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Performance Measurement for Supply Chain Management: A Systematic Literature Review

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Abstract. Performance measurement models are evolving fast in recent years, many research studies have been done regarding the nature and the methodologies of measuring performance in organizations. The present global economic environment of continuous change is demanding new business models and competitive strategies. These new models are being characterized by integration, and new technologies adoption, their operations are being forced to look not only in individual company, but also in their entire set of operations networks. The present challenge is to extend the performance management and measurement models developed for isolated companies to supply chains. This article aims to systematically review the literature on supply chain performance management and measurement in order to map the trends and behavior of scientific production developed in the field.

Keywords. Performance measurement, Supply chain management, Supply chain performance measurement systems, Systematic literature review.

Introduction

The concept of performance measurement is progressing and in recent years, many research studies have been done regarding the nature and the methodologies of measuring performance in organisations [1]. This field developed over a number of phases, so ordered: productivity management; budgetary control; integrated performance measurement and integrated performance management [2].

With continuous changes happening in the world, in the new business environment, such as integration, and new technologies like the Internet, many organisations are forced to focus on the supply chain (SC) rather than their internal operations. Like this, the next step is to extend the performance management and measurement from isolated companies to supply chains. Aramyan *et al.* [3] put that an adequate performance measurement system needs to be developed in order to assess the success of supply chains.

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Therefore, measuring supply chain performance plays an important role in supply chain management and improvement, and has received a lot of attention from the research community so that measuring it can improve the understanding and the cooperation between SC partners [4], increases SC integration [5] and can reveal the gap between planning and execution, helping companies to identify potential problems and areas for improvement [6].

This article aims to systematically review the literature on supply chain performance management and measurement from the perspective of operations management, highlighting the factors that affect the supply chain performance, performance dimensions and decision areas. A bibliometric analysis was conducted in order to show the research evolution on this theme. This paper is organized into the following sections: description of the systematic review methodology used research trands based on the literature; findings and conclusions.

1. Systematic review of performance measurement and management in the supply chain

This paper undertakes a systematic literature review in seeking all the relevant papers about supply chain performance management e measurement and the factors that influence the SC performance.

A systematic review has many advantages over other types of reviews such as traditional reviews as a systematic review requires an extensive review of articles following a list of specific steps to ensure the most relevant information with regard to a specific topic (subject) is obtained in an unbiased manner. Eventually, this ensures the fidelity, completeness and rigorous nature of the review [7]–[9].

The systematic literature review was conducted by creating a dataset constructed based on six different databases: Web of Science, Scopus, Science Direct, Emerald, Taylor & Francis, and Wiley. These databases have important journals in the field of supply chain. Search was made for papers written in english and portuguese, at all times. The search criteria are as follows: The search expressions were divided into three groups: The first group of expressions related to SC (Supply Chain, SCOR, Operations Network, Collaboration Network, Extended enterprise, Supplier, Interorganizational). The second group consists of expressions that represent the measurement and performance management (Performance, Indicator, Metric, Measure, KPI, Performance Measurement, Performance Management). The third group was set up with the intention to find references about models and performance measurement practices in the supply chain referenced in the literature (Model; Framework, Process, Method, Technique, Tool, System). The expressions were used as search engine in the title, abstract and keywords. Papers related to humanitarian chains and services were not considered in the analysis.

In total 1252 papers were founnded in the six bases. All papers abstracts were reviewed in order to exclude not pertinent works to the research and to identify the main methodology of each article. Repeated papers among the databases were also excluded, resulting in a dataset of 816 papers. Then, an bibliometric analysis was to perform within the filtered set of papers in order to understand the evolution of the theme under various perspectives. Bibliometric studies were used as techniques for supporting SLR strategy and, the study applies them as a set of research methods to map the structure of knowledge in the researched theme. Thus, from the processing of

information relating to the authors of the research, the publication of vehicles, research institutions and keywords can be evaluated trends and behavior of scientific production developed in a specific field [10], [11].

2. Research Trends

For performance measurement and management (PMM) companies to be effective, it has to fit the environment in which it operates. The environmental changes should be reflected in the strategies developed and deployed, and these strategic changes should affect the PMM system. One of the most important changes now a days is the increasing importance of the supply chain [12].

Wong *et al.* [13] wrote "A supply chain consists of a chain of suppliers and customers aiming to provide a product or service to the end customers", and the alignment within a SC is an emerging and important issue. Chae [6] wrote that supply chain performance measurement (SCPM) means a set of metrics and processes related to assessing and evaluating how accurate the planning is and how well the execution is carried out. Acording to Chen and Paulraj [14], measuring SC performance can facilitate a better understanding of the SC, positively influencing SC players' behaviour and improving its overall performance.

Literature reviews were conducted regarding SC in different contexts. Many researchers have suggested different measurement systems using the metrics of performance from different aspects. Arzu Akyuz and Erman Erkan [15] reviewed 24 articles from 1999 to 2009, and concluded the frameworks and models were still immature. Bhagwat and Sharma [16] determined the required performance measures and developed a model for performance evaluation, based on these selected measures using analytical hierarchy process (AHP) methodology. Gunasekaran, Patel and Mcgaughey [17] develop a framework for SCPM that provides a detailed 'measurement and metrics classification' and uses a survey aiming at assessing importance within each metric group. Gunasekaran and Kobu [18] offer a comprehensive review and classification for SC measurement and metrics. Arzu Akyuz and Erman Erkan [15] present some characteristics and requirements that new era performance measurement metrics should have. Beamon [19] categorised performance measures in the literature into two groups of qualitative and quantitative measures.

Some other researchers reviewed supply chain management within the context of sustainability. The study of Ahi and Searcy [20] identifyed and analyzed the metrics that have been published in the literature on green supply chain management (GSCM) and sustainable supply chain management (SSCM). Bhattacharya *et al.* [21] delineated a green supply chain (GSC) performance measurement framework using an intra-organisational collaborative decision-making (CDM) approach. Chin, Tat and Sulaiman [22] reviewed the extant literature on the relationship between GSCM, environmental collaboration and sustainability performance and propose a plausible conceptual model to elucidate the relationship between these three variables in the context of Malaysian manufacturing companies. Olugu, Wong and Shaharoun [23] reviewed various literatures on green supply chain performance measurement, environmental management, traditional supply chain performance measurement, and automobile supply chain management.

The influence of information technology (IT), information and knowledge sharing in the performance of the supply chain is also targeted by investigators. In their study,

Byrd and Davidson [24] examined the impact of information technology (IT) on the supply chain through a survey of 225 large for-profit US firms. Based on the dynamic capabilities perspective and the view of a hierarchy of capabilities, Liu *et al*. [25] proposed a model to examine how IT capabilities affect firm performance through absorptive capacity and supply chain agility in the SC context. In their study, Baihaqi and Sohal [26] conceptualised and assessed several factors that influence the degree of information sharing in supply chains.

Melnyk et al. [37] suggest that SC operating in the current working environment should have the ability to provide one or more (blend) of the six basic outcomes depending on the customer/market requirements, which are cost, responsiveness, resilience, security, innovation and sustainability. The findings of a survey conducted by Ambe [27] revealed that quality, final product delivery reliability and cost were highly rated and the most important indicators for the South African automotive market. Terpend and Ashenbaum [28] examines the intersecting effects of power, trust and supplier network size on 5 dimensions of supplier performance (delivery, quality, cost, innovation and flexibility). Other authors developed their studies with a focus on delivery [29]–[31] and SC flexibility [32], [33].

Several authors based their studies on the Supply Chain Operations Reference (SCOR) model and Balanced Scorecrd [15], [34]–[43]. The SCOR model is a framework, being developed and maintained by the SC council, for examining the SC in detail through defining and categorizing the processes that make up the chain, assigning metrics to these processes and reviewing comparable benchmarks [34]. It is a flexible framework and a common language that can help companies improve their SC internally and externally [35]. Hwang, Wen and Chen [36] explored the relationship between the plan-do-study-act (PDSA) cycle of green purchasing and the SCOR purchasing/sourcing process and its performance indices/metrics. Ganga and Carpinetti [37] proposed a SC performance model based on fuzzy logic to predict performance based on causal relationships between metrics of the SCOR model. Based on the survey data from 232 companies that have obtained ISO 9000 certification, Li, Su and Chen [38] studied the five decision areas of the SCOR model by integrating quality assurance measures in the SC process. Collectively, ‘Plan’ and ‘Source’ decisions are more important to customer-facing supply chain performance (reliability, response, and flexibility), and ‘Make’ decisions positively affect internal-facing performance metrics (cost and asset).

Sellitto *et al.* [39] presented a SCOR-based model for performance measurement in supply chains (SC) and apply it in the context of Brazilian footwear industry. The model has two dimensions: SCOR processes (source, make, deliver and return) and performance standards adapted from original SCOR (cost, quality, delivery and flexibility). And Thunberg and Persson [40] evaluated construction material supplier and construction site performance according to the SCOR model.

Kaplan and Norton [44] BSC concept reflects an intent to keep score of a set of items that maintain a balance ‘‘between short term and long term objectives, between financial and non-financial measures, between lagging and leading indicators, and between internal and external performance perspectives’’ [45]. The importance of the balanced scorecard approach for SCPM is beyond discussion [15]. The BSC holds the potential to facilitate performance measurement for SC [46]. Although extensive studies have been recorded in the evaluation of SC efficiency through balanced scorecard (BSC), these studies do not focus on the relationships between the four perspectives of the BSC. Kim and Rhee [41] examined the impact of green supply

chain management CSFs (critical success factors) on the BSC (balanced scorecard) performance by the structural equation modelling metodology. Jalali Naini *et al.* [42] proposed a mixed performance measurement system using a combination of evolutionary game theory and the balanced scorecard (BSC) in environmental supply chain management (ESCM). Kusrini, Subagyo and Masruroh [43] has developed an integrated model that combines the BSC with the SCOR to identify key indicators of SC performance based on strategic objectives of supply chain actors and for the government (regulator) especially with regard to public sector policy.

3. Findings

This section presents the bibliometric analysis results, including time distribution, publishing country, journals, authors, methodologies and keywords analysis.

3.1. Time distribution and publishing country

83% of the papers were published during the last ten years, almost 40% during the last three years. Figure 1 represents the the publications evolution over the years. The analyzed publications are from 55 different countries. The nine most representative countries are shown in Figure 2.

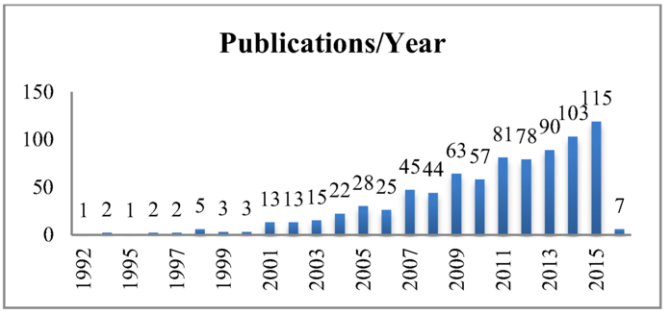

Figure 1. Amount of publications per year.

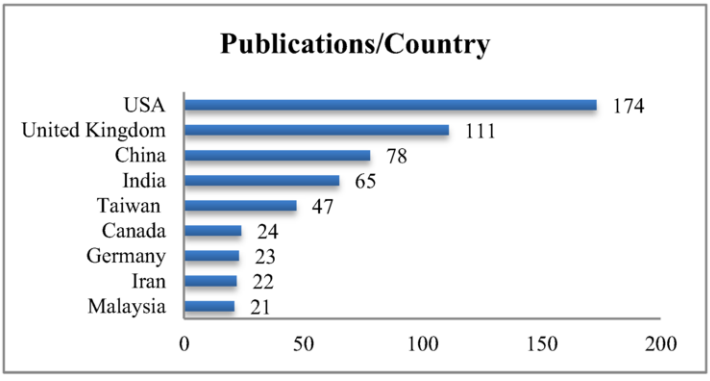

Figure 2. Amount of papers per country.

The fast growth of research may be justified not only by the strengthening of academic communities in general, but also by the increasing importance given to the supply chains management, which generates the need to develop ways to measure and manage the performance of companies working together.

Once the development of performance measurement went through the phases of productivity in the 50s, financial indicators until the 70s, measuring new dimensions from 80s, a change from measuring to managing performance in 90s, and only then aroused need for research in supply chain performance measurement and management, it was expected that the bulk of studies in the area had started to occur after 2005, with faster growth in recent years.

3.2. Journals

The 816 identified papers were published in 241 different journals. The ten most expressive journals, listed in Table 1 represented together 39% of all the papers.

Table 1. Papers distribution by journals.

Supply Chain Management: An international Journal	63
International Journal of Production Economics	58
International Journal of Production Research	48
International Journal of Operations and Production Management	37
Industrial Management and Data Systems	22
Benchmarking: An International Journal	21
International Journal of Physical Distribution and Logistics Management	20
Production Planning and Control	20
International Journal of Productivity and Performance Management	19
Journal of Operations Management	16

According to the databases, the subject area of the publications varies a lot. The most important fields interested in performance measurement and management of supply chain are (based on the amount of papers published): Business, Management and Accounting, Engineering, Decision Sciences, Computer Science, Economics, Econometrics and Finance, Social Sciences, Environmental Science and others.

3.3. Authors

Were considered for this analysis all authors of each identified paper, not just the correspondinng author. Were listed a total of 1.698 different authors, of which 80,6% are present in only one article. These data show a wide range of researchers interested in the topic, but points to a situation in which few of them use this theme as the main focus of their studies or research groups. Table 2 shows informations about tewelve authors who participated in six or more papers.

Table 2. Principal authors.

Authors	Number of papers	University/ Departament	Country	h-index
Sarkis, Joseph	11	Worcester Polytechnic Institute, School of Business	United States	54
Chan, Felix T.S.	11	Hong Kong Polytechnic University, Department of Industrial and Systems Engineering	China	42
Lai, Kee-hung	9	Hong Kong Polytechnic University, Faculty of Business	China	35
Fynes, Brian	8	National University of Ireland, Michael Smurfit Graduate Business School	Ireland	16
Huo, Baofeng	7	Zhejiang University, School of Management	China	10
Forslund, Helena	7	Linnaeus University, Department of Accounting and Logistics	Sweden	8
Tan, Keah-Choon	6	University of Nevada, Lee Business School	United States	22
Wiengarten, Frank	6	Universitat Ramon Llull, ESADE Business School	Spain	10
Zhao, Xiande	6	China Europe International Business School	China	25
Govindan, Kannan	6	Syddansk Universitet, Department of Technology and Innovation	Denmark	22
Green Jr., Kenneth W.	6	Southern Arkansas University, Department of Management	United States	23
Koh, S.C. Lenny	6	University of Sheffield, Management School	United Kingdom	27

3.4. Methodologies and Keywords

All papers on the dataset were classified by its most important methodological approach, based on the authors' description of their works. The following Figure 3 presents the amount of papers identified for each of these categories.

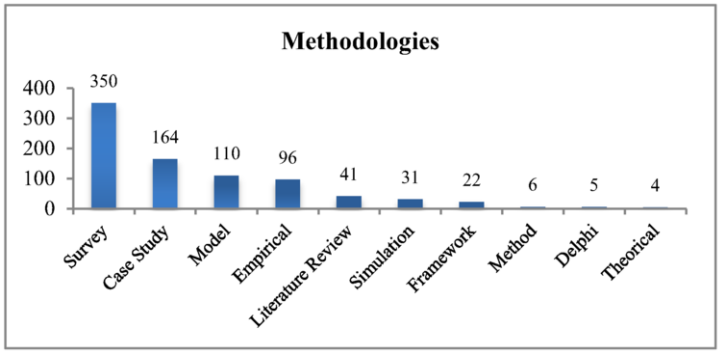

Figure 3. Amount of papers per methodological approach.

The most addressed keywords used for represent the studies in supply chain performance management, presented in the analyzed papers, were identified. Figure 4 lists the amount of papers studied that used the most cited keywords.

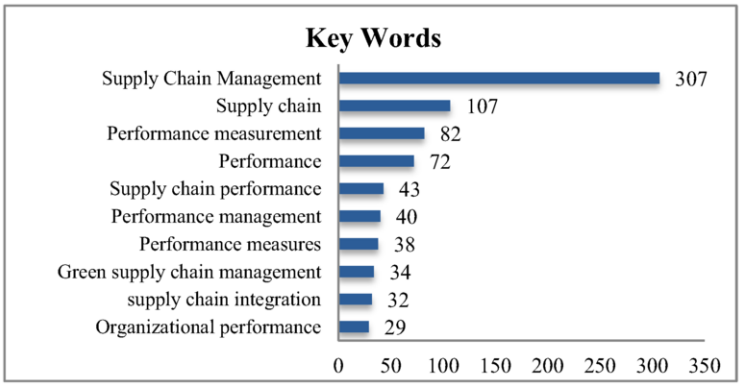

Figure 4. Principal keywords and number of publications.

4. Conclusion

The initial literature review showed many authors in the performance measurement and management field were pointing the need to extend the researches from companies to the SC context. Aiming to check if this calls for research were being answered, a Systematic literature review and bibliometric analysis, were conducted to map the search field.

The findings showed a greater amount of papers started to appear only in the last five years, publications are from journals from various areas and researchers from several countries. The diversity of research origins shows the importance of the theme and indicates it is continuing to grow in the future, but, in the other hand, hinders the search process maturity. Many papers have been conducted with the purpose of identifying the issues involved in supply chain performance measurement and management or proposing frameworks, models, and methods to solve them, but few studies have been made about application and validation of these proposals.

This paper contributes for theory in terms of mapping and reviewing the present research in the theme of Supply Chain Performance Measurement, and it creates conditions for academics to identify research opportunities in topics and research problems not fully addressed.

The main limitations of the approach are related to the selected scientific databases, document type (ie articles), language (i.e. English or Portuguese) and search phrases, which can delete items. The papers are not included in the data set may be pertinent to the field, but it is not likely that they would change the results of this evaluation. As future work, we propose an in-depth analysis on performance measurement models and indicators of the supply chain and consolidate in a conceptual framework, the supply chain performance measurement systems requirements proposed in the literature.

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