Chronological Survey of Analysing Performance Factors in Supply Chain Management

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Abstract-- The success of any organization is reflected upon by its performance which is in turn highly dependent upon its strategies. In this era of cut-throat competition, what an organization requires is not just framing the right strategies but also manage the same.

In the beginning was darkness, we went to work, did our job and went home day in and day out. We did not have to worry about targets, annual assessment, and metric driven incentive. Then there came light. Boses everywhere cast envious eyes towards our transatlantic cousins whose ambition was to increase production and efficiency year by year. Like eager younger siblings we trailed behind them on the thorny path to the enlightenment.

This paper contains chronological survey for developing supply chain framework for analyzing performance index given by various authors. The aim of the author was to optimize profit.

I. INTRODUCTION

Supply chain management (SCM) is the management of a network of interconnected businesses involved in the ultimate provision of product and service packages required by end customers (Harland, 1996).[1] Supply chain management spans all movement and storage of raw materials, work-in-process inventory, and finished goods from point of origin to point of consumption (supply chain).

Another definition is provided by the APICS Dictionary when it defines SCM as the "design, planning, execution, control, and monitoring of supply chain activities with the objective of creating net value, building a competitive infrastructure, leveraging worldwide logistics, synchronizing supply with demand and measuring performance globally chain management—a term that first appeared in the late 1980s—refers to the management of a distribution channel across organizations. All the members of the channel, from suppliers to end users, coordinate their business activities and processes to minimize their total costs and maximize their effectiveness in the market. The goal is to achieve the coordination and continuity of a vertically integrated channel without centralized ownership of the entities comprising the channel.

The firms in the channel form a long-term partnership or strategic alliance in order to improve service to the end consumer, reduce channel costs, and create a competitive advantage.

Supply chain management can be contrasted with a traditional distribution channel in which firms deal with one another on a short-term, arm's-length basis, with each one trying to maximize their own gain from each transaction. Without supply chain management, the relationship between firms in the channel lasts only from transaction to transaction. Most organizations in the traditional channel do not really see themselves as part of a vertically integrated channel. They only see themselves as independent businesses that buy from suppliers at the lowest possible price and sell to customers at the highest possible price. Diseconomies caused by redundancies, particularly of inventory, are common in such a channel. By looking across the entire channel, supply chain management tries to eliminate these redundancies.

II. LITERATURE REVIEW

This literature review examines key concepts and approaches used in the study. This study examines supply chain performance measurement framework for manufacturing sector, including measurement of supply chain performance, benchmarking for supply chain performance and also suggestion of improvements on supply chain performance, exploring these issues in one developing country, India. There are three interconnected themes in this literature review, covering the themes of supply chain management, performance measurement and supply chain performance measurement. The review begins with a discussion of supply chain management, including definitions and development, evolution of supply chain management, advantages of supply chain management for manufacturers and supply chain management practices. The review then considers the performance measurement. This performance measurement perspective assists in understanding the relationships between performance measurement and supply chain management.
Then, the review focuses on supply chain performance measurement that involves on the issues of: 1) Supply chain performance measurement models or frameworks and 2) Performance measurement factors for supply chain performance measurement.

The performance of supply chain management is required to measure with respect to some standard models or frameworks.

Beamon (1999) presents an overview and evaluation of the performance measures used in supply chain models and also presents a framework for the selection of performance measurement systems for manufacturing supply chains. Three types of performance measures (resources, output and flexibility) are identified as necessary components in any supply chain performance measurement system, and flexibility quantitative measurement approach for supply chains is proposed. However, it lacks of system thinking, in which a supply chain must be measured widely across the whole.

Gunasekaran et al. (2001) illustrate and discuss different performance measures and metrics of the supply chain management with the help of a framework that gives cohesive picture to address what needs to be measured, and how it can be dealt with. The framework is classified into strategic, tactical and operational levels of management. The metrics are also divided into financial and non-financial so that a suitable costing method based on activity analysis can be applied. However, due to the large number of metrics and measures given in the framework, firms find it difficult to use. Not many firms use all metrics and measures in day-to-day business operations. Also, the framework does not provide guidelines to prioritise these metrics. Further,firms require a comprehensive way to analyse their operations from every angle that covers all perspectives of business.

Chan and Qi (2003) propose an innovative performance measurement method to contribute to the development of supply chain management from five core processes: supplying, inbound logistics, core manufacturing, outbound logistics and marketing & sales. These process-based systematic perspectives are employed to build an effective model to measure the holistic performance of complex supply chains (cross organization). Fuzzy set theory is introduced to address the real situation in judgment and evaluation processes. However, this proposed model overlooks the decision making ability across strategic, tactical and operational levels. Otto and Kotza (2003) design suitable metrics to measure the effectiveness of supply chain management in six unique sets of supply chain metrics from six perspectives on supply chain management.

Each perspective follows a particular set of goals, which consequently leads to a particular set of performance metrics. The various perspectives refer to these disciplines, which contributed the most to the development of supply chain management: system dynamics, operations research or information technology, logistics, marketing, organization and strategy. Each perspective has its very own notion of a supply chain, its standard problems and solutions, and its performance metrics. However, all the metrics are not used in business practice to measure supply chain performance.

Gunasekaran et al. (2004) develop a framework to promote a better understanding of the importance of supply chain management performance measurement and metrics. The proposed framework considers the measurement of supply chain processes (plan, source, make and deliver) with respect to strategic, tactical and operational levels and evaluates a score for prioritize for each metric by three level: highly, moderately, and less important level from an empirical study of selected British companies. It lacks identifying critical success factors for the whole supply chain system. Furthermore, for evaluating the score, the organization, suppliers and customers should come together to discuss how they will address the measurement and improvement of supply chain management performance. Industry consortiums, consultants and researchers could be helpful in promoting supply chain management performance measurement generally, and in developing measures and measurement techniques specifically.

Huang et al. (2005) summarize the supply chain operations reference (SCOR) model, its benefits along with illustrative case stories and describe a computer-assisted tool to configure supply chain threaded diagram per SCOR specification. Supply chain configuration is an integral part in SCOR project implementation. Currently, the configuration of ‘as-is’ or ‘to-be’ threaded-diagram describing a supply chain is done manually. To automate this process, a computer-assisted configuration tool has been developed and described in this paper. However, the configuration tool can so far only deal with a single manufacturing facility of a company. It does not take into account the interactions among multiple manufacturing facilities. Thus, this research limits to only single manufacturing facility of a company for studying.

Aranyanet al. (2007) propose conceptual framework that founds to be useful for measuring performance of the Dutch-German tomato supply chain. From the case study, it is concluded that four main categories of performance measures (efficiency, flexibility, responsiveness and food quality) are identified as key performance components of the tomato supply chain performance measurement system.
This study also develops an integrated performance measurement system that contains financial as well as non-financial indicators combined with the specific characteristics of agri-food supply chains. Given the fact that the framework was evaluated in one particular case study (the Dutch-German tomato supply chain), caution is needed when generalizing the results. It also can be the limitation of this research to investigate only one food company.

Berrah and Cliville (2007) propose to build performance measurement systems by linking an overall performance expression to elementary performance. The overall performance is associated to a global objective whose break-down provides elementary objectives. Elementary performances are thus aggregated in a corollary way. This study deals with the supply chain performance formalization as it uses the performance indicators extend form Gunasekaran et al. (2004). These main strategic, tactical and operational indicators respect to SCOR model’s processes: plan, source, make and deliver. The case study concerns a bearing company with its suppliers and deliverers.

The overall performance expression results from the aggregation, by the weighted arithmetic mean (WAM), of the involved elementary performances. Besides, the multiattractiveness categorical based evaluation technique (MACBETH) methodology has been applied to the performance expression of the four main processes of a supply chain. Indeed, this methodology gives a structured framework, which links the elementary performance expression to the overall performance. Factually, the SCORModel is originally founded on five distinct management processes, namely: plan, source, make, deliver and return. This study, however, the return process is not considered the supply chain overall performance propose model.

Bhagwat and Sharma (2007a) develop a balanced scorecard (BSC) for measuring and evaluating day-to-day business operations of supply chain management from following four perspectives: finance, customer, internal business process and learning and growth. Three case studies develop and apply in small and medium sized enterprises (SMEs) in India. The balanced scorecard developed in this paper provides a useful guidance for the practical managers in evaluation and measuring of supply chain management in a balanced way and proposes a balanced performance measurement system to map and analyze supply chains. However, addition research is recommended in order to determine whether the proposed perspectives and measures are a necessary and sufficient set.

Jammernegg and Reiner (2007) discuss the opportunities and challenges for improving the performance of supply chain processes by coordinated application of inventory management and capacity management. The propose technique by using process simulation to approach a supplier in the telecommunication and automotive industry, where a manufacturer (production facility) is located in a country with low labour costs and high worker deployment flexibility. Using process simulation, the authors demonstrate how the coordinated application of methods from inventory management and capacity management result in improved performance measures of both intraorganizational (costs) and interorganizational (service level) objectives. But it lacks to view the whole supply chain process as this research concentrates only costs and service level.

Yeh et al. (2007) propose a modified 2-tuple fuzzy linguistic computing (FLC) model to evaluate the performance of supply chain management. In this model, the management implication of high precision setting involving in the Six Sigma: define, measure, analyze, improve and control (DMAIC) processes is employed to construct the evaluation framework. The original 2-tuple fuzzy linguistic representation model is modified as the proposed model to provide the aggregation algorithm toward ensuring the consistent property. In this study, the Delphi method is used to precisely integrate the experts’ opinions on criterion selection, weighting identification and performance appraisal that are realistically expressed by fuzzy linguistic variables. The modified 2-tuple FLC technique is formed by utilizing a geometric operator and a couple of new symbol translation functions to aggregate precisely the 2-tuple terms involved. However, this framework lacks of combining the decision making levels.

Hwang et al. (2008) investigate the sourcing processes and their accompanied performance metrics in the SCOR model version 7.0 by using the stepwise regression model. The regression model was applied to examine the sourcing process of SCOR at level 2 and its performance metrics. The results obtained were further extended for discussion on the sourcing process of level 3. The researchers develop the questionnaire survey to collect empirical information from the thin film transistor-liquid crystal display (TFT-LCD) industry in Taiwan. In addition, this study also elaborates the institutionalization of the SCOR model and justifies the project planning system based on the SCOR model. However, this research concentrates on SCOR model version 7 only. When the newly developed version comes out, this study will have to consider for revision again.
Robb et al. (2008) propose and develop a model exploring the relationship between supply chain or operations practice and operational or financial performance by using a structural equation model with China furniture manufacturers of study. The industry is of particular interest in that, while labour productivity remains relatively low, exports have undergone substantial growth. The research highlights the relative importance of supply chain and operations practices and shows that the impact of practice on business performance is mediated by capabilities on operations dimensions. Another key finding is that practices are related to the importance placed on various dimensions the strongest link being between human resources and innovation, thus training can be seen to be a key to securing competitive advantage. The limitation of this research is it studied only operations dimension performance, not for the whole supply chains.

Theeranuphattana and Tang (2008) revisit the recent work of Chan and Qi (2003) which proposed an innovative performance measurement method for supply chain management. This research aims to propose a more user-friendly alternative performance measurement model by using fuzzy logic technique. The performance measurement model is a combination of two existing methods: Chan and Qi’s model and the supply chain operations reference (SCOR) model. To demonstrate the applicability of the combined approach, actual SCOR level 1 performance data and the measurement information from a case supply chain are collected and processed by Chan and Qi’s measurement algorithm. These two methods complement each other when measuring supply chain performance. However, only one Thai manufacturing company case study is presented to demonstrate the measurement and the application of the performance measurement method.

Zhu et al. (2008) aim to empirically investigate the construct of and the scale for evaluating green supply chain management (GSCM) practices implementation among manufacturers., the measurement scale instrument in the form of a survey questionnaire developed from the various literature sources and interview academics and practitioners among Chinese manufacturers. Two measurement models of GSCM practices implementation were tested and compared by confirmatory factor analysis. The multitem five-point Likert measurement scales using to evaluate the different facets of green supply chain management practices implemented and evaluate their strengths and weaknesses. However, this study concentrates only environmental performance with operational performance, not for the whole supply chain performance.

Cai et al. (2009) propose a framework using a systematic approach to improve the iterative key performance indicators (KPIs) accomplishment in a supply chain context. The proposed framework quantitatively analyzes the interdependent relationships among a set of KPIs. This framework can provide an effective approach to managing supply chain performance in a dynamic environment. A KPI accomplishment cost transformation matrix (PCTM) analysis proposes in this paper, it is a new extension of the existing eigen structure analysis methods, work transformation matrix (WTM) derived from the design structure matrix (DSM) model from engineering to business performance management. However, the results from PCTM analysis method should not be adopted as direct decisions, but as supporting information for decision making.

Chia et al. (2009) apply the balanced scorecard (BSC) approach on the logistics industry for measuring supply chain performance. This research empirically examines what senior supply chain executive’s measure and how they perceive performance measurement from a balanced scorecard. A survey designed from the four perspectives of the balanced scorecard framework is conducted on senior executives involved in the supply chain functions of client firms, and those executives from the logistics service provider industry. This study suggests that the measurement of performance of supply chain entities could be improved by using a more balanced perspective as provided for by the BSC framework. Further, the results show an apparent lack in the focus on drivers of strategic future performance, as implied in the results of the measurement of internal business processes and learning and growth indicators.
These two perspectives contain measures that create future value, and address the development of core competencies but they were not as well measured. The limitation of this work is the sizes of some respondent clusters are smaller than others. Hence, the results may not be representative of the individual clusters.

Rodriguez et al. (2009) propose the quantitative relationships performance measurement system (QRPMS) that clearly establishes traceability between a group of strategic objectives and associated key performance indicators (KPIs). This study presents a unique proposal able to objectively identify and quantify relationships between KPIs defined within a performance measurement system base on the balanced scorecard (BSC), that offering additional information to managers to make cross enterprise decisions. Then, the research projects KPIs upstream in the performance measurement system, establishing meaningful cause and effect relationships at the objectives levels. The proposed model is applied to a baby clothing manufacturer in Spain. As the research studied only one manufacturing company, it may be the disadvantage for this paper.

Thakkar et al. (2009) propose an integrated supply chain performance measurement framework for the case of small and medium scale enterprises (SMEs) in India using set of qualitative and quantitative insights gained during the case study research. The proposed framework integrates the features of balanced scorecard (BSC) and supply chain operation reference (SCOR) model to deliver a comprehensive performance measurement framework for SMEs. It also outlines the detailed guideline for the implementation and use of the framework. This research reports set of performance indicators for the supply chain processes like source, make and deliver in SMEs. It also relates the measures with various supply chain cycles like procurement, manufacturing, replenishment and customer order, but it does not consider in decision making levels.

Bigiardi and Bottani (2010) develop a balanced scorecard (BSC) model that is designed and delimited for performance measurement in the food supply chain. The research provides a structured performance measurement system tailored for the food supply chain. The BSC model developed could serve as a reference for the food industry, to establish applicable performance appraisal indicators. The study starts from the literature concerning performance measurement and metrics, the food industry and the BSC model, the relevant financial and non-financial indicators, suitable to be used for companies belonging to the food industry. Then, indicators are submitted to a panel of experts, which operate following the Delphi technique, to gather possible suggestions or amendments.

In its final form, the resulting BSC model is tested on two companies operating in the food industry, for a final validation. However, the fact that a specific industry field (the food industry) is examined could be seen as a limitation of the work as the results presented are not suitable to be generalized or extended to other contexts.

Flynn et al. (2010) study the relationship between three dimensions of supply chain integration, operational and business performance, from both a contingency and a configuration perspective. This research defines supply chain integration as the degree to which a manufacturer strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organizational processes, in order to achieve effective and efficient flows of products and services, information, money and decisions, to provide maximum value to the customer. In applying the contingency approach, hierarchical regression is used to determine the impact of individual supply chain integration dimensions (supplier, internal and customer integration) and their interactions on performance. In the configuration approach, cluster analysis is used to develop patterns of supply chain integration, which are analyzed in terms of supply chain integration strength and balance. Analysis of variance is used to examine the relationship between supply chain integration pattern and performance. However, it overlooks the decision making ability across strategic, tactical and operational levels.

Lin et al. (2010) present a proposed model which addresses the drivers of innovation in channel integration in supply chain management of Taiwan qualified high-tech manufacturers. This research surveys the previous studies of strategy orientation, the innovation in channel integration and supply chain performance to construct a theoretical model and hypotheses specifications. The study tests the measurement model for overall factors with a confirmatory factor analysis (CFA) through AMOS 7.0 analysis. The results indicate that a significant relationship has been established between market orientation (customer focus, competitor oriented and cross-functional coordination) and supply chain performance. However, this model only concentrates on innovation perspective.

III. Conclusion

This review has outlined key areas of literature that may enhance an understanding of views regarding supply chain performance frameworks and their performance measurement factors. It focused on supply chain performance measurement. The literature identified a number of frameworks and performance measurement factors for supply chain performance measurement.
Based on the literature, the contemporary supply chain performance measurement frameworks measure performance in many 91 different aspects. They measure the performance from supply chain stakeholders (supplier, focal company and customer), measure performance across supply chain processes (e.g. SCOR model) or measure performance in the decision making levels (strategic, tactical and operational). In summary, this research categories the supply chain performance measurement frameworks into three main models as follows: result based (balanced scorecard), hierarchical (decision making levels) and process based (supply chain operations reference, SCOR) models. Each model focuses only its perspective and has its own advantages and disadvantages as mentioned earlier. There is no coalition framework that can measure for the whole supply chain performance. Therefore, to fulfill these gaps, this study is intended to provide a more holistic approach to the study of supply chain performance measurement framework by combining both supply chain macro process and decision making levels. This framework will provide a balanced horizontal (cross-process) and vertical (hierarchical decision) view on one developing country, specifically, India. The proposed conceptual supply chain performance measurement framework comprises performance measurement factors will be developed across supply chain macro processes, which integrate upstream suppliers (supplier relationship management) and downstream customers (customer relationship management) along with firm (internal supply chain management) and across decision making levels (strategic, tactical and operational). The framework will enable organizations to make enhanced supply chain management decisions at different levels.

REFERENCES


