristics	1-ABC: Activity-Based Costing	2-FLR: Framework for Logistics Research	3-BSC: Balanced ScoreCard	4-SCOR: Supply Chain Operation Reference Model
Models/characteristics	9-WCL: World Class Logistics Model	10-AFNOR FD X50-605	11-SCM/SME	12-APICS: Association for Operations Management
References	(Bowersox et al., 1999)	(AFNOR, 2010)	(Jouenne, 2008)	(Lamouri and Thomas, 2000; APICS (2010))
Origin of model	<ul style="list-style-type: none"> Developed by Michigan State University in the 1990s 	<ul style="list-style-type: none"> Developed in 2008 	<ul style="list-style-type: none"> Developed in 2007 within an SME context 	<ul style="list-style-type: none"> Developed by professional association APICS
Type of analysis used	<ul style="list-style-type: none"> Evaluates company's performance in terms of its ability to account for inter-organisational relationships Model comprised of 68 questions 	<ul style="list-style-type: none"> Offers general framework for strategic reflection Defines different logistics processes Identifies performance levers associated with each process 	<ul style="list-style-type: none"> Questionnaire featuring 25 modules: corporate strategy, organisation and development of logistic competencies, performance processes and measurements and information system 	<ul style="list-style-type: none"> Analyzes innovation and customer service management, efficiency drivers, agility, risk control and sustainability
Conditions and constraints	<ul style="list-style-type: none"> Applies at strategic and organisational level 	No constraints	<ul style="list-style-type: none"> Mainly targets industrial SMEs in fast moving consumer goods sector 	<ul style="list-style-type: none"> Mainly applies to industrial firms
Degree of conceptualisation	<ul style="list-style-type: none"> Revolves around four areas of competency: positioning, integration, agility and performance measurement 	<ul style="list-style-type: none"> Model featuring 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 	<ul style="list-style-type: none"> Structured around demand management, distribution, import/export flows, stocks, production, sourcing, returns and after-sales support and tracability 	<ul style="list-style-type: none"> Processes structured via model that is mainly geared towards production planning
Established indicators	<ul style="list-style-type: none"> Assesses actors' degree of an integration Assesses an extent of control over supply concepts 	<ul style="list-style-type: none"> Proposes logistics performance measurement approach based on performance levers and indicators 	<ul style="list-style-type: none"> Enables internal benchmarking 	<ul style="list-style-type: none"> Grouped into multiple performance management indicators

Models/Characteristics	13-ECR: Efficient Customer Response	14-EFQM: Excellence Model	15-SCALE: Supply Chain Advisor Level Evaluation	16-SPM: Strategic Profit Model
References	(ECR, 2010)	(EFQM, 2010)	(Favre Bertin and Estampe, 2004)	(Stapleton et al., 2002)
Origin of model	<ul style="list-style-type: none"> Created in 1994 by an ECR Association of manufacturers and retailers 	<ul style="list-style-type: none"> Introduced in 1992 	<ul style="list-style-type: none"> Created in early 2000s by the Institute for Supply Chain Excellence (ISIE) 	<ul style="list-style-type: none"> Derived from the DuPont model
Type of analysis used	<ul style="list-style-type: none"> Evaluates good inter-organisational practices Uses maturity-based evaluation tool: global mapping 	<ul style="list-style-type: none"> Questionnaire with 50 questions; respondents positioned along the scale of excellence Covers areas relating to process efficiency, continuous improvement in products and services, personnel management and progression 	<ul style="list-style-type: none"> Revolves around questionnaire that assesses strategic and tactical dimensions, elements of value creation 	<ul style="list-style-type: none"> Displays existing interactions between strategic and operational levels by means of financial ratios
Conditions and constraints	<ul style="list-style-type: none"> Focuses on collaboration between industrialists and distributors in fast moving consumer goods sector 	<ul style="list-style-type: none"> Suitable for all types of companies 	<ul style="list-style-type: none"> Developed for all sectors of activity 	<ul style="list-style-type: none"> Strategic and financial implementation based on cost drivers Based on return on an asset or return on net value measurements
Degree of conceptualisation	<ul style="list-style-type: none"> Establishes common language based on joint evaluation of performance by actors in the chain 45 Criteria structured into four areas: consumer demand management, supply chain management, technological platforms and integration 	<ul style="list-style-type: none"> Based on eight principles: customer focus, leadership, definition of objectives, process-based management, staff involvement, continuous innovation process, development of partnerships and civic responsibility 	<ul style="list-style-type: none"> 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 optimisation 	<ul style="list-style-type: none"> Based on the DuPont model
Established indicators	<ul style="list-style-type: none"> 13 Performance measurement indicators enabling inter-sectorial comparisons 	<ul style="list-style-type: none"> General indicators (margins, cash flow, stock turnover, etc.) Indicators relating to satisfaction of customers and staff, and to the company's integration into the rest of the society 	<ul style="list-style-type: none"> Evaluates the creation of value 	<ul style="list-style-type: none"> Financial ratios

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 organisational level. It aims to establish causalities between the performance of each analytical axis.

- (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.
- (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 commercialisation, and returns management.
- (6) **ASLOG audit:** it has been created in 1997 by ASLOG, based on models used in the automobile sector. It assesses logistics procedures by analysing 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) **SASC: Strategic Audit Supply Chain:** it has been developed in 1999. It analyzes supply chain in terms of processes, information technologies and organisation at an organisational 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 organisation of chain.
- (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 (metalworks, chemicals). It is structured into six areas: strategy and improvement, work organisation, production planning, customer interface, process control and supplier interface.
- (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-organisational relationships through a model comprised of 68 questions. It can be applied at strategic and organisational level. It revolves around four areas of competency: positioning, integration, agility and performance measurement.
- (10) **AFNOR FD X50-605:** 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.
- (11) **SCM/SME:** it has been developed in 2007 within an SME context. It is composed by a questionnaire featuring 25 modules: corporate strategy, organisation 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.
- (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.
- (13) **ECR: Efficient Customer Response:** it has been created in 1994 by an ECR Association of manufacturers and retailers. It evaluates good inter-organisational 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 actors in the chain. It is based on 45 criteria structured into four areas: consumer demand management, supply chain management, technological platforms and integration.
- (14) **EFQM: Excellence model:** it has been introduced 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.
- (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 optimisation.
- (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 conceptualisation; 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 characterising particular decision-making levels ("strategic, tactical or operational"), the typology of flows and processes in question or the areas of activity under study.

Fabbe-Costes (2002) has also shown that supply chain management is actually based on the idea of creating value for all actors in a chain, even when stakeholders use overly differentiated performance

evaluation systems that are almost impossible to reconcile. This is why the choice of an evaluation model is so crucial in a networked organisation, where everyone must provide evidence of the value being created by the firm, either within the value chain with respect to the customer, within several chains with respect to one another or else with respect to society as a whole. Not all current models are relevant in all companies. A firm that benefits from an integrated or extended organisation will clearly not rely on the same performance evaluation model as one whose organisation is “functional” in nature—where the latter will be happy to make a separate use of indicators specific to each function, the former must combine indicators to attain a more global vision. This is because the choice of one model as opposed to another depends largely on a company’s level of supply chain maturity.

The models in question here have been applied in a large number of supply chains (Ulusoy, 2003; Estampe and Chandès, 2003; Schmitz and Platts, 2004) without any evaluation having been made of their usefulness within a broader supply chain management framework.

Shepherd and Günter (2006) have undertaken a relatively sweeping survey of research literature relating to supply chain performance system measurements. They show how different authors have strived to identify the shortcomings of certain performance measurement systems (relatively few links to strategy, measurements largely geared toward cost instead of non-cost indicators, imbalanced approach, lack of customer or competitor orientation, absence of inter-organisational vision, and an absence of a systemic approach). At the same time, it is also not possible to find any articles in this corpus characterising or classifying models according to criteria that managers will to choose models reflecting their positioning along the chain.

The important questions for efficient and effective application are:

What is the maturity level characterising each actor in the chain? Is the chosen model adapted to each? Which decision-making level suits the use of a particular model? What kind of

benchmarking is being sought by each of the actors in the chain? etc.

We suggest surveying the models used most frequently to measure supply chain performance and ranking them according to criteria reflecting managers’ expectations.

5. Grids enabling the choice of an appropriate model

5.1. Analysis of different models

Table 2 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 interdependent 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.

5.1.1. 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).

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

In its commonly accepted definition, logistics distinguishes between physical and information flows. Originally, the optimisation of physical flows dominated efficient logistics management

Table 2
Performance evaluation models matrix.

	FLR	GSCF	SASC	WCL	ASLOG	EVALOG	AFNOR	SCM/SME	BSC	SPM	ABC	SCOR	SCALE	APICS	ECR	EFQM
Decision level																
Tactical level	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
Operational level	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓
Type of flows																
Physical flow		✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓
Informational flow	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Financial flow				✓			✓		✓	✓	✓	✓	✓			✓
Level of supply chain maturity																
Intra-organisational	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Inter-organisational		✓	✓	✓		✓	✓	✓		✓	✓	✓	✓		✓	
Extended inter-organisational										✓	✓	✓	✓		✓	
Multi-chain										✓		✓	✓			
Societal							✓	✓	✓		✓	✓	✓			✓
Type of bench-marking																
Internal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
External				✓		✓				✓	✓	✓	✓		✓	✓
Contextualisation																
SME								✓								
Retailer																✓
Industry						✓								✓	✓	
Service																
All sectors	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓	✓			✓
Quality factors				✓			✓					✓				✓
Human capital				✓					✓			✓				✓
Sustainability							✓	✓	✓			✓		✓		✓

efforts, with performance measurement tools being entirely devoted to this one area (Fabbe-Costes and Colin, 2007). Controlling materials via information systems achieved savings at 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).

5.1.3. 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 Paché 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-organisational relations within the supply chain plus a number of societal aspects.

5.1.4. 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).

There are two kinds of benchmarking:

- *Internal benchmarking*: this involves analysing and comparing concepts, methods, processes, products and services within one's own organisation—in which case information is easily accessible. On the other hand, the company will lack vision of the outside world.
- *External benchmarking*: this involves competitive benchmarking between a company and its direct competitors. Where such comparisons are feasible, the approach allows companies to discover what methods allow rivals to achieve top performance revealing the origins of their competitive advantage.
 - *Functional benchmarking*: where a company analyzes its internal functions compared to other firms in the same sector of activity.
 - *Organisational benchmarking*: where a company compares activities that have a strong effect on its organisation with the same activities in non-rival companies operating in the same sector of activity.
 - *Generic benchmarking*: where the company analyzes best practices by leader organisations from different sectors of activity
 - *Strategic benchmarking*: where a company adapts winning strategies together with partners with whom it has established a collaborative relationship, in order to generate strategic thinking aimed at new improvement orientations.

Within each of these visions, supply chain evaluation benchmarks have been developed and used as a basis for benchmarking studies. Hence the distinction we make, among the different benchmark models under study, between ones used in an external benchmarking approach and ones used for internal benchmarking reasons.

5.1.5. Contextualisation (sector of activity, organisational typology)

Bazire and Brézillon (2005) have written that contexts are tantamount to constraints restricting the behaviour of a given system. Thus, performance evaluation must be viewed in the

context of a given supply chain's sector of activity or an organisational 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 organisations are pursuing, and which might lead to sudden shifts or significant improvements.

5.1.6. Quality factors

Quality impacts on organisation and performance, the end effect being that companies will start to inject quality management approaches into 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 the entire 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 widespread interest in this area, it is worth trying to ascertain which supply chain evaluation models incorporate quality and excellence dimensions in their supply chain performance evaluation measurements.

5.1.7. Human capital

This factor plays a crucial role in supply chain organisation 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 thereof (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.

5.1.8. Sustainability

Environmental issues have become a key concern for companies, most of whom integrate a sustainability approach into 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).

Note that not all performance evaluation models feature the same characteristics, whether this involves the levels where decisions are being taken, the use of internal or external benchmark or the way that implementation varies from one supply chain maturity level to another. Based on these criteria, there is no clear characterisation at present of how models might be implemented within a particular organisation—justifying the suggestion below of a typology for these models. This will mainly revolve around supply chain maturity levels and indicate to any and all organisations the level at which they should implement a given model to achieve a certain kind of supply chain performance.

5.2. Using the grid

Before choosing a performance evaluation model, we need to define which kind of creation value is desirable for different actors within a chain and apply the relevant evaluation model based on this description and definition. In a sense, the grid is a summative table that starts out by identifying two main categories of models as well as their positioning on the supply chain maturity grid:

- Models oriented toward an internal analysis of companies and which mainly incorporate organisational performance measurements (ASLOG, ABC, SCM/SME). This category applies primarily to firms that have achieved supply chain maturity levels 1 and 2, i.e. one that would like to pursue internal supply chain approaches aimed at improving organisational performance at a local level. The evaluation here is intra- or inter-organisational in nature and does little more than measure the performance of the relationships between the supply chain and other corporate functions. Measuring the performance of internal supply chains or how things are working out with proximity partners is important, but insufficient since it only accounts for the individual performance of each link in the chain separately, without focusing on linkages between different supply chain actors.
- Models that have a sweeping overview of the supply chain, viewing it as something ranging from suppliers' suppliers to customers' customers and incorporating the financial, organisational and societal aspects of performance (models like SCOR, WCL and SCALE). This second category is geared towards firms with supply chain maturity levels of 3, 4 or 5 or else who want to achieve such levels. Firms of this kind are integrated into a complex network of inter-company relationships and want to raise performance by pursuing an extended inter-organisational, multi-chain or societal vision.

Subsequently, these two main categories will allow us to link a model to a company's degree of maturity and to the development choices it is making for the future. In this way, the grid will help managers to evolve towards a model that is more suitable for their needs. Performance evaluation models of this kind also constitute benchmarking tools that can be used to create references to the best practices and imitate "best-in-class".

Companies that start at given maturity level and want to evolve towards better supply chain performance, while implementing new practices should choose the model corresponding to their desired trajectory. This classification should enable them to identify which models to choose.

6. Conclusion

The present article has not sought to define which assessment model is the most suitable but instead to uncover, in light of the specific criteria being applied, which might provide satisfactory analysis in terms of the particular performance level that a given company is seeking within its own particular context.

Towards this end, it suggested a table displaying various performance evaluation models organised by the model's origin, the type of analysis used, relevant conditions and constraints, the degree of conceptualisation and the indicators being devised. A second comparison has incorporated criteria such as the level of decision-making, the specific flows in question, the relationship between performance and supply chain maturity levels, interest in the quality dimension, human competency and sustainability.

The overall comparison has enabled a distinction between two main categories of models:

- ones geared toward measuring the internal performance of each actor in the chain and targeting companies with intra and inter-organisational maturity levels;
- ones geared toward measuring all of the actors in the chain and targeting companies, whose maturity levels have an extended, multi-chain or societal organisation.

Future research paths might focus on the following questions:

- How would different evaluation model choices affect each of the firms operating within one and the same supply chain in terms of the overall creation of value?
- What is the effect on a chain's performance when each of its actors finds itself at a different level of maturity?
- What happens when new evolution concepts arise?
- What level of competency does a company require to be able to use one or the other of these performance models?

The usefulness of studies in this area is that they provide managers with panoply of tools, whose impacts can be assessed in specific economic and societal terms. These future research paths will very probably be able to generate new evaluation models capable of integrating new ways of creating value for the whole of the supply chain.

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