Doctor of Business Economics

Facilitating Trust and Logistics Collaboration in the Era of Physical Internet

Shiqi Sun

Supervisors: Prof. Cathy Macharis, PhD and Prof. Koen Mommens, PhD

Abstract

Trust has been a long-standing problem in the logistics industry. With the recent call for collaboration to enhance operational efficiency and strive for the sustainability goal of 2050, trust is becoming an increasingly prominent bottleneck.

A recent concept called Physical Internet (PI) has made significant re-designs to the future of logistics with disruptive features like interconnectivity and decentralisation. PI aims to transport standardised containers in which cargo is encapsulated, mimicking how data is transmitted on the Internet. By leveraging these game-changing reformations of PI, trust issues can be alleviated. However, a dedicated trust-facilitating solution is still missing in the existing PI research, especially in the operational aspect, even though PI provides a concrete ground.

This thesis formally investigates the trust problem in logistics with a special focus on the routing problem in PI. The purpose of the thesis is to answer this principal research question: what are the current and future potentials of Physical Internet in addressing the trust issues in the logistics industry?

First, the problem of trust and research gaps are identified. Trust is considered a complex and multidisciplinary concept, and it is currently hindering greater collaboration and information sharing, which is essential. Next, an examination of the current research reveals a significant lack of focus on the concept of trust, especially for PI. A definition of trust is formulated to profile the concept of trust more carefully, with relevant factors to confine the applicable scenarios. For logistics, particularly PI, the factors include ability, benevolence, integrity, interests, risk, propensity, situational intention, reliability, and vulnerability. The following survey on trust reveals that the current perceptions in the industry are still preliminary despite various trusted data-sharing solutions being proposed. These efforts allow for distilling the design principles of a trust-enabling PI solution.

To address these challenges and principles, I propose a novel communication-based PI routing (CPIR) protocol that minimises data exposure while maintaining operational efficiency and sustainability. According to the evaluation, nearly 95% of data-sharing is unnecessary, which is potentially higher in reality. A further comparison between decentralised PI routing protocols with reservation systems integrated in realistic settings confirms the feasibility and optimality of such routing protocols. The sensitivity test also highlights the significance of highly automated data sharing in PI and, therefore, a higher level of trust.