Analysis of Supply Chain Complexity Drivers in Make-to-Stock and Make-to-Order Supply Chain using AHP-DEMATEL Approach

Yahya Al Hinai, *Sujan Piya, Nasr Al-Hinai

Department of Mechanical and Industrial Engineering

College of Engineering, Sultan Qaboos University

Muscat, Oman

s125022@student.squ.edu.om, sujan@squ.edu.om, nhinai@squ.edu.om

Extended Abstract

To become competitive, companies use different strategies to produce their product. Make-to-Stock (MTS) and Make-to-Order (MTO) are the most popular production strategies. Each of these strategies has its own advantages and drawbacks. Irrespective of the strategy company uses, today in the global market, it is essential for the companies to understand the complexities associated with their supply chain (SC) and aim to ease or manage them. Supply Chain Complexity (SCC) can be defined as any property of a SC that increases its complexity and leads to difficulties in producing the product and delivering the service. The complexity in SC can be caused by factors, which are either internal or external to the SC or the factor may lie at the demand and supply interface. All the factors that create complexity to the SC are known as the SCC drivers. Many researches have been carried out in the past to identify and analyze the SCC drivers. However, these researches did not explicitly distinguish and analyze the identified drivers based on the production strategy the company uses. As MTS and MTO are two completely different strategies with different production planning, procurement and inventory characteristics, the associated SCC drivers and impact of one driver over others for these two strategies may be different. Therefore, in order to fulfill the gap that exists in the existing literature, this study focuses on identifying, analyzing and comparing the SCC drivers in MTS and MTO production systems.

To fulfil the aforementioned research gap, in this study at first generic drivers of SCC were identified from the extensive literature review. Altogether, twenty-two drivers of SCC were identified from the literature review. To filter the unimportant drivers, as compared to other, from the identified twenty-two drivers, Pareto analysis is conducted. For this purpose, a questionnaire survey was carried out to understand the level of impact these drivers has on the SC. Questionnaire was send to a sample of two hundred random manufacturers in Oil and Gas (O&G) SC. The reason for the selection of O&G SC is due to the fact that some of the O&G SC partner operates based on MTS strategy while others operate under MTO production strategy. Out of the two hundred random samples, fifty valid responses were recorded. The questionnaire was prepared such that from the response it will be able to identify the strategy the company uses to operate their system. Based on the 80/20 rule of Pareto analysis, six drivers were eliminated from the identified twenty-two drivers. However, the eliminated drivers form MTS and MTO systems are different. The eliminated drivers for MTS systems are: number of supporting parts to produce a product, collaboration between the supplier and manufacturer, forecasting error, diversity of demand/ demand uncertainty, and delivery lead time. On the other hand, for the MTO system, the drivers are: diversity of demand/demand uncertainty, new technology required to produce the product, government regulation, incompatible information technology between partners, competitor action and forecasting error. These eliminated drivers were further discussed with the experts from the industry to confirm the results obtained from Pareto analysis.

The final seventeen drivers obtained from Pareto analysis in each MTS and MTO systems are further analyzed using a proposed novel integrated AHP-DEMATEL method to understand the importance and influence of one driver over others. AHP method can give the weight of the drivers in the SC. However, it does not give the cause and effect relation between drivers. On the other hand, DEMATEL gives the relational degree between the drivers, as well as, the type of relationship, but the judgments from different experts are not weighted to the actual driver weight in SC. Therefore, to overcome the shortcomings of these methods in their individual form, this work proposes analyzing the identified drivers using the integrated method. The use of the integrated method can satisfy the condition of priority of the driver in SC, while giving the relational degree with other drivers and strength of the relationship. From the analysis of the integrated AHP-DEMATEL method, it was found that the "well-defined procurement system" driver is ranked as the first important driver in Make-to-Stock and the "government regulation" driver is ranked last. In contrast, in Make-to-Order, the "delivery lead time" driver is ranked first and the "average length of the production life cycle" driver is ranked last. The results of integrated AHP-DEMATEL can assist the company to devise strategy focusing on the most important drivers taking into consideration the driver's priority and its cause and effect relationships with others. This will lead to manage or reduce the complexity in the SC.

Keywords: Supply Chain Complexity, Complexity Drivers, Make-to-Stock, Make-to-Order, AHP-DEMATEL