Assessment the Supply Chain Reliability

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Abstract

This research is concerned with Supply Chain performance subject to reliability. Performance measures and metrics are essential for effectiveness and efficiency and increase the organization competitiveness. Effectiveness refers to the extent to which customer requirements are met, while efficiency is a measure of how economically the firm’s resources are utilized when providing a given level of customer satisfaction. In order to obtain high efficiency and effectiveness in supply chain management, supply chain must have a high reliability as guarantee. Reliability has now become an important performance measure for assessment the supply chain. This paper firstly defines the concept of the supply chain reliability and reliability of the supply chain members. Secondly apply the Fault tree analysis (FTA) and Supply Chain Operation Reference Model (SCOR Model) of the supply chain members of the assessment degree of reliability is established. Finally used the System Reliability Theory for assessment the Supply chain reliability.

Keywords: supply chain performance, supply chain member, reliability, System reliability Theory.

1. Introduction

The supply chain is the integration of logistics, information flow and capital flow. In such circumstances, in order to make the supply chain management of high efficiency and effectiveness, the supply chain must have high reliability as a guarantee, thus enhancing the overall competitiveness of supply chain.

Thomas (2002) introduces the engineering reliability theory to the supply chain management, gives the definition of supply chain reliability is as the probability of the chain meeting mission requirements to provide the required supplies to the critical transfer points within the system. Wang Jian (2004) makes quantitative analysis on reliability of multi-stage supply chain based on the Markov process. Guohua Chen (2004) has put forward the network structure and chain model of supply chain. Based on the reliability of nodes enterprises in supply chain, analyze the reliability of the supply chain system. In addition, he also analyzes the function of warehouse which improves the reliability of supply chain system.
Then from the node enterprises in Supply Chain, taking the member of supply chain as the background, with the reliability degree in SCOR model, analyzes the factors influencing the reliability, establishes the fault tree Analysis (FTA). Finally use the system reliability Theory to combine the reliability degree in every node in Supply Chain.

3. Literature review

A performance measurement system plays an important role in managing a business as it provides the information necessary for decision-making and actions. As per Kaplan (1996), “No measures, no improvement,“ it is essential to measure the right things at the right time in a supply chain and virtual enterprise environments so that timely action can be taken. Performance measures and metrics are not just measuring the performance. They are also embedded with politics, emotions and several other behavioral issues. Good performance measures and metrics will facilitate a more open and transparent communication between people leading to a co-operative supported work and hence improved organizational performance. Co-operative supported work and hence improved organizational performance.

The purpose of measuring organizational performance is to (a) identify success; (b) identify whether customer needs are met; (c) help the organization to understand its processes and to confirm what they know or reveal what they do not know; (d) identify where problems, bottlenecks, waste, etc. exist and where improvements are necessary; (e) ensure decisions are based on facts, not on supposition, emotion, faith or intuition; and (f) show if improvements planned actually happened (Parker 2000). Traditional business performance measures have been mostly financial – measuring rate of return on investment, cash flow and profit margins. However, conventional measures have the drawbacks of tending toward inward looking, fail to include intangibles and lagging indicators. This forced researchers and companies to revisit the performance measures and metrics in the new economic environment (Parker 2000).

Performance Measurement

Performance measurement can be defined as the process of quantifying the efficiency and effectiveness of an action. A performance measure is a set of metrics used to quantify the efficiency and/or effectiveness of an action (Neely et al. 1995). There are two groups of major measurement bases: (i) quantitative and (ii) qualitative. The most pressing and challenging tasks for the managers are how to determine the key performance indicators based on organization’s strategic goals and then how to measure and implement them.

There are many articles published in the literature on qualitative-based PM in SC systems. For example, McAdam and McCormack (2001) developed a conceptual model of integrated business process by means of a qualitative study of the integration of SC. Researchers in 1990’s began focusing on SCM as a whole and promoted customer satisfaction, collaboration of buyers and suppliers, information sharing (Kaplan and Norton 1996, Lee and Dale 1998, Christopher 1999). Van Hoek (1998) highlighted the importance of measuring intangibles in SCs (Bechtel and Jayaram 1997). Scapens (1998) explains the significance of innovative strategies and other nonfinancial measures such as teamwork and lead times on organizational performance. Basu (2001) points out that measuring external, consumer, value based competition, network performance, and intellectual capital may lead to SC productivity.

Supply Chain Performance

According to Lambert (2001), the management of multiple relationships across the supply chain is referred to as SCM. The supply chain is not a chain of businesses with one-to-one, business-to-business relationships. Instead, it is a network of multiple businesses and
relationships, offering the opportunity to capture the synergy of inter organizational management. The implementation of SCM requires that the internal perspective of performance measures be expanded to embrace a partnership perspective and avoid a self-focused attitude in management’s approach Holmberg(2000). To this end, an appropriate performance measurement, i.e., Supply Chain Performance is necessary for firms to successfully implement Supply Chain Management Lee and Billington (1992). Given that there are different perspectives on the measurement of SCP, many firms find it difficult to effectively evaluate the performance of their activities on a supply chain-wide basis Cooper et al., (1997).

Supply Chain Reliability

In the supply reliability of the study, most scholar main concern overall reliability of the supply chain measurement. Each node has some reliability will affect the reliability of whole supply chain. So reliability of the supply chain member is the microeconomic foundation of overall reliability of the supply chain. The impact of its change on the overall reliability of the supply chain. The supply chain reliability is the measurement to the work ability without fault in supply chain system. Specific definition of inmates in the outside interference, the supply chain at a stipulated time and conditions, the demand for the completion of orders functional capacity, and the completion of this function, the probability of reliability. Similarly we have members of the supply chain to define the reliability of node enterprise: in the supply chain management of the environment, members of the supply chain enterprises in a certain period of time to the normal operation of the capacity.

4. Methodology

Step 1. Finding the Reliability degree in each member of supply chain use the SCOR Model and Fault Tree Analysis.

In the provided model uses FTA and SCOR reference model to define the relationship and the degree of reliability. We can measure the unreliability degree on node member in Supply Chain and convert to the reliability degree.

The SCOR model supports the operational evaluation metrics at three levels. The metrics of level one provide an approach to supply chain in order to assess management, and the metrics of levels two and three include more specific and detailed criteria regarding the categories and elements of the processes. The SCOR model, which is a means of analyzing and configuring the supply chain, was devised by the Supply Chain Council. It was established by the Institute of Advanced Manufacturing Research, The SCOR metrics are applied in relation with operation attributes. Operation attributes are the supply chain attributes through which it is possible to analyze and assess the company's supply chain strategy at each level separately and to compare it with other strategies. The metrics of level one are systematically divided into five classes, i.e., reliability, flexibility, and responsiveness, which are customer facing attributes, and costs and assets, which are internal facing attributes. Fault Tree Analysis (FTA) for in depth analysis on reliability patterns of SCOR Model.

\[
\text{Reliability} = 1 - \text{Unreliability} \quad [1]
\]
Step 2. Calculate the Supply Chain Reliability by System Reliability Theory

System Reliability Theory
1) Series
Reliability = \( P_1 \times P_2 \times P_3 \ldots \times P_k \)  

\[ R_{sys} = \prod_{i=1}^{k} P_i \]  

2) Parallel

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System Reliability = \( 1 - \prod_{i=1}^{k} (1 - P_i) \)  

3) Complex System
Divided to more subsystems, and then with the reliability computation of lesser subsystems, reliability of main systems is computable.

5. Conclusion
The reliability attribute is one of the measuring and assessing the performance in Supply Chains such as the reliability attribute in SCOR Model. The goal of this paper is using system reliability for assessment the supply chain reliability. However every member enterprise in Supply Chain find the reliability by Fault tree Analysis on SCOR Model Level1 and Level2 patterns that are the reliability degree and then used the system reliability for calculated the supply chain reliability.

However, the reliability assessment based on failure of SCOR Model is way to improve the supply chain performance, by the improve reliability of member enterprise in supply chain.

References
Manag., 1997, 8, 15–34.
. 265-275.
Cooper, M.C., Lambert, D.M., Pagh, J.D., 1997. Supply chain management—more than a new
CHEN Guo-hua, WANG Yong-Jian. Reliability based supply chain construction . Industrial
Holmberg, S. A systems perspective on supply chain measurement. International Journal of 
Boston, MA).
Lambert, D.M., The supply chain management and logistics controversy. In: Brewer, 
A.M., 2001
McAdam, R. and McCormack, D., Integrating business processes for global alignment and 
Neely, A., Gregory, M. and Platts, K., Performance measurement system design. Int. J. 
Thomas, M. U., Supply Chain Reliability for Contingency Operations. The proceeding of 
Van Hoek, R.I., Measuring and improving performance in the supply chain. Supply Chain 
WANG Yong-Jian. Reliability based supply chain construction . Industrial Engineering and 