Journal of Supply Chain Management Science, Vol. 4, No 3-4 (2023)

Journal of Supply Chain Management Science

https://journals.open.tudelft.nl/jscms

http://dx.doi.org/10.18757/jscms.2023.7326

Special Issue on Hyperconnectivity in the Physical Internet

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Published 29-12-2023

This special issue of the Journal of Supply Chain Management Science (JSCMS) presents four papers that were discussed at the 9th International Physical Internet Conference (IPIC) in 2023. The vision of Physical Internet (PI) has gone through a strong maturing process since its conception (Montreuil, 2011), both in terms of its practical articulation and scientific grounding. Recent reviews of the PI-literature (Treiblmaier et al., 2020; Pan et al., 2021; Chen et al., 2022; Nguyen et al., 2022; Cortés-Murcia et al., 2022) explicitly link the PI system concepts to its founding disciplines: industrial engineering (IE) and supply chain management (SCM). Together these PI innovation agendas have helped to involve IE and SCM researchers outside the PI community and have promoted the bundling of global R&D efforts into converging streams of work. In the light of these developments, JSCMS has offered to consider papers presented at IPIC 2023. The four selected and peer-reviewed contributions included in this special issue all revolve around the organization of high levels of connectivity between network services of individual carriers, leading to collaborative deployment of services in an integrated network. In the PI-jargon, this high-level connectivity is termed "hyperconnectivity".

Firstly, the paper by Shahedi et al. formulates the shipment routing problem with exchange hubs and multiple modes of transport that can operate at part-shipment level, allowing splitting and re-joining of shipments between origins and destinations. The optimization problem developed here considers three objectives (mode share, total costs, and lead time) and is formulated as a mixed-integer linear programming (MILP) problem. A case study for shipping options of a major European manufacturer demonstrates the working of the model. Secondly, the paper by Schrotenboer et al. introduces a share-first-plan-second policy for efficient cooperation in a multi-modal transportation corridor. A simple and elegant algorithm is introduced to allocate shipments to vehicles dynamically, based on cyclical joint schedules for the shared fleet and real time direct assignment. Comparisons are made with the benchmark of centralized, jointly optimal planning for the group of collaborating carriers. The simple approach performs almost equally well, but is much easier to execute. Thirdly, the paper of Filom et al. asks the question of how optimized synchromodal networks would respond to carbon taxes. In such networks, freight is distributed according to a system optimum across different modes of transport, which are connected by transshipment terminals. The network model is also formulated using MILP and applied for an empirical case study of freight flows around the Great Lakes Region. The authors find that internalization of today's carbon prices could lead to a reduction of road vehicle trips by 20%. Also, further-reaching scenarios are explored. Finally, the paper by Cebeci et al. presents a systematic literature review of consumer choice behaviour in the context of hyperconnected urban logistics networks. Interestingly, most studies in the context of the PI so far have focused on optimization of systems and consider logistics choices of consumers only very crudely, if at all. The paper proposes a framework to study this behaviour and sketches research opportunities.

Together, the four papers should contribute to the understanding of the antecedents of hyperconnectivity, to the design of different modes of collaboration as well as their impacts for efficiency and sustainability.

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