



Exploring Factors Influencing Vietnamese SMEs' Container Round-Use Platform Adoption



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ABSTRACT

Objective - The global expansion of container shipping has intensified challenges related to empty container logistics, significantly impacting supply chain efficiency and costs. In Vietnam, like in other regions, the repositioning of empty containers incurs high expenses and inefficiencies in the supply chain. To optimize container utilization and mitigate these challenges, Container Round-Use Platforms (CRUPs) have emerged as innovative solutions.

Methodology/Technique – This study aims to identify factors influencing the adoption of Container Round-Use Platforms in the Vietnamese supply chain and examine the relationship and degree of influence between these factors and the platform's adoption. Employing the Technology-Organization-Environment (TOE) framework, the research explores contextual factors at the firm level that influence technological innovation adoption. The data was collected through an online survey with the participation of 349 valid respondents during July 2023.

Finding – The survey data are analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM). The findings reveal that factors, including cost, ease of use, usefulness, relative advantage, firm size, top management support, and workforce, significantly influence the adoption of the Container Round-Use Platforms. By exploring these factors comprehensively, this research not only validates established adoption drivers but also unveils novel insights into enhancing CRUPs adoption strategies in Vietnam.

Novelty – This study contributes uniquely to the literature by bridging theoretical gaps and offering practical implications for stakeholders seeking to enhance logistical efficiency and sustainability through advanced technological solutions in container logistics.

Type of Paper: Empirical

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Keywords: Container Round-Use Platforms, PLS-SEM, TOE framework, Vietnam, Vietnamese supply chain.

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1. Introduction

The repositioning of empty containers is a significant challenge in the global container shipping industry, leading to inefficiencies and high logistics costs. Empty container status causes a shortage of containers and increases logistics costs, further causing inefficiencies in the supply chain. On average, companies transport at least 60 million empty containers yearly, making every third container empty (Container-xchange, 2019).

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The transportation of a substantial number of empty containers results in high costs for moving them to locations where they are needed. As the Vietnam Transport Development and Strategy Institute research indicates, around 70% of container trucks only transport goods and travel empty in one direction, causing trucking expenses to be about 30% higher than their actual value (Tran, D., & Nguyen, 2018). The high cost of empty container voyages, amounting to around US\$300 to US\$500 million for a medium-sized shipping line annually and about US\$15 to US\$20 billion for the entire shipping industry, represents approximately 20% of the total expenses for a given shipping company (Shintani et al., 2019). Therefore, increasing the utilization rate of empty containers is one of the critical decisions businesses must make. Addressing this problem through the adoption of CRUPs presents an opportunity to enhance supply chain efficiency, reduce costs, and minimize environmental impact.

This study aims to identify the factors influencing the adoption of CRUPs in Vietnam's logistics industry. By leveraging the TOE framework, this research provides a comprehensive analysis of the technological, organizational, and environmental factors that drive CRUPs adoption. The findings contribute to the existing literature by offering insights into the adoption process of innovative technologies in emerging markets, specifically within the Vietnamese context. The Container Round-Use Platforms represent one such solution in this context. From that, this study proposes the following questions:

RQ1: *What are the critical factors affecting the adoption of the Container Round-Use Platforms in the logistics industry?*

RQ2: *What are the relationships among the critical factors affecting the adoption of the Container Round-Use Platforms in the logistics industry?*

To achieve these objectives, this study employs the TOE Framework model as a theoretical lens for the analysis (Tornatzky et al., 1990). The researcher utilizes the quantitative method in this research, employing questionnaires to collect data from relevant businesses participating in Vietnam's adoption of the Container Round-Use platforms. The Smart PLS software version 4.0 applies the regression analysis-based structural equation model (SEM) technique. This study estimates the sample using G*power to calculate the sample size.

2. Literature Review

2.1 Literature Review on Adoption Container Round- use platform in the logistics industry

The literature on CRUPs and their adoption highlights these platforms' potential benefits in optimizing empty container use and reducing logistical costs. Existing studies emphasize the importance of technological innovation, organizational readiness, and environmental factors in influencing technology adoption (Tornatzky et al., 1990). This section develops the hypotheses based on the TOE framework, linking them to relevant literature and the research questions guiding this study.

A Container Round-Use Platform allows demand-side matching with supply-side related to empty container volume and freight demand through an algorithm to determine geographic distance, availability, scale, and other predefined constraints. Exporters can search for available containers and trucking services at reasonable spot prices. Importers do not need to return unloaded containers to pre-designated warehouses; empty containers are shipped directly from importer to exporter. Trucking companies can win bids to increase trip-fill rates with the least sales effort.

The Boston Consulting Group has created a global exchange marketplace for empty containers called the xChange to aid industry players in collaborating more effectively at scale. This project works with several of the top 20 carriers globally. It has introduced critical new perspectives on the magnitude of container imbalances worldwide and the opportunity for the container shipping sector to employ interchanges to address its repositioning difficulties (Sanders et al., 2015).

In Vietnam, several businesses like Vinatake, Matchbox, and Smartlog have introduced their Container rotation solution platforms to connect the supply and demand of empty containers in import and export. The

platform intelligently matches container supply with demand through advanced algorithms and real-time data, optimizing the allocation and routing based on various factors (SmartLog, 2019). This automation and optimization drive operational efficiency, reduce port congestion, lower transportation costs, and contribute to sustainability efforts by minimizing carbon emissions (SmartLog, 2019). The platform fosters collaboration and resource sharing, creating a culture of cooperation within the container logistics industry

2.2 Theoretical basis and developing research hypotheses and model

The author bases the analysis on the TOE model. The TOE theory is a framework used to explain the adoption and use of technology in organizations. The theory proposes that technology adoption and use are influenced by three key factors: Technology, organizational, and environmental characteristics (Tornatzky et al., 1990). TOE theory has been widely applied in research on technology adoption and uses across various industries, including healthcare, manufacturing, and service sectors (Nguyen et al., 2022). This study proposes the following hypotheses:

Hypothesis 1. (H1): There is a statistically positive relationship between the perceived ease of use and the adoption of the Container Round–Use Platforms in the Vietnam supply chain.

Hypothesis 2. (H2): There is a statistically positive relationship between the perceived usefulness and the adoption of the Container Round–Use Platforms in the Vietnam supply chain.

Hypothesis 3. (H3): There is a statistically positive relationship between the relative advantage and the adoption of the Container Round–Use Platforms in the Vietnam supply chain.

Hypothesis 4. (H4): There is a statistically negative relationship between the cost and the adoption of the Container Round–Use Platforms in the Vietnam supply chain

Hypothesis 5. (H5): There is a statistically negative relationship between the security concern and the adoption of the Container Round–Use Platforms in the Vietnam supply chain.

Hypothesis 6. (H6): There is a statistically positive relationship between the top management support and the adoption of the Container Round–Use Platforms in the Vietnam supply chain.

Hypothesis 7. (H7): There is a statistically positive relationship between the firm size and the adoption of the Container Round–Use Platforms in the Vietnam supply chain.

Hypothesis 8. (H8): There is a statistically positive significant relationship between the workforce and the adoption of the Container Round–Use Platforms in the Vietnam supply chain.

Hypothesis 9. (H9): There is a statistically positive significant relationship between the IT infrastructure and the adoption of the Container Round–Use Platforms in the Vietnam supply chain.

Hypothesis 10. (H10): There is a statistically positive relationship between the policy/regulation and the adoption of the Container Round–Use Platforms in the Vietnam supply chain.

Hypothesis 11. (H11): There is a statistically negative relationship between the stakeholder pressure (trade partner, competitor, government) and the adoption of the Container Round–Use Platforms in the Vietnam supply chain.

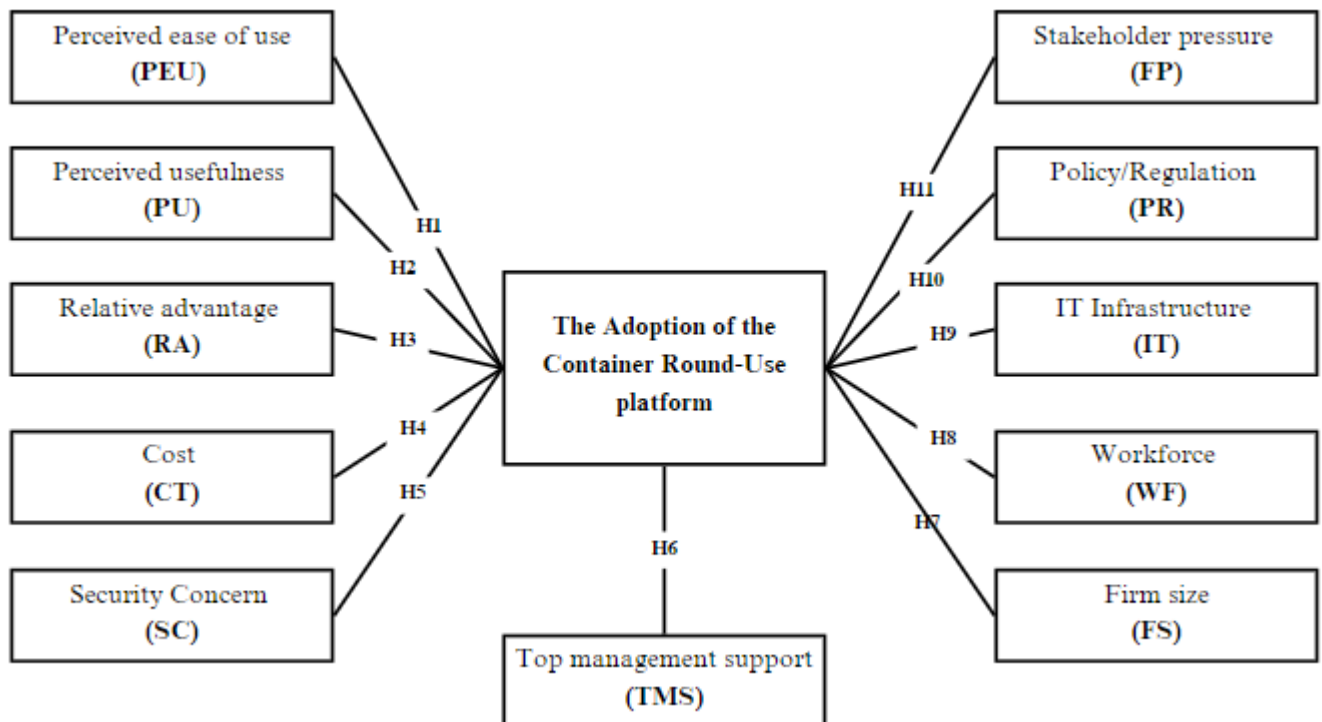


Figure 1: Proposed research model

3. Research Methodology

In this study, the researcher uses the purposive sampling method. The survey will be sent online to the multi-stakeholder company's senior managers, middle managers, and employees. These are the people involved in logistics activities using containers in Vietnam. To ascertain the suitable sample size for the study, the researcher employs G*Power, a widely used standalone power analysis program in social sciences, behavioral sciences, and biomedical sciences (Faul et al., 2009).

The data for this study will be collected through an online survey minimum targeting 128 voluntary respondents. The survey and informed consent form will be distributed to participants via email and social networking. Confidentiality of the data will be maintained, and it will be used solely for this research. The questionnaire, consisting of 53 mostly closed-ended questions, will be generated using Google Forms and sent online to the multi-stakeholder from July 10, 2023, to July 20, 2023. All questions were measured on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The survey was completed by a total of 349 respondents, thereby yielding a substantial dataset for analysis and interpretation.

Stringent security measures will be implemented to ensure the integrity and privacy of the collected data during its transmission and storage. The researcher will utilize Mendeley, a secure data warehouse commonly used by researchers, for data storage. After three years, all data will be deleted by the author.

The collected data was analyzed using PLS-SEM, a widely employed method in exploratory research for theory development. PLS-SEM explains the variance of dependent variables within the model (Hair Jr et al., 2014). By employing the PLS-SEM approach, this research successfully identifies and analyzes crucial factors influencing the intention to use digital technologies, ultimately contributing to developing and validating a theoretical model.

4. Results

4.1 Measurement Model Analysis

In convergent validity, for the first time, outer loadings for all items, except FS1, exceed the cut-off value of 0.7, supporting convergent validity (Hair Jr et al., 2014). We eliminated FS1 and rerun the model the second time. All things were, therefore, appropriate for additional statistical analysis (Hair Jr et al., 2014). The results also report the Average variance extracted (AVE), Composite reliability (CR), and Cronbach's Alpha for all constructs. All indicators exceed the recommended threshold, 0.5 for AVE and 0.7 for reliability statistics (Hair Jr et al., 2017). These results suggest that all construct measures exhibit sufficient internal consistency reliability.

Additionally, discriminant validity was assessed by the Fornell-Lacker criterion. Values positioned above the principal diagonal denote the extent of correlation with themselves (derived from the square root of AVE). In contrast, values situated outside the principal diagonal indicate the degree of correlation between pairs of variables. The analysis findings indicate that the square root of AVE for each latent variable surpasses all correlations between latent variables, affirming that discriminant between variables is guaranteed (Fornell & Larcker, 1981). This evidence substantiates the high reliability of the factors and the data employed in the research process.

4.2 Structural Model Analysis

The R-square adjusted value for the variable ADT is 0.801. It suggests a strong relationship between the independent and dependent variables, highlighting their significant explanatory power in understanding the variation in the outcome variable.

All variables have Variance Inflation Factor (VIF) values smaller than 3, suggesting that there may be no significant multicollinearity issues among the independent variables (Hair et al., 2019).

4.3 Testing hypothesizes result

Table 1. Structural Estimates: Path Coefficients

Hypotheses	Path Coefficient (Beta - β)	Standard Deviation	T-Statistics	p-value	Study Results
CT $\rightarrow$ ADT	0.256	0.040	6.470	0.000	Supported
PEU $\rightarrow$ ADT	0.208	0.027	3.894	0.000	Supported
PU $\rightarrow$ ADT	0.172	0.029	3.884	0.000	Supported
RA $\rightarrow$ ADT	0.169	0.055	3.801	0.000	Supported
TMS $\rightarrow$ ADT	0.156	0.026	3.070	0.000	Supported
WF $\rightarrow$ ADT	0.115	0.037	4.669	0.000	Supported
IT $\rightarrow$ ADT	0.114	0.043	1.330	0.000	Supported
FS $\rightarrow$ ADT	0.083	0.027	0.678	0.002	Supported
SC $\rightarrow$ ADT	-0.018	0.029	3.825	0.498	Not Supported
PR $\rightarrow$ ADT	-0.350	0.031	4.998	0.183	Not Supported
SP $\rightarrow$ ADT	-0.050	0.030	1.763	0.078	Not Supported

Based on the findings presented in Table 1, it can be observed that SC, PR, and SP do not exhibit a significant impact on ADT, as evidenced by their p-values exceeding 0.050 (Hair Jr et al., 2017). As a result, hypotheses H5a, H10a, and H11a are rejected. Conversely, the remaining direct effects demonstrate

statistical significance, implying meaningful relationships. Notably, CT, PEU, and PU emerge as the primary drivers with the strongest influence on ADT, highlighting their substantial impact in shaping the dependent variable.

5. Discussion

The findings indicated that the perceived ease of use, perceived usefulness, and relative advantage emerged as crucial factors positively influencing the adoption of CRUPs in Vietnam. These results are consistent with global research that emphasizes the role that practical advantages, competitive advantages, and user-friendly interfaces have in encouraging the adoption of new technologies (Davis, 1989; Venkatesh et al., 2003). The robust statistical significance of these factors underscores their critical role in shaping organizational decisions to integrate CRUPs into supply chain operations. Besides, cost was identified as another significant determinant affecting CRUPs adoption. Companies are more inclined to adopt platforms that offer cost-effective solutions for managing empty containers, thereby reducing operational expenses associated with repositioning and storage (Tornatzky et al., 1990). Corroborate global trends, hence, where cost efficiency remains a pivotal factor influencing technology adoption across various industries.

Drawing parallels with international practices, countries like Germany and the Netherlands have implemented sophisticated CRUPs systems to optimize container logistics. For instance, platforms similar to xChange have been instrumental in these regions, facilitating efficient container repositioning through collaborative networks and advanced digital tools (BCG, 2015). Comparatively, while Vietnam's adoption of CRUPs is advancing, challenges such as regulatory frameworks and infrastructure development differ significantly, influencing adoption rates and operational outcomes (Unctad, 2022).

In contrast, developing economies in Southeast Asia, including Indonesia and Thailand, are increasingly exploring CRUPs solutions to mitigate logistical inefficiencies and enhance supply chain resilience (Development Bank, 2023). The experiences of these countries underscore the universal benefits of CRUPs in optimizing resource allocation, reducing carbon footprints, and fostering industry collaboration.

The findings suggest several practical implications for industry practitioners and policymakers in Vietnam. Firstly, enhancing the usability and demonstrating clear advantages of CRUPs through pilot projects and case studies can accelerate adoption rates among logistics stakeholders. Secondly, fostering top management support and investing in IT infrastructure are critical for overcoming implementation barriers and ensuring long-term sustainability of CRUPs initiatives (Garcia-Ortega et al., 2021; OECD, 2024). Thirdly, aligning regulatory frameworks with international best practices can create an enabling environment for CRUPs adoption, promoting interoperability and scalability across global supply chains (UNCTAD, 2022).

Despite its contributions, this study has limitations, including its focus on the Vietnamese context and reliance on self-reported survey data. Future research could explore cross-country comparisons to uncover nuanced factors influencing CRUPs adoption across diverse socio-economic landscapes. Additionally, longitudinal studies could track the evolution of CRUPs adoption and its impact on logistics efficiency and sustainability over time.

6. Conclusion

In conclusion, this study advances our understanding of the factors influencing the adoption of CRUPs in Vietnam's logistics industry. By applying the TOE framework and conducting empirical analysis, significant drivers such as perceived ease of use, usefulness, relative advantage, cost considerations, top management support, firm size, workforce competence, and IT infrastructure have been identified. These findings not only validate universal adoption drivers observed in international contexts but also provide specific insights tailored to Vietnam's logistics landscape. The study underscores the importance of user-centric design, cost

efficiency, and organizational readiness in promoting CRUPs adoption. Stakeholders can leverage these insights to enhance operational efficiencies, foster innovation, and navigate regulatory landscapes conducive to sustainable logistics practices. While this research contributes valuable knowledge, future studies could expand cross-national comparisons and longitudinal analyses to capture evolving adoption dynamics and deepen the impact of CRUPs on logistics sustainability globally.

Author Contributions

Conceptualization; Methodology; Funding; Writing – D.-H.N.; Investigation; Resources; Supervision – B.G.

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