An Empirical Investigation of the Role of Process Improvements in Organizational Supply Chain Performance

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Abstract
Process view of supply chain management is investigated in this paper. This study explores the measurement of process orientation with respect to core forward supply chain processes as well as the effects of process orientation on various aspects of supply chain performance.

Keywords: Supply Chain Management, Business Process Orientation, Performance

Introduction
Keith Oliver, an American industry consultant, has been credited for coining the phrase "supply chain management", in an article titled "Supply-chain management: logistics catches up with strategy", co-authored with Michael Webber in 1982 (Moller 1995; as cited in Persson 1997). The inventors of the term supply chain management, define the concept "as a new logistics concept [which] differs significantly from classical materials and manufacturing control in this respect: It views the supply chain as a single entity rather than relegating fragmented responsibility for various segments in the chain" (as cited in Hieber 2002).

According to the Supply Chain Operating Reference (SCOR) model, which is widely utilized in academics and among practitioners, supply chain deals with planning, sourcing, making, delivery and return activities (SCOR 2008). Supply chain management has evolved significantly during the past few decades. Some of these developments can be observed in the alteration of the supply chain definition. Hieber (2002) conducted a review of supply chain management studies based on definitions from 1985 to 1997, and identified four schools of thought, which are: functional chain awareness, linkage, information, and integration/process. Heiber (2002) sees the integration school of thought as the most recent view of supply chain management studies. In this view, supply chain integration happens through "a system defined as a set of processes" (Heiber 2002, p: 35).

The Supply Chain Council (SCC) in their most recent guideline (version 9.0) describes its process view of the supply chain. The SCC defines its SCOR model based on five core processes within the organizational supply chain: planning processes, sourcing processes,

making processes, delivery processes and return processes. The SCC model is also extensively used in scholarly research on supply chain management and specifically in the process view of supply chain management.

Process Orientation and Supply Chain Management

The role and importance of business processes in organizations have been documented since the late 19th century. For example, Gordon (1899) in his article on "quarry methods" emphasizes the existence and explains "business process" involved in the operation (Gordon, 1899, p.21). Process orientation has attracted significant attention during the past few years as a management philosophy to enhance the operation of activities in the organization. Several contemporary management gurus including Michael Porter, Thomas Davenport, James Short, and Michael Hammer have been among the seminal key contributors in development of the role of processes orientation in organizations during the 1980s and the 1990s (McCormack et al. 2002; Lynch et al. 2012).

Based on the finding from the research conducted by the authors of this research, the term business process orientation, was first used in the management context by Hammer and Champy (1994) where they elaborated the idea of a "process-centered business organization". Michael Hammer further details the concept of "process orientation" in his subsequent publications (e.g. see Hammer 1997, 2003). The concept of process orientation promotes the dominant role of the process view in the execution of operations. In contrast, the traditional view of operations management promotes the role of functional silos in performing tasks. This concept is extensively described in the works of Ljungberg (2002), McCormack, and Johnson (2002), Lockamy and McCormack (2004), Reijers (2006), McCormack et al. (2008), McCormack et al. (2009) and Chen et al. (2009). Based on the review of the studies on process orientation, Kumar et al. (2011) define process orientation as "the philosophy of process centered design of organizational activities which requires a transformation from one based on a functional paradigm to one based on a process paradigm". In other words, process orientation is defined in opposition to the functional paradigm of operation management, which is characterized with the formation of functional silos (McCormack et al. 2009; Chen et al. 2009).

It is important to note that all organizations have some degree of functional orientation as well as process orientation in their execution of processes. This means that there exists a process orientation "continuum" ranging from low process orientation to high process orientation (Davenport 2005, p: 65).

Several studies have been conducted to identify the benefits of process orientation in various aspects of organizations. These studies provide evidence that process orientation has been beneficial for various aspects of organizations. In this study, the measurement of process orientation is conducted with respect to recent developments in this area and separate assessments are proposed to be conducted in various supply chain core processes (with respect to the major supply chain stakeholders). Furthermore, the measurement of supply chain performance is conducted with respect to the proposed comprehensive framework, which includes specific benefit indicators of supply chain performance.

Research Model Design

For evaluating the role of process orientation in various aspects of supply chain performance in the first step, two measurement models were developed: a. measurement model of supply chain performance to assess various aspects of performance in supply chain operations; b.

measurement model of process orientation to assess process orientation with respect to core activities of forward supply chain performance. In the following sections the development of these measurement models is described.

Measurement of Supply Chain Performance

Neely, Gregory and Platts –of the manufacturing engineering group, Cambridge University– are among the most cited authors in the area of performance measurement in organizations and specifically in the context of supply chain management. Performance measurement is about quantifying the actions that lead to performance (Neely et al. 2005). Performance measurement has been used in various contexts, and there have been rare occasions where consensus in measurement and definition is achieved (Neely et al. 2005; Aramyan et al. 2007). However, there exists a consensus that the performance of an organization can be measured in terms of 'efficiency' and 'effectiveness' (Neely et al. 2005). Several authors such as Shepherd and Gunter (2006) and Theeranuphattana and Tang (2008) have suggested the application of the SCOR model for measuring performance in the context of supply chain management. Shepherd and Gunter (2006) propose a "taxonomy of measures" for assessing supply chain performance following Neely et al.'s (1995) measurement framework. Theeranuphattana and Tang (2008) cleverly utilized the innovative process-based model of Chan et al. (2003) and the SCOR model for measurement of supply chain performance. Based on an extensive review of the literature, a measurement system for assessing supply chain performance is proposed. The proposed model is based on a review of the literature, which measures performance mainly in the context of organizational supply chains.

To construct the proposed measurement model, in the first step, measurement factors were identified and categorized based on their similarities. In several cases, various authors had used different terminologies to address a certain concept. In the second step, the performance indicators were identified. Table 1 displays the proposed measurement model.

Table 1 - Proposed supply chain performance measurement model

	Factor	Codes	Indicator
I	**Cost**	Cost-1 Cost-2 Cost-3	Supply chain productivity Supply chain efficiency (in terms of per unit cost) Profit margin
II	**Time**	Time-1 Time-2 Time-3 Time-4	Manufacturing lead time Delivery lead time Suppler lead time New product development cycle
III	**Responsiveness**	Re-1 Re-2 Re-3 Re-4	Ability to handle small disruptions (Flexibility) Ability to handle large disruptions (Resilience) Ability to recover from short-term changes (Agility) Ability to adapt to long-term changes (adaptability)
IV	**Operations quality**	Op Q-1 Op Q-2 Op Q-3 Op Q-4	Perceived quality of products and services (by customers) Information accuracy Real-time information Forecasting accuracy

V	**Innovations**	Inno-1 Inno-2 Inno-3 Inno-4	Product innovation New product development Process innovation Technology acquisition

The above supply chain performance measurement model is constructed based on an investigation measurement model developed by Kaplan (1990), Garvin (1987), Schonberger (1990), Stalk (1988), Gervin (1987), Slack (1987), Neely and Wilson (1992), Chan, Qi, Chan, Lau and Ip (2003), SCC (2006), Theeranuphattana and Tang (2008), Movahedi et al. (2008), Shepherd and Gunter (2006), Cai et al. (2009), Netland et al. (2007), McCormack,(2008), and De Toni and Tonchia (2001).

Measurement of Process Orientation

There have been relatively few studies which provide depth into our understanding of process orientation measurement. In this section, first a comprehensive review of the process orientation measurement models is provided. Later, the proposed process orientation measurement model is presented. It is important to note that the proposed measurement model will be applied to four core business processes –sourcing, planning, making, and delivering– in the organizational supply chain. The goal is to measure the level of process orientation within each of the four core supply chain processes separately.

Table 2: Proposed Indicators and Factors of Measuring Process Orientation

	Factors	Indicators
I	**Process View**	Clear definition of processes (holistic view of inputs and outputs) Well documentation of processes Well communication of employees about processes Top management support in line with process definition Resource allocation based on the processes (not functions)
II	**Process Jobs**	Organization designating process managers Capability of handling simultaneous tasks Carrying out majority of processes without human discretion Process design toward customer satisfaction Alignment of organizational information system with processes
III	**Process Measures**	Measuring process effectiveness toward satisfying customer needs Measuring process efficiency through defined performance indicators Using performance measure to enhance processes
IV	**Process Culture**	Promoting Teamwork in execution of processes Customer center culture throughout the processes Continuous training and learning

Based on reviews of the literature, eight measurement models for assessing the level of process orientation in organizations were identified. These measurement models were developed by Lockamy and McCormack (2004), Reijers (2006), Kumar et al. (2010), Willaert Van den et al. (2007), McCormack at al. (2009), Chen et al. (2009), Skrinjar et al. (2008), and Gemmel et al. (2008). For each model –pending the availability of information– the scope of the study, factors of the measurement model and the related indicators are investigated. Not all of the information about every proposed measurement model is presented in the published papers. For example, in some cases, the indicators are not mentioned. While in some other cases, the indicators and factors have only been mentioned after the completion of factor analysis (Table 2).

Data Collection

The unit of analysis is for-profit medium (100 to 499 employees) and large (more than 500 employees) firms in Canada and the US with accordance to Statistics Canada's definition of medium and large organizations. The data was collected from managers involved with activities such as purchasing, procurement and other related activities tightly associated with internal and external organizational supply chain management. The information about the organizations and their managers was collected from Scott's Directory of Canadian firms and Hoover's database for US firms. The questionnaire was pretested through five practitioners. All of the questions with regards to the measurement of supply chain performance as well as measurement of process orientation were presented on a 5-point likert scale.

The data was collected from 2500 Canadian and US managers. 2500 questionnaires were distributed through mail and email and 245 responses were collected. 62 responses were not complete or had too much missing data, which yields 183 usable responses. The 62 incomplete datasets were not used in data analysis. Response rate including the incomplete responses is 9.8%, and without the incomplete responses is 7.32%. While 67.8% of participants were from Canadian based organizations, 32.2% of participants were found to be from US based firms. 50% of respondents were from medium organizations while the rest were from large organizations. With respect to the type of business activities of participants, 54% of participants were from manufacturing sector, 55% from service sector, and 1% from agriculture sector.

Data Analysis

In the first step of data analysis screening of data, missing values treatment, test of normality of variables and test of multicollinearity of variables were conducted to ensure that the data is appropriate to be used for further analysis through factor analysis. After data preparation, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were conducted using SPSS software to construct measurement models of supply chain performance, as well as four measurement models for process orientation with respect to planning, sourcing, making and delivering processes.

Tests of sampling adequacy, scales reliability, and construct validity were also conducted to ensure the reliability of the measurement models. In construct validity, the tests of content validity, convergent validity, divergent validity, and discriminant validity were conducted to ensure that the developed measurement models are stable and robust to be utilized in structural analysis. Structural Equation Modeling (SEM) using LISREL software was conducted to explore the role of process orientation in various aspects of the supply chain performance. The comprehensive structural model is presented in Figure 2.

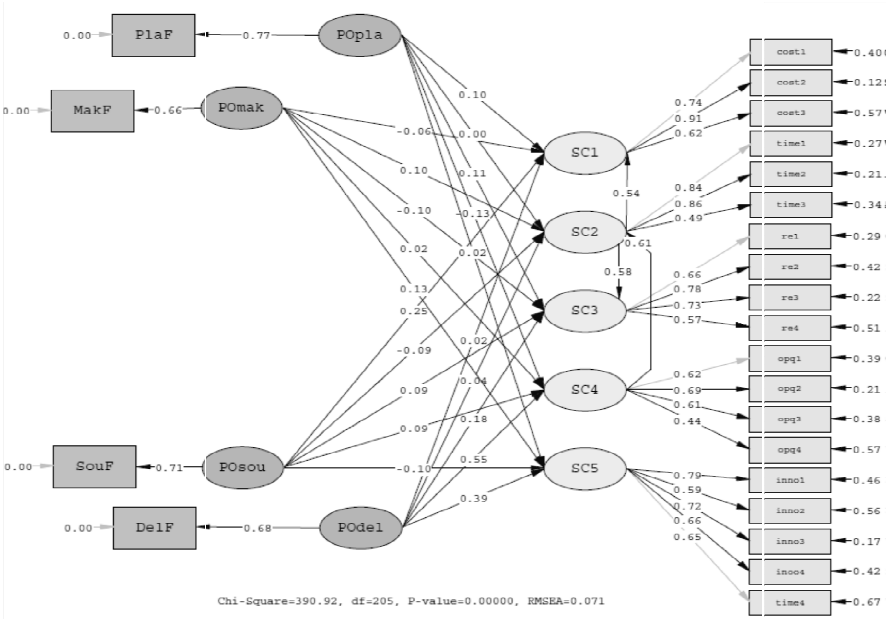

Figure 2 - Comprehensive Structural Model

The LISREL output data is used to assess the goodness of fit of this model. RMSEA and the ratio of chi-square to degrees of freedom (1.9) provide supporting evidence for the goodness of fit of this model to the data. Furthermore, other goodness of fit indicators including Normed Fit Index (NFI=0.93),Comparative Fit Index (CFI=0.96), Incremental Fit Index (IFI=0.96), Relative Fit Index (RFI=0.91) and Goodness of Fit Index (GFI=0.84) are examined, which provide additional supporting evidence for the goodness of fit of this model. All of this evidence provides us with confidence to further examine the findings and further explore the implications of the results.

Discussion of the Findings and Conclusion

The findings of this study were investigated in two phases: findings from the measurement models, and findings about the role of process orientation on supply chain performance. This paper focuses on discussion of the role of process orientation in supply chain performance. The results of the analysis provide support for the direct role of process orientation within making activities in time and innovation aspects of supply chain operations. A process orientation in planning activities was not found to have a significant positive direct effect on time, operation quality or innovation aspects of supply chain performance. Process orientation in sourcing activities was found to a have direct positive effect only on cost. Finally, process orientation in delivering activities was found to have a positive direct effect on responsiveness, operation quality and innovation aspects of supply chain performance.

The findings can be explored from two perspectives. First, they can be investigated based on the five dimensions of supply chain performance. Five dimensions of supply chain performance were discussed in this study. For each dimension, the role of process orientation in certain supply chain process or processes that have significant direct or indirect effect on that particular dimension of supply chain performance has been identified. For example, higher level of cost related performance can be achieved through higher level of process orientation in planning (direct effect), sourcing (direct effect), and delivering (indirect effect). Moreover,

achieving higher levels of operational quality in supply chain can be achieved only through higher levels of process orientation in delivering activities.

The second approach that can be used to explore the findings is through identifying the various supply chain performance dimension or dimensions that can be gained through a higher level of process orientation in each of the core supply chain processes. We previously explored the various aspects of supply chain performance that can be enhanced through a higher level of process orientation in each of the four core supply chain processes. For example, for example according to the results, having higher levels of process orientation in planning will yield higher levels of supply chain performance in terms of cost and responsiveness. Also, having higher a level of process orientation in delivery activities will help organizations to achieve a higher level of supply chain performance in terms of responsiveness (directly and indirectly), operational quality, innovativeness, cost (indirect effect), and time (indirect effect). The result of this study has valuable applications for academics as well as practitioners, at the process management level as well as the strategy management stage. The limitations of the study and directions for future studies are discussed in the following section.

Limitations and Future Studies

One of the limitations in this study is with respect to the intra-organizational perspective in measurement of process orientation. Inter-organizational supply chain collaborations are practiced widely in today's business environment, investigating the concept of process orientation with respect to inter-organizational collaborative supply chain operations can be a fruitful area of research. While collecting the data directly from inter-organizational partners (customer and suppliers) would not be feasible considering the time and cost limitations, it is possible to conduct case studies or multiple case studies in this area. Another limitation in this study is that the process orientation as a management philosophy is still in development stage and is viewed as a managerial perspective rather than a theory. As a result, the measurement of process orientation in this study is based on the models and perspectives, which are in development. The main difficulty facing the researchers in this study was data collection. Access to managers of medium and large organizations that have the knowledge of various aspects of organizational operations as well as persuading them to participate in the data collection were the main obstacles in this research. Future studies can be conducted based on the collected data to conduct comparative investigations; for example, exploring the differences across manufacturing and service business sectors, or between large and medium organizations. This study explored forward supply chain processes. Exploring the role of process orientation in return supply chain process would be a subject for future studies. Conducting case studies in this area is another possible avenue for productive research. Single or multiple case studies can provide detailed insights about the role process orientation and supply chain performance play in a particular organization, industry or business environment.

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