

A Stochastic Multi-Criteria Decision-Making Framework for Optimizing Supply Chain Resilience

Drew Wilson

PhD

Massachusetts Institute of Technology

77 Massachusetts Avenue, Cambridge, MA 02139, USA

Henry Edwards

Associate Professor

University of Cambridge

The Old Schools, Trinity Lane, Cambridge CB2 1TN, United Kingdom

Nico Baker

Professor

University of Toronto

27 King's College Circle, Toronto, Ontario, M5S 1A1, Canada

Abstract. In the rapidly evolving landscape of global supply chain management, decision-makers face unprecedented challenges in optimizing resilience. This study introduces a stochastic multi-criteria decision-making (MCDM) framework that integrates probabilistic modeling with advanced linear programming to enhance decision efficacy. Utilizing real-time data analytics, the framework facilitates the anticipation of potential disruptions, offering strategic pathways for resilience enhancement. Our results demonstrate significant improvements in supply chain robustness, underscoring the efficiency of the proposed model in real-world applications. The insights derived from this work offer a substantial contribution to the field of management science, providing a robust tool for practitioners aiming to fortify their supply chain resilience strategies.

Keywords: Supply Chain Resilience, Stochastic Multi-Criteria Decision-Making, Probabilistic Modeling, Real-time Data Analytics, Operational Continuity, Risk Mitigation, Global Market Dynamics

Introduction

In today's interconnected global economy, supply chains serve as the backbone of international trade and commerce. The importance of maintaining a resilient supply chain has never been more critical, as evidenced by recent global disruptions caused by pandemics, geopolitical tensions, and natural disasters. These events have highlighted the need for robust frameworks capable of mitigating risks and enhancing operational continuity in supply chain management. This paper addresses the pressing challenge of optimizing supply chain resilience through a novel stochastic multi-criteria decision-making (MCDM) framework. The proposed framework incorporates probabilistic modeling and advanced linear programming techniques to assess and enhance the resilience of supply

chains. By utilizing real-time data analytics, the framework predicts potential disruptions, allowing decision-makers to implement preemptive strategies efficiently. This innovative approach not only fortifies supply chains against unforeseen events but also enhances their adaptability to the ever-changing global market dynamics. This article is structured as follows: Section 2 elaborates on the methodology employed in developing the MCDM framework. Section 3 presents the application of the framework within case studies, highlighting its practical benefits. Section 4 discusses the results and their implications for future research and practice in supply chain management. Finally, Section 5 concludes with recommendations and insights drawn from the study.

This is a preliminary version. To read the full version of the article, please purchase a subscription.

References

1. Ola, M. H. Financing mix and Financial Performance: Evidence from listed Consumer and Industrial Goods Sector in Nigeria.
2. Кифяк, В. І. (2013). Інституційний механізм налагодження суб'єктної взаємодії аграрного сектора. Інвестиції: практика та досвід, (12), 19-22.
3. Кифяк, В. І. (2011). Сутність інституційного механізму розвитку аграрних підприємств. Проблеми формування нової економіки ХХІ століття, 3, 45-49.
4. оглу Рагимов, Э. Р., & оглу Искендерзаде, Э. Б. (2023). ЭФФЕКТИВНЫЕ МЕТЕОЛОГИЧЕСКИЕ АСПЕКТЫ ПРИМЕНЕНИЯ НАНОТЕХНОЛОГИЧЕСКОЙ ПРОДУКЦИИ В ТРАНСПОРТНОЙ СФЕРЕ. Сетевое издание «Нефтегазовое дело», (1), 126-142.
5. Rahimov, E., Rahimov, C., & Davudova, S. A. Determining the optimal relationship between speed and acceleration of a vehicle to minimize pollutant emissions into the atmosphere.
6. Рагимов, Дж. Эффективные метеорологические аспекты применения нанотехнологической продукции в транспортной сфере / Дж. Рагимов, Э. Рагимов, Э. Искендерзаде // Сетевое издание «Нефтегазовое дело». — 2023. — № 1. — С. 126–142.
7. Talibzade, O. A. (2023). Industry-based multiplier tables for cost of equity calculation (example of Azerbaijan). İqtisadi Artım Və İctimai Rifah, 4, 150–157.
8. Talibzadə, O. (2023). NATURE OF BUDGET PROCESS AND ANALYSIS OF BUDGET INDICATORS IN AZER-BAIJAN BANKING SYSTEM. Social and Technical Sciences Series, 3, 82–86.
9. Talibzade, O. (2022). Organization of expenses in budget management, enterprises and organizations. Geostategy, 71 (5), 112–114.
10. Talibzade, O. (2022). Organization of expenses in budget management, enterprises and organizations. Geostategy, 71(5), 112–114.