

Abstract

Port logistics are crucial for the global supply chains and economic growth. The dynamic nature of the logistics market and increasing global trade demand pose significant challenges in managing and monitoring the infrastructure, operations, and connectivity of port logistics. Port-led development is a strategy that enhances performance by integrating Industry 4.0 technologies like the Internet of Things (IoT) and Blockchain. This thesis investigates the potential success factors influencing IoT and blockchain adoption in port logistics and contrasts different modes of freight transport.

The thesis first analyses the port logistics infrastructure, especially to investigate the performance of the seaport container terminal through efficiency measurement and explore the efficiency under several aspects. Landlord-operated terminals on the western coast, managed by major ports, perform better than the private-operated terminals on the eastern coast, managed by minor ports. However, major ports' managed landlord-operated terminals on the eastern coast are more effective in terms of individual efficiency.

The study identifies 18 potential success factors for adopting IoT and 30 for blockchain for port logistics. It categorizes IoT factors in the Technology–Organization–Environment (TOE) framework and blockchain factors in the Unified Theory of Acceptance and Use of Technology (UTAUT) model. The most important factors for IoT adoption are Technology readiness, Competitive advantage, and Management support, whereas Competitive pressure, Relative advantage, Market turbulence, and Transparency for blockchain adoption. The study developed the hierarchical framework for IoT and blockchain adoption and shows how globalization and sustainability drive the adoption process through optimal utilization of port resources.

The study analyses the contrasts among road, rail, and maritime freight transport concerning IoT and blockchain adoption factors. The findings show individual freight modes' preferences, infrastructure-related factors for road, management support-related factors for rail, and external environmental and ease of operations-related factors for maritime. Further, the study scrutinized maritime transport as the most suitable mode for adopting IoT and blockchain. The study provides suitable implications for the government, policymakers, port management, freight transporters, and technology developers.

Keywords: Port logistics; Freight transport; Industry 4.0; Internet of things; Blockchain; MCDM; DEA; TOE; UTAUT; FANP; TISM; MICMAC; MULTIMOORA; CoCoSo.