

Editorial

# Preface to the Special Issue “Mathematical Modelling and Optimization of Service Supply Chain”

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## 1. Introduction

In recent years, as the world economy has grown, increasingly, service-oriented systems play a more significant role in the supply chain. Therefore, the optimization of service supply chains has become crucial for organizations aiming to achieve strategic advantages. Unlike traditional product-based supply chains, service supply chains are characterized by their intangible outputs, variable demand patterns, and the significant influence of human resources. In the meantime, the application of advanced analytical methods, ranging from various programming models and stochastic optimization to game-theoretical models, is essential to help service supply chain members make better decisions.

In this context, this Special Issue, “Mathematical Modelling and Optimization of Service Supply Chain”, aims to look for innovative approaches to realize the modeling and optimization of service supply chains, as well as high-quality research solicited to address both theoretical and practical issues in the service supply chain. This Special Issue is intended for a diverse audience, including students, researchers, and practitioners in the fields of supply chain management, operations research, industrial engineering, and business management. Our goal is to equip readers with both the theoretical foundations and practical tools necessary for optimizing service supply chains in various industries.

## 2. Overview of the Published Papers

The present Special Issue contains 14 papers accepted for publication after a conscientious review process.

Zhongxiu Peng, Cong Wang, Wenqing Xu, and Jinsong Zhang (Contribution 1) investigate the location-routing problem within the context of multi-agent participation in maritime emergency materials distribution decision-making. Based on deterministic scenarios, an overall layout of the maritime emergency logistics system is examined. Utilizing a bi-level programming approach, a model considering the time windows of accident points and the priority of multiple types of emergency materials distribution is constructed. A hybrid algorithm combining ant colony optimization and tabu search was devised to solve the model, with a case study conducted in the Bohai Sea area. The method proposed in this study achieves the coordinated optimization of onshore emergency material reserves and multi-level emergency material distribution routes in maritime emergency logistics systems. It can assist decision makers at different levels of maritime emergency logistics systems in making more scientifically rational decisions, thereby enhancing the service capability of maritime emergency logistics systems.

Peng Zhang, Sisi Ju, and Hongfu Huang (Contribution 2) focus on restaurants’ take-out model choice and the take-out platform and how to set the commission rate and coordination mechanisms to attract more restaurants. By adopting mathematical modeling methods, they first derived the restaurant’s optimal price and/or platform’s commission rate. Then, by comparing the profits of restaurants under different models, they obtained the optimal take-out model for restaurants in different situations. Lastly, they designed a sales reward contract that could achieve price and model choice coordination as well as win–win outcomes for the restaurant and platform.



**Citation:** He, Y. Preface to the Special Issue “Mathematical Modelling and Optimization of Service Supply Chain”. *Mathematics* **2024**, *12*, 2292. <https://doi.org/10.3390/math12142292>

Received: 15 July 2024  
Accepted: 18 July 2024  
Published: 22 July 2024



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N. Anbazhagan, Gyanendra Prasad Joshi, R. Suganya, S. Amutha, V. Vinitha, and Bhanu Shrestha (Contribution 3) examine a perishable queueing-inventory system for two commodities with optional customer demands. The study focuses on the impact of these optional demands on system performance. Customers can choose to purchase either the first item or the second item or service exclusively. Using Markovian arrival processes, the analysis considers a finite waiting hall with limited capacity and evaluates various performance measures. The steady-state joint probability distribution for both commodities and the number of customers was computed using matrix geometric methods. Numerical illustrations highlighted optimal parameter values and the effects of service rates on the total cost rate (TCR) of the inventory system. The findings emphasize the significance of understanding customers' optional demands in modern organizations. Future research directions include exploring additional conditions, such as service and lead times under different distributions, and investigating batch Markovian arrival processes and server vacation policies.

Xiaotong Guo and Yong He (Contribution 4) contribute to the understanding of the operational and management issues of the Platform Service Supply Chain (PSSC). The findings of this paper address the dispersed studies extant in the literature and identify key trends and research gaps in the field of PSSC. Based on Scopus and Web of Science databases, this paper adopted bibliometric and thematic analyses to comprehensively review the related literature. Six main research topics within the literature in the field of PSSC were identified. A predominant focus on E-commerce platforms was identified. The growing concern for sustainability drives attention towards recycling and remanufacturing platforms. This paper conducted a comprehensive exploration of PSSC members' decision-making processes. Pricing and information-sharing strategies were extensively studied by researchers using game theory, which can capture competitive and collaborative dynamics within PSSCs. These findings offer insights for managers and policymakers involved in PSSC management and provide references for researchers to explore this field.

Liu Liu, Ying Yuan, Xiaoya Wang, and Hongfu Huang (Contribution 5) contribute to the literature by studying the licensing of green technologies between rival companies, which results in higher economic and environmental benefits. To study this problem, they established a game-theoretical model and analyzed the equilibrium results regarding the licensing contract design (i.e., no licensing, royalty licensing, and fixed-fee licensing) and the corresponding pricing and quantity decisions. They show that fixed-fee licensing performed best among the three contracts when the competition intensity was high and the market expansion effect was strong. They also show that when the green company was more concerned about environmental welfare, fixed-fee licensing was also preferable. This paper can help firms foster a cooperative relationship with rivals through green technology licensing and can also provide guidelines for policymakers to manage green technology diffusion in competing markets.

Komeyl Baghizadeh, Nafiseh Ebadi, Dominik Zimon, and Luay Jum'a (Contribution 6) propose a multi-product mathematical model to determine an optimal inventory policy by considering the Markov chain. Four meta-heuristic methods, namely, the Grey Wolf Optimizer (GWO), Genetic Algorithm (GA), Moth-Flame Optimization (MFO) Algorithm, and Differential Evolution (DE) algorithm, are proposed to solve the problem. Both numbers of iterations and spent time were used to evaluate the efficiency of the methods, and GWO performed best in solving the inventory decision-making model. Moreover, a real case study and analysis were carried out on the main parameters of the model. The results show that companies should consider an unreliable supplier when the reliable supplier is under disruption, even if this approach costs more.

Lei Song, Qi Xin, Huilin Chen, Lutao Liao, and Zheyi Chen (Contribution 7) analyze the influence of manufacturers' fairness concerns on supply chain decision-making under the government subsidy policy. The realization of green innovation is the inevitable trend of supply chain development, and the government's subsidy policy can mobilize the enthusiasm of enterprises for green development. In the dual-channel green supply chain,

the manufacturer's fair concern behavior may have a significant impact on the overall performance of the supply chain. The results show that, with the support of government subsidies, manufacturers' fairness concerns affect wholesale prices, manufacturers' profits, and retailers' profits. The research results can help supply chain members understand how to make optimal decisions by considering fairness concerns under government subsidy policies and improving the greenness and economic benefits of the supply chain. In addition, for the government, it is helpful to formulate more effective policies to support green innovation.

Shan Lu, Peng Wu, Lei Gao, and Richard Gifford (Contribution 8) construct comprehensive indicators and different regression models to study the trade-off between two management earnings strategies: accruals management and real earnings management. This paper finds that compared with non-state-owned enterprises, state-owned enterprises (SOEs) are more inclined to choose real earnings management rather than accruals management, and similar results were found for SOEs controlled by the central government. This paper also finds that SOEs and central SOEs with higher media attention or an incidence of litigation are more inclined to choose real earnings management.

Yonit Barron (Contribution 9) studies an inventory control problem with two types of storage facilities, which differ in purpose and capacity: a primary warehouse (PW) of capacity  $M$ , managed according to an  $(M, S, s)$  policy,  $0 \leq s < S \leq M$  with lost sales, and a subsidiary one (SW) of sufficiently large capacity. It is also considered how two types of customers, individuals, and retailers, cause continuous and batch-type bilateral changes on an inventory level. Applying the first passage time results, the author analyzed the cost components under the discounted criterion and the optimal parameters. It is shown that the limited capacity yields lower thresholds, and as demands become more frequent, it is worthwhile to order more frequently and in smaller quantities. It is further shown that the timing has a significant impact on the optimal policy; for a high discount factor, it is worth considering postponing the distributor even at the risk of causing more shortage events.

Xiao Zhou and Xiancong Wu (Contribution 10) delve into the strategies manufacturers in retailer-led low-carbon supply chains can employ to address the escalating costs associated with carbon reduction efforts set against the backdrop of national policies aimed at energy conservation and emissions reduction, alongside a rise in consumer environmental consciousness. By conducting a comparative analysis across three decision-making frameworks—centralized decision-making, decentralized decision-making without altruistic preferences, and decentralized decision-making with altruistic preferences—the research reveals that the centralized approach yields superior outcomes in terms of carbon emissions reduction efficiency, market demand, and profitability compared to the decentralized models. Furthermore, it highlights the beneficial impact of retailers' altruistic preferences on enhancing carbon emissions reductions, bolstering market demand, and improving profits for both manufacturers and the supply chain at large. This study also identifies that, under specific conditions, carbon trading mechanisms can significantly mitigate cost pressures on manufacturers, thereby augmenting carbon reduction efficiency and boosting overall profitability within the supply chain. This paper's primary contribution lies in offering a robust decision-support framework for managing low-carbon supply chains and presenting a novel theoretical perspective on the irrational behaviors observed in supply chain decision-making under carbon policy constraints. These insights offer invaluable guidance for theoretical exploration, practical management applications, and policy formulation.

Yuling Sun, Xiaomei Song, Yihao Jiang, and Jian Guo (Contribution 11) focus on introducing the strategy of the blockchain between two competitive enterprises of fresh agricultural products. They extend the consumers' traceability preferences for fresh agricultural products to more realistic factors and analytically investigate how blockchain technology is effectively used in two competing enterprises. This study compares the pricing decision between traditional and blockchain traceability modes. Our analysis shows that fresh agricultural enterprises may benefit from blockchain adoption, depending on the degree of consumer traceability preferences and the blockchain impact factor. Next, it was

found that introducing blockchain techniques in the traceability system could shift demand from traditional enterprises to blockchain enterprises when the blockchain influence factor meets a certain range. Moreover, it was found that both consumer traceability preferences and the blockchain influence factor could significantly affect optimal pricing. Finally, some management suggestions are provided to improve fresh supply chain performance.

Cong Wang, Zhongxiu Peng, and Wenqing Xu (Contribution 12) explore the location-routing problem of emergency materials distribution (MEMD-LRP) in uncertain maritime environments from the perspective of joint decision-making by multiple decision-making agents, leveraging methods such as bi-level programming and robust optimization. Uncertainty in the problem mainly consists of uncertain sailing times and uncertain emergency material demands at accident points during the planning horizon. A robust optimization bi-level model was constructed to address this uncertainty, with a hybrid algorithm combining the ant colony and tabu search utilized to solve a case study in the Bohai Sea area. With the method proposed in this paper, decision-makers can be empowered to flexibly formulate emergency material reserve locations and distribution decisions that can effectively cope with uncertainties in maritime emergencies while ensuring rapid responses. This study aids in achieving a more optimized and flexible emergency logistics system, thereby enhancing the capability to respond to maritime emergencies.

Yuling Sun, Xiaomei Song, Xiang Fang, and Jian Guo (Contribution 13) investigate the strategic implications of blockchain technology to trace products in dual-channel supply chains composed of a manufacturer and an e-retailer. They analyzed how a monopoly manufacturer chooses between a self-built blockchain traceability system (SBT) and a third-party blockchain traceability system (TBT). Game analysis is developed to depict the pricing decision for the manufacturer and e-retailer. Our results demonstrate that the manufacturer will prefer to adopt a TBT when the fee paid to the blockchain service provider is low. Moreover, they found that consumers' traceability awareness, the cost of adopting TBT, the blockchain traceability technology level, and the research and development cost factor of blockchain technology could affect the decisions of supply chain members. Practical guidance for supply chain managers is also put forward for determining the optimal blockchain adoption strategy.

Golnaz Hooshmand Pakdel, Yong He, and Sina Hooshmand Pakdel (Contribution 14) present a model with four main goals to improve environmentally friendly closed-loop supply chain management. The model focuses on cutting costs, reducing risks, lowering emissions, and speeding up deliveries in uncertain demand conditions. It takes into account factors like goods and quality degradation that were overlooked in models. By using a customized NSGA II algorithm with a selection tournament method, the study effectively balanced conflicting priorities, surpassing the MOPSO algorithm in both solution quality and efficiency. This model is especially useful for supply chain managers working with perishable products as it offers a decision-making framework that supports sustainability efforts. The results indicate a cost decrease of around 2.38% compared to previous methods, demonstrating improved solution discovery and efficiency. The study highlights the value of objective optimization in refining theoretical concepts and real-world applications, recommending that decision-makers adopt these sophisticated techniques to enhance sustainability practices in supply chain management regulations.

### 3. Conclusions

The 14 published papers cover a wide range of topics connected to the theory and applications of advanced analytical methods in the service supply chain. To be specific, these topics include the following: (1) the study of customer preferences and behaviors, e.g., environmental consciousness, traceability preferences, and optional demand; (2) the optimization of service supply chain members' decisions, e.g., operational strategies, revenue management, and sustainability practices; (3) the proposal of coordination mechanisms in service supply chains, e.g., sales reward contracts and carbon trading mechanisms; and (4) the effects of the external environment, e.g., risks, government subsidies and innova-

tive technology. In addition, these topics have been studied under some special service scenarios, including maritime logistics, food services, and green innovation.

These papers present new theoretical results, structural investigations, new models, and algorithmic approaches, as well as empirical research on the service supply chain. These studies can, to some extent, assist academics and practitioners to better address current issues and potential challenges in service supply chains. As a result, the performance and efficiency of the service supply chain can be enhanced.

**Funding:** This work is supported by the National Natural Science Foundation of China (Nos. 72171047).

**Conflicts of Interest:** The authors declare no conflicts of interest.

#### List of Contributions:

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