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**INTER-TERMINAL TRANSPORT AUTOMATION IN  
SEAPORTS: GLOBAL INSIGHTS, IMPLEMENTATION  
BARRIERS AND SYSTEM INTEGRATION APPROACHES**

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Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree  
Master of Science (Major Component Research)

Department of Transport Management and Logistics Engineering  
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March 2026

## **DECLARATION**

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The above candidate has carried out research for the Masters dissertation under my supervision. I confirm that the declaration made above by the student is true and correct.

Name of the supervisor: Prof. H.N. Perera

Signature of the supervisor:

Date: 13.03.2026

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## ABSTRACT

Container terminal automation has progressed notably in recent decades, especially in quay and yard operations. However, inter-terminal transport (ITT) remains largely manual, despite its vital role in the efficiency of multi-terminal ports where the transshipment incidence is high. This research addresses this gap by examining the current status, adoption dynamics, and operational integration of ITT automation in container ports. The study is structured around three research objectives. First, a global assessment is conducted to identify the level of transshipment activity, the presence of ITT systems, and the degree of automation across the top 100 container ports worldwide. The results confirm that, despite increasing terminal-level automation, ITT automation adoption remains limited and uneven. Second, a system dynamic modelling framework is developed to analyse the factors delaying ITT automation adoption. The model integrates Bass diffusion theory with an economic investment mechanism to capture behavioral, structural, and financial interactions. Sensitivity analysis reveals that behavioral and organisational factors such as resistance to change, limited imitation effects, and low internal automation readiness are the primary constraints on adoption, while economic investment variables play a secondary role. Third, the study develops scenario-based conceptual operational models for ITT automation by aligning feasible operational configurations with different levels of port automation maturity. By consolidating terminal automation levels into three representative scenarios, the study demonstrates that ITT automation requires staged and context-specific operational solutions rather than a single universal approach. The findings contribute a system-level understanding of ITT automation diffusion and provide practical guidance for port authorities and terminal operators seeking to plan effective and realistic ITT automation strategies in multi-terminal port environments. Future research should explore the governance frameworks, technological integration strategies, and coordinated port-wide approaches necessary to enable the transition toward automated ITT systems, which is a crucial step for achieving a sustainable port system.

**Keywords:** inter-terminal transportation, port automation, system dynamics, container terminal, maritime logistics

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## **LIST OF ABBREVIATIONS**

|      |                                  |
|------|----------------------------------|
| ACT  | – Automated Container Terminal   |
| AGV  | – Automated Guided Vehicle       |
| ASC  | – Automated Stacking Crane       |
| AT   | – Automated Trucks               |
| CLD  | – Causal Loop Diagram            |
| IT   | – Information Technology         |
| ITT  | – Inter Terminal Transport       |
| MTS  | – Multi-Trailer Systems          |
| OCR  | – Optical Character Recognition  |
| OM   | – Operational Model              |
| RFID | – Radio Frequency Identification |
| RMG  | – Rail Mounted Gantry cranes     |
| RTG  | – Rubber Tiered Gantry cranes    |
| SD   | – System Dynamics                |
| SFD  | – Stock and Flow Diagram         |
| STS  | – Ship to Shore                  |
| TEU  | – Twenty-foot Equivalent Unit    |
| TOS  | – Terminal Operating System      |