Editorial - Evolving Trends in Supply Chain Management: Complexity, New Technologies, and Innovative Methodological Approaches

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Editorial

Evolving Trends in Supply Chain Management: Complexity, New Technologies, and Innovative Methodological Approaches

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Supply chain management has become one of the primary key success factors to deal with the increasing *complexity* of the current business environment [1, 2]. Although supply chain management is a mature discipline, the complexity of actual supply chains has greatly evolved over the last two decades [3–5] due to the dynamic interaction of a wide range of processes, decisions, and structures, whose understanding becomes essential for gaining a competitive advantage in the marketplace. Indeed, most supply chain management research has focused on the assumption of linear relationships between nodes buyers and suppliers. However, these supply chains are no longer linear systems, but are characterized by network structures with autonomous and heterogeneous members [6]. As a result, the Operations Management community is currently rethinking on celebrated concepts and largely accepted ideas, with the aim of developing new theory that better captures the requirements of this organizational scene.

New technologies have also played a key role in the aforementioned evolution of supply chains [7]. Continuous technological developments, such as augmented reality, direct digital manufacturing, warehouse automation, and 3D printing [8, 9]—to name a few—open a new world of opportunities from a supply chain perspective. These new technologies not only allow increasing the efficiency and flexibility of manufacturing and distribution processes, but also modify the relationship between the different echelons of the supply chain, with a special emphasis on the consumer. For this reason, the use of these technologies has been deemed as one of the key tools for firms to enhance their competitiveness and to build up their relationships with up- and downstream supply chain nodes. Accordingly, the applications of these technologies for supply chain management have become a fruitful area of research, given its clear and strong managerial implications.

Overall, all these opportunities and challenges currently emerging emphasize the need for fostering *innovative methodological approaches* in supply chain research [10]. Decision-makers need to be equipped with methodological frameworks that enable them to gain understanding on the different problems and to facilitate the finding of robust solutions. In this regard, several methodological approaches, such as agent-based modelling and fuzzy control systems, have proven to be instrumental laboratories for supply chain analysis and decision-making [11, 12]. In this manner, methodology, together with complexity and technology, becomes the third strategic axis of this special issue aimed at disseminating emerging developments in the supply chain area.

Reflecting on these three axes, this special issue brings together five high quality research works exploring the new challenges and proposing new solutions for modern supply chains. We note that each submission was evaluated through a blind-review process, where at least two reviewers, who are experts in their corresponding fields, have assessed the quality of the article. As guest editors, we are very satisfied with the quality of the papers presented in this issue, which

contribute to the body of knowledge in this crucial topic for businesses from the three mentioned axes. We briefly describe their contributions below.

Z. Chen, in his paper "The Influence of 3D Printing on Global Container Multimodal Transport System," evaluates the impact of 3D printing on a container logistics system by developing a system dynamics model of a sneakers' supply chain and establishing a comprehensive index system. The author finds that the aggregate demand for international transport would decline after the application of 3D printing. In addition, the evaluations based on the data of Guangzhou port suggest that the 3D printing of sneakers was not enough to subvert the existing container logistics system. Finally, this research paper concludes that deglobalization caused by 3D printing and globalization strengthening caused by trade cooperation will work together in this container system and lead to more complex changes.

Another work explores the practice of *inventory consignment*, an arrangement where the retailer holds items in its inventory which are still owned by the supplier, as a fruitful mechanism for supply chain collaboration. While the opportunities derived from consignment are well known in terms of supply chain efficiency, it does not come without relevant challenges to be dealt with. In this regard, establishing a fair and robust pricing agreement becomes essential to ensure the long-term viability of this collaborative solution. In light of this, P.-Y. Chen, in the paper entitled "Optimal Retail Price Model for Partial Consignment to Multiple Retailers," explores the product pricing decision in a supply chain with one supplier and multiple retailers operating under a consignment stock policy. This work proposes a partial product consignment model, where both the seller and the buyers absorb a portion of the inventory costs. Moreover, a relevant feature of this work is a valuable range of managerial implications, which would allow decision-makers to adjust product prices depending on the market fluctuations and sales requirements.

The article "Discrete Switched Model and Fuzzy Robust Control of Dynamic Supply Chain Network," by S. Zhang et al., investigates a fuzzy robust strategy to accomplish the robust operation of supply chain networks. They consider both production and ordering lead times in a scenario characterized by uncertainty in customer demand. To do so, the authors establish a discrete switched model of the dynamic supply chain network based on Takagi-Sugeno (T-S) fuzzy systems and propose a fuzzy strategy to control the switching actions among subsystems. From this perspective, they show how the proposed fuzzy strategy (consisting of the fuzzy switched strategy and the fuzzy control strategy) can guarantee the robust operation of the supply chain network in a cost-effective manner.

I. Cabral and A. Grilo, in their research "Impact of Business Interoperability on the Performance of Complex Cooperative Supply Chain Networks," propose an agent-based model for evaluating the effect of business interoperability on the performance of cooperative supply chain networks. After rigorously identifying specific and relevant gaps in the business interoperability literature, they address this question by adopting a multimethod approach which combines empirical data and simulation. More specifically, they first collect data via face-to-face interviews and by analysing the annual reports and newsletters of Valorpneu, which is one of the industrial networks with the best business interoperability performance in Portugal. Later, they populate the agent-based model with these data and perform a "what-if" analysis. As a result, they reveal novel conclusions for the business interoperability field by accurately formalising both theoretical and managerial implications. Finally, they propose interesting new research questions for further analysis in other business network contexts (e.g., automotive and aircraft industries).

D. A. O. Vera et al., in their article "Combined Use of Mathematical Optimization and Design of Experiments for the Maximization of Profit in a Four-Echelon Supply Chain," propose and employ an innovative methodological approach for designing supply chain networks based on the combination of mathematical optimization and experimental designs. Through these techniques, they address the location of manufacturing facilities and distribution centres, the selection of the appropriate suppliers, and the allocation of the material flow in a four-echelon supply chain. To illustrate their proposal, they evaluate the impact of four main factors (capacity, quality, delivery time, and interest rate) on the operational and financial performance in a case study, showing how this methodological framework allows practitioners to gain understanding on the complex interdependencies that govern the dynamics of supply chains.

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