Article

Key determinants of digital transformation stages in Vietnam logistics industry

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Abstract: This research investigates the determinants of digital transformation among Vietnamese logistics service providers (LSPs). Employing the Technological-Organizational-Environmental framework and Resource Fit theory, the study identifies key factors influencing this process across different three stages: digitization, digitalization, digital transformation. Data from in-depth interviews with industry experts and a survey of 390 LSPs were analyzed using covariance-based structural equation modeling (CB-SEM). The findings reveal that the factors influencing the digital transformation of Vietnamese LSPs evolve across different stages. In the initial phase, information technology infrastructure, financial resources, employee capabilities, external pressures, and support services are key determinants. As digitalization progresses, leadership emerges as a crucial factor alongside the existing ones. In the final stage, the impact of these factors persists, with leadership and employee capabilities becoming increasingly important.

Keywords: digital transformation; logistics service providers; technological-organizational-environmental; resource fit; CB-SEM

1. Introduction

The logistics landscape is undergoing a significant revolution in the digital transformation era, leveraging cutting-edge technologies and data-driven solutions to optimize global supply chain processes. A digital divide has emerged, distinguishing digital giants from traditional logistics industry participants. While some companies have successfully implemented fully automated warehouses, Automated Guided Vehicles (AGVs), and robotics, others need help achieving supply chain visibility and effectively analyzing collected data (Kern, 2021). Digital transformation, extending beyond mere technology implementation, requires a holistic organizational transformation involving people, business models, and enterprise procedures (Osmundsen et al., 2018). Most industry players currently exhibit a low to medium level of digitalization maturity. Despite recognizing the importance of digital transformation in the logistics service sector, current technology applications are falling short of expected effectiveness. It is a common challenge faced by logistics service firms, including those in Vietnam.

In Vietnam, digital transformation in Logistics Service Providers (LSPs) is a focal point for the government and companies. The Vietnam National Digital Transformation Program, aiming for completion by 2025 with a vision reaching 2030, explicitly designates the logistics sector as a leading industry at the forefront of digital evolution. LSPs play a crucial role, with 50%–70% of their operations involving

outsourcing (Cichosz et al., 2020). Nevertheless, logistics costs in Vietnam constitute a significant 16.8% of the GDP, notably surpassing the global average of approximately 10.6% (Vietnam Logistics Association, 2018). Thus, digital transformation becomes an urgent necessity for LSPs to streamline costs, preserve competitiveness, and foster growth. Despite this urgency, practical efforts toward digital transformation within LSPs in Vietnam progress slowly due to resource-related, technological, and human resource challenges (Nguyen, 2020). These efforts often manifest as isolated initiatives lacking cohesive integration. The COVID-19 pandemic further accelerated the recognition of digital transformation's paramount significance for LSPs, yet challenges and opportunities stemming from the current environment have led to a more passive transformation process.

Existing research on digital transformation offers valuable insights but exhibits notable gaps that demand further exploration. A crucial deficiency lies in the limited depth of studies examining specific factors influencing each stage of the digital transformation process in businesses. The current research often lacks nuanced evaluations of how elements like technology, organizational dynamics, and external environments impact distinct phases of this long-term transformation (Bin et al., 2021; Jović et al., 2022; Tarutė et al., 2018). Additionally, in the Vietnamese context, the literature reveals a fragmented understanding of the factors influencing digital transformation. Nguyen and Le (2022), Le and Dang (2023) identify factors influencing digital transformation, yet these factors are scattered and lack comprehensive assessment. In the logistics service industry in Vietnam, there is a significant gap in research topics and a lack of consensus on viewpoints, providing an opportunity for in-depth exploration into challenges and opportunities faced by businesses in the early digital transformation stages.

The main research questions of this paper are:
- What are the main factors affecting the digital transformation of Vietnamese Logistics Service Providers?
- How do these factors impact each stage of the digital transformation of Vietnam Logistics Service Providers?

The purpose of this paper is to:
- Utilize the Technology–Organization–Environment (TOE) framework and Resource Fit theory to formulate a model to present factors that would impact the digital transformation of Vietnamese Logistics Service Providers.
- Conduct a qualitative method through in-depth interviews to confirm the relevance of affecting factors.
- Implement a quantitative analysis of data collected to evaluate the impact of those factors on each stage of the digital transformation of Vietnamese Logistics Service Providers.

The results of the study are intended to provide valuable insights into the digital transformation of Vietnamese LSPs and its underlying factors. In theory, the study utilizes theoretical frameworks such as the Technology-Organization-Environment (TOE) framework and the Resource Fit theory. The ultimate goal is to develop a model that can effectively illustrate the factors impacting the digital transformation of LSPs in Vietnam. It would help close gaps in the literature review, assessing the practicality

of factors in the TOE framework based on resource fit theory. Qualitative methods through in-depth interviews and quantitative methods of data collected by 390 Vietnamese LSPs were conducted to validate the proposed model and provide concrete evidence and a deeper understanding of how these factors operate in the context of digital transformation within Vietnam's logistics service industry.

The paper unfolds with a comprehensive literature review in Section 2, exploring relevant concepts and theories underpinning the digital transformation of LSPs in Vietnam. Section 3 presents the research framework and hypotheses derived from the literature. Section 4 details research methods, including data collection and analysis approaches. The paper then presents the primary findings in Section 5, focusing on how identified factors impact the digital transformation of LSPs in Vietnam. The final section concludes by summarizing key takeaways, acknowledging limitations, and proposing opportunities for future research and improvements.

2. Literature review

This paper investigates the multifaceted phenomenon of digital transformation within the logistics service industry. To achieve this, the study delves into two primary areas: the intricacies of digital transformation and the theoretical underpinnings informing this research. Specifically, the paper will elucidate the concept of digital transformation, outlining its various stages and conduct a comprehensive review of empirical studies examining factors influencing digital transformation among global and Vietnamese logistics service providers. Subsequently, the research will ground itself in established theories to construct a research model aimed at exploring the determinants of digital transformation within the Vietnamese logistics context.

2.1. Digital transformation of logistics service providers

2.1.1. Digital transformation process

In the realm of organization studies, the concept of digital transformation has garnered substantial attention due to its pivotal role in shaping the contemporary business landscape. Digital transformation refers to changes and shifts built and propelled on the foundation of digital technology (Nwankpa and Roumani, 2016; Westeman et al., 2011). Vial (2019) highlighted that this process aims to improve an entity by triggering an essential transformation of its resources through combinations of information, computing, communication, and connectivity technologies. This is an evolution driven by the imperative of remaining competitive in an increasingly digital world and the pursuit of enhanced operational efficiency, heightened customer experiences, and innovative business models (Morakanyane et al., 2017).

In the context of rapid technological advancements today, organizations are navigating a complex journey toward successful digital transformation. This journey is often divided into three interconnected stages: Digitization, Digitalization, and Digital Transformation (**Figure 1**). Herbert (2017) asserts that misconceptions about these stages are a significant reason for the failure of digital transformation initiatives. A clear understanding of the concepts associated with each stage is crucial for businesses to develop strategies, processes, and adaptations to new business models (Bookshecker et al., 2018; Savic, 2019).

Figure 1. Process of digital transformation.

Digitization involves the conversion of data and information from analog to digital form. Internal process digitization focuses on integrating and utilizing digital data and processes within an organization's activities (Khan et al., 2015).

Digitalization comprises two dimensions, which are technical and social (Yoo et al., 2010). According to Savic (2019), digitization consists of three levels: Level 1—individual activities or processes are automated; Stage 2—related processes are automated and interconnected; Stage 3—process support systems and information flows are integrated.

Digital transformation represents a comprehensive change in all aspects of an organization, including information technology systems, business models, business processes, and customer experiences (Osmundsen et al., 2018).

2.1.2. Digital transformation of logistics service providers

The digital transformation of Logistics Service Providers refers to the process of integrating digital technologies and strategies into the core operations and functions of a company that offers logistics services. Logistics enterprises transform by investing in infrastructure, adopting new technologies and social networks, integrating software for support, and utilizing electronic channels for data storage and information exchange involving data, technology, and processing activities (Le and Dang, 2023). This transformation aims to enhance efficiency, improve customer experiences, and remain competitive in a rapidly changing industry.

Table 1 provides a concise summary of research on the impact of digital transformation on logistics companies. The logistics sector faces unique challenges due to its traditional roots, complex supply chain operations, manual processes, and limited technology integration. Previous studies by Cichosz et al. (2020) and Singhdong et al. (2021) focused on factors influencing digital transformation, but their scope was limited to specific regions and industries. Lutfi et al. (2022) examined the adoption of a single technology within organizations. However, they lack assessments of the impact of digital transformation processes on organization. Ta and Lin (2023) used TOE as a framework to evaluate the factors influencing digital transformation adoption among SMEs in an emerging economy, indicating environmental factors are most influenced factors and customer experience as the sub-dimension are the most critical dimension. Taurute's (2018) study introduces the concept of resource fit, emphasizing the role of strategic resource allocation in successful digital transformation. Building on this foundation, Duong's (2024) research expands the scope by examining the digital maturity of Hanoi-based SMEs and the broader organizational factors influencing their digital transformation journeys.

Table 1. Summarize studies on factors affecting the digital transformation of logistics service providers.

Author	Purpose of studies	Methods and data	Main findings	Limitation
Morakanyance et al. (2017)	Determine digital triggers, digital culture, digital vision, digital drivers, digital organization, transformed areas, and impacts.	• Systematic literature review method • From 89 articles, 16 articles were chosen to describe 10 digital transformation successful stories.	• Digital transformation is an evolutionary process, leveraging digital capabilities and technologies. • Three key transformation areas: business model, processes, and customer experiences.	Lack of documentation on the impact of digital transformation on various aspects.
Tarutė et al. (2018)	The factors affecting the digital transformation process of SME enterprises.	• Systematic literature review method • 75 articles were selected for the qualitative analysis.	• Internal factors: Capability fit, resource fit, and changes in the business model. • External factors: External Capability and resource fit, government regulations, and industry-specific influencing factors.	Using a single term "digital transformation" can lead to overlooking others important research.
Cichosz et al. (2020)	Barriers, organizational elements, and leading practices for digital transformation success at LSPs.	Qualitative method through nine global logistics service providers	• Eight factors: Leadership capability, Organizational culture supporting digital transformation, Employee commitment, Alignment of business and IT strategy, Standardized and integrated data processes, Employee training and skill development, Lean change management, and Lever aging internal and external knowledge • Five barriers: the complexity of logistics systems and subsequent processes, resource shortages including skills, application of information technology, resistance to change, and information security.	Not assessed the drivers and barriers for small and medium-sized LSPs (Logistics Service Providers)
Singhdong et al. (2021)	The factors influencing the digital transformation process of logistics service providers in Thailand, with a focus on sustainable logistics service development.	• Quantitative analysis using the Structural Equation Model (SEM) • 545 samples collected from Logistics service providers in Thailand in 2020	• The objectives and drivers of digital transformation (Osmundsen et al., 2018) positively impact on the factors contributing to a successful digital transformation. These factors also positively influence the sustainability of the Thailand logistics industry.	Not assessed a specific digital platform or examined the relationship between digital transformation factors and their impact on the sustainable development of logistics businesses in Thailand.
Lutfi et al. (2022)	Explored how technological, organizational, and environmental factors affect big data adoption in Jordanian SMEs.	• Both qualitative and quantitive methods • Collected data from 116 questionnaire surveys. Employed the PLS-SEM approach to test hypotheses, verify variable validity and reliability, and analyze the structural model thereafter.	• Technology factors: relative advantage has significant effects; complexity of big data and security had negative effects • Organization factors: Top management support and organization readiness had significant effect • Environmental factors: Government regulations had significant effects, however, competitive pressure was not.	• Limited to SMEs, which have unique resources and flexibility. • Study's focus on Jordan during Covid-19 may limit generalizability. • Limits causality establishment in variable relationships.

Table 1. (*Continued*).

Author	Purpose of studies	Methods and data	Main findings	Limitation
Jović et al. (2022)	Present models of factors influencing the digital transformation in the maritime transport sector	• Qualitative and quantitative methods • Collected data from in-depth interviews with 6 experts and a survey of 262 Croatian stakeholders	• The research highlights that organizational, technological, and environmental factors impact the digitization of organizations in maritime transport. • Digitalization can bring changes to the business model (generating additional revenue, offering new services, and introducing fresh sales channels)	The research sample is focused on one country, so these factors may vary in the maritime transport sector in other countries worldwide.
Ta and Lin (2023)	Exploring the Factors Influencing Digital Transformation Adoption Among SMEs in an Emerging Economy	• Data for this study were collected through questionnaires administered to 72 respondents, who were leaders of SMEs in Vietnam. • The Fuzzy Analytic Hierarchy Process (FAHP) methodology was employed to identify and rank the key determinants influencing digital transformation adoption among these SMEs.	• Proposed a hierarchical model grounded in the TOE framework, comprising three primary dimensions and nine sub-dimensions influencing digital transformation in emerging economies. • Environmental factors are paramount in this hierarchical structure, with customer experience emerging as the most critical sub-dimension for SMEs' digital transformation adoption, followed by technological compatibility, government support, organizational support, and human resources.	• Limited sample of SMEs across all industries in Vietnam. • Future research should expand upon the Fuzzy AHP methodology by incorporating additional ranking techniques to enhance analytical accuracy.
Le and Dang (2023)	Analyzed the factors and the current situation in logistics companies in Vietnam.	• Qualitative and quantitative methods • Collected data from interviews with 20 experts and a survey of 258 Vietnamese logistics companies in Vietnam.	Five factors: Leadership, Human Resources, Information Technology, Cost, and Support Services, impact the digital transformation of logistics companies in Vietnam. The most significant barriers are leadership awareness and implementation costs.	Not assessed the comprehensive impact of the external business environment.
Duong (2024)	Research on Digital Maturity of Hanoi-Based SMEs and its policy implications	• Both qualitative and quantitative methods. • Data was collected through in-depth interviews with 12 experts from 3 small and medium-sized enterprises and distributed questionnaires to 250 enterprises, obtaining 221 valid samples.	• Business model, human resources, infrastructure, technology, environmental factors, and industry dynamics positively influence enterprise-wide digital transformation. • Business strategy exhibits no significant impact on the level of digital transformation.	• Limited to the level of digital transformation and the factors affecting it in SME enterprises. • Not extend to cover other aspects of the business such as finance, human resource management
Nhan (2024)	Explore factors Influencing Digital Transformation in Ho Chi Minh City's Logistics Sector	• Quantitative method. • Data was collected by random sampling with 350 employees working at logistics enterprises in Ho Chi Minh City	• Digital transformation strategy, technology infrastructure, information security, human resources, government support, and customer preferences collectively contribute to the successful digital transformation of logistics enterprises in Ho Chi Minh City. • Customer preferences exert the most significant influence, underscoring the imperative for businesses to leverage digital solutions to effectively address evolving customer needs and foster a flexible, efficient operating environment.	Limited by small sample size and the reliance on pre-existing measurement scales that were not specifically designed for this research context.

Jović et al. (2022) investigated the digital transformation of maritime transport companies, highlighting the pivotal role of process digitization in shaping new business models. The study emphasized the significance of organizational factors, particularly digital awareness, which is essential for driving investments in technology and talent. Furthermore, the research underscored the importance of robust IT infrastructure and alignment with environmental regulations, specifically those promoting green technologies and corporate social responsibility, as key determinants of successful digital transformation in the maritime sector. Le and Dang (2023) researched on digital transformation in Vietnam's logistics sector has primarily focused on internal factors, identifying leadership, human resources, information technology, costs, and support services as key determinants, with management awareness and implementation costs emerging as significant barriers. While Nhan's (2024) research expanded the scope to include external factors such as government support, customer preferences, and technology infrastructure, a comprehensive understanding of the interplay between internal and external elements remains essential for successful digital transformation in this industry.

Existing studies often address factors affecting general digital transformation in LSPs. Still, a comprehensive exploration of internal and external factors influencing various stages of the transformation process is lacking. This research aims to fill these gaps, providing empirical evidence on the digital transformation of LSPs in Vietnam and formulating a model that captures the factors impacting the digital transformation stages of Vietnam Logistics Service Providers.

2.2. Theoretical framework

2.2.1. Technology-Organization-Environment (TOE) framework

To comprehend the factors influencing a business's digital transformation, it's crucial to clarify those affecting the adoption of new technology within the organization. The adoption process involves individuals or organizations voluntarily deciding to accepting and using technology to address specific problems (Khasawneh, 2008). Theoretical foundations for researching technological innovation's impact on organizations include Information Systems Theory, Diffusion of Innovation Theory, Theory of Planned Behaviors, Technology Acceptance Model, and the Technology-Organization-Environment (TOE) Framework (Tonartzky and Fleischer, 1990). These frameworks have shaped numerous studies in the Information Systems field. While the Information System Theory and Technology Acceptance Model focus on technology, overlooking social and organizational factors, the TOE model proposes a comprehensive approach. Innovation Diffusion Theory and Theory of Planned Behaviors address TAM's shortcomings but lack extensive usage in contemporary IS research like the TOE framework, which evaluates environmental factors (Awa et al., 2016).

The TOE framework, introduced by Tornartzky and Fleischer (1990), highlights three main factors—technology, organization, and the organizational environment—shaping the decision-making process regarding new technology adoption in organizations. Technology encompasses existing and potential technologies, considering factors like security and interoperability. The organization factor

addresses resources, structure, communication, scale, and resource utilization. The environmental factor covers external influences, such as industry characteristics, market structure, technological infrastructure, and government regulations (Baker, 2011). This framework thoroughly assesses how technology, organization, and the environment interact.

However, the digital transformation process entails a holistic organizational change based on technology usage, surpassing the discrete use of specific technologies. Therefore, considerations of factors influencing digital transformation within a business are crucial. Simply constructing a TOE model alone does not guarantee comprehensive coverage of the complexities of digital transformation stages.

2.2.2. Resource fit theory

The concept of resource fit originates from the Resource-Based View (RBV) theory (Barney, 1991) and the Strategic fit theory (Smith and Reece, 1998; Xu et al., 2006). RBV emphasized that distinct resources create competitive advantages and operational efficiency for businesses. Grant (1991) further differentiates the concepts of resources and capabilities within the RBV framework. Resources are defined as the tangible and intangible factors that an organization owns or controls, while capabilities refer to the ability of a company to deploy existing resources to achieve future goals. The concept of "fit" presents an alternative perspective (Smith and Reece, 1998). "Fit" is considered a core issue in organizational strategic management research, encompassing internal and external domains (Xu et al., 2006). Resource fit theory underscores the importance of achieving coherence between an organization's internal resources, capabilities, and external environmental conditions (Grant, 2008). This coherence results in a strategic alignment that maximizes the organization's ability to respond to market changes, exploit opportunities, and mitigate threats. It seems that a comprehensive perspective on Resource fit in the context of digital transformation should encompass the principles of resource-based theory, including resources and capabilities, as well as strategic fit, incorporating both external and internal factors, to enhance our comprehension of the phenomenon (Liu et al., 2011).

Resources, both internal and external, are crucial for organizational success (Barney, 1991). Internally, tangible and intangible assets like financial capital, human capital, technology, and brand equity contribute to a company's competitive advantage (Bharadwaj, 2000). These resources need strategic deployment to support the chosen competitive strategy. External resources involving customers and suppliers (Liu et al., 2011) are also integral to the company's developmental history and future roadmap (Teece et al., 1997).

Capabilities, essential for both internal and external aspects, are a company's learning and value-added resource accumulation, effectively synchronized for competitive advantages (Amit and Schoemaker, 1993). Internal capabilities include integrating resources, utilizing digital technology, and adapting to environmental changes (Christopher, 2000). Externally, capabilities involve mobilizing and deploying external resources, monitoring market trends, and analyzing factors like competitive forces and customer preferences—critical elements for successful digital business transformation (Terwiesch and Loch, 2004).

Exploring digital transformation within organizations through the lens of resource fit is a worthwhile endeavor. However, to date, there has been limited research on the concept of resource fit, and analytical frameworks for investigating firms' digital transformations are also lacking (Liu et al., 2011).

3. Research framework and hypothesis

Based on the literature review and the theoretical information background provided by the previous studies, there are two points of view related to the digital transformation of an LSP:

- A firm can gain a competitive advantage by strategically aligning its resources and capabilities with digital transformation (Barney, 1991; Bharadwaj, 2000; Liu et al., 2011).
- The TOE framework provides a holistic lens through which logistics companies can assess the interplay of technology, organizational capabilities, and external environmental factors in the context of digital transformation (Baker, 2011; Bin et al., 2021; Dyk and Belle, 2019; Jović et al., 2022).

Digital transformation is a long-term endeavor for businesses aiming to achieve sustainable growth. This initiative is carried out in parallel with the organization's regular activities. In reality, enterprises can only allocate some of their resources or have abundant resources solely dedicated to digital transformation efforts (Cichosz et al., 2020). The digital transformation journey for each business is unique, and there is no one size-fits-all approach for every business context. Especially in the context of logistics service market in Vietnam, where nearly 90% of businesses are small to medium-sized enterprises, resources allocated to digital transformation activities are quite limited (Vietnam Ministry of Industry and Trade, 2022). Therefore, factors influencing the business's digital transformation process will be explicitly considered specifically from the perspective of both internal and external resources and capabilities of logistics service businesses. In **Figure 2**, the proposed model outlines the factors impacting a business's digital transformation process from the standpoint of the business's appropriate resource allocation.
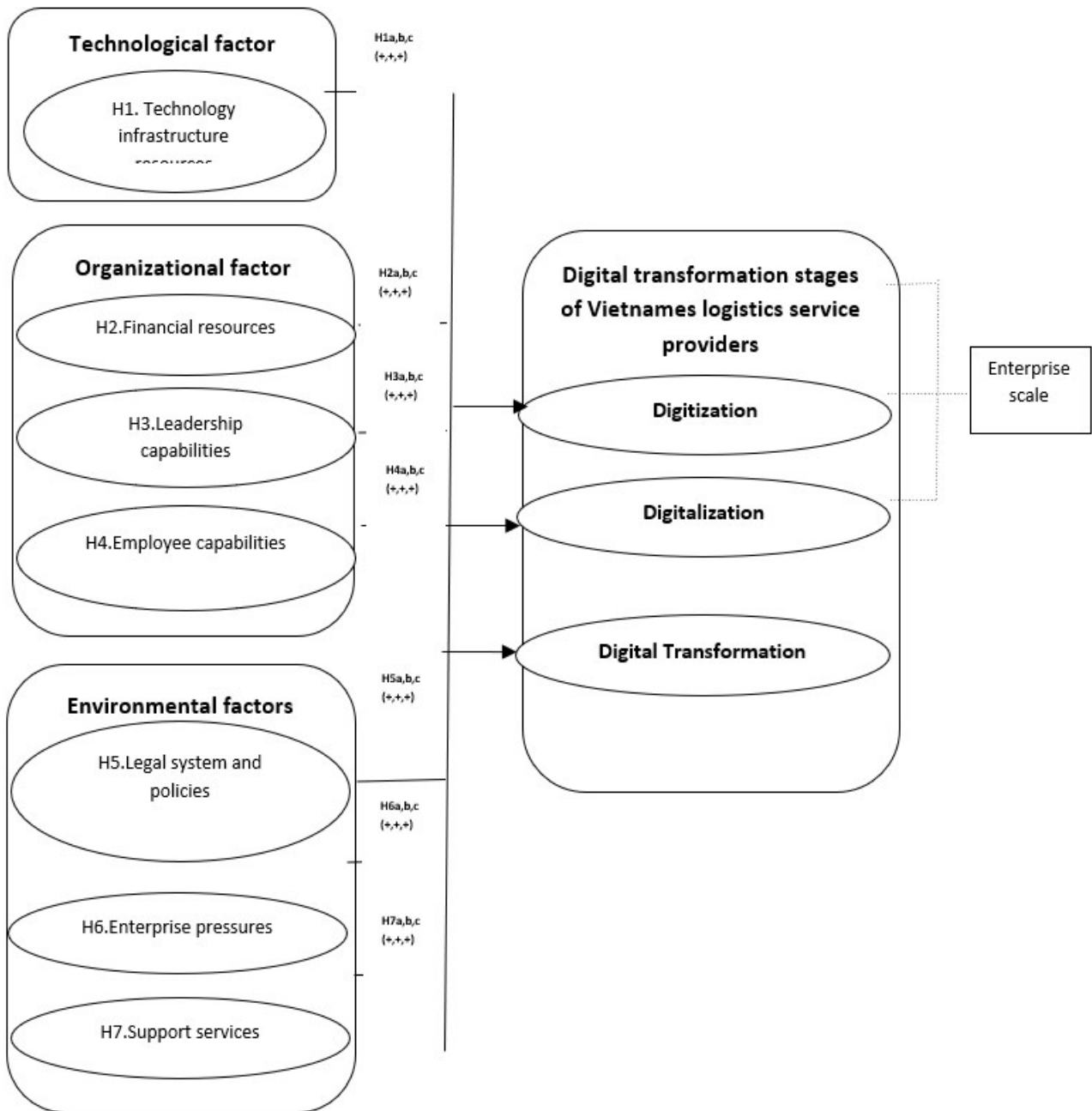
Figure 2. The research model on factors influencing the digital transformation stages of Vietnamese logistics service providers.

3.1. Technology factor

Technology infrastructure resources

The TOE framework, exploring technology factors, delves into technologies currently used and those available in the market, addressing characteristics such as relative advantage, ambiguity, difficulty, trialability, technology readiness, and integration. Awa et al. (2016) specifically identify Information and Communication Technology Infrastructure as one of the key technology factors, focusing primarily on evaluating the impact of specific technologies within organizations.

Assessing the digital transformation journey, especially for logistics companies, a resource-fit perspective underscores the importance of considering information

technology infrastructure. Gu and Jung's (2013) research builds upon the Resource-Based View, highlighting how information technology infrastructure serves as the foundation, impacting deployment capabilities, system quality, business process, and organizational performance.

Studies by Liu et al. (2011), Dyk and Belle (2019) and others emphasize that a robust technological infrastructure, including security risk identification, is critical for successful digital transformation. In logistics enterprises, the technological foundation is deemed the origin of logistics innovation and a pivotal factor in digital transformation. Information technology infrastructure emerges as the backbone of digital transformation, enabling optimization of operations, enhanced customer service, adaptability to industry changes, and sustained competitiveness in a digital and interconnected world.

H1a: Technology infrastructure resources positively affect the digitation of Vietnam logistics service providers.

H1b: Technology infrastructure resources positively affect the digitalization of Vietnam logistics service providers.

H1c: Technology infrastructure resources positively affect the digital transformation of Vietnam logistics service providers.

3.2. Organization factors

3.2.1. Financial resources

Baker (2011) outlines that the organization aspect in the TOE framework encompasses factors like resources, structure, employee communication, scale, and the ability to utilize available organizational resources. This perspective aligns with Barney (1991) and Liu et al. (2011) in highlighting the significance of internal resources, including tangible and intangible assets, for creating a competitive advantage. Dyk and Belle (2019) and Bin et al. (2021) stress the importance of reserving financial resources during digital transformation implementation. Specifically, financial resources are deemed a prerequisite for innovation in logistics companies, especially in the context of digital transformation (Jović et al., 2022; Le and Dang, 2023). Cichosz et al. (2020) contend that LSPs cautiously weigh the decision to undertake a digital transformation project due to its substantial investment and extended payback period, posing challenges for small and medium-sized enterprises (SMEs). Providing value-added logistics services may not generate sufficient revenue for SMEs to invest in new technology, complicating the digital transformation process. The primary challenge stems from the reluctance of financial institutions to lend money for technology-related projects in small-scale companies despite the demand for substantial initial investments in innovative technologies (An, 2022; Cichosz et al., 2020). Cao (2020) highlights that Vietnamese logistics service businesses, both small and medium-sized, encounter significant cost pressures during digital transformation. These challenges in securing resources hinder LSPs in preparing financial resources for digital transformation investments.

H2a: Financial resources positively affect the digitation of Vietnam logistics service providers.

H2b: Financial resources positively affect the digitalization of Vietnam logistics

service providers.

H2c: Financial resources positively affect the digital transformation of Vietnam logistics service providers.

3.2.2. Leadership capabilities

Internal fit refers to a company's capacity to integrate its internal resources for developing digital transformation capabilities (Tarutė et al., 2021). Leadership's pivotal role in the digital transformation process has been consistently emphasized in numerous studies (Cichosz et al., 2020; Morkayane et al., 2017; Nguyen and Nguyen, 2022; Singhdong et al., 2021; Vial, 2019). According to Cichosz et al. (2020), leadership capabilities are "crucial for any transformation, including digital transformation," as leaders continuously monitor market trends, identify technology opportunities, and translate them into business opportunities, securing the position of logistics service providers. Leadership capability is also evident in the flexible management of transformation activities, rational resource allocation, and prompt response to evolving customer needs (Cichosz et al., 2020; Osmundsen et al., 2018; Singhdong et al., 2021). In the logistics industry, transformation involves various stakeholders, requiring leaders to foster employee engagement (Cichosz et al., 2020; Osmundsen et al., 2018) and build cross-functional or empowered teams for high-level digital transformation missions (Tarutė et al., 2021; Warner and Wager, 2019). Leadership capabilities extend to developing digital business strategies (Osmundsen et al., 2018), adapting business strategies to technological changes (Cichosz et al., 2020; Singhdong et al., 2021; Tarutė et al., 2021), standardizing processes, and integrating data (Cichosz et al., 2020). Success in digital transformation for LSPs relies on adjusting goals and allocating resources to navigate the dynamic and complex business environment and technological developments. Given the multifaceted nature of the logistics service industry, efficient process management and standardization are crucial, necessitating rigorous control over activities to ensure organizational and customer information security (Cichosz et al., 2020).

H3a: Leadership capabilities positively affect the digitation of Vietnam logistics service providers.

H3b: Leadership capabilities positively affect the digitalization of Vietnam logistics service providers.

H3c: Leadership capabilities positively affect the digital transformation of Vietnam logistics service providers.

3.2.3. Employee capabilities

Employee capabilities play a crucial role in the organizational "fit" influencing the digital transformation process (Tarutė et al., 2021). Resistance from employees, a significant barrier identified by various researchers (Cichosz et al., 2020; Singhdong et al., 2021; Vial, 2019; Warner and Wager, 2019), often stems from the challenge of adapting daily behaviors to technological changes in logistics service providers. Shifting employee perceptions and fostering readiness for digital transformation is vital in Vietnamese logistics service provider businesses (An, 2022). Employee resistance, linked to a lack of understanding of digital technology benefits, can be mitigated through training and internal knowledge about digital transformation (Cichosz et al., 2020; Osmundsen et al., 2018; Singhdong et al., 2021). The success of

digitalization efforts is enhanced by having a skilled and empowered workforce (Tarutė et al., 2018). Building high-empowerment teams with the necessary skills is crucial for achieving successful digital transformation (Weber et al., 2017). Numerous studies emphasize that the key to successful digital transformation lies in assembling a team with the appropriate skills and capabilities (An, 2022; Cichosz et al., 2020; Le and Dang, 2023; Morakanyane et al., 2017; Vial, 2019).

H4a: Employee capabilities positively affect the digitation of Vietnam logistics service providers.

H4b: Employee capabilities positively affect the digitalization of Vietnam logistics service providers.

H4c: Employee capabilities positively affect the digital transformation of Vietnam logistics service providers.

3.3. Environment factors

3.3.1. Legal system and policies

Regulatory frameworks and policies offer crucial structures and guidelines for companies navigating the evolving digital landscape. According to Baker (2011) and Zhu and Kremer (2006), government regulations are integral external factors within the TOE framework. In the resource fit theory, Tarutė et al. (2018) also highlight government regulations as pivotal in the digital transformation process. Jović et al. (2022) underscores the significant impact of legal compliance on the digital transformation of maritime transport enterprises. In Vietnam, there is considerable government interest in enhancing the policy environment and legal framework for logistics, especially in data protection, cybersecurity, intellectual property rights, and privacy, requiring updated and widely disseminated regulations for LSPs (Cao, 2020). Government support is evident through research, the issuance of legal policies, and efforts to foster collaboration between government agencies, technology industry organizations, and logistics associations, all aimed at building a digital transformation ecosystem within the industry (An, 2022).

H5a: Legal system and policies positively affect the digitation of Vietnam logistics service providers.

H5b: Legal system and policies positively affect the digitalization of Vietnam logistics service providers.

H5c: Legal system and policies positively affect the digital transformation of Vietnam logistics service providers.

3.3.2. Enterprise pressures

Digital transformation brings benefits and challenges to logistics enterprises fueled by the need to meet customer expectations and intense industry competition. Customer demands for real-time tracking, efficient communication, and personalized experiences have escalated with digital transformation, pressuring logistics companies to adapt (Cao, 2020; Jović et al., 2022; Verhoef et al., 2021; Warner and Wager, 2019). The lowered entry barriers in the logistics sector due to digitalization intensify competition, prompting established players to innovate and enhance services to stay competitive (Baker, 2011). Jović et al. (2022) suggest that logistics service providers leverage digital transformation for socially responsible business practices.

H6a: Enterprise pressures positively affect the digitation of Vietnam logistics service providers.

H6b: Enterprise pressures positively affect the digitalization of Vietnam logistics service providers.

H6c: Enterprise pressures positively affect the digital transformation of Vietnam logistics service providers.

3.3.3. Support services

The presence of a robust technology support infrastructure has a significant influence on innovation. Companies that must offer high wages to attract skilled labor are frequently driven to innovate by developing labor-saving solutions (Globerman, 1975; Levin et al., 1987). Furthermore, a qualified labor pool and access to technology service providers, such as consultants, encourage innovation (Rees et al., 1984). Thanks to the support of digital transformation service providers, logistics service businesses can focus on their core activities without worrying about technology issues and technical support. This can help reduce costs, increase productivity, and improve the overall efficiency of the business (Chung et al., 2018). Le and Dang (2023) also assert that if logistics companies implement simple, standalone software, they need support to enhance operational efficiency. This includes order management software, warehouse management, and transportation management connected to information infrastructure, providing real-time data, allowing customers and businesses to access order information anytime, anywhere.

H7a: Support services positively affect the digitation of Vietnam logistics service providers.

H7b: Support services positively affect the digitalization of Vietnam logistics service providers.

H7c: Support services positively affect the digital transformation of Vietnam logistics service providers.

4. Methodology

Data collection encompassed both secondary and primary sources. Secondary data were extracted from a range of statistical reports pertaining to the digital transformation of Vietnam's Logistics Service Providers spanning the years 2020 to 2023. Primary data, on the other hand, were acquired through a combination of qualitative and quantitative methodologies. Initially, direct interviews were conducted with 10 experts representing diverse roles within Vietnam's Logistics Services Providers. Subsequently, in order to validate the research model, a survey was administered to 390 respondents within the domain of Vietnam's Logistics Services Providers. The survey was disseminated in hard copies and digital forms and distributed to companies via email between April and November 2023.

The research methodology employed a fusion of both qualitative and quantitative approaches and presented steps in **Figure 3**. Drawing insights from the extant literature, influential factors shaping digital transformation were discerned, utilizing the Technological-Organizational-Environmental (TOE) framework and Resource Fit Theory. To affirm the significance of these factors, in-depth interviews were conducted with 20 experts representing a diverse spectrum of Vietnam's Logistics

Services Providers. Subsequently, a preliminary research model was conceived. Following this, a structured questionnaire was formulated, and quantitative data was gathered pertaining to the elements impacting the digital transformation of LSPs in Vietnam. Respondents were asked to express their level of agreement with statements on the questionnaire using a five-point Likert scale, ranging from 1 (totally disagree) to 5 (totally agree). Because of a large sample distribution, the collected data were analyzed using covariance-based structural equation modeling (CB-SEM).
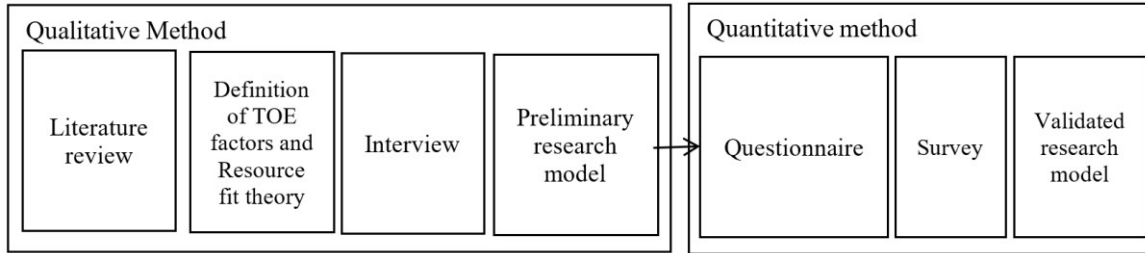

Figure 3. Method steps.

5. Results

5.1. Descriptive statistics

As displayed in **Table 2**, utilizing the chosen research framework, the study collected 550 responses through direct and online survey methods. After the screening process, 390 relevant survey responses were retained, while 160 respondents were excluded. Among the 390 respondents, 34.1% were team leaders, 33.6% were managers, 27.2% were employees, and 5.1% were in other roles. The majority of surveyed businesses (56.4%) had a workforce of 10 to 100 employees, followed by 35.1% with 100–500 employees, 7.4% with over 500 employees, and a small percentage (1%) with less than 10 employees. Regarding the nature of businesses participating in the survey, 34.3% provided logistics services, 17.3% offered freight forwarding services, 16.8% were involved in warehousing services, and 14.4% each provided transportation and other services.

Table 2. Descriptive statistics.

Enterprise scale		
Items	Number	Size/Percentage
< 10 employees	4	1.0%
10–100 employees	220	56.4%
100–500 employees	137	35.1%
> 500 employees	29	7.4%
Total	390	100%

Table 2. (*Continued*).

Primary Service		
	Number	**Size/Percentage**
Logistics service provider	390	34.3%
Freight forwarder	197	17.3%
Warehouse service	196	17.2%
Transportation service	191	16.8%
Other	164	14.4%
Total	1138	100%
Interviewee position		
	Number	**Size/Percentage**
Management (Department manager/deputy manager)	131	33.6%
Business leaders (Chairman of the Board of Directors/General Director/Deputy General Director/Director/Deputy Director)	20	5.1%
Leaders	133	34.1%
Employees	106	27.2%
Total	390	100%

5.2. Measurement model evaluation

5.2.1. Assessing the scale reliability

To assess the reliability of the scale, the study utilizes two statistical indices: (1) Cronbach's Alpha coefficient and (2) Corrected Item-Total Correlation. The results indicate that, with a scale consisting of 38 initial observed variables, after testing with Cronbach's Alpha, all variables meet the condition of having Corrected Item-Total Correlation coefficients greater than 0.3, and the Cronbach's Alpha coefficients, if variables are excluded, are all above 0.6. It suggests that the scales have high reliability and can be used for exploratory factor analysis.

5.2.2. Evaluating exploratory factor analysis EFA

As shown in **Table 3**, the KMO coefficient, utilized to evaluate the appropriateness of factor analysis, is shown in the analysis results to be 0.909, falling within the range of 0.8–0.95. The statistically significant Bartlett's test result (sig. = 0 < 0.05) indicates that the observed variables exhibit correlations within the entire dataset. These results imply that conducting factor analysis is appropriate were analyzed using covariance-based structural equation modeling (CB-SEM).

Table 3. KMO and bartlett's test.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		**0.909**
	Approx. Chi–Square	8844.966
Bartlet's Test of Sphericity	df	666
	Sig.	0

Factor Analysis indicates the identification of 10-factor groups, accounting for a cumulative variance of 69.233% (>50%), thus fulfilling the predetermined criteria.

After removing observed variables that did not meet the condition of a factor loading > 0.5 to ensure clear differentiation between the factor variables, the study retained 37 observed variables. The ultimate outcomes of the exploratory factor analysis (EFA) are showcased in **Table 4** after eliminating variables that did not meet the criteria. The scale, as assessed preliminarily, consists of 10 factors.

Table 4. Result of exploratory factor analysis.

	Factors									
	1	2	3	4	5	6	7	8	9	10
TC3	0.872									
TC4	0.770									
TC5	0.761									
TC1	0.746									
TC2	0.741									
TC6	0.685									
CN1		0.885								
CN4		0.832								
CN2		0.783								
CN3		0.707								
PL3			0.967							
PL1			0.961							
PL2			0.746							
LD4				0.801						
LD1				0.783						
LD2				0.772						
LD3				0.625						
SQT1					0.903					
SQT2					0.885					
SQT3					0.869					
NV3						0.902				
NV2						0.852				
NV1						0.748				
AL3							0.874			
AL2							0.871			
AL1							0.694			
SHT4								0.824		
SHT3								0.727		
SHT2								0.719		
SHT1								0.662		
HT3									0.929	
HT1									0.850	
HT4									0.643	

Table 4. (*Continued*).

	Factors									
	1	2	3	4	5	6	7	8	9	10
CDS4										0.851
CDS3										0.701
CDS2										0.688
CDS1										0.532

The AMOS 24 software was used to analyze overall reliability and convergence validity indices. As illustrated in **Figure 4**, the analysis results reveal key fit indices, including a Chi-square value (χ^2) of 1032.4 with df = 584 (χ^2/df = 1.768). The CFI = 0.947 and TLI = 0.940, surpassing 0.9; GFI = 0.876, exceeding 0.8; RMSEA = 0.44, below 0.06, and P close greater than 0.05. According to Hu and Bentler (1999), these assessment indices meet the established thresholds, indicating a well-fitted model.
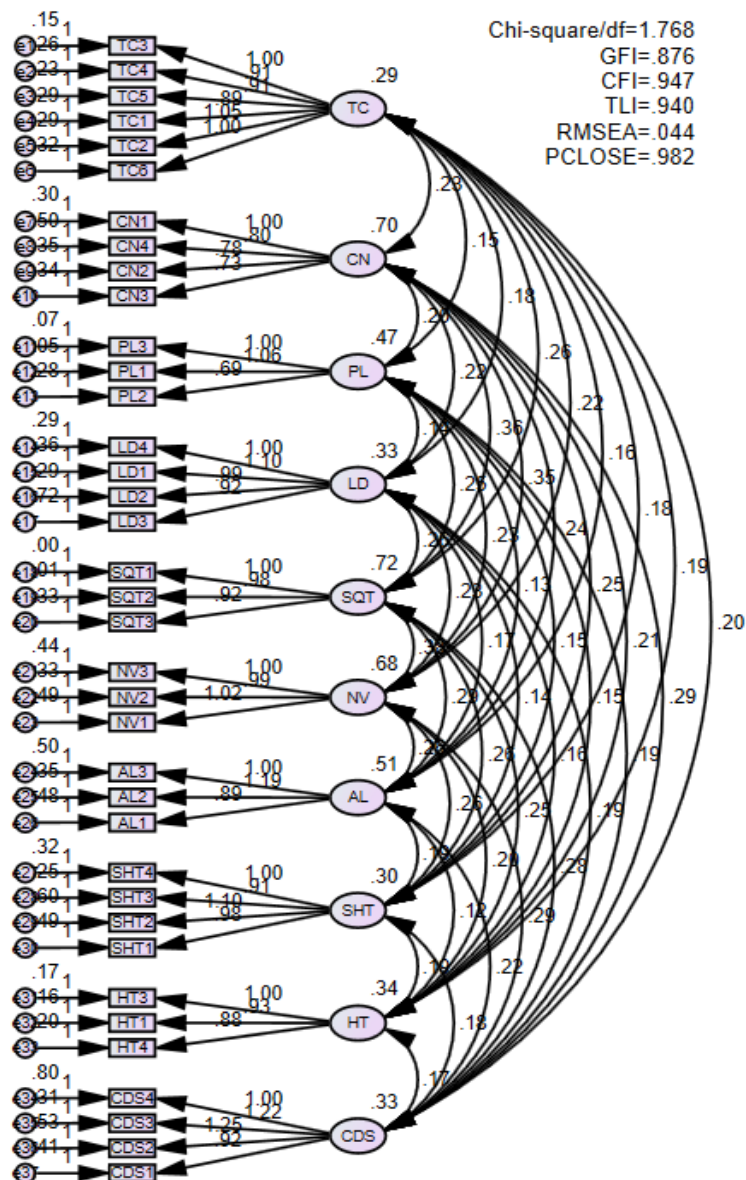

Figure 4. Result of confirmatory factor analysis.

Moreover, all Composite Reliability (CR) indices surpass 0.7, and the Average Variance Extracted (AVE) values for convergence validity are above 0.4, following findings of Fornell and Larcker (1981). The results of the analysis, presented in **Table 5**, affirm that the measurement scale for the research concepts adheres to the established standards for reliability and convergence validity.

Table 5. Result of composite reliability and average variance extracted.

Factors	CR	AVE
Technology Infrastructure Resources (CN)	0.837	0.563
Financial Resources (TC)	0.865	0.517
Leadership Capabilities (LD)	0.774	0.465
Employee Capabilities (NV)	0.832	0.623
Legal system and policies (PL)	0.895	0.744
Enterprise pressures (AL)	0.784	0.549
Support services (HT)	0.837	0.631
Digitization (SHT)	0.750	0.429
Digitalization (SQT)	0.955	0.878
Digital Transformation (CDS)	0.765	0.453

This study utilizes the square root of Average Variance Extracted (AVE) and the correlation among variables to assess discriminant validity.

Table 6 presents the results of assessing discriminant validity. Under the suggestion by Fornell and Larcker (1981) that the square root of AVE should exceed the correlation among variables, the test results fulfill the specified criteria, affirming the model's attainment of discriminant validity.

Table 6. Result of assessing discriminant validity.

	TC	CN	PL	LD	SQT	NV	AL	SHT	HT	CDS
TC	**0.719**									
CN	0.514	**0.750**								
PL	0.416	0.354	**0.863**							
LD	0.568	0.460	0.357	**0.682**						
SQT	0.558	0.510	0.429	0.541	**0.937**					
NV	0.487	0.512	0.404	0.490	0.542	**0.789**				
AL	0.421	0.400	0.257	0.404	0.468	0.447	**0.741**			
SHT	0.610	0.542	0.401	0.456	0.553	0.577	0.479	**0.655**		
HT	0.609	0.418	0.376	0.483	0.501	0.414	0.292	0.588	**0.794**	
CDS	0.629	0.593	0.477	0.585	0.580	0.610	0.522	0.564	0.504	**0.637**

5.3. Hypothesis assessing

5.3.1. Model fit testing

In order to assess the research hypotheses, an analysis using Structural Equation Modeling (SEM) was carried out. The SEM analysis yielded the following results (**Figure 5**): CMIN/df = 1.762 < 5 (considered good); CFI = 0.947 > 0.90 (considered

very good); TLI = 0.94 > 0.90 (considered good); RMSEA = 0.044 ≤ 0.06 (considered good); PCLOSE = 0.984 ≥ 0.05 (considered good). These findings suggest that the theoretical model aligns well with the research data.
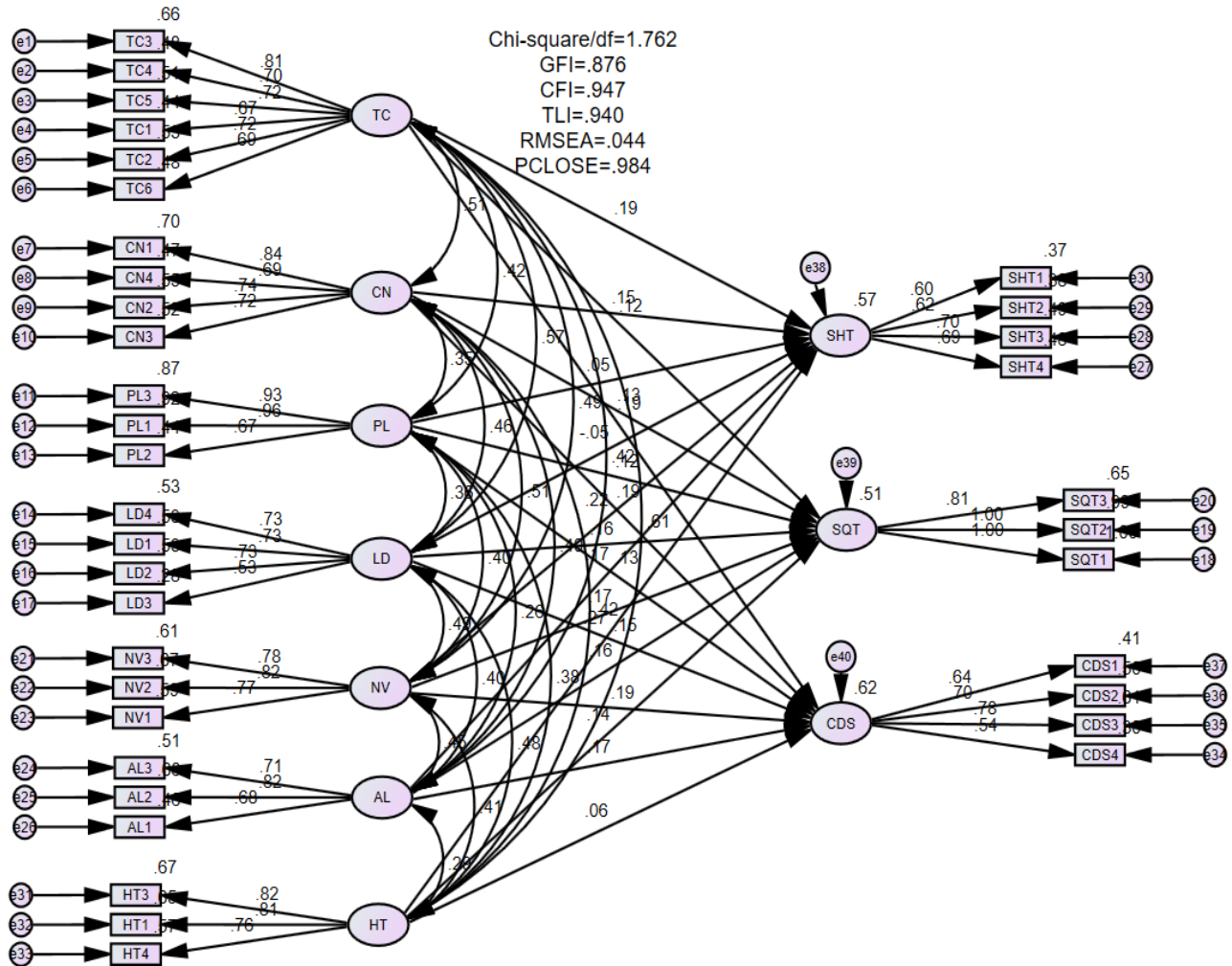

Figure 5. Result of model fit testing.

5.3.2. Evaluating the research hypotheses

Table 7 displays the non-standardized parameter estimates for the primary parameters in the model. The findings suggest that the research hypotheses within the model are validated with *p*-values below 0.05. Hypothesis H2a, with a *p*-value of 0.053, is accepted within a 90% confidence interval. Conversely, hypotheses H5a, H3a, and H7c are refuted. There is insufficient evidence to affirm the influence of "Leadership capabilities" and "Legal system and policies" on "Digitization" stage. Similarly, the "Support services" provided by digital transformation units lack substantial evidence to establish an impact on "Digital transformation", given that all *p*-values exceed 0.05 (95% confidence interval).

Table 7. Results of evaluating the research hypotheses.

Hypotheses	Relationship			Regression Coefficient	S.E.	*p*-value	Result
H2a	SHT	←	TC	0.196	0.08	0.015	Accepted
H1a	SHT	←	CN	0.101	0.044	0.022	Accepted
H5a	SHT	←	PL	0.037	0.043	0.389	Rejected
H3a	SHT	←	LD	−0.046	0.07	0.508	Rejected
H4a	SHT	←	NV	0.148	0.047	0.002	Accepted
H6a	SHT	←	AL	0.126	0.049	0.009	Accepted
H7a	SHT	←	HT	0.252	0.067	***	Accepted
H2a	SQT	←	TC	0.195	0.101	0.053	Accepted
H1b	SQT	←	CN	0.13	0.055	0.018	Accepted
H5b	SQT	←	PL	0.142	0.055	0.01	Accepted
H3b	SQT	←	LD	0.234	0.089	0.008	Accepted
H4b	SQT	←	NV	0.171	0.059	0.004	Accepted
H6b	SQT	←	AL	0.189	0.061	0.002	Accepted
H7b	SQT	←	HT	0.202	0.083	0.015	Accepted
H2c	CDS	←	TC	0.203	0.08	0.011	Accepted
H1c	CDS	←	CN	0.13	0.044	0.003	Accepted
H5c	CDS	←	PL	0.113	0.044	0.01	Accepted
H3c	CDS	←	LD	0.155	0.07	0.027	Accepted
H4c	CDS	←	NV	0.136	0.047	0.004	Accepted
H6c	CDS	←	AL	0.137	0.049	0.005	Accepted
H7c	CDS	←	HT	0.055	0.064	0.389	Rejected

The results of the structural equation modeling (SEM) analysis confirm the influence of the proposed factors on the digital transformation stages of Vietnamese logistics services providers. Regarding the variable "Digitization," an *R*-squared value (R^2) of 0.570 indicates that 57% of the variability in Information and Data Digitization is accounted for by factors such as "Financial Resources", "Technology Infrastructure Resources", "Employee Capabilities", "Enterprise pressures", and "Support services".

For the variable "Digitalization", the *R*-squared value (R^2) of 0.506 illustrates that 50.6% of the variability in Process Digitization is explained by the combined impact of "Financial Resources", "Technology Infrastructure Resources", "Leadership Capabilities", "Employee Capabilities", "Enterprise pressures", "Support services", "Legal system and policies".

Concerning the variable "Digital Transformation", the *R*-squared value (R^2) of 0.621 signifies that 62.1% of the variability in Digital Transformation is elucidated by "Financial Resources," "Technology Infrastructure Resources," "Leadership Capabilities," "Employee Capabilities," "Enterprise pressures," "Legal system and policies".

5.3.3. Evaluating the impact of control variables on the digital transformation process of Vietnam LSPs

To examine the impact of the control variable "Scale" on the digital transformation stages, a homogeneity of variance test (Levene) was executed.

The Levene test results in **Table 8** reveal that the *p*-value concerning various scales of business sizes during the process digitization phase is less than 0.05, suggesting a noteworthy variance difference among groups of businesses with different scales. Consequently, a Welch analysis is pursued. Regarding the "Digitization" factor, the Levene test yields Sig. = 0.161 > 0.05. For the "Digital Transformation" factor, the Levene test produces Sig. = 0.093 > 0.05, signifying that there is no substantial variance difference among groups of businesses with different scales.

Table 8. Result of Leneve testing.

	Levene Statistic	**df1**	**df2**	**Sig.**
SHT	1.833	2	387	0.161
SQT	3.272	2	387	0.039
CDS	2.391	2	387	0.093

As shown in **Table 9**, the findings from the Welch analysis reveal a significance level (Sig.) of 0.005, below the 0.05 threshold. It suggests a statistically significant disparity in the "Digitalization" phase across various business size groups. In simpler terms, the control variable "Scale" significantly influences the "Digitalization" phase.

Table 9. Result of robust testing between "scale" and "digitalization".

	Statistics	**df1**	**df2**	**Sig.**
Welch	5.555	2	132.266	0.005

As shown in **Table 10**, the outcomes of the ANOVA analysis examining the relationship between the variable "Scale" and both "Digitization" and Digital Transformation indicate *P*-values below 0.05. It signifies a statistically significant difference in business size concerning "Digitization", and "Digital Transformation". Essentially, the control variable "Scale" exerts an impact on the stages of Information "Digitization" and "Digital Transformation".

Table 10. Result of ANOVA testing among "scale", "digitization" and "digital transformation".

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
SHT					
Between Groups	4.244	2	2.122	5.369	0.005
Within Groups	152.942	387	395		
Total	157.186	389			
CDS					
Between Groups	5.433	2	2.716	5.321	0.006
Within Groups	200.947	387	0.519		
Total	206.38	389			

6. Implications

Examining the results table reveals that various factors play a role in the different processes of digital transformation of Vietnam logistics service providers:

In the digitization stages for Vietnamese LSPs, key factors impacting the process include "Technology Infrastructure Resources," "Financial Resources," "Employee Capabilities," "Enterprise Pressures," and "Support Services". Vietnamese LSPs upgrade technology infrastructure, providing employees with flexible work tools and facilitating continuous connectivity through network enhancements. Primary financial resources are essential for investing in hardware, software systems, and network infrastructure. This finding is consistent with the research of Jović et al. (2022). Employee capabilities, particularly IT skills, are crucial for organizing and updating digital information. External pressures, such as cost efficiency in a competitive environment, drive the need for digitization to optimize various supply chain aspects. Customer demands for fast, accurate, and transparent services lead to cloud storage solutions and online updates (Nhan, 2024). Le and Dang (2023) asserted that leadership capabilities play a crucial role in the digitalization process, however, the study presents a new finding, not observing the impact of leadership capacity on the initial stage of digital transformation. This can be explained that leaders of Vietnamese LSPs may not fully grasp the value of digitization in their transformation strategies. Some leaders lack a comprehensive understanding of data's potential benefits, resulting in insufficient guidance for employees. Furthermore, contrary to the findings of Jović et al. (2022), and Nhan (2024), this study revealed that legal regulations have no significant influence on the digitization stage. Information security risks may be underestimated, with lax regulations contributing to data leaks on social media platforms. The Vietnamese government emphasizes information security, but the lack of strict regulations and public awareness hinders the effective implementation of digital transformation plans for LSPs.

In the digitalization process of Vietnam LSPs, all seven factors positively impact the transformation, which is consistent with the results of Tarutė et al. (2018), Cichosz et al. (2020), Jović et al (2022), Le and Dang (2023), Duong (2024), Nhan (2024). Similar to Le and Dang's study (2023), his study underscores the importance of leadership capabilities in the digitalization stage. Successful leaders are adept at articulating the vision and role of each process within the supply chain. By understanding the interconnected nature of these processes and the critical role of data in driving business decisions, leaders can harness technology to optimize operations, improve efficiency, and make timely strategic choices.

The final stage signifies complete transformation, including overhauling processes, business models, and data systems. Support services do not necessarily affect transformation positively, as businesses may choose independent implementation after earlier support. Security gains prominence as information is digitized, with organizations prioritizing control and flexibility, sometimes avoiding long-term contracts with external providers, which contrary to the findings of Jović et al. (2022), Le and Dang (2023).

Through the analysis, it was observed that the factors of leadership capabilities and employee capabilities are emphasized throughout the digital transformation

process. Leaders have the role of initiating, building, and designing digital transformation strategies; employees are the ones who grasp, learn knowledge and technological skills to master the process, promoting work efficiency. However, in Vietnam, most enterprises are going through the initial stages of digital transformation (Vietnam Ministry of Industry and Trade, 2023) so many business leaders have not defined their role in this initial stage. The factor of support from digital transformation services is emphasized in the first two stages because logistics enterprises need consulting units to design suitable digital transformation software for the needs of the enterprise. In the final stage, when comprehensive digital transformation takes place, people master technology, and enterprises pay great attention to information security in the enterprise.

7. Conclusions

In conclusion, digital transformation is imperative for the sustainable development of Vietnamese LSPs. The process reshapes the information data system, improves business models and procedures, and enhances customer experiences in utilizing logistics services.

7.1. Contributions

The paper has several contributions from both theoretical and empirical perspectives. The literature review revealed a lack of the exploration of internal and external factors influencing various stages of the digital transformation of Vietnamese Logistics Service Providers. This study contributes by proposing a distinct model that fills this gap, combining the TOE model and Resource Fit theory, identifying internal and external factors influencing the organizational transformation, encompassing information "Technology infrastructure resources," "Financial resources", "Leadership capabilities," "Employee capabilities," "Enterprise pressures," "Legal systems and policies," and "Support services". Besides, the study also provides empirical evidence by conducting both qualitative and quantitative analysis to evaluate the impact of those factors on each stage of the digital transformation of Vietnamese Logistics Service Providers. In-depth interviews with ten logistics industry experts were conducted, followed by a survey involving 390 Vietnam LSPs. The data were analyzed using the covariance-based structural equation model (CB-SEM) to assess the specific impacts of the seven factors on each stage of the digital transformation process.

The study findings show that the dynamic digital transformation landscape, the journey for Vietnamese logistic service providers unfolds in three distinct stages, each presenting its own challenges and opportunities. At the outset, the early stage marks a critical juncture characterized by the emergence of information digitization and data management challenges. These hurdles stem primarily from a need for long-term leadership direction, underscoring the indispensable need for visionary guidance and robust policy frameworks. Furthermore, the study emphasizes the imperative for enhanced legal structures to fortify data security measures, which are crucial for navigating the complexities of the digital realm.

Transitioning into the second stage, Vietnamese logistic enterprises are urged to

embark on a strategic trajectory, capitalizing on resources, cultivating information technology infrastructure, and nurturing a digitally adept workforce. This phase emphasizes proactive measures aimed at harnessing technological capabilities to streamline operations and enhance competitiveness within the industry.

As the transformation journey progresses towards its culmination, cybersecurity emerges as a paramount concern, demanding heightened vigilance and strategic investment. Notably, the final stage advocates for a shift towards self-reliance, advocating for a reducing external dependency to empower businesses in internalizing technology ownership. Vietnamese logistic service providers can fortify their resilience and thrive amidst the evolving digital landscape by fortifying cybersecurity measures and minimizing reliance on externa; support.

7.2. Limitations

Similar to other studies, this study also has some limitations. Firstly, it selectively collects data from Vietnamese logistics service businesses affiliated with the Vietnam Logistics Business Association, potentially biasing results. Secondly, it lacks detailed evaluations of digital transformation factors for different service types or specific technologies. Thirdly, it only explores impact factors across three stages of digital transformation without analyzing business development trajectories within these stages. Lastly, it overlooks the influence of control variables like Vietnam's logistics infrastructure on the relationship between factors and digital transformation.

7.3. Future research directions

From these identified limitations, several directions for further research are proposed. Future studies should devise effective sampling methods to yield more accurate results while also considering other control variables, such as the infrastructure of the Vietnamese logistics industry. Building upon the current research, future studies can serve as a foundation for developing tailored digital transformation roadmaps for logistics service providers in Vietnam and a reference point for policymakers and the Vietnamese government. Additionally, it is advisable to expand research into the influencing factors of specific prominent technologies (such as Big Data, Blockchain, Robots, etc.) on the digital transformation process of Vietnamese logistics service providers or the impact of digital transformation on a specific group of services offered by logistics service providers (such as air freight services, road freight services, maritime services, etc.).

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Conflict of interest: The authors declare no conflict of interest.

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