Guest editorial: Towards large-scale industry-wide physical internet deployment

Physical Internet (PI) is a recent innovative breakthrough in global logistics and supply chain management (LSCM) that aims to improve, by several orders of magnitude, the economic, environmental and socially sustainable ways that physical objects are globally moved, deployed, realized, supplied, designed and used (Montreuil, 2011; Mervis, 2014). The PI is described as "a global logistics system based on the interconnection of logistics networks by a standardized set of collaboration protocols, modular containers, and smart interfaces for increased efficiency and sustainability" (Ballot *et al.*, 2014; Treiblmaier *et al.*, 2020). After more than a decade of development, PI has gradually moved forward from conceptual research to large-scale enterprise applications. Several special issues (SI) concentrating on the concept have been published on flagship journals, and have successfully attracted enormous attentions, such as the first SI (Pan *et al.*, 2017) aiming at collating the first research works that contributed to the development and applications of the concept, and (Ballot *et al.*, 2021) gathering research works investigating how PI reshapes the organizational models and practices in LSCM. More recently, the SI (Pan *et al.*, 2021) investigated the digital interoperability in PI. It is obvious that innovations in digital technologies (DT) influence the development of new paradigms, principles, and models in PI. Everything in the future physical world would be replicated in the digital space through advanced techniques, and across various industrial sectors, including aerospace, electric power, automotive, manufacturing, healthcare and medicine, logistics and supply chain, etc. Aligning with the recent research foci of PI, the purpose of this special issue is to develop interdisciplinary researches that address the large-scale industry-wide PI applications and deployments for major original theories building.

This special issue of *Industrial Management and Data Systems* contains five research papers. These papers focus on resent advances topics of physical internet development and application. Three papers investigated the specific industrial sectors in tobacco logistics, city logistics in new retail environment and a multi-level supply chain considering the greenhouse gases optimization. One paper concentrated on the physical internet teaching and learning aspect, while the last one conducted a review and proposed research opportunities of physical internet development in industry.

The work by Shen *et al.* investigated a real-life case of tobacco supply chain in Guangxi Province, China. Under the management of tobacco monopoly system, China's tobacco logistics has formed the characteristics of the separation of industrial logistics and commercial logistics. The standard three-tier supply chain structure makes tobacco logistics have a good foundation in the application of PI concept and digital promotion. Based on the relevant data of tobacco enterprises in Guangxi, the paper calculated the performance values of tobacco companies in Guangxi. Through the analysis of each indicator and the performance values of each city, the authors found that the improvement ability has a major impact on tobacco supply chain performance. Then, the paper established a system dynamics model to further demonstrate the impact of information digitalization on the performance of the tobacco supply chain, thus providing theoretical support for building digital tobacco logistics in Guangxi.

The work by Luo *et al.* addressed the challenges and solutions of city logistics in the new retail era. The new retail, which is characterized by omni-channel, fragmented orders and decentralized 2C distribution, is becoming the mainstream of the retail industry

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worldwide. In order to achieve a comprehensive breakthrough in new retail, a PI enabled two-tier city logistics solution was proposed by redefining the key facilities in city logistics with the PI concept. The Key innovation of is paper is the "Container-as-a-Warehouse" operation mode. The PI enabled container can be dropped in city parking lot as a mobile warehouse to provide flexible city logistics service. A mathematical model of the proposed solution is established. An adaptive large neighborhood search (ALNS) was designed based upon an iterative procedure, which ensures consistent and optimal results.

The work by Huang *et al.* focused on the marketing decisions and supplier selections in supply chain level considering the greenhouse gases (GHG) emission. The manufacturer purchases optional components of a certain functionality from his alternative suppliers and customizes a set of platform products for retailers in different independent market segments. To tackle the studied problem, a hierarchical analytical target cascading (ATC) model was proposed, Jaya algorithm is applied and supplier selection and product family design are implemented in its encoding procedure. This research is a good exploration and attempt to consider greenhouse gases emission in PI enabled supply chain.

The work by Wang *et al.* focused on the education and popularization of PI. From the perspective of higher education, to help students understand the sophisticated coordination mechanism of PI, this research has made a very useful attempt. This is the first study about the impact of gamification on teaching and learning PI. Gamification is an effective approach to help students improve their learning curve. The psychological and behavioral changes in learning will also pose an impact on learning efficiency. This paper introduced a PI transportation game and designed a set of gamification teaching experiments. In the experiment, a control group and three experimental groups were set up, and the experiment was designed to respond to a plethora of research questions using the methods of *T*-test, correlation analysis and regression analysis. Experimental results were analyzed through the method of multivariate statistics.

The work by Chen *et al.* identified the key themes and point out the gaps to demonstrate the current state of the PI deployment in the industry. This paper followed the methodology of systematic literature review (SLR), a total of 88 papers ranging from 2011 to 2021 were selected and coded for analysis. This paper has identified 7 themes, including the PI concepts, assessments of the PI, components of the PI, innovative facilities applied in the PI, collaboration in the PI, the PI implementation and literature review. Meanwhile, five key methodologies including experimental, exploratory, review, design science research as well as mixed-methods have been classified. This article provided guidance for the future application of PI in the industrial field.

We would like to express our appreciation to all the authors who have submitted their valuable works. We also thank all the reviewers for their service and contribution to this special issue. It is crucial to analyze application of PI with the fast development of the society and supply chain innovation. This special issue involves in various interfaces of PI deployment in real-life industrial frontiers in the form of formal models as well as applications, which could provide advanced perspective to future research.

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Further reading

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