A Stochastic Programming Model of Sustainable-Resilient Supplier Selection and Order Allocation under Disruption Risks – The Case of Iran-Khodro Supply Chain

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Asma Bakhtiari Tavana
Department of Industrial and Information Technology Management, Management and Accounting Faculty, Shahid Beheshti University, Tehran, Iran,
asma.bakhtiari@yahoo.com
Masood Rabieh [*]
Department of Industrial and Information Technology Management, Management and Accounting Faculty, Shahid Beheshti University, Tehran, Iran, m_rabieh@sbu.ac.ir
Mahdi Esmaeili
Department of Industrial Management, Management and Accounting Faculty, Allameh Tabataba'i University, Tehran, Iran, esmaeili.m.e@gmail.com

Purpose: Suppliers, as one of the vital partners of the supply chain, contribute to creating a sustainable supply chain. Also, resilient supplier selection can help to reduce the severity of the disruptions' effects. Thus, the simultaneous application of the sustainability and resilience principles in the process of supplier selection and order allocation plays a significant role in achieving sustainability and continuity of business processes in the occurrence of disruptions. This study aims to select a set of sustainable and resilient suppliers and to allocate demand in an automotive supply chain under disruption risks.

Design/methodology/approach: In this research, a hybrid approach has been presented for evaluating and ranking suppliers based on sustainability criteria and modeling the problem of selecting a sustainable-resilient supplier and order allocation under disruption risks. VIKOR (Vlse Kriterijumska Optimizacija Kompromisno Resenje which means multi-criteria optimization and compromise solution, in Serbian) as a multi-criteria decision-making technique has been used to determine the sustainability score of suppliers and the results have been considered as the input parameter for the mathematical model. The proposed mathematical model is two-stage stochastic programming to minimize total cost and maximizing sustainability performance in the case of disruptions, which is solved using the Ɛ-constraint method. Multiple sourcing and flexibility in the production capacity of suppliers have been considered as effective strategies to reduce the severity of disruptions. Iran-Khodro supply chain data has been also used to validate the research model. Finally, sensitivity analysis has been performed to investigate the effects of parameters' change on the final results.

Findings: The results indicated that by increasing the importance coefficient of sustainability performance in the supply chain, the overall value of the supply process increases during disruptions,

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[*] Corresponding author

and multiple sourcing and the use of suppliers' flexible capacity are effective strategies in reducing the severity of disruptions. Also, examining the effect of reliability on the expected cost indicates that the occurrence probability of disruption risk in suppliers can affect the total cost of the procurement process and can also reduce the sustainability goals.

Research limitations/implications: In this research, the effect of disruption risk has been examined. As a subject of future study, the operational risk is suggested to be recognized in the supplier selection problem. Besides, unique events have been considered in the model of this research. In the future, semi-super and super events can be also studied. Finally, using other resilience strategies in supplier selection problem such as adopting backup suppliers, protecting suppliers, and pre-positioning inventory can be a potential direction for future research.

Practical implications: The company under study can consider the results of the presented model and focus on utilizing suppliers' flexible capacity, multiple sourcing instead of single sourcing of parts, partially. Given the importance of sustainable development, particularly in automotive supply chains, it is essential to consider the sustainability performance of suppliers in sourcing decisions with disruption risk in addition to cost and reliability criteria. Thus, the company can evaluate the suppliers' sustainable performance in the occurrence of disruption to achieve sustainable development and business continuity and to meet the needs of stakeholders.

Social implications: Due to the subject of this study, i.e. sustainable supplier selection in the resilient supply chain, the performance of each supplier has been evaluated based on social and environmental criteria to consider social responsibility and environmental issues in the sourcing decisions under disruption risk.

Originality/value: A few studies have taken into account the dimensions of sustainability and supplier risk simultaneously in the field of supplier selection and demand allocation. Flexibility in the supply capacity of the supplier, as an effective resilience strategy, and economic criteria such as C/100 index, PPM production line, payday resistance, communication system, etc. have not been studied in the literature of sustainable and resilient supplier selection.

Keywords: Supplier selection, Order allocation, Sustainability, Resilience, Disruption risk, Stochastic Programming