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The Impact of Data-driven Dispatching and Load Recommendation Systems on Logistics Platform Continuance Intention: A PLS-SEM Analysis

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Abstract

This study systematically analyzes the mechanism underlying the formation of continuance intention toward logistics platforms in a digital transformation environment, using an approach based on partial least squares structural equation modeling. Considering the characteristics of regional logistics, where physical consolidation is difficult to implement, we developed a conceptual research model integrating the Technology-Organization-Environment framework, the Expectation–Confirmation perspective, and dynamic capabilities theory. The research model includes measurement and structural models, with characteristics of digital logistics platforms, strategic orientation, delivery and pickup system, and continuance intention specified as latent variables.

Based on survey data collected from freight transport operators in Jeollanam-do, the empirical analysis yielded the following:

- (1) Platform reliability and compatibility exert significant positive effects on technology and network market orientations.
- (2) The strategic orientation latent variable has a significant positive effect on the delivery and pickup system's efficiency.
- (3) The delivery and pickup system has a strong positive effect on continuance intention and plays a mediating role in the relationship between strategic orientation and continuance intention.
- (4) The Sobel test confirmed that the mediating effect of the delivery and pickup system was statistically significant.

These results suggest that continuance intention toward digital logistics platforms is driven not only by technological preferences, but also by users' perceptions of improved delivery and pickup efficiency and operational performance. By empirically elucidating the role of digital logistics platforms from an information-based consolidation perspective, this study has practical implications for formulating digital transformation strategies and platform operation policies in regional logistics industries.

Keywords

Logistics platform characteristics; AI-based information matching; Technology orientation; Network market orientation; Logistics consolidation

1. Introduction

In recent years, industries worldwide have experienced rapid advances in digital technologies, such as artificial intelligence (AI), big data, cloud computing, blockchain, and the Internet of Things (IoT). Driven by the Fourth Industrial Revolution, these technologies are fundamentally transforming industrial structures and business models. They have become key drivers of productivity and efficiency in the global economy [1]. In particular, the transportation and logistics sector has undergone an accelerated digital transformation centered on data-driven decision making and automation, shifting traditional manual transport operations toward algorithm-based matching structures [2].

Logistics supply chains are directly influenced by digital transformation. Logistics 4.0 is commonly defined as an integrated paradigm that emphasizes logistics automation, information integration, and real-time decision making to standardize logistics functions and optimize supply chains at the system level [3]. Within this paradigm, digital logistics platforms have emerged as a critical mechanism for reducing information asymmetry between shippers and carriers by enabling real-time dispatching and transportation information sharing, thereby contributing to reduced empty mileage and improved transportation efficiency (Korea Trucking Association, 2011).

Recently, the core functions of digital logistics platforms have evolved beyond simple information provision to advanced information-matching mechanisms, such as AI-based dispatching and freight recommendation systems. These functions connect transportation supply and demand in real time and support optimal dispatching decisions by comprehensively considering transportation conditions, routes, and vehicle characteristics. Consequently, they enhance both transportation efficiency and transparency [4,5]. Empirical evidence from global logistics markets indicates that AI-driven automated matching algorithms generate tangible operational outcomes, including reductions in empty mileage, improvements in truck utilization rates, and decreases in transportation costs [6,7].

McKinsey, and Company [2] has emphasized that, as competition in digital logistics technologies intensifies, automated matching capabilities and data-driven decision making competencies will become the minimum requirements for maintaining firm competitiveness. Prior studies have demonstrated that logistics digitalization significantly affects not only operational efficiency, but also service quality perceptions and user satisfaction. However, most existing literature focuses on platform adoption decisions and post-adoption performance evaluation. Consequently, the causal mechanisms through which AI-based dispatching and freight recommendation functions influence users' continuance behavior remain relatively underexplored.

Logistics activities include transportation, warehousing, handling, packaging, value-added processing, and logistics information management. Among these, transportation is widely regarded as the most critical in terms of cost and time. It is directly linked to the "Place" component of the marketing 4P framework and has recently been recognized not merely as a cost-reduction tool, but as a strategic value-creation element; it is often referred to as a "third source of profit" for firms [8,9]. AI-based dispatching and freight recommendation systems are the core technological components that directly affect transportation efficiency and play a decisive role in determining the strategic value and long-term sustainability of logistics platforms.

An examination of the Korean transportation industry reveals that road freight transport accounts for a dominant share of the country's overall logistics system and is largely composed of small-scale carriers. In particular, 92.4% of total freight volume is handled by road transport, indicating a strong structural dependence on road-based logistics [10]. This dependency generates systemic inefficiencies such as repetitive trips, low load factors, and increased empty mileage, while simultaneously exacerbating information asymmetry and transaction opacity [10,11]. These structural characteristics underscore the growing need for digital logistics platforms incorporating AI-based dispatching and freight recommendation mechanisms.

Nevertheless, the use of digital logistics platforms varies substantially across regions. Although adoption has expanded in metropolitan areas, non-metropolitan regions continue to exhibit relatively low levels of digital technology acceptance [12,13]. In particular, in Jeollanam-do Province, less than 10% of freight transport operators report experience with platform-based dispatching, indicating that most carriers still rely on traditional phone-based transaction methods [14]. This regional context provides an appropriate empirical setting for examining how AI-based information-matching functions are perceived in practice and how such perceptions translate into continuance usage behavior.

Traditional logistics consolidation strategies typically presuppose physical infrastructure, such as shared logistics centers and integrated delivery networks. However, these approaches have structural limitations in

regions dominated by small-scale carriers. Accordingly, recent studies suggest that information-based logistics consolidation enabled by digital platforms may be a realistic and effective alternative for improving logistics system efficiency (Hongsakul et al., 2025; Huang et al., 2025; Lin et al., 2021; Liu & Pan, 2024; Wu et al., 2024). In particular, AI-based dispatching, empty-trip information sharing, and freight recommendation systems are increasingly recognized as key mechanisms for realizing consolidation effects without relying on physical integration. In this study, information-based logistics consolidation is positioned as a core analytical lens rather than a supplementary outcome, reflecting its growing relevance in digitally mediated logistics environments.

Despite these developments, empirical research has predominantly focused on large logistics firms or urban transportation systems, emphasizing service quality, customer satisfaction, and performance outcomes. Comprehensive empirical analyses integrating AI-based information-matching functions and continuance usage behavior among small-scale freight operators in non-metropolitan regions remains extremely scarce.

To address this gap, this study integrates the Technology–Organization–Environment (TOE) framework (Tornatzky & Fleischer, 1990) with the Expectation–Confirmation Model (ECM) [15] and then uses partial least squares structural equation modeling (PLS-SEM). Thus, the study empirically examines the causal structure through which digital logistics platforms, including AI-based dispatching and freight recommendation systems, shape strategic orientation, induce information-based logistics consolidation effects, and ultimately influence continuance intention. By extending prior research centered on physical consolidation, this study contributes both theoretically and practically to the literature by validating the feasibility and strategic relevance of digital information technology–based consolidation in regional logistics markets.

2. Literature Review

2.1 Digital Logistics Platforms

Digital logistics platforms function as data-driven intermediary infrastructures that connect shippers and carriers in real time, integrating automated matching, freight pricing, shipment tracking, and settlement services into a unified system [1,16]. By replacing traditional brokerage methods based on phone calls, fax transmissions, and manual documentation, these platforms significantly reduce information asymmetry and operational inefficiencies, while enhancing transparency and predictability throughout the transportation process.

Recent developments in Korea have illustrated this technological evolution, as shown in Fig. 1. The Korea Trucking Association (KTA) has progressively upgraded its KTA Freight Line platform from a basic one-to-one real-time matching system to an advanced platform that incorporates AI-based dispatching and recommendation functions. By learning from historical transportation records, region- and time-specific demand patterns, and repeated transaction behaviors, the platform supports improvements in dispatching accuracy, prediction of empty trip occurrences, and rationalization of freight rates. Thus, a simple brokerage platform shifts to a decision-support-oriented logistics platform that actively assists carriers' operational and strategic decision-making processes (Korea Trucking Association, 2011).

Globally, digital freight platforms are rapidly advancing their automation levels by leveraging AI and big data as core technologies. For example, Uber Freight uses large-scale transaction data to implement AI-driven automated dispatching, dynamic pricing, and real-time demand–supply forecasting. By jointly considering transportation routes, waiting times, and empty mileage, the platform provides optimized matching solutions that enhance overall transportation efficiency [17,18].

Similarly, Convoy applies machine-learning techniques to analyze freight demand patterns and transportation networks. Through automated bidding and dispatching systems, intelligent network design, and empty-mileage reduction algorithms, Convoy seeks to improve the operational efficiency of both shippers and carriers. Notably, Convoy's technological approach extends beyond the optimization of individual transactions to maximize platform-level network efficiency, reflecting a system-wide optimization perspective [5].

Meanwhile, Loadsmart strengthens data-driven logistics decision making through its FreightIntel AI solution. FreightIntel AI integrates historical transportation data with real-time market information to support freight rate forecasting, demand fluctuation analysis, and optimization of vehicle and route utilization. Thus, shippers and carriers can manage risks and formulate strategic transportation plans based on predictive analytics [19].

Collectively, these developments illustrate that contemporary digital logistics platforms are evolving beyond simple brokerage services to intelligent operational platforms that employ AI, big data, and cloud computing.

The data accumulated within platforms are continuously reutilized for prediction, recommendation, and optimization functions. Consequently, AI-based dispatching and freight recommendation systems no longer serve as auxiliary operational tools but function as core information-matching mechanisms that reshape decision-making structures within platform-mediated logistics systems.

2.2 Logistics Infrastructure and Platform Utilization in Jeollanam-do

Jeollanam-do has a high concentration of agriculture, fisheries, and manufacturing that generate sustained logistics demand. However, significant disparities exist between Jeollanam-do and metropolitan areas in terms of logistics infrastructure development and levels of digital utilization. As of 2022, approximately 92.4% of the total freight volume in Korea is handled by road transportation, and this road-centric structure is similar to that observed in Jeollanam-do [10,11]. Due to insufficient railway freight networks and intermodal logistics complexes, this region is highly dependent on medium- and long-distance road transportation, which reduces its efficiency and increases the likelihood of greater empty mileage [10].

In terms of physical infrastructure, Jeollanam-do possesses port logistics functions centered on Gwangyang Port. However, compared with major hub ports, its port has limited logistics agglomeration and weak intermodal connectivity. According to the National Logistics Information Center [20], the number of logistics warehouses and total floor area in Jeollanam-do account for approximately 5% and 6%–7% of the national total, respectively. Large-scale integrated logistics complexes are sparsely distributed, resulting in a fragmented logistics structure dominated by small hubs and carriers.

The structure of transportation operators further constrains efficiency. More than 99% of freight transport firms in Korea are small-scale operators, and Jeollanam-do is dominated by owner-operators or firms operating a small number of vehicles [8,11]. In particular, light trucks under one ton are estimated to account for nearly 80% of freight vehicles, creating structural barriers to the realization of traditional, physically based logistics consolidation [20].

These physical and structural characteristics directly affect the adoption of digital logistics services. According to the Korea Transport Institute [13,14], platform utilization rates among freight transport operators in non-metropolitan regions are 20–30 percentage points lower than those in metropolitan areas. In Jeollanam-do and other provincial regions, phone-, text-, and bulletin board-based dispatching methods still account for the majority of transactions. The proportion of operators regularly using platform-based real-time matching, automated dispatching, and information-sharing services remains at approximately 10%.

Moreover, advanced digital functions, such as GPS-based real-time tracking, estimated arrival time prediction, and data-driven route optimization, are only partially adopted by large carriers and have not diffused broadly among small and micro-sized operators in the region [13]. This limited diffusion reflects a combination of factors, including adoption costs, insufficient data utilization capabilities, dependence on established transaction practices, and a lack of trust in digital platforms [12,21].

Despite public- and private-sector efforts to promote platform diffusion, the ratio of active users to registered users on public logistics platforms and freight information networks remains below 30%. Even platforms such as KTA Freight Line, which recently introduced AI-based functions, have not yet achieved sufficient penetration among small-scale carriers in Jeollanam-do [22] (see also Korea Trucking Association 2011).

In summary, Jeollanam-do represents a structurally constrained logistics region that has existing logistics demand and basic transportation infrastructure, but limited logistics agglomeration and low utilization of digital services. These characteristics suggest that information-based logistics consolidation and operational efficiency strategies mediated by digital logistics platforms may represent realistic alternatives for large-scale physical infrastructure development. Accordingly, Jeollanam-do constitutes a representative case study examining the strategic adoption and continuance usage mechanisms of digital logistics platforms.

2.3 Strategic Orientation

Strategic orientation refers to the consistent strategic posture and behavioral tendencies through which organizations allocate resources and make decisions in response to environmental changes [23] (see also Venkatraman 1989). Strategic orientation plays a critical role in shaping the direction of technology adoption and utilization in digital transformation contexts. In platform-based industries, strategic orientation influences

not only internal operational strategies but also patterns of external network engagement and collaborative structures [17,24].

Prior studies have conceptualized strategic orientation in terms of dimensions such as technology orientation and market orientation. Technology orientation reflects an organization's propensity to explore, adopt, and utilize new technologies [23]. Organizations with a high technology orientation tend to perceive digital technologies as strategic assets rather than mere operational tools and seek to enhance operational efficiency through data-driven decision making and automation (Rezazadeh et al., 2016).

Network market orientation is equally important in platform environments. This orientation emphasizes connectivity among platform participants, information sharing, and collaborative expansion, thereby strengthening network externalities and economies of scale [18] (see also Jullien et al. 2021). Together, platform reliability, information accuracy, system stability, and compatibility function facilitate the formation of strategic orientations (Kang, 2023).

Strategic orientation assumes heightened importance in regions such as Jeollanam-do, where small-scale carriers dominate and digital utilization remains low. It shapes whether platforms are perceived merely as brokerage tools or as collaborative infrastructure that enables information-based consolidation and operational efficiency [13,14].

2.4 Logistics Consolidation Effects

Logistics consolidation refers to strategies through which multiple transportation actors share resources and information to enhance efficiency and reduce costs. Consolidation has traditionally been discussed in the context of physical infrastructure aggregation, such as shared logistics centers and integrated delivery networks. However, in regions characterized by a high prevalence of small-scale carriers and limited logistics agglomeration, such forms of physical consolidation face inherent structural constraints [8].

Recent studies have proposed an alternative approach: information-based logistics consolidation enabled by digital logistics platforms. Such consolidation generates collaborative effects through real-time sharing of dispatch information, linkage of empty-trip data, and optimization of pickup and delivery routes without requiring physical co-location. In platform-mediated logistics environments, this consolidation has been shown to reduce empty mileage, improve vehicle turnover rates, and enhance delivery system efficiency, thereby yielding tangible operational performance outcomes [2,5,6].

Importantly, consolidation effects do not automatically arise from the mere presence of platform technology. Rather, outcomes depend on participants' strategic usage patterns and willingness to collaborate [23]. When information sharing and repeated interactions are sustained, network externalities and economies of scale are reinforced, thereby determining the durability of the consolidation effects [18] (see also Jullien et al. 2021).

Digital-platform-mediated, information-based consolidation may function as a practical alternative in regions, such as Jeollanam-do, where implementing physical consolidation is difficult. By improving pickup and delivery efficiency and operational stability, such approaches have the potential to strengthen regional logistics competitiveness [13,14].

2.5 Platform Continuance Intention

Platform continuance intention refers to a user's willingness to repeatedly use and maintain engagement with a platform after initial adoption. It is widely recognized as a core determinant of platform-based service performance [15]. In platform industries, sporadic or one-time use cannot fully realize network effects and data accumulation benefits; therefore, continuance intention constitutes a necessary condition for sustained platform value creation [17] (see also Jullien et al. 2021).

Moreover, continuance intention extends beyond simple technological preference; it is closely associated with users' perceptions of whether platform usage yields tangible operational efficiency and transaction stability. When functionalities such as real-time dispatching, empty-trip information sharing, and enhanced transportation transparency are consistently experienced through repeated use, platforms are perceived as superior operational alternatives to traditional transaction methods, thereby strengthening continuance intention [2,6,15].

Conversely, when platform functionalities fail to translate into meaningful benefits during actual transportation operations, or are perceived as introducing greater uncertainty than existing practices, continuance intention may weaken. Given the logistics industry's reliance on repeated transactions and trust-based relationships, perceptions of efficiency and stability formed through the platform usage experience play a decisive role in determining long-term engagement [17,18]. Accordingly, continuance intention toward digital logistics platforms is formed through accumulated operational experience and performance perceptions, making it a key explanatory variable for understanding platform diffusion and the long-term outcomes of digital logistics transformation.

3. Methodology

Digital logistics platforms have increasingly integrated AI-based dispatching and freight recommendation functions as core operational components. However, empirical analyses of how such platform characteristics translate into sustained platform usage through organizational strategic orientation and information-based collaborative efficiency remain limited. This gap is particularly evident in regional logistics markets dominated by small-scale carriers, in which the structural mechanisms underlying platform utilization have not yet been sufficiently elucidated. To address this limitation, the present study develops an integrated causal framework linking key characteristics of digital logistics platforms, strategic orientation, information-based logistics consolidation effects, and continuance intention, and empirically tests this framework using PLS-SEM.

3.1 Theoretical Framework and Conceptual Structure for Platform Continuance

Continuing usage of digital logistics platforms should not be understood merely as a matter of initial technology adoption; rather, it represents a recurrent operational choice shaped by the interaction of technological conditions, an organization's strategic capabilities, and the surrounding operational environment. Accordingly, this study adopts an integrative conceptual foundation to explain platform continuance by drawing on the Technology-Organization-Environment (TOE) framework, the Expectation–Confirmation perspective, and the dynamic capabilities view in a complementary manner.

The TOE framework emphasizes that information technology utilization emerges from interactions among technological characteristics, organizational conditions, and external environmental factors [25] (see also Tornatzky & Fleischer 1990). Technological factors in logistics platforms include operational attributes, such as platform reliability, information accuracy, and system stability. Organizational factors refer to strategic orientations and internal capabilities that determine how platforms are incorporated into transportation. Environmental factors reflect exogenous conditions including transaction structures, industry practices, and regional logistics infrastructure. These factors are shown in Fig. 1.

Platform continuance is also closely associated with the Expectation–Confirmation perspective, in that sustained usage represents a repeated usage decision formed through operational experience following initial adoption, as shown in Fig. 2. Prior studies have indicated that when perceived efficiency, system stability, and operational performance experienced during platform use meet or exceed users' initial expectations, individuals are more likely to continue using the system [15]. For digital logistics platforms, performance perceptions related to real-time dispatching, empty-trip information sharing, and improvements in pickup and delivery efficiency are critical drivers of continuance intention.

In addition, this study interprets the use of digital logistics platforms from the perspective of an organization's dynamic capabilities, which refer to its ability to reconfigure resources and integrate new operational practices in response to rapidly changing environments [26] (see also Teece et al. 1997). This perspective is closely aligned with the process through which digital logistics platforms evolve from simple brokerage tools into operational infrastructure that enables collaboration and logistics consolidation.

Specifically, this study employs the TOE framework to explain how the technological characteristics of digital logistics platforms, together with organizational and environmental factors, shape strategic orientation. The Expectation–Confirmation perspective is then used to interpret how perceptions of operational performance formed after platform use influence continuance usage decisions. By integrating the dynamic capabilities view, this study further elucidates a structural mechanism in which platform characteristics stimulate strategic orientation, foster new operational capabilities, such as information-based logistics consolidation, and ultimately lead to sustained platform utilization. Through this integrative approach, this study provides a comprehensive

explanation of the causal pathways linking platform features to long-term usage behavior.

3.2 Research Model and PLS-SEM Method

The research model proposed in this study consists of platform characteristics, strategic orientation, logistics consolidation effects, and platform continuance intention. Platform characteristics encompass technical and operational attributes, such as system reliability, information accuracy, stability, and compatibility, which are necessary for shaping strategic attitudes toward platform utilization (Kang, 2023; Liu et al., 2025). Strategic orientation refers to an organization's strategic posture toward integrating digital technologies into transportation operations and using platforms as collaborative infrastructure [23].

Logistics consolidation effects are defined as operational performance outcomes realized through platform use, including improved pick-up and delivery efficiency, reduced empty mileage, and enhanced sharing of transportation information. These effects are key mediating constructs that capture the tangible benefits of platform utilization. Platform continuance intention is defined as the decision to repeatedly and persistently employ the platform in transportation operations and decision-making processes. Moreover, it is specified as the ultimate outcome variable explaining the diffusion and long-term performance of digital logistics platforms.

To empirically test the proposed research model, this study applies PLS-SEM, as illustrated in Fig. 3. PLS-SEM is well-suited for predictive-oriented research and the analysis of complex causal structures, particularly in cases involving relatively small sample sizes or data that do not satisfy multivariate normality assumptions [27,28]. The analytical procedure involves first assessing the reliability and validity of the measurement model, followed by an examination of the path coefficients and explanatory power within the structural model.

4. Survey Design

4.1 Sample Selection

To empirically test the proposed hypotheses, we conducted a survey of freight transport operators in Jeollanam-do Province. The respondents were practitioners who performed pick-up and delivery operations and had direct experience using digital logistics platforms in their daily work. Thus, they were field-oriented respondents with practical knowledge of platform-based transportation operations.

Notably, 73.4% of the respondents (132 individuals) reported that they were either familiar or very familiar with the "KTA Freight Line" platform, while 59.4% (107 individuals) indicated a high level of awareness of its core functions, such as one-to-one matching and real-time information provision. These results suggest that the respondents possessed sufficient understanding of the platform's concept and functionalities, thereby supporting the suitability of the sample for the empirical analysis.

Ethics Statement. All methods were carried out in accordance with relevant guidelines and regulations. The study involved an anonymous and voluntary online survey of adult freight transport operators and employees. Before beginning the survey, all participants were provided with information regarding the purpose of the study, the voluntary nature of participation, the anonymity of their responses, and the use of the collected data for academic research purposes. Informed consent was obtained from all participants prior to participation by their voluntary decision to proceed with the survey after reviewing this information.

4.2 Operational Definitions of Variables and Measurement Instruments

The variables in this study include the key characteristics of digital logistics platforms, strategic orientation, logistics consolidation effects, and platform continuance intention. All variables are operationally defined based on conceptual definitions established in prior studies and adapted to fit the context of digital logistics platforms.

Among the core characteristics of logistics platforms, reliability is the extent to which transportation and transaction information provided by a platform is perceived as accurate, up-to-date, trustworthy, and useful for operational decision-making. Compatibility refers to the degree to which a platform is perceived as compatible with existing work practices, so that it can be smoothly integrated with internal and external systems. Perceived personalization is operationally defined as the extent to which a platform is perceived to recognize user characteristics and needs and provide customized dispatching, freight recommendations, and services

accordingly.

Among the strategic orientation variables, technology orientation denotes a strategic propensity to perceive new technologies as a core source of competitiveness and adopt and utilize them in transportation operations. Network market orientation is defined as a strategic posture that emphasizes linkages with external collaborative networks, information sharing, and the pursuit of shared objectives through the platform. Logistics consolidation effects refer to the extent to which users perceive improvements in operational efficiency and collaborative performance in transportation processes as a result of using a digital logistics platform. Finally, platform continuance intention is defined as a user's willingness to repeatedly and persistently use a digital logistics platform.

The specific measurement items and their corresponding sources for each construct are presented in Table 1, which summarizes the measurement indicators by variable.

Table 1. Measurement items by construct.

Construct		Measurement Items	References
Platform Characteristic s	Reliability	• The information provided by the platform is detailed.	[29] (see also Hong 2023)
		• The platform provides up-to-date information.	
		• The platform provides accurate information.	
		• The information provided by the platform is useful.	
	Compatibility	• Using the platform enables faster task processing.	Rogers (1983); Hong (2023)
		• Using the platform reduces repetitive work.	
		• Using the platform helps reduce transportation and operational costs.	
Strategic Orientation	Perceived Personalization	• Using the platform eliminates the need to search multiple websites.	[30] (see also Lee et al. 2011)
		• The platform accurately identifies and provides the transportation services I need.	
		• The platform recommends services that match our firm's transportation conditions.	
	Technology Orientation	• The platform provides customized transportation services based on our firm's information.	[31] (see also Coombs et al. 2006)
		• The platform prioritizes technology in service development and responds quickly to technological changes.	
		• The platform demonstrates superior technological adoption and idea generation capabilities compared to other firms.	
Strategic Orientation	Technology Orientation	• The platform supports firms in actively adopting new technologies to gain competitive advantage.	[31] (see also Coombs et al. 2006)
		• The platform facilitates effective external technological collaboration and systematic management of technology-related information.	

		• The platform enables rapid provision of products and services aligned with network members' and customers' needs and facilitates swift information exchange when problems arise.	
	Network Market Orientation	• The platform is actively used for discussions aimed at achieving shared goals among network members. • The platform contributes to identifying, sharing, and collaboratively resolving conflicts or issues within the network. • The platform actively supports the assimilation, codification, sharing, and diffusion of knowledge and information within the network.	[31] (see also Helfert et al. 2002)
Logistics Consolidation Effects	Pickup and Delivery System	• Transportation tasks are expected to be processed faster than before. • Response times for shipment requests, allocation, and arrivals are expected to improve. • On-time delivery performance and information provision are expected to improve. • Value-added services such as packaging and delivery are expected to expand.	Choi (2019)
Continuance Intention		• I intend to continue using the current platform. • This platform aligns with our firm's objectives and will continue to be used. • This platform contributes to improving competitiveness and will therefore continue to be used.	[15,32]

5. Results

5.1 Data Collection and Sample Characteristics

This study empirically examines how key characteristics of digital logistics platforms, namely reliability, compatibility, and perceived personalization, affect logistics consolidation and platform continuance intention through strategic orientation. Data were collected through a structured survey incorporating measures of platform characteristics, strategic orientation (technology and network market orientation), logistics consolidation effects (improvements in pickup and delivery systems), and platform continuance intention. The survey was administered to employees working in freight transport firms through a freight transport association community using an online survey system provided by the Korea Social Science Data Center (KSDC) via a university library. Data collection was conducted over an 11-day period, from June 5 to June 15, 2025. A total of 220 questionnaires were distributed, of which 180 valid responses were retained for final analysis after excluding incomplete or careless responses, yielding a response rate of 81.8%.

To simultaneously analyze the proposed relationships among multiple variables, this study employed PLS-SEM. Prior to the PLS-SEM analysis, an exploratory factor analysis (EFA) was conducted using SPSS to ensure the validity of the measurement items. Items exhibiting low factor loadings or substantial cross-loadings that could undermine construct validity were excluded. Only items that satisfied the validity criteria were retained for subsequent PLS-SEM analysis.

The adequacy of the sample size was assessed using the 10-times rule. According to Barclay et al. [33] and Hair et al. [34], the minimum sample size should be at least ten times the maximum number of structural paths directed at any endogenous construct. In this study, the maximum number of incoming paths to an endogenous variable was three, requiring a minimum sample size of 30. With 180 observations included in the analysis, the sample size was deemed sufficient for PLS-SEM estimation.

An examination of the demographic characteristics of valid respondents revealed that drivers affiliated with freight transport firms (employed or contract-based drivers) constituted the largest group, accounting for 86 respondents (47.8%). This group was followed by owner-operators who personally operate their vehicles (62 respondents, 34.4%), and non-driving firm owners or managers (32 respondents, 17.8%). The gender distribution was highly skewed, with 177 male respondents (98.3%) and only three female respondents (1.7%). In terms of age, respondents aged 30–39 years accounted for the largest proportion (44.4%), followed by those aged 40–49 years (30.6%), 50–59 years (21.1%), 20–29 years (2.8%), and 60 years or older (1.1%). The largest group reported 5–10 years of experience (46.1%), followed by 10–15 years (22.2%), less than 5 years (12.2%), 15–20 years (11.1%), and > 20 years (8.3%).

Regarding firm size (including owners), enterprises employing five or more workers accounted for the largest share (47.8%), whereas single-person enterprises represented a substantial proportion (33.3%). Annual sales revenue exhibited a relatively diverse distribution, with firms reporting revenues of KRW 1 billion or more (24.5%), KRW 80 million to less than KRW 200 million (23.3%), and KRW 500 million to less than KRW 1 billion (19.4%), among other categories.

Although each latent construct was initially measured using four to five items derived from previous studies, items exhibiting low factor loadings or threatening construct validity were removed during the reliability, validity, and EFA procedures. Consequently, only measurement items that satisfied the required reliability and validity criteria were retained in the final PLS-SEM analysis.

5.2 Measurement Model Assessment

To validate the reflective measurement model, we conducted an analysis using SmartPLS (Ringle & Sarstedt, 2015). SmartPLS is a component-based approach that is relatively insensitive to sample size and data distribution, and imposes fewer theoretical assumptions than covariance-based structural equation modeling techniques. Due to these characteristics, SmartPLS has been widely employed in confirmatory factor analysis (CFA). This approach places greater emphasis on the explanatory and predictive power of exogenous variables for endogenous constructs than on overall model fit indices [35]. Accordingly, ensuring the reliability and consistency of the measurement items is a critical step in PLS-SEM, as the validity of structural path estimates depends fundamentally on the quality of the measurement model.

5.2.1 Internal Consistency Reliability and Convergent Validity

This study simultaneously evaluated the internal consistency reliability and convergent validity of the measurement model. Internal consistency reliability was examined using Cronbach's alpha (α), rho_A, and composite reliability (CR). Convergent validity was assessed based on outer loadings, average variance extracted (AVE), and composite reliability.

The results indicated that although the Cronbach's alpha and rho_A values for some constructs fell slightly below the conventional threshold of 0.70, the composite reliability values for all constructs exceeded the recommended minimum level of 0.70. Given that Cronbach's alpha tends to provide a conservative lower-bound estimate of reliability [36,37], the measurement instruments employed in this study can be regarded as exhibiting adequate overall internal consistency. With respect to convergent validity, all constructs demonstrated AVE values greater than 0.50, and composite reliability values exceeded 0.70 across all constructs. In addition, all measurement items exhibited outer loadings above 0.40, indicating that each indicator adequately represented its corresponding latent construct [28,38,39].

Table 2. Construct reliability and convergent validity.

		Outer Loadings $\geq$ 0.4	Indicator Reliability $\geq$ 0.7	Average Variance Extracted (AVE) $\geq$ 0.5	Composite Reliability (CR)
Reliability	Reliability 1	0.87	0.66	0.66	0.85

	Reliability 3	0.86			
Compatibility	Compatibility 1	0.88	0.69	0.69	0.87
	Compatibility 3	0.87			
Perceived Personalization	Perceived Personalization 2	1.00	1.00	1.00	1.00
Technology Orientation	Technology Orientation 1	0.88	0.70	0.71	0.87
	Technology Orientation 3	0.88			
Network Market Orientation	Network Market Orientation 2	0.84	0.64	0.65	0.85
	Network Market Orientation 4	0.88			
Pickup and Delivery System	Pickup and Delivery System 1	0.84			
	Pickup and Delivery System 3	0.82	0.74	0.75	0.85
	Pickup and Delivery System 4	0.78			
Continuance Intention	Continuance Intention 2	1.00	1.00	1.00	1.00

5.2.2 Discriminant Validity Assessment

Discriminant validity was comprehensively assessed using the Fornell–Larcker criterion, cross-loading, and the heterotrait–monotrait ratio (HTMT). First, the results based on the Fornell–Larcker criterion (Table 3) indicate that the square root of the AVE for each construct exceeded the corresponding inter-construct correlation coefficients in both rows and columns. This finding suggests that each latent construct is empirically distinct from the others and discriminant validity is satisfactorily established [28,38].

Second, the cross-loading analysis (Table 4) showed that all the measurement items loaded most strongly on their intended latent constructs and consistently exhibited higher loadings than any other construct. These results indicate that each indicator represents its designated construct and meets the discriminant validity criteria proposed by Chin [27]. Finally, the HTMT analysis (Table 5) revealed that all HTMT values between constructs were below the recommended threshold and that none of the corresponding confidence intervals included a value of one. According to the more stringent criteria recommended in recent PLS-SEM studies, these results provide additional confirmation that discriminant validity is adequately established [40].

Table 3. Discriminant validity assessment based on the Fornell–Larcker criterion.

	Reliability	Compatibility	Perceived Personalization	Technology Orientation	Network Market Orientation	Pickup and Delivery System	Continuance Intention
Reliability	0.86						
Compatibility	0.54	0.87					

Perceived Personalization	0.45	0.54	1.00				
Technology Orientation	0.63	0.69	0.57	0.88			
Network Market Orientation	0.65	0.65	0.50	0.60	0.86		
Pickup and Delivery System	0.66	0.69	0.61	0.71	0.64	0.81	
Continuance Intention	0.61	0.57	0.57	0.56	0.52	0.58	1.00

Table 4. Discriminant validity assessment based on cross-loadings.

	Reliability	Compatibility	Perceived Personalization	Technology Orientation	Network Market Orientation	Pickup and Delivery System	Continuance Intention
Reliability 1	0.87	0.50	0.41	0.55	0.57	0.61	0.54
Reliability 3	0.86	0.43	0.37	0.54	0.55	0.54	0.53
Compatibility 1	0.49	0.88	0.51	0.60	0.60	0.65	0.50
Compatibility 3	0.46	0.87	0.43	0.60	0.54	0.56	0.48
Perceived Personalization 2	0.45	0.54	1.00	0.57	0.50	0.61	0.57
Technology Orientation 1	0.55	0.58	0.53	0.88	0.49	0.61	0.52
Technology Orientation 3	0.56	0.62	0.47	0.88	0.55	0.63	0.46
Network Market Orientation 2	0.49	0.55	0.39	0.48	0.84	0.52	0.39
Network Market Orientation 4	0.62	0.57	0.46	0.54	0.88	0.57	0.50
Pickup and Delivery System 1	0.57	0.64	0.47	0.65	0.55	0.84	0.46
Pickup and Delivery System 3	0.55	0.48	0.55	0.57	0.50	0.82	0.48
Pickup and Delivery System 4	0.49	0.57	0.47	0.51	0.49	0.78	0.48
Continuance Intention 2	0.61	0.57	0.57	0.56	0.52	0.58	1.00

Table 5. Discriminant validity assessment based on the HTMT (Heterotrait–Monotrait ratio).

	Reliability	Compatibility	Perceived Personalization	Technology Orientation	Network Market Orientation	Pickup and Delivery System	Continuance Intention
Reliability							
Compatibility	0.80						
Perceived Personalization	0.56	0.65					
Technology Orientation	0.93	0.98	0.68				
Network Market Orientation	0.99	0.97	0.62	0.89			
Pickup and Delivery System	0.95	0.96	0.70	0.97	0.92		
Continuance Intention	0.76	0.68	0.57	0.66	0.65	0.68	

5.3 Evaluation of the PLS-SEM Structural Model

PLS-SEM analysis was conducted using the SmartPLS software. The path coefficients and outer loadings of the structural model were estimated using the PLS algorithm, and the statistical significance of the path coefficients was assessed using a bootstrapping procedure. Bootstrapping was performed with 500 re-samples, from which t-values, p-values, and bias-corrected confidence intervals were obtained. The explanatory power of the structural model was evaluated by examining the coefficient of determination (R^2). The resulting structural model derived from the PLS-SEM analysis is shown in Fig. 4.

To comprehensively evaluate the explanatory and predictive powers of the structural model, this study examined the coefficient of determination (R^2), predictive relevance (Q^2), and multicollinearity using variance inflation factors (VIF).

The R^2 values were 0.60 for technology orientation, 0.56 for network market orientation, 0.57 for pickup and delivery system, and 0.34 for continuance intention, as shown in Table 6. According to Cohen and Levinthal's [41] guidelines, these values indicate that the model achieves adequate explanatory power for all endogenous constructs. The predictive relevance was assessed using blindfolding-based Q^2 values. The Q^2 values were 0.44 for technology orientation, 0.39 for network market orientation, 0.36 for pickup and delivery system, and 0.31 for continuance intention, as illustrated in Table 7. All Q^2 values were greater than zero and exceeded the threshold of 0.26, indicating strong predictive relevance (Fornell & Cha, 1993; Geisser, 1974; Stone, 1974). Multicollinearity was assessed by examining VIF values. The results (Table 8) show that all inner VIF values were below the conservative threshold of 5, suggesting that multicollinearity among the constructs does not pose a concern in the structural model [28] (see also Henseler et al. 2013).

Overall, these results indicate that the proposed structural model is appropriate for hypothesis testing, demonstrating satisfactory explanatory power, strong predictive relevance, and absence of significant multicollinearity issues.

Table 6. Evaluation of the coefficient of determination (R^2).

	R Square	Adjusted R-squared
Technology Orientation	0.60	0.59
Continuance Intention	0.34	0.34
Pickup and Delivery System	0.57	0.57
Network Market Orientation	0.56	0.55

Table 7. Evaluation of predictive relevance (Q^2).

변수	SSO	SSE	$Q^2 (=1-SSE/SSO)$
Reliability	360.00	360.00	
Compatibility	360.00	360.00	
Perceived Personalization	180.00	180.00	
Technology Orientation	360.00	201.51	0.44
Network Market Orientation	360.00	219.85	0.39
Pickup and Delivery System	540.00	343.42	0.36
Continuance Intention	180.00	124.13	0.31

Table 8. Evaluation of inner VIF values.

	Reliability	Compatibility	Perceived Personalization	Technology Orientation	Network Market Orientation	Pickup and Delivery System	Continuance Intention
Reliability							
Compatibility							
Perceived Personalization							
Technology Orientation	1.49	1.68	1.49				
Network Market Orientation	1.49	1.68	1.49				
Pickup and Delivery System				1.55	1.55		
Continuance Intention						1.00	

5.4 Hypothesis Testing Results

5.4.1 Direct Effects Path Coefficient

Hypotheses regarding the direct effects in the structural model were tested using SmartPLS, and the statistical significance of the path coefficients was evaluated based on the t- and p-values obtained from the bootstrapping procedure [27,28]. Table 9 presents the results of these tests.

The analysis reveals that the platform characteristics of reliability and compatibility exert significant positive effects on both dimensions of strategic orientation, namely, technology orientation and network market orientation. Reliability has a significant positive effect on technology orientation ($\beta = 0.33$, $t = 5.61$, $p < .001$) and network market orientation ($\beta = 0.40$, $t = 6.49$, $p < .001$). Compatibility also demonstrates significant positive effects on both strategic orientation variables. In contrast, perceived personalization has a significant effect on technology orientation, but its effect on network market orientation is not statistically significant. Furthermore, strategic orientation has a significant positive effect on pickup and delivery systems, which represents logistics consolidation performance. In turn, pickup and delivery systems had a significant positive effect on continuance intention.

Table 9. Significance testing of structural model path coefficients.

Path	Path Coefficient	Standard Error	t-value	p-value	Bias-corrected 95% Confidence Interval		Hypothesis Result
Reliability → Technology Orientation	0.33	0.06	5.61	0.00	0.22	0.45	Supported
Reliability → Network Market Orientation	0.40	0.06	6.49	0.00	0.28	0.52	Supported
Compatibility → Technology Orientation	0.40	0.06	6.66	0.00	0.28	0.51	Supported
Compatibility → Network Market Orientation	0.37	0.06	5.55	0.00	0.24	0.49	Supported
Perceived Personalization → Technology Orientation	0.21	0.07	3.23	0.00	0.08	0.33	Supported
Perceived Personalization → Network Market Orientation	0.12	0.06	1.71	0.09	-0.01	0.25	Not Supported
Technology Orientation → Pickup and Delivery System	0.51	0.07	8.99	0.00	0.40	0.61	Supported
Network Market Orientation → Pickup and Delivery System	0.33	0.06	5.22	0.00	0.21	0.46	Supported
Pickup and Delivery System → Continuance Intention	0.58	0.07	8.02	0.00	0.41	0.70	Supported

5.4.2 Mediation Effect of Delivery and Pickup System

To examine the mediating effect of the pickup and delivery system on the relationship between strategic orientation and continuance intention, this study compared a reduced model and a full model and calculated the effect size (f^2) based on changes in the coefficient of determination (R^2) [27,41].

The effect size (f^2) was computed using the following formula:

$$f^2 = \frac{R_{full}^2 - R_{reduced}^2}{1 - R_{full}^2}$$

The results indicate that the explanatory power of the full model increased compared to that of the reduced model, with an effect size (f^2) of 0.059, which corresponds to a small effect according to the established criteria.

The path coefficient analysis further shows that in the full model, the delivery and pickup system exerted a significant positive effect on continuance intention, while the direct effects of the strategic orientation variables were reduced. This pattern suggests that the delivery and pickup system mediates the relationship between strategic orientation and continuance intention. The statistical significance of the mediation effect was additionally confirmed using the Sobel test [42]. That test revealed that both network market orientation and technology orientation exhibited significant indirect effects through the delivery and pickup system.

Table 10. Results of the PLS path model analysis (reduced model and full model).

(Standardized coefficients, standard errors, and t-values)

Step	Path Model	Path Coefficient	Standard Deviation	t-value	R^2
Step 1: Reduced Model	Network Market Orientation → Continuance Intention	0.302	0.074	4.109***	0.371
	Technology Orientation → Continuance Intention	0.379	0.078	4.941***	
Step 1: Full Model	Network Market Orientation → Continuance Intention	0.203	0.079	2.553*	0.405
	Technology Orientation → Continuance Intention	0.232	0.088	2.601**	
	Network Market Orientation → Pickup and Delivery System	0.335	0.066	4.996***	
	Technology Orientation → Pickup and Delivery System	0.507	0.060	8.934***	
	Pickup and Delivery System → Continuance Intention	0.289	0.086	3.124**	

* $p < .05$, ** $p < .01$, *** $p < .001$

Table 11. Results of the Sobel test.

Mediation Path	a	sa	b	sb	Z-value	Significance
		(Standard Error)		(Standard Error)		

	(Coefficient)	Error)	(Coefficient)	Error)		
Network Market Orientation → Pickup and Delivery System → Continuance Intention	0.335	0.066	0.289	0.086	2.802	Significant (p < .01)
Technology Orientation → Pickup and Delivery System → Continuance Intention	0.507	0.060	0.289	0.086	3.122	Significant (p < .01)

6. Conclusion

This study empirically examines the structural relationships among platform characteristics, strategic orientation, pickup and delivery system, and continuance intention at the latent variable level by focusing on freight transport operators in Jeollanam-do, a region characterized by relatively low utilization of digital logistics platforms. To this end, an integrated research model combining the Technology-Organization-Environment (TOE) framework, the Expectation–Confirmation perspective, and dynamic capabilities theory was developed and tested using PLS-SEM.

The results indicate that platform reliability and compatibility exert significant positive effects on the latent dimensions of strategic orientation—namely, technology orientation and network market orientation ($\beta = 0.33\text{--}0.40$, $p < .01$). In turn, the strategic orientation latent variables have significant positive effects on the pickup and delivery system latent construct ($\beta = 0.33\text{--}0.51$, $p < .01$). Moreover, the pickup and delivery system latent variable exhibits a strong positive effect on the continuance intention latent variable ($\beta = 0.58$, $p < .01$). As the direct effects of strategic orientation decrease in the full model, the mediating role of pickup and delivery system is confirmed. This mediating effect is further validated using the Sobel test, which demonstrates statistical significance ($Z = 2.80\text{--}3.12$, $p < .01$ [42]).

These findings suggest that continuance usage of digital logistics platforms is not determined by isolated technological functionalities at the level of individual observed variables, but rather by a comprehensive evaluation of strategically constructed perceptions and performance outcomes of the pickup and delivery system, represented as latent variables. The results empirically demonstrate, through structural relationships among latent constructs, that information-based logistics consolidation enabled by digital platforms can be a realistic and effective alternative in regions where implementing physical consolidation is difficult.

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Author contributions

Seon-Ok Park conceived the initial draft, performed the theoretical literature review, and prepared the manuscript as the first author. Min Jung Kang, serving as the corresponding author, conceptualized the study, developed the methodology, and articulated the significance of the research.

Declarations of competing interests

The authors declare no conflicts of interest regarding the publication of this paper.

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Figures

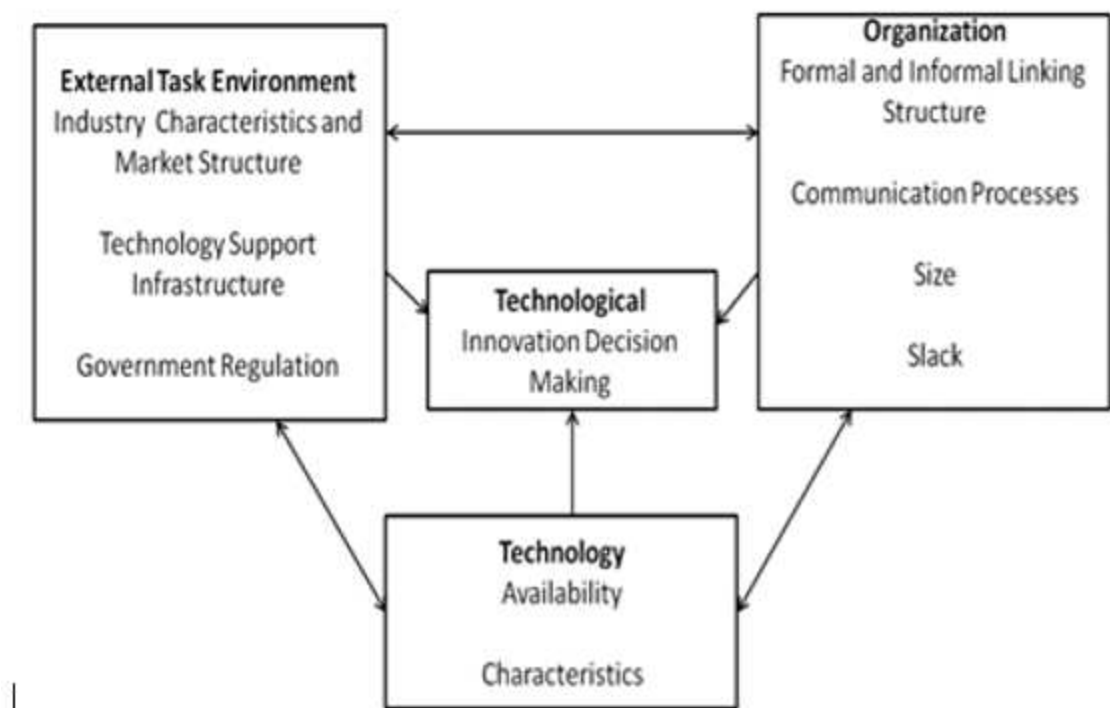


Figure 1

TOE framework (Tornatzky & Fleischer, 1990).

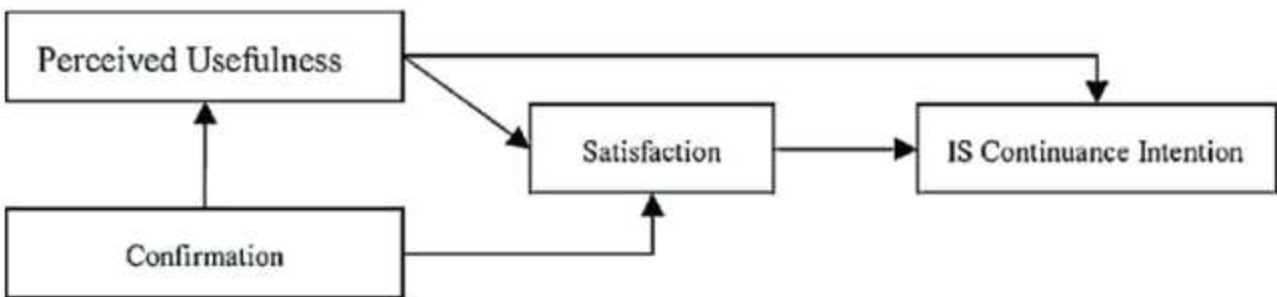


Figure 2

The expectation confirmation model [15].

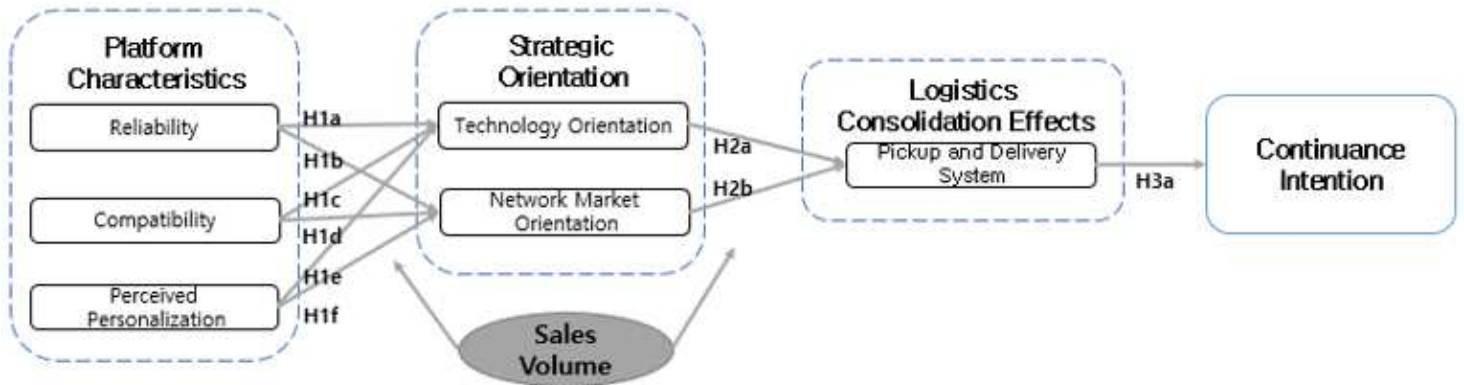


Figure 3

Conceptual research model.

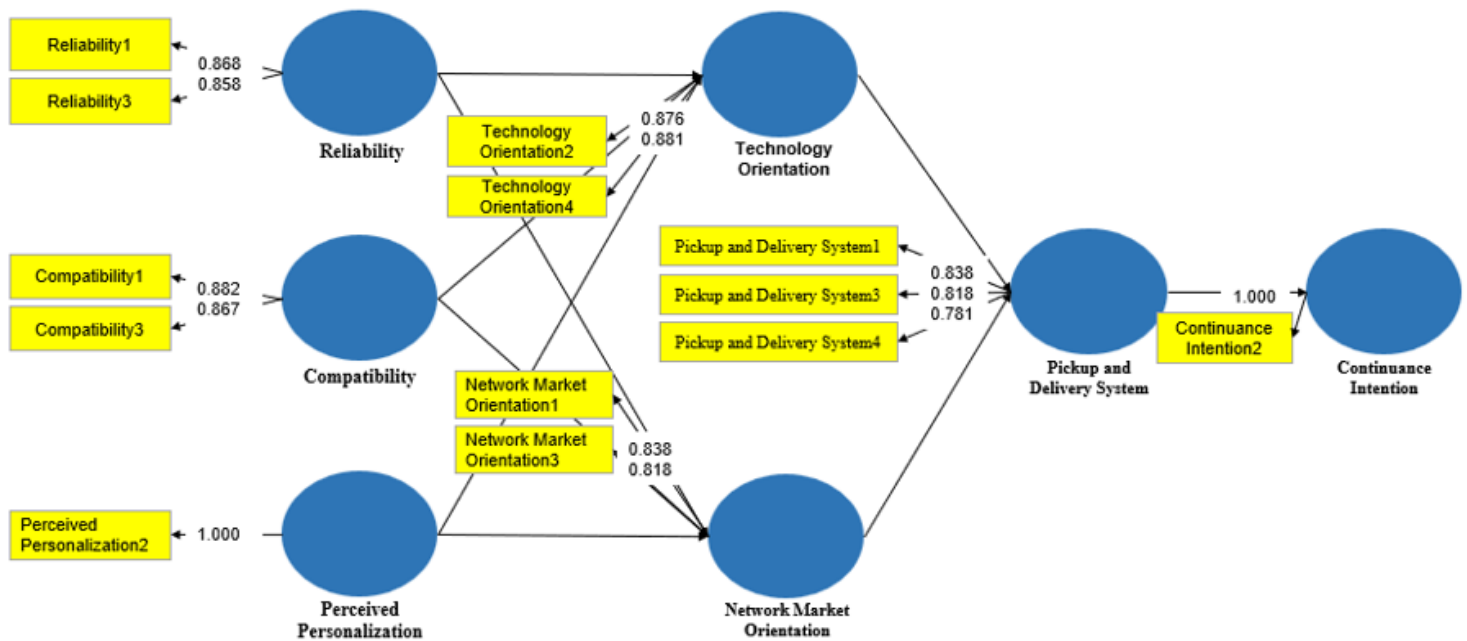


Figure 4

PLS-SEM structural model.