STOCHASTIC MODELING OF STRATEGIC SUPPLY CHAIN DESIGN

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Rezumat. *Managementul riscului lanțului de aprovizionare joacă un rol critic în orice mediu de afaceri sau industrie și permite o bună coordonare a parametrilor de intrare și de ieșire care pot afecta dezvoltarea fără probleme a proceselor, cum ar fi un proces de fabricație, de exemplu. Cu toate acestea, managementul riscului lanțului de aprovizionare este adesea predispus la impactul diferitelor incertitudini asociate cu întreruperi ale lanțului de aprovizionare cauzate de meteorologie, pandemie, deficit de resurse etc. Prin urmare, o modalitate de a cuantifica aceste incertitudini sunt abordările de modelare stocastică ale managementului lanțului de aprovizionare. Modelarea stocastică este un instrument puternic care poate prezice cu o anumită probabilitate evenimentele care pot apărea în cadrul lanțului de aprovizionare, cum ar fi cel asociat proceselor de producție. În cadrul cercetării de față este dezvoltat și propus un model stocastic, bazat pe teoria probabilității, pentru analiza managementului riscului lanțului de aprovizionare, pentru procesele de fabricație. Prin urmare, studiile sunt efectuate pentru a investiga impactul numărului de procese de fabricație asupra evoluției corecte a lanțului de aprovizionare. Studiul actual arată faptul că o creștere a numărului de procese de producție are ca rezultat o creștere a incertitudinii în managementul lanțului de aprovizionare și, astfel, crește probabilitatea de apariție a întreruperii lanțului de aprovizionare. Prin urmare, se recomandă ca un lanț de aprovizionare să conțină un număr minim de procese de fabricație, dacă timpul de livrare și produsul final o permit.*

Abstract. *Supply chain risk management plays a critical role in the any business or industry environments, and it enables a good coordination of the input and outputs parameters that may affect the smooth processes development such as a manufacturing process for example. However, the supply chain risk management is often prone to the impact of various uncertainties associated with supply chain disruptions caused by meteorological, pandemic, resources shortage, etc. Therefore, one way to quantify these uncertainties are the stochastic modeling approaches of supply chain management. The stochastic modeling is a powerful tool that can predict with certain probability the events that may occur within the supply chain such as that associated with manufacturing processes. In the present research a stochastic model, based on probability theory, is developed and proposed for the analysis of supply chain risk management, for manufacturing processes. Therefore, the studies are performed to investigate the impact of the number of manufacturing processes on the supply chain proper evolution. The current study shows that the increase of the number of the manufacturing processes*

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results in an increase of uncertainty in the supply chain management and thus, it increases the probability of supply chain disruption occurrences, within the supply chain. Therefore, it is recommended that a supply chain should contain a minimum number of manufacturing process, if the delivery time and final product allows.

Keywords: Supply chain, stochastic modeling, numerical modeling, dynamical systems

1. Introduction

Various science and engineering processes can be modeled using either deterministic or stochastic approaches. It is important to mention here that a deterministic system is a system in which there is no randomness and thus, it ensures the certainty of the process. However, it is well known that in business or industrial processes there are always uncertainties, and therefore, these uncertainties must be taken into account, and have a plan to mitigate their impact on the supply chain risk management. On the other hand, the stochastic systems are governed by randomness and thus, the outcomes of these systems are prone to uncertainty. It is worth mentioning here that in the stochastic/probabilistic models the uncertainty is explicitly considered and thus, in spite of their uncertainty these models can enhance the supply chain by providing feedback and thus, it allows for the development of alternatives to mitigate the disruptions of the supply chain.

The stochastic /probabilistic models are mathematical techniques which represent the uncertainty of demand by a set of possible outcomes (i.e. a probability distribution). In factory environment setup stochastic/probabilistic models enable the inventory management strategies under probabilistic demands. Stochastic optimization methods are optimization algorithms that incorporate probabilistic (random) elements, either in the problem data (objective function, constrains, etc.) or in both.

The growth of the supply chain management as a discipline, and due to the expanded nature of uncertainty, complexity, and risk, it is important to use different techniques that take into account the uncertainty, to manage global risk of the supply chain. Studies showed that the probabilistic methods/techniques can facilitate the risk management within complex global supply chain [1-15]. Supply chains can be regarded as a network with speeds and feeds, inputs, outputs and processing times that can be modeled as dynamic systems.