Supply Chain: A Conceptual Framework to Analyse Supply Chain Designs and Performance Measurement

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ABSTRACT

Supply chain design (SCD) is a concept that forms an integral part of supply chain management (SCM). Effective SCD enhances supply chain integration (SCI) which in turn contributes towards improved supply chain performance and also understanding of the value concept as well as to enlighten the role of value to create a chain which provides a basic framework for the development of goods or services. Any value adding activities or strategy which enlighten the customer satisfaction. Therefore, organisations' supply chain designs need to be analysed. Effective SCD is a complex and demanding undertaking and has become a major challenge for organisations. Moreover, the literature suggests that organisations allow their supply chains to evolve rather than consciously designing them. Although the importance of SCD is emphasised, very little attention is given to what it entails exactly. The problem statement of this article is thus: What are the elements of SCD and how can these elements be included in a conceptual framework to analyse organisations' supply chain designs? This paper also focusing on efforts and commitment to understand really what it means to provides value to customers, how added value which actually customers' needs and provides wealth to all stakeholders who involved. There is no any specific ways to add value in goods or services but it emphasized the ways which minimize cost and time without compromise the quality of the products in an effective and efficient ways. Measurement of Supply Chain (SC) performance with regards to key practices of SC paradigms is the area which is under research. Presently there are no guidance or set rules under which we can measure SC performance. The lack of clarity and comparability concerns in this area creates misunderstanding and makes it more difficult to formulate a clear strategy. The aim of this research is to identify antecedents of existing SC paradigm's practices, as well as antecedents for SC performance measurement to formulate a conceptual framework. Based on this research, new sustainable SC performance measurement conceptual framework is proposed for existing SC paradigms.

KEYWORDS: *Value, Supply Chain, Value chain, Strategy, Differentiation, Customers, Paradigms; Performance measurement; Conceptual framework*

1. INTRODUCTION

Supply chains put products and services in the hands of organisations and customers. Therefore all products and services form part of organisations that constitute the supply chain. Supply chain management (SCM) links all the supply chain members in the supply chain (Lam & Postle, 2006;

Mouritsen, Skjøtt-Larsen & Kotzab, 2003) by coordinating and integrating all the supply chain activities into a seamless process in the most effective and efficient ways possible (Bozarth & Handfield, 2006). SCM has become a key issue for many organisations (Cagliano, Caniato & Spina, 2006; Mentzer, 2001; Ittman, 2004). Supply chains, which form an integral part of SCM, have to be consciously designed (Bagchi, Ha, Skjoett-Larsen & Soerensen, 2005; Persson & Olhager, 2002). SCD can be regarded as the determination of how to structure a supply chain (Saxton, 2006; Persson & Olhager, 2002) and refers to the process of determining and configuring all the required components of the supply chain and deciding how resources will be allocated and what processes will be performed at each stage by each supply chain member (Sharifi, Ismail & Reid, 2006; Chopra & Meindl, 2010; Waters, 2007). SCD, which is a critical factor in determining the efficiency and effectiveness of a supply chain (Sezen, 2008), is extremely important due to the commitment of resources over long periods of time (Santoso, Ahmed, Goetschalckx & Shapiro, 2004). SCD influences supply chain performance (Moon, 2004), and changes in the structural design of the supply chain may improve the supply chain's performance (Persson & Olhager, 2002).

To enhance the competitiveness SCs are implementing new innovative paradigms of management. Among the existing SC paradigms particularly few are required to be mentioned here, since its better performance of SC and importance: agile, lean, green and resilient (LARG). Green drive has been converted from a simple cause to protect our environment into a well-developed, scrutinized economy. Environmental obligation has progressed from a fashion to a business imperious; it does help corporations to accomplish their business goals. The objective of SC is to provide the exact product, in the exact amount, in the exact state, at exact time to exact place and that too at the exact cost. Since the consumer necessities are incessantly changing, so SCs must also be adjustable to advanced modifications, so that requirements of changing markets could be accommodated. Business economic security is influenced by global SC as well as on a mutual acceptance of global risk. These common threats and susceptibilities in SC stress building sufficient resilience. Equally agility and lead time reduction are preferably required by each SC manger, to contest with the varying demands and necessities of the businesses. Currently four SC paradigms are normally practiced by the business managers, namely Lean, Agile, Resilient and Green. But in current scenario disruptive innovative technologies change market tendencies very rapidly. That allows very less time for business for responding as per the varying demands and desires of the customers. Besides next disruptive innovation in technology is about to be launched, which poses extra pressure on the business managers and making it difficult to select any one SC paradigm permanently. It is extremely needed to formulate a framework; which could incorporate all best practices of existing SC paradigms as well as measure SC performance.

2. REVIEW OF LITERATURE

A SC could be labeled as that chain which connects several components, starting from end consumer to far most contractors, over the process of manufacturing and various amenities so that the course of information, resources and cash could effectively be accomplished for meeting the commercial necessities (Stevens, 1989; Azevdo, et al., 2011). The SCM could be considered as a tactical aspect, so that managerial efficacy and profitability could be achieved as well as for the greater fulfillment of

organizational objectives e.g., better customer service, enhanced competitiveness, (Gunasekaran and Tirtiroglu, 2001). (Gunasekaran, Patel and McGaughey, 2004) explained that in the perspective of SC, the measurement of performance is strategic and also essential because most firms realize that SC prerequisite that its performance should be measured as well as techniques of SC should have been precise and measured. In contemporary business, it is assumed that SCs compete each-other instead of corporations (Christopher & Towill, 2000), whereas the failure or success of SC is mostly determined by the open market. However, to guarantee the improved SC, development of a system for measuring the performance which suitably reveals the factual presentation is essentially vital. The literature review indicates that mostly researches remained concentrated on the study of singular paradigm of SC (Anand and Kodali, 2010; Hong, Kwon and Roh, 2009); or maximum in the combination of only two of these, e.g., green verses lean (Kainuma and Tawara, 2006), agile verses resilience (Christopher and Rutherford, 2004), green verses resilient (Rosič, Bauer, and Jammernegg, 2009), or agile verses lean (Naylor, Naim, and Berry, 1999). Nevertheless the simultaneous incorporation of agile, lean, green and resilient paradigms of SC; might support SCs to be extra sustainable, rationalized and efficient. Despite a wealth of literature and state-of-the-art surveys on proactive SCD with disruption considerations, to the best of our knowledge there is no state-of-the art review on SCD and SCP with disruptions and recovery considerations. The goal of this study is to structure and classify existing research streams and application areas of different methods for SCD with disruptions and recovery considerations as well as identifying gaps in current research and delineating future research avenues with the aim of relating the existing quantitative methods to empirical research.

3. ANALYSIS OF SC

There are four existing SC paradigms, namely agile, lean, green and resilient, given the nomenclature as LARG, which are reasonably interesting SC paradigms, but lately it got fair intention to integrate of these LARG paradigms (Azfar, 2012). This paper is focused on formulation of a conceptual framework, after finding antecedents of LARG practices as well as deducting antecedents for SC economic, operational, and environmental performance. This research paper adds value to the literature by presenting a new conceptual framework, to improve the agility, leanness, greenness and resilience of manufacturing SCs. This paper is structured as the following: After introducing the research, review of published work is presented for the LARG paradigms in the SC viewpoint and some practices of these paradigms are also explained. Following to these practices of SC Paradigms; insight on performance measurement of SC is presented. Consequently, a conceptual-framework is offered for advising antecedents of LARG- practices of SC and few antecedents for measurement of SC-performance.

From the literature it can be concluded that SCD essentially consists of three basic phases. These phases are illustrated in Figure 1 and have to be aligned with each other (Sharifi et al., 2006). Firstly, supply chains must understand the nature of the needs of their end customers (Taylor, 2004) and how these needs can be met by some value proposition (Christopher, 2005). Each organisation must know how it can contribute value to meet the demands of its supply chain's end customers (Fawcett et al., 2007; Christopher, 2005). Secondly, organisations must select a supply chain strategy to be

able to deliver value to their end customers (Taylor, 2004). Thirdly, once a supply chain strategy has been selected, the supply chain structure needs to be configured (Sharifi et al., 2006; Fawcett et al., 2007). Phase of SC for it's design are listed below:

P-I

The supply chain's end customer is the person at the end of the supply chain who makes the decision whether or not to buy the product or service offered by the supply chain (Harrison, 2001). The customer is the ultimate judge of supply chain performance (Jeong & Hong, 2007). The end customer should thus be the starting point of any supply chain's design. The challenge is to design supply chains with the end customer's needs in mind (Christopher, 2005). Therefore, to design a world-class supply chain, organisations need to understand their end customers. They have to know who their end customers are and they have to understand their real needs (Fawcett et al., 2007). After defining the value proposition, organisations must develop their core competencies to be able to deliver the value proposition. Phase one of SCD can thus be divided into two sections, namely understanding end customers' needs and how to meet these needs. The research questions (RQ) that have been formulated for each of these sections in phase one of SCD are thus:

RQ 1.1: Do organisations understand their end customers' needs?

RQ 1.2: Do organisations know how to meet their end customers' needs?

P-II

Once organisations understand their end customers' needs and have determined how to meet these needs (phase one of SCD), they can select a supply chain strategy (phase two of SCD) (Christopher, 2004; Taylor, 2004; Raturi & Evans, 2005). Supply chain strategies can be defined as strategies required to manage the integration of all the supply chain activities through improved supply chain relationships to achieve a competitive advantage for the supply chain (Hines, 2004). The supply chain strategy starts with the business value proposition to customers, based on core competencies and identified market winners (which was identified in the first phase of SCD) and shows how the supply chain can contribute to achieving business goals (Tang & Gattorna, 2003).

Downstream of the decoupling point the processes are designed to be agile (i.e. responsive) (Towill & Christopher, 2002) to make provision for the more unpredictable marketplace (Mason-Jones et al., 2000). The flow of products should therefore be market driven (Lysons & Farrington, 2006; Christopher, 2003). Upstream of this decoupling point, the processes are designed to be lean (Towill & Christopher, 2002), enabling a level schedule and opportunities to reduce costs (Appelqvist, 2003; Mason-Jones et al., 2000). Upstream organisations work to a stable demand with relatively low variety and can therefore focus on low costs (Lysons & Farrington, 2006). The following research question has been formulated for phase two of SCD, namely: RQ: Are organisations implementing the correct supply chain strategy based on market demand predictability, market winners and position of the supply chain's decoupling point? The SCD elements identified in phase two in SCD to be included in the conceptual framework are: SCD element Determining market demand predictability SCD element: Using specific market winners to select a supply chain strategy SCD element: The organisation's position in terms of the decoupling point SCD element : The supply chain strategy

P-III

The supply chain structure implies the integration of the focal organisation and the links between supply chain members and must support the supply chain strategy (Defee & Stank, 2005:34). The supply chain structure thus embodies the configuration of the supply chain's processes and operations. Organisations have to identify the supply chain partners they would want to build collaborative relationships with and the extent to which they would want to manage these relationships (Raturi & Evans, 2005; Taylor, 2004). Managing specific supply chain drivers is also an important aspect of SCD (Rafele, 2004; Raturi & Evans, 2005). These drivers include facilities, inventory, transportation, information, sourcing and pricing, which interact with each other (Chopra & Meindl, 2010) and have an impact on the supply chain's responsiveness and efficiency (Hugos, 2006). Establishing the right supply chain key performance indicators (KPIs) is also an important aspect of SCD (Rafele, 2004; Raturi & Evans, 2005).

RQ 3.1: Do organisations know who their critical supply chain partners are and how are they managing those relationships?

RQ 3.2: How are organisations managing their supply chain drivers?

RQ 3.3: On which KPI categories are organisations focusing to measure their performance?

3.1 ANALYSIS OF P-I SCM

Five assessment questions are used in the conceptual framework to analyse phase one of SCD to determine whether organisations understand their customers' needs and know how to meet their needs. There is one assessment question for each SCD element in phase one. Organisations have to achieve a minimum acceptable score in each of these assessment questions in this section and those that do not achieve the minimum score are provided with possible reasons (or explanations) and potential solutions to improve their SCD practices in this phase. A five-point Likert-response format (where 1 = very limited; 2 = limited; 3 = average; 4 = good and 5 = very good) was used to measure the elements in phase one of SCD. The assessment questions for phase one of SCD determine the extent to which an organisation:

3.2 ANALYSIS OF P-II SCM

In phase two of SCD, organisations will analyse the market demand predictability and market winner for the product, the position of the decoupling point and their selected supply chain strategy. To analyse the level of their market demand predictability, organisations will be requested to indicate the extent to which the demand for their product is predictable as opposed to being unpredictable. A continuum is used for the assessment question where a score of one indicates a high level of predictability and a score of four indicates a low level of predictability. A four-point scale is used in this case to ensure that organisations do not select the 'middle' or 'neutral' option. Organisations will also be requested to indicate what the specific market winners for their products are. A continuum is also used in this assessment question where a score of one indicates that the market winner for the product is low cost, while a score of four indicates that the market winner is agility in the form of high service levels, quality and responsiveness.

3.3 ANALYSIS OF P-III SCM

The first section for analysing phase three of SCD analyses an organisation's relationships with its supply chain partners (i.e. suppliers and customers). Three assessment questions are used to establish how well organisations have identified and manage their relationships with their customers. Three assessment questions are also used for supplier relationships. Organisations will be asked to indicate the extent (where 1 = limited; 2 = average; 3 = good; 4 = very good and NA = not applicable) to which their organisation: Assessment questions are used across the six supply chain drivers of facilities, inventory, transportation, information, sourcing and pricing to determine whether the supply chain drivers are being managed in line with the selected supply chain strategy. The supply chain drivers of a lean supply chain should be managed differently to those of an agile supply chain. If discrepancies exist, organisations are prompted to determine possible reasons and/or solutions for these discrepancies. Organisations are asked to indicate where they would position their organisation in terms of how they manage their supply chain drivers along a continuum (where 1 = a strong focus on efficiency and 4 = a strong focus on responsiveness). A response of one on the one side of the continuum will indicate that the supply chain drivers are managed according to lean principles while a response of four will indicate that the supply chain drivers are managed with agility in mind.

4. RESEARCH METHODOLOGY

The research methodology for the research consisted of two phases. In the first phase, a literature study was conducted on the topic of SCD to determine the elements of SCD. Numerous sources were used in the literature review. The main sources included books written by authors specifically about these topics and relevant articles in journals. The literature study was summarised in the previous sections. The identified SCD elements were included in the proposed conceptual framework. In the second phase of the research the conceptual framework was tested in various organisations to determine whether the conceptual framework was a workable instrument for organisations to analyse their SCD practices. The nature of the empirical research reported in this article was exploratory and descriptive. The literature study is characteristic of exploratory research while the structured questions are characteristic of descriptive research. Triangulation, a combination of both quantitative and qualitative research methods was also used. Qualitative research was used to compile the conceptual framework from the literature and in-depth personal interviews were conducted using a small sample. Quantitative research was used in the form of a structured questionnaire. Personal interviews were used as survey method to obtain data by means of the questionnaire which was developed to cover all the areas of the framework. A structured questionnaire was necessary to ensure that various respondents would respond consistently to a given consistent set of variables within similar scenarios to ensure reliability. An extensive assessment instrument was developed to serve as basis for the conceptual framework. The functioning of the conceptual framework entails the usage of an assessment instrument which uses questions as a basis for gathering information from which organisations' SCD practices can be analysed. This made the use of a structured assessment instrument a necessity in this research. The questionnaire was pilot tested across three organisations.

5. PERFORMANCE OF SC

(Lambert and Pohlen, 2001), indicated that the deficiency of suitable metrics might be the major reason for the following breakdowns and failure in the SCs: (1) incapability to meet satisfaction of the customers; (2) sub-optimized performance of firms; (3) missed-opportunities for outclassing the competition (4) creating clashes inside SC. Measuring the performance would be decisive for improved SCs. That could be made possible to understand and integrate SCs allies; whereas during close-fitting special properties to strategy for probable prospects of SCs. Gunasekaran, Patel and Tirtiroglu, 2001 considered that SC performance should be evaluated from a tactical level, strategic level and operational level as well as from a commercial and non-commercial perspective. Bearing in mind this approach of thought, some measures offered by these researchers are: (1) accuracy in forecasting methods/demand predictability; (2) lead time of delivery; (3) flexibility in meeting particular customer requirements; (4) proper capacity utilization; (5) total time of cycle as well as amount of buyers\suppliers partnerships; (6) inquiry-time for customer; (7) amount of collaboration to improve quality; (8) total cost of transportation; (9) cost of carrying inventory; (10) cycle time for product-development; (11) cost of manufacturing; (12) investment rate of return; (13)) cost of carrying information; and (14) total time of cash-flow. Above mentioned measures try to quantify the SC performance in relations to suppliers, delivery, order planning, strategic planning and production. Cash to cash metric is an additional important measure; in the meantime it ties inbound activities related to material with the suppliers, doing it through operations of manufacturing as well as outbound activities with the clients (Farris II and Hutchison, 2002).

6. PROPOSED CONCEPTUAL FRAMEWORK

This particular portion of paper, proposes conceptual-framework for discovering interactions amongst (practices of LARG-SC) verses performance of SCs. It's assumed in this particular conceptual-framework that set of antecedent practices for (LARG) practices that add improvements for SC-performance. The conceptual framework is proposed in figure-1. This conceptual-framework attempted by suggesting few LARG-practices of SC which would help business related to distribution SCs become more lean, agile, resilient and green, simultaneously, moreover to discover the interrelations among these practices and SC's performance. The proposed conceptual framework is shown at figure1. This conceptual framework is different with previous ones, as it has different antecedents and structure of framework.

supply chain design (and the resulting supply chains) as being the result of a process that is shaped by three salient dimensions that have a hierarchical relationship: influencers, design decisions and building blocks Influencers: These are very broad-based environmental factors that constrain and significantly influence the overall nature of the resulting supply chain. Included are life cycle considerations, desired supply chain outcomes, business models/critical customers, and the overall environment (e.g., political, economic, technology, industry and adjacencies). This is the domain where supply chain architecture is most evident. Design decisions: These are the specific decisions that must be made regarding the overall structure and design of the supply chain. Included are decisions regarding physical network design (capacity positioning, transportation network and

geographic dispersion of sites), sourcing strategies (component/subsystem sourcing, global sourcing, spend allocation decisions), social network design (contract flows, information flows, relationship flows, etc.), relationship governance mechanisms (contractual versus collaborative governance), and behavioural management strategies. Building blocks: At the lowest level, building blocks are the specific investments required to implement the above listed design decisions and are the necessary inputs into building the desired supply chain.

7. CONCLUSION

From the literature it was concluded that SCD essentially consists of three phases. Twelve broad supply chain design elements across the three phases of SCD were identified from the literature study. These SCD elements were included in the conceptual framework to form the basis on which SCD practices can be analysed. Empirical research was conducted to test whether the conceptual framework could be used as an assessment instrument to analyse SCD practices. The empirical research indicated that organisations could use the conceptual framework to analyse each phase of their organisation's SCD. If organisations were satisfied with their SCD practices, they were directed to a next phase of the analysis. However, the conceptual framework could highlight areas where organisations may not be aligning their SCD practices with their supply chain strategy. These potential areas for improvement could then be further explored to determine whether organisations could in fact improve their SCD practices to possibly improve their supply chain performance. The empirical research concludes that the conceptual framework is in fact a workable instrument in helping organisations to analyse their SCD practices.

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