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Editorial

Complexity Measures and Models in Supply Chain Networks

Vladimir Modrak,[1] **Petri T. Helo**,[2] **and Dominik T. Matt**[3]

[1] *Technical University of Košice, Košice, Slovakia*
[2] *University of Vaasa, Vaasa, Finland*
[3] *Free University of Bozen-Bolzano, Bolzano, Italy*

Correspondence should be addressed to Vladimir Modrak; vladimir.modrak@tuke.sk

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Supply chains networks (SCNs) have become in the last two decades increasingly global and are generally considered to be one of leading drivers of business value. SCNs create more and more complex systems that tend to move from tightly coupled to loosely coupled structures. The loosely coupled structures allows for higher flexibility due to low interdependency. Moreover, Brown et al. [1] observed that those companies that swapped their tightly coupled processes for loosely coupled ones achieved performance improvements. On the other hand, loosely coupled SCNs resulted in more complex logistics infrastructures. Also for that reason, complexity is a topical issue in the supply chain literature. While definitions of supply chain complexity may vary due to contextual differences, there is a general consent that supply chain complexity is multifaceted phenomenon that is driven by several sources (see, e.g., [2–6]). Among them, uncertainty, technological intricacy, organizational practice, the number of suppliers, the portfolio of products' structure, and the flow of manufacturing processes can be identified. Naturally, it is difficult to recognize what exactly determines supply chain complexity and which consequences are critical for effective coordination and/or scheduling in the supply chain. The main hurdle in that effort is the lack of the comprehensive principles that govern how supply chains with complex organizational structure and function arise and develop [7]. The positive thing is that there are many partial approaches to the problem, dealing with different perspectives. For example, a promising approach has been used in Portuguese automotive supply chain [8]. In this regard, each novel supply chain complexity measures and models may help in better understanding the yet unknown effects of the possible factors.

This special issue collection on complexity measures and models in supply chain networks encompasses a series of articles, which can be divided into two major categories: (1) optimization models of SCNs as tools for decision-making and management under uncertainty; (2) scheduling problems in supply chain networks. Articles belonging to the first one are introduced in the following four paragraphs.

The reliability-based robust design optimization (RBRDO) model of inventory management system in terms of furniture merchandising company is developed and used in the paper titled "Stochastic Reliability Measurement and Design Optimization of an Inventory Management System." Proposed reliability-based robust design optimization (RBRDO) approach consists of reliability-based design optimization (RBDO) and robust design optimization (RDO). RBRDO considers various uncertainties arising from changes in specifications, transportation delays, raw material availability, manufacturing processes, and operational conditions. The results of the case study showed that RBRDO allows the supply chain company to effectively control reliability of deliveries according to customer requirements.

A model of multichannel household appliance supply chain with price competition and demand uncertainty is presented in the paper titled "Complex Characteristics of Multichannel Household Appliance Supply Chain with the Price Competition." Considering that price competition often leads to the demand and order fluctuation, the authors of this paper focus their research on bullwhip effect (BWE) phenomena in supply chain. For this purpose, a numerical experiment to investigate how the bullwhip effect is affected by the channels' price strategy in different states was invented and applied. Moreover, the feedback control method was used to control the chaos and the BWE in the supply chain system. Based on the numerical simulation, they found among other findings that a chaotic state of a supply chain system will suffer larger bullwhip effect than a stable system.

The design and operation of complex supply chain processes are considered as NP-hard optimization problems and approached through metaheuristics. In the work titled "Optimization of Consignment-Store-Based Supply Chain with Black Hole Algorithm," an optimization approach of consignment-store-based supply chain with black hole algorithm is applied through a case study in a power plant supply chain company. The optimization of this complex supply chain problem is aimed to minimize the materials handling costs of the whole supply chain. Obtained results in this paper indicate the efficiency of new advanced black hole optimization operators to increase the convergence of the algorithm.

Development of a mathematical model for the evaluation of the distribution of production tasks in several plants to achieve maximum production in the shortest possible time is described in the paper titled "Modelling Decision-Making Processes in the Management Support of the Manufacturing Element in the Logistic Supply Chain." The proposed model focuses on seeking satisfactory solutions by making orders in various locations, which differ in production capacity and manufacturing cost. The model was tested through simulation experiments independently for two manufacturing strategies. Obtained results showed that the model appears to be a valid instrument for optimization of total production cost.

Articles focused on scheduling problems in supply chain networks are briefly characterized in the following three paragraphs.

Consequences of supply chain complexity are quite frequently articulated and complexity sources can be more or less predicted. Nevertheless, those factors cannot be managed without the ability to measure them. Therefore, the main challenge in the complexity metric is to increase their effectiveness by getting a better appreciation of the real problems. In this context, a novel complexity measure of manufacturing systems is proposed in the paper titled "Novel Complexity Indicator of Manufacturing Process Chains and Its Relations to Indirect Complexity Indicators." The principle of the method in this article relies on using the sequences of machine operations for manufacturing of group of product according to the scheduled plan. The authors also analyzed relations between production line balancing rate, number of intercell part flows, intracell part flows, and the complexity measure.

The paper titled "Architecting a System Model for Personalized Healthcare Delivery and Managed Individual Health Outcomes" offers architecture of system model for personalized healthcare delivery and managed individual health outcomes. Its scope is to show an analogy between mass-customized production systems and healthcare delivery systems and to highlight the stochastic evolution of an individual's health state as a key distinguishing feature. Therefore, modelling of healthcare processes requires a systems approach. The research presented provides knowledge-based modelling support for the planning and scheduling of healthcare processes.

In the last but not least research paper titled as "A Multilayer Model Predictive Control Methodology Applied to a Biomass Supply Chain Operational Level," the authors presented their multilayer model predictive control methodology applied to a biomass supply chain operational level. The methodology is composed of two interconnected levels that closely monitor the system state update, in the operational level, and delineate a new routing and scheduling plan in case of an expected deviation from the original one. The authors proved their approach by using an experimental case study. This novel strategy enables the online scheduling of the supply chain transport operation using a predictive approach.

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Vladimir Modrak
Petri T. Helo
Dominik T. Matt

References

[1] J. S. Brown, S. Durchslag, and J. Hagel, "Loosening up: how process networks unlock the power of specialization," *The McKinsey Quarterly*, no. 2, pp. 59–69, 2002.

[2] C. Bode and S. M. Wagner, "Structural drivers of upstream supply chain complexity and the frequency of supply chain disruptions," *Journal of Operations Management*, vol. 36, pp. 215–228, 2015.

[3] I. Manuj and F. Sahin, "A model of supply chain and supply chain decision-making complexity," *International Journal of Physical Distribution and Logistics Management*, vol. 41, no. 5, pp. 511–549, 2011.

[4] C. C. Bozarth, D. P. Warsing, B. B. Flynn, and E. J. Flynn, "The impact of supply chain complexity on manufacturing plant performance," *Journal of Operations Management*, vol. 27, no. 1, pp. 78–93, 2009.

[5] V. Modrák and V. Moskvich, "Impacts of RFID implementation on cost structure in networked manufacturing," *International Journal of Production Research*, vol. 50, no. 14, pp. 3847–3859, 2012.

[6] M. Milgate, "Supply chain complexity and delivery performance: an international exploratory study," *Supply Chain Management Review*, vol. 6, no. 3, pp. 106–118, 2001.

[7] A. Surana, S. Kumara, M. Greaves, and U. N. Raghavan, “Supply-chain networks: a complex adaptive systems perspective,” *International Journal of Production Research*, vol. 43, no. 20, pp. 4235–4265, 2005.

[8] H. Carvalho, A. P. Barroso, V. H. MacHado, S. Azevedo, and V. Cruz-Machado, “Supply chain redesign for resilience using simulation,” *Computers & Industrial Engineering*, vol. 62, no. 1, pp. 329–341, 2012.