Analysis and Evaluation of Supply Chain Complexity: Perspective from MTS and MTO Companies

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Abstract

products. 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 an 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. An extensive amount of studies have been carried out in the past to identify and analyze the SCC drivers. However, these studies 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 least important drivers, as compared to other, from the identified twenty-two drivers, a Pareto analysis was conducted. For this purpose, a questionnaire survey was carried out to understand the level of impact these drivers have on the SC. The questionnaire was sent to a sample of four hundred random manufacturers in Oil and Gas (O&G) SC. The reason for selecting the O&G SC is due to the fact that some of the O&G SC partners operate based on the MTS strategy while others operate under the MTO production strategy. Out of the four hundred random samples, fifty valid responses were recorded. The questionnaire was designed in such a way that from the response, it will be possible to identify the strategy the company uses to operate their system. Based on the Pareto analysis, six drivers were eliminated from the identified twenty-two drivers. However, the eliminated drivers from MTS and MTO systems are different. The eliminated drivers for MTS systems are: the number of supporting parts to produce a product, collaboration between the supplier and the 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 and validate the results obtained from the analysis.

The final seventeen drivers obtained from the analysis in each MTS and MTO systems are further analyzed using a novel proposed integrated AHP-DEMATEL method to understand the importance and influence of one driver over others. AHP method can identify the VI

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 an 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 the strength of the relationship. From the analysis of the integrated AHP-DEMATEL method, it was found that the driver "well-defined procurement system" is ranked as the most important driver in Make-to-Stock and it is influences by other drivers. On the other hand, the "government regulation" driver is ranked least important and it influence other drivers in MTS. In Make-to-Order, the driver "delivery lead time" is ranked as the most important and it influences the other drivers within the system. In contrast, the driver "product life cycle" is ranked as the least important and it is as well influences the other drivers. The research included a framework of how the results of the integrated approach of AHP-DEMATEL can be utilized. Also, the result can assist the company to diversify its used strategies and shift its focus to the most important drivers taking into consideration the driver's priority and its cause-and-effect relationships with others. This will lead to have a better control or reduce the complexity in the SC. This will lead to have better control over their supply chain or at least reduces its complexity.