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Factors Affecting Logistics Information Technology (LIT) Implementation by Malaysian Logistics Service Providers (LSPs)

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Abstract

This paper aims to identify the Factors Affecting Logistics Information Technology (LIT) Implementation by Malaysian Logistics Service Providers (LSPs). The rapid advancement of digital technologies has transformed the logistics industry, making Logistics Information Technology (LIT) essential for improving operational efficiency, service quality, and competitive advantage. Despite these benefits, the adoption of LIT among Malaysian Logistics Service Providers (LSPs) remains relatively low. Existing studies have primarily examined technology adoption in general organizational settings, with limited empirical evidence on the factors influencing LIT implementation among Malaysian LSPs. To address this gap, this study investigates the determinants affecting LIT implementation using the Technology–Organization–Environment (TOE) framework. Data were collected from Malaysian LSPs and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to examine the relationships between technological, organizational, and environmental factors and LIT implementation. The findings indicate that the TOE framework provides a robust explanation of LIT implementation among Malaysian LSPs, highlighting the critical role of technological, organizational, and environmental determinants in influencing adoption decisions. The study contributes to the existing literature by extending the application of the TOE framework to the Malaysian logistics sector and provides practical insights for logistics managers and policymakers seeking to accelerate digital transformation and enhance industry competitiveness through effective LIT implementation.

Keywords: *Logistics Information Technology (LIT), Logistics Service Providers, Technology–Organization–Environment (TOE), PLS-SEM, Malaysia, technology implementation.*

1. Introduction

The logistics industry is a key pillar of Malaysia's economy and plays a critical role in supporting domestic and international trade. As Malaysia advances towards Industry 4.0, the logistics sector is expected to undergo significant digital transformation. Industry 4.0, the fourth industrial revolution, represents the latest stage in the digitisation and automation of industrial processes through the integration of technologies such as the Internet of Things (IoT), artificial intelligence (AI), big data analytics, cloud computing, and cyber-physical systems. Unlike previous industrial revolutions that focused primarily on manufacturing automation, Industry 4.0 extends across the entire value chain, including procurement, production, logistics, distribution, and customer service, enabling greater operational efficiency, flexibility, and real-time decision-making.

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The implementation of Industry 4.0 has important implications for logistics service providers (LSPs). The adoption of advanced digital technologies requires logistics firms to move beyond traditional logistics practices and develop technology-enabled capabilities that support data integration, process automation, and real-time information sharing. Consequently, the successful implementation of Industry 4.0 is closely linked to the adoption of Logistics Information Technology (LIT), as digital logistics operations rely on integrated information systems to coordinate transportation, inventory management, warehousing, order processing, and supply chain visibility. Without effective LIT, logistics firms may be unable to fully realize the benefits of Industry 4.0, such as improved operational efficiency, enhanced responsiveness, and better customer service.

Countries such as Germany, Japan, and the United States have emerged as leaders in Industry 4.0 through sustained investment in research and development (R&D) and digital innovation. In comparison, Malaysia recorded R&D expenditure of only 1.30% of GDP in 2016, highlighting the need for greater investment in technological capability and innovation. To accelerate Industry 4.0 adoption, Malaysia must strengthen its digital infrastructure, encourage R&D investment, and develop a workforce capable of adopting and managing advanced digital technologies. Accordingly, Malaysian LSPs are encouraged to invest in information and communication technology (ICT) systems that enable them to manage complex logistics activities, including large-scale inventory management, real-time shipment tracking, demand forecasting, and reverse logistics.

The Malaysian logistics industry has experienced substantial growth over the past decade, driven by increasing trade activities, improved infrastructure, and greater connectivity. Information technology has long been recognized as a strategic resource for enhancing logistics performance and competitiveness. The integration of ICT into logistics operations improves productivity and service quality by facilitating timely and accurate information exchange while reducing operational costs.

Within the context of Industry 4.0, Logistics Information Technology (LIT) has become more than an operational support tool; it is a strategic capability that enables digital transformation. LIT refers to the software and hardware systems that facilitate logistics activities, including order processing, inventory management, warehouse management, and transportation management.. By integrating these technologies, LSPs can improve supply chain visibility, enhance operational coordination, support data-driven decision-making, and achieve sustainable competitive advantage. Therefore, understanding the factors influencing LIT adoption is essential for explaining how Malaysian logistics firms can successfully implement Industry 4.0 initiatives and improve their organisational performance.

2. Literature Review

While many companies have implemented Information Systems (IS) to improve business processes and organisational performance (Rajagopal, 2002), researchers have expressed differing views regarding the effectiveness of these systems. O'Brien (2004) argued that the success of IS largely depends on how effectively information technology (IT) supports an organisation's strategic objectives. However, implementing IT systems often involves substantial financial investment, including hardware, software, maintenance, and user licensing costs, which may limit their effectiveness, particularly for organisations with limited resources.

In the logistics industry, IT has become essential for supporting supply chain integration, order processing, transportation management, and warehouse management. Prior research indicates that information technology (IT) improves collaboration among supply chain partners and automates routine logistics operations, thereby enabling logistics professionals to concentrate on strategic decision-making (Benjamin & Wigand, 1995; Handfield & Nichols, 1999). Similarly, Prahalad and Krishnan (1999) argued that effective logistics services rely heavily on adequate IT support.

Despite these positive findings, the existing literature does not consistently demonstrate that IT implementation automatically improves logistics performance. Some organisations continue to face challenges such as high implementation costs, integration difficulties, employee resistance, and underutilisation of information systems, which can reduce the expected benefits of IT investments. Moreover, many earlier studies focused on the general advantages of logistics information technology rather than examining the conditions under which IT contributes to organizational performance.

Therefore, a gap remains in understanding how information systems influence logistics performance in different organisational contexts, particularly in environments where financial, operational, or technological constraints may affect implementation success. Addressing this gap will provide a better understanding of the factors that determine whether IT investments lead to sustainable competitive advantage in the logistics industry.

2.1 LIT Implementation

Although investment in Logistics Information Technology (LIT) provides long-term strategic benefits, its implementation remains a major challenge for many Logistics Service Providers (LSPs). Recent studies indicate that digital logistics technologies enhance operational visibility, improve inventory and transportation management, facilitate integration across supply chain partners, and strengthen organisational competitiveness. However, successful implementation requires organisations to overcome technological, organisational, and environmental challenges to ensure that these technologies are effectively adopted and continuously used over time.

Despite these potential benefits, empirical studies indicate that many LSPs face significant barriers when implementing LIT. In the Malaysian context, financial constraints remain one of the most frequently cited obstacles, particularly among small and medium-sized LSPs, where the high costs of acquiring, integrating, and maintaining advanced logistics systems discourage technology adoption. In addition, many firms experience shortages of skilled employees capable of managing digital logistics systems, while resistance to organisational change further slows successful implementation. Malaysian researchers have also reported that limited top management commitment, inadequate technological infrastructure, and insufficient alignment between business strategy and technology investment reduce the effectiveness of LIT adoption.

Beyond Malaysia, similar implementation challenges have been reported in international studies. Logistics firms often struggle with the complexity of integrating new technologies into existing logistics networks, limited organisational resources, cybersecurity and data protection concerns, and the need to coordinate multiple stakeholders across the supply chain. These barriers frequently delay digital transformation and reduce the expected performance benefits of LIT unless they are supported by strong leadership, employee training, and effective change management strategies.

Overall, the literature suggests that while LIT has considerable potential to improve logistics performance, successful implementation depends not only on technological capability but also on organisational readiness, management support, financial resources, and employee acceptance. Addressing these barriers is therefore essential for Malaysian LSPs seeking to achieve sustainable competitive advantage through digital transformation.

2.2 TOE Framework

TOE Framework According to Khasawneh (2008), technology implementation refers to the initial use or acceptance of a new technology or product within an organisation. To explain the factors influencing the implementation of Logistics Information Technology (LIT), this study adopts the Technology–Organization–

Environment (TOE) framework developed by Tornatzky and Fleischer (1990). The TOE framework is one of the most widely used models for examining organisational adoption of information systems and information technology because it considers not only technological factors but also organisational capabilities and external environmental influences. Compared with individual-level adoption models such as the Technology Acceptance Model (TAM), the TOE framework is more appropriate for this study because LIT implementation is an organisational decision involving technological readiness, organisational resources, and external pressures. Furthermore, the framework has been extensively applied in Malaysian information technology adoption studies (Salwani et al., 2009; Abdul Hafaz et al., 2017), making it suitable for examining LIT implementation among Malaysian logistics service providers (LSPs).

Technological Context

The technological context comprises both the internal and external technologies relevant to an organisation and includes factors that influence the adoption of technological innovations (Huang et al., 2008; Claycomb et al., 2005; Abdul Hafaz et al., 2017). Within the Malaysian logistics industry, technological context refers to the availability, compatibility, complexity, and relative advantage of LIT applications such as warehouse management systems (WMS), transportation management systems (TMS), radio-frequency identification (RFID), Global Positioning System (GPS), cloud computing, and Internet of Things (IoT) technologies. Logistics service providers are more likely to implement LIT when these technologies are perceived to improve operational efficiency, inventory visibility, delivery accuracy, and customer service.

Organizational Context

The organisational context refers to the characteristics and resources of an organisation, including firm size, organisational structure, top management support, financial capability, employee competency, and managerial beliefs (Salwani et al., 2009; Abdul Hafaz et al., 2017). In the Malaysian logistics sector, successful LIT implementation depends largely on organisational readiness. Larger logistics firms generally possess greater financial and technological resources to invest in advanced information systems, whereas small and medium-sized logistics service providers may encounter resource constraints. In addition, strong commitment from top management, adequate employee training, and organisational willingness to embrace digital transformation are critical factors that facilitate successful LIT implementation.

Environmental Context

The environmental context focuses on the external environment in which an organisation operates, including competitive pressure, customer demand, government policies, industry regulations, and relationships with business partners (Salwani et al., 2009; Abdul Hafaz et al., 2017). For Malaysian logistics service providers, environmental factors such as increasing customer expectations for real-time tracking, growing competition within the logistics industry, digitalisation initiatives under the Malaysian government, and regulatory requirements encourage firms to adopt LIT. Furthermore, collaboration with suppliers, customers, and logistics partners often requires integrated information systems, creating additional pressure for organisations to implement logistics information technologies.

In summary, the TOE framework provides a comprehensive perspective for examining LIT implementation because it captures the technological, organisational, and environmental factors that collectively influence adoption decisions. Therefore, it serves as an appropriate theoretical foundation for investigating the determinants of LIT implementation among Malaysian logistics service providers.

3. Methodology

This study adopted a quantitative research design to examine the factors influencing Logistics Information Technology (LIT) implementation among Logistics Service Providers (LSPs) based on the Technology–Organization–Environment (TOE) framework. The research began with a comprehensive literature review to identify the theoretical models most frequently employed in organizational technology adoption studies. Articles were retrieved from major academic databases, including Emerald Insight, EBSCOhost, ScienceDirect, Scopus, and Web of Science, using combinations of keywords such as *technology adoption*, *technology implementation*, *Technology–Organization–Environment (TOE)*, *logistics information technology (LIT)*, *electronic data interchange (EDI)*, *RFID*, *cloud computing*, and *logistics service providers*. The selected studies were screened for relevance based on their focus on organizational technology adoption and logistics information systems, enabling the identification of constructs applicable to LIT implementation.

The findings from the literature review were used to develop the conceptual framework and research hypotheses. The research process consisted of the following stages: (1) identifying current issues in LIT implementation among LSPs; (2) selecting relevant search keywords; (3) searching published literature in academic databases; (4) screening and selecting relevant studies; (5) identifying organizational-level technology adoption models; (6) developing the research model and hypotheses; and (7) conducting empirical validation and discussing the findings.

Primary data were collected using a structured questionnaire administered to managers and executives involved in information technology, logistics operations, or supply chain management within Malaysian logistics service providers. A purposive sampling technique was adopted because respondents were required to possess sufficient knowledge and experience regarding their organisations' LIT implementation practices. The questionnaire comprised two sections: respondent and organisational profiles, and measurement items for the study constructs. All measurement items were adapted from validated instruments reported in prior technology adoption studies and measured using a five-point Likert scale ranging from 1 ("strongly disagree") to 5 ("strongly agree").

Partial Least Squares Structural Equation Modelling (PLS-SEM) was employed to analyse the data using SmartPLS software. PLS-SEM was selected because it is well suited for predictive research, complex research models with multiple latent constructs, relatively small to medium sample sizes, and situations where data may not satisfy multivariate normality assumptions. Furthermore, PLS-SEM enables the simultaneous assessment of both the measurement model and the structural model, making it appropriate for testing the proposed TOE framework.

The analysis followed the two-step approach recommended in the PLS-SEM literature. First, the measurement model was evaluated by assessing indicator reliability, internal consistency reliability using Cronbach's alpha and Composite Reliability (CR), convergent validity using Average Variance Extracted (AVE), and discriminant validity using the Fornell–Larcker criterion and the Heterotrait–Monotrait (HTMT) ratio. Second, the structural model was assessed by examining collinearity, path coefficients, coefficient of determination (R^2), effect sizes (f^2), predictive relevance (Q^2), and hypothesis testing through bootstrapping with 5,000 resamples to determine the significance of the proposed relationships.

The overall research methodology is summarised as follows:

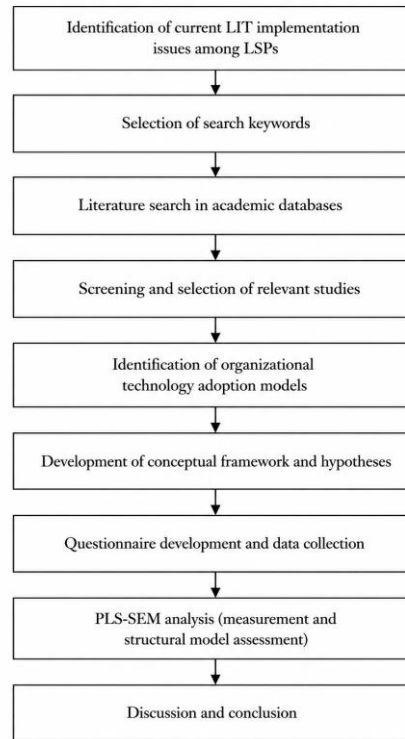


Fig. 1. Research Process and Analytical Framework

4. Significance of The Study

The implementation of Logistics Information Technology (LIT) has become increasingly important as the logistics industry faces rapid technological advancement, growing customer expectations, and a highly competitive business environment. Modern logistics operations require efficient information sharing, real-time visibility, and seamless coordination across supply chains to improve service quality and organisational performance. Despite the recognised benefits of LIT, many logistics service providers (LSPs), particularly in developing countries such as Malaysia, continue to experience challenges in adopting and implementing these technologies effectively.

This study is significant because it contributes to the existing body of knowledge by examining the organisational factors that influence LIT implementation among Malaysian logistics service providers using the Technology–Organisation–Environment (TOE) framework. While previous studies have extensively investigated technology adoption in general, limited empirical research has focused specifically on LIT implementation within the Malaysian logistics sector. By addressing this gap, the study provides updated empirical evidence on the key determinants that influence successful LIT implementation.

From a practical perspective, the findings will assist logistics service providers in identifying the critical organisational factors that facilitate successful LIT implementation, enabling them to make more informed investment and strategic decisions. Improved implementation of LIT can enhance operational efficiency, information integration, customer service, and overall organisational competitiveness.

The findings are also valuable for policymakers and government agencies responsible for promoting digital transformation within the logistics industry. The study provides evidence that can support the development of policies, incentives, training programmes, and digitalisation initiatives aimed at encouraging wider adoption of logistics information technologies among Malaysian logistics firms. Ultimately, this research contributes to strengthening the competitiveness and sustainability of Malaysia's logistics industry in an increasingly digital economy.

5. Conclusion

This study developed and proposed a conceptual model to explain the process of Logistics Information Technology (LIT) implementation in organisations by integrating technological, organisational, and environmental factors. The proposed model enhances the understanding of how these three dimensions collectively influence the successful implementation of LIT within organisations, particularly among logistics service providers. By identifying the key determinants of LIT implementation, the study contributes to addressing the gap in existing literature, which has often examined these factors in isolation rather than within a comprehensive framework.

The findings suggest that successful LIT implementation is influenced by a combination of technological readiness, organisational capabilities, and external environmental conditions. The proposed model therefore provides a structured framework for understanding the complex interactions among these determinants and offers a foundation for future empirical validation.

The study also has important practical implications. Managers and decision-makers can use the proposed model to evaluate their organisations' readiness for LIT implementation, identify potential barriers, and develop strategies to improve the likelihood of successful adoption and implementation. By understanding the critical technological, organisational, and environmental factors, organisations can make more informed decisions regarding investments in logistics information technologies and implementation planning.

From a research perspective, the proposed model provides a useful basis for future studies on LIT implementation. Researchers can empirically test and validate the model across different organisational settings, industries, and countries, as well as investigate the relative influence of individual determinants. Such studies will contribute to refining the model and expanding knowledge on the factors that drive successful LIT implementation in different contexts.

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7. References

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