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Managing Supply Chain Disruptions through Design Science Research: A Mathematical Modeling and Simulation Approach

This study examines supply chain dynamics through the development of a mathematical optimization model —considered as a research artifact—designed to analyze supply chain behavior under various disruption scenarios. These may affect supply, demand, or pricing conditions. A mathematical formulation of the problem was developed and implemented using the python programming language. To validate the proposed model, a case study concerning the production of coffee capsules was conducted, simulating multiple operational scenarios across the supply chain. These scenarios encompass the key stages of the chain—namely supplier, manufacturer, distributor, and retailer—as well as distinct planning and operational requirements. The Design Science Research (DSR) methodology guided the research process, enabling a systematic evaluation of the impacts of disruptive factors (e.g., supply failures, delivery delays, price fluctuations), their magnitude (total, partial, or other disruptions), and the duration of these occurrences. This work contributes to a deeper understanding of supply chain dynamics, particularly in terms of decision-making and operational planning under uncertainty and disruption.

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