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Factors Influencing Digital Transformation of Logistics Service Providers: A Case Study in Thailand

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Abstract

This research explores and develops digital transformation factors influencing the logistics service-provider sector in Thailand while also examining the impact sustainability factors associated with digital transformation. Divided into two parts, Part one of the theoretical study framework covers 21 factors relating to logistics, including drivers, objectives, implications, and success factors. The second part concerns 23 factors associated with logistics sustainability, including economic, environmental, and social aspects. This quantitative empirical research was conducted using an online questionnaire instrument, and a structural equation modeling (SEM) technique was used to test the proposed model. The findings from 545 samples collected between August and November 2020 from respondents working in logistics service-provider companies in Thailand show that digital transformation drivers and objectives seem likely to impact success factors and implications in digital transformation positively. Digital transformation success factors also positively impact logistics sustainability. In comparison, logistics sustainability has a significant impact on Thailand's logistics service-provider sector's economic, environmental, and social aspects. Lastly, this research highlights the significance of digital transformation success factors and extends the current knowledge about digital transformation factors and their potential impact on logistics sustainability.

Keywords: Digital Transformation, Logistics Sustainability, Logistics Service Providers

JEL Classification Code: M19, O20, O30, Q56

1. Introduction

The application of digital technology in the logistics business shows a growing trend. Businesses across every sector are now adopting digital technologies and reshaping their models in line with new digital transformation trends. They come up with new processes or modify the existing ones, build new company cultures, and even introduce brand-new customer experiences to satisfy the changing needs of consumers and market demands. Digital transformation in logistics and transportation helps companies from the sector to take advantage of new technologies and stay competitive in a market that is continuously expanding. These include the web, the cloud, sensors, data analytics, machine learning, blockchain technology, and the Internet of Things (IoT), which improve vertical and horizontal alignment around supply chain networks.

Representing a revolutionary change in business thinking and logistics implementation, this digital transformation is likely to create a need for a new business model to produce smarter, more enabled, efficient, and feasible digital logistics. To achieve authentic and real-time information exchange among supply chain stakeholders, it is necessary to adopt useful technologies such as sensor-enabling technology, the IoT, and Cloud-based database systems (Schrauf & Berttram 2016) The integration of these technologies with the supply network offers easy access to customer needs by effectively sharing the tracking information of product or service

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deliveries. This technological integration can typically entail high costs with slow diffusion (Korpela et al., 2017).

Another goal of business is sustainability. Sustainable digital logistics will require firms to reconsider their digital business strategies and reorganize the direction of business operations throughout the supply chain towards more sustainability, including balanced, sustainable economic, environmental, and social development, representing complex inter-relationships. Digital transformation in logistics and supply chain management is the changes in value creation by the use of digital transformation technologies (DTT), an adaptation of strategies and processes, and the adaptation of enablers such as innovation and leadership to support the achievement of goals such as an increase in agility, higher productivity, and a more customer-centric supply chain. The main drivers concerning manufacturers' investment in logistics and supply chain management are to achieve real-time product visibility, faster innovation, and lower cost to serve as well as an improvement in planning (Salam & Hoque, 2019).

The latest research suggests that digital transformation in logistics and supply chain management is currently evolving, and there is still no clear understanding of its concrete implications (Junge et al., 2020). This exploratory research paper intends to provide insights into more sustainable logistics and supply chain management. Specifically, the study aims to identify digital transformation factors influencing logistics sustainability and examine the impact of digital transformation on sustainable logistics and logistics service providers (LSPs) in Thailand.

2. Literature Review

2.1. Digital Transformation

Digital transformation has mainly been associated with the need to use emerging technologies to maintain viability in the Internet era. Both online and offline services and products are distributed to the customer (Puriwat & Tripopsakul, 2021). The transformation of online services has increased flexibility and automation by standardization (Andal-Ancion et al., 2003). Digital technology is rapidly developing globally because of its widespread availability, portability. More importantly, its capability to transmit information, merchandise, and distribute content (Lee et al., 2015). According to consumer demand, some define transformation as a process of updating business models to use the latest technologies (Berman, 2012). The effects of digital transformation strategies include market delivery changes and new types of direct customer interactions, such as adapting goods and services to changing customer needs through social media (Bilgeri et al., 2017). Digitization provides for the development of network economies, in which the core business model offers a platform for interactions between external suppliers and consumers. (Bechtsis et al., 2017).

2.1.1. Digital Transformation among LSPs

Digitization disrupts logistics systems to the degree that it enables processes to be streamlined or increases efficiencies. The logistics networks of businesses can become more environmentally sustainable using analytics (including hyperconnectivity, supercomputing, and big data). Companies can use technology to save money and contribute to a more efficient and environment-friendly approach. A white paper from the World Economic Forum shows that the value of the logistics industry could increase by up to US$ 1.5 trillion by 2025 (Weinelt, 2016). Digital logistics comprises four main elements: technology, operation, organization, and expertise (Stuermer et al., 2011).

2.1.2. Factors Involved in Digital Transformation

A systematic review of publications on digitization and related concepts was conducted by Morakanyane et al. (2017), who evaluated 21 research-related contributions, dividing them into three groups, based on which research may contribute useful insights: drivers and goals, success factors, and implications (Osmundsen et al., 2018). Drivers and goals are responsible for initiating and affecting digital transformation (Morakanyane et al., 2017). Essential organizational elements for digital transformation are linked to success factors. Implications relate to the impacts of an enterprise's digital change (Morakanyane et al., 2017).

2.2. Logistics Services Providers (LSPs)

LSPs play an essential role in the global supply chain by delivering goods or services from suppliers to customers. Globalization has become a crucial driver in shaping business strategies. In the last two decades, leading firms have developed products for the global market while also having to source components worldwide (Banomyong & Supatn, 2011). External trade growth has occurred in both directions, i.e., imports and exports, with newly industrializing countries such as Singapore, Malaysia, Thailand, and Indonesia experiencing substantially higher growth. Increased world trade has resulted in increased demand for logistics services, as well as increased competition in the sector. The Council of Supply Chain Management Professionals defined LSPs as "Any business which provides logistics services including those businesses typically referred to as 3PL, 4PL, LLP, etc. Services may include provisioning, transport, warehousing, packaging, and so on." (CSCMP, 2013 p. 117). According to Multaharju and Hallikas (2015), third-party logistics (3PLs) are "activities carried out by a logistics service provider on behalf of a shipper and consisting of at least management and

execution of transportation and warehousing (if warehousing is part of the process)" Razzaque and Sheng (1998). described 3PLs as "the use of external companies to perform logistics functions which have traditionally been performed within an organization". A third-party firm's responsibilities may include the entire logistics process or specific tasks within it. The use of LSPs is indisputably linked to business outsourcing in the same way as a driven model of business competitiveness.

2.3. Logistics Sustainability

Digitization facilitates the automation of workflows and accelerating the production and distribution of documents (Choi et al., 2019). A sustainable digital logistics ecosystem reveals how digitization can impact logistics from a sustainable economic, environmental, and social perspective (Monnet & Le Net, 2011) The characteristics of sustainability dimensions can be summarised as follows:

Economic: An affordable mechanism that works effectively, provides collaborative solutions and a mixture of choices in the mode of transport, and benefits the local economy.

Environmental: Decreased greenhouse gas emissions, pollution, and waste; minimized non-renewable energy use; and the use of technologies that reuse and recycle their components.

Social: An essential individual/community access criterion to be safer and encourage healthier behaviors and equality within and across generations (Kayikci, 2018). Sustainability is especially playing a pivotal role in dealing with the business' ascent in terms of speed and change (Fakir & Jusoh, 2020).

3. Conceptual Framework and Hypothesis Development

The effect of digital transformation factors on the competitiveness of LSPs in Thailand is described in this report. The research uses a sequential exploratory design, characterized by the collection and analysis of quantitative data. The experimental research examined all applicable current models and gathered data from previous studies on warehouse activity services and distribution among Thailand's LSPs, focusing on various factors, including digital transformation and logistics sustainability. The results of the literature review helped to establish the conceptual model.

The following research hypotheses were formulated concerning the link shown in Figure 1 between digital transformation factors and the Sustainability of LSPs in Thailand. This research will be useful in explaining issues related to sustainability. The hypotheses proposed, based on the conceptual model, are described below:

H1: *The drivers of digital transformation create a positive impact on digital transformation success factors.*

H2: *The objectives of digital transformation have a positive impact on digital transformation success factors.*

H3: *Digital transformation success factors have a positive impact on logistics sustainability.*

H4: *Logistics sustainability has a positive impact on the economic impact of logistics sustainability.*

H5: *Logistics sustainability has a positive impact on the environmental impact of logistics sustainability.*

H6: *Logistics sustainability has a positive impact on the social impact of logistics sustainability.*

H7: *Digital transformation success factors have a positive impact on the implications of digital transformation*.

4. Research Methodology

4.1. Research Design and Data Collection

Using an online survey questionnaire, a quantitative method was used to examine the research hypotheses and test the proposed model. SPSS AMOS 20.0, using structural equation modeling (SEM), was used to analyze and test the

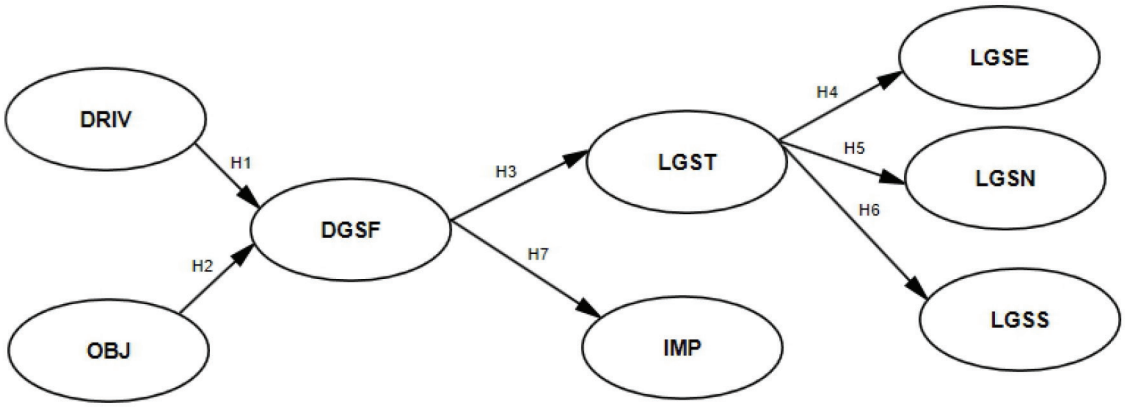

Figure 1: A proposed Research Framework

data. The questionnaire was developed in consultation with a group of logistics experts from business and academia, following a series of interviews. Quantitative data was collected through the questionnaire survey. The structured questionnaire comprised questions on the effects of digital transformation factors on the competitiveness of LSPs in Thailand. The survey research phase included the generation of hypotheses based on established literature and theory, research design, instrument design, sample design, data collection, data analysis, and inference making (Bell & Bryman, 2007).

4.2. Questionnaire Development

The research questionnaire was developed based on the instrument creation methods suggested by Churchill and Gilbert (1979) and Haynes (1995), involving three stages. Stage 1 consists of examining studies in the literature review, defining the construct, and producing a sample of factors to operationalize each construct. Stage 2 involved instrument development and data collection. This study used questions formulated using a Likert scale, which is often used in similar research and enables respondents to display a favorable or unfavorable attitude toward the object of interest (Cooper & Schindler, 2006). Pre-testing the instrument involves content validity testing to ensure that standardized procedures are applied during data collection.

The pilot study involved appraising and refining the tool and examining the internal consistency of the factors. After a pre-test with eleven industry and academia experts, the results showed one additional driver of digital transformation, namely technology transfer from foreign countries. Regarding the digital transformation objectives, there were two new factors: reducing operational costs and competitive advantage. There were also two new digital transformation success factors: leadership vision and information technology acceptance. Logistics sustainability in terms of the economy and the environment remained the same.

In contrast, logistics sustainability in society saw two new factors: visibility and social enterprise. Finally, the implications for digital transformation remained at three factors. The questionnaire was then validated using index objective congruence (IOC), and its reliability was tested using Cronbach's alpha. The IOC, obtained from interviewing eleven experts in logistics, was more significant than 0.5. Next, the reliability was tested in a pilot study of 30 individuals involved in the logistics industry. In total, Cronbach's alpha was more significant than 0.7, except for the digital transformation driver construct, a changing competitive landscape, which was 0.517.

The results revealed a total of 51 factors which, along with constructs and measurement scales, are presented in Table 1.

Exploratory factor analysis is a statistical technique that is used to reduce data to a smaller set of summary variables and to explore the underlying theoretical structure of the phenomena. It is used to identify the structure of the relationship between the variable and the respondent. In this study, the inter-relationships among the four dimensions of digital transformation and the three dimensions of logistics sustainability were examined using exploratory factor analysis (EFA) to establish the underlying dimensionality of digital transformation and logistics sustainability construct. The result of KMO value near 1.0 and Bartlett's Test significance near 0.00 indicates that the data is adequate and suitable to continue the reduction process (Hoque & Awang, 2016). The output shown in Table 2 demonstrates that seven dimensions or components were obtained using the EFA method, which suggests a drop item when the factor loading value is below 0.5 (Mvududu & Sink, 2013). Table 2 below summarizes the EFA output. Overall, the EFA procedure dropped seven items under the seven dimensions of digital transformation and logistics sustainability constructs, while 44 items were considered for confirmatory factor analysis (CFA).

5. Results

5.1. Sample Profile

Data was collected through a self-completed online questionnaire distributed to Logistics Service Providers (LSPs) employees in Thailand. To pinpoint the specific research areas, we compiled a list of five well-known LSP associations in Thailand, viz., The Federation of Thai Industries (TILOG), the Thai International Freight Forwarders Association (TIFFA), the Thai Airfreight Forwarders Association (TAFA), the Thai Logistics and Productions Society (TLAP), and the Thai Transportation & Logistics Association (TLTA). Data from a total of 545 valid questionnaires was used for the data analysis. SPSS statistics 25 was used to generate descriptive statistics to analyze respondents' demographic characteristics. The primary service offered was Transportation service at 33.6%, the most common number of employees was 100 to 500 people (33%), the most frequent length of work experience was 2 to 5 years (34.5%), and the most common annual income was THB 100–500 million (22%) (Table 3).

5.2. Measurement Model

Confirmatory factor analysis was used to assess the relationships between constructs and their retained objects. To estimate the presumed relationships of the variables, a total goodness-of-fit test was conducted, as well as separate tests for significance. This model contains 44 observable variables and seven latent variables. Table 4 summarises

Table 1: Summary of Questionnaire Constructs, Variables, and Results from the Pilot Validity and Reliability Tests

Construct	No	Item	Factor Criteria	IOC	Cronbach's Alpha
Digital transformation drivers	1	DV1	Customer behavior and expectations	0.91	0.517
	2	DV2	Digital shifts in the industry	0.82	
	3	DV3	Changing competitive landscape	0.91	
	4	DV4	Regulatory changes	0.64	
	5	DV5	Technology transfer from foreign countries*	0.55	
Digital transformation objectives	6	OB1	Ensure digital readiness	0.82	0.844
	7	OB2	Digitally enhance products	0.55	
	8	OB3	Embrace product innovation	0.64	
	9	OB4	Develop new business models	0.73	
	10	OB5	Improve digital channels	0.91	
	11	OB6	Increase customer satisfaction	0.82	
	12	OB7	Reduce operation costs*	0.82	
	13	OB8	Competitive advantage*	0.82	
Digital transformation success factors	14	SF1	A supportive organizational culture	0.82	0.803
	15	SF2	Well-managed transformation activities	0.82	
	16	SF3	Leverage external and internal knowledge	0.82	
	17	SF4	Engage managers and employees	0.64	
	18	SF5	Grow information system capabilities	1.00	
	19	SF6	Develop dynamic capabilities	0.82	
	20	SF7	Develop a digital business strategy	0.91	
	21	SF8	Align business and information systems	0.73	
	22	SF9	Leadership vision*	0.55	
	23	SF10	Information technology acceptance*	0.64	
Implications for digital transformation	24	IP1	Reforming an organisation's information system	64	0.82
	25	IP2	New business model	0.91	
	26	IP3	Effect outcome and performance	0.91	
Logistics sustainability – economics	27	LSE1	Logistics costs	1.00	0.905
	28	LSE2	Delivery time	0.73	
	29	LSE3	Transport delays	0.55	
	30	LSE4	Inventory reduction	0.55	
	31	LSE5	Loss/damage	0.64	
	32	LSE6	Frequency of service	0.55	
	33	LSE7	Forecast accuracy	0.64	
	34	LSE8	Reliability	0.73	
	35	LSE9	Flexibility	0.73	
	36	LSE10	Transport volume	0.64	
	37	LSE11	Application	0.64	

Table 1: (Continued)

Construct	No	Item	Factor Criteria	IOC	Cronbach's Alpha
Logistics sustainability – environment	38	LSN1	Resource efficiency	0.64	0.876
	39	LSN2	Process energy	0.55	
	40	LSN3	Process emissions	0.64	
	41	LSN4	Waste	0.55	
	42	LSN5	Pollution	0.64	
	43	LSN6	Land-use impact	0.64	
Logistics sustainability – society	44	LSS1	Development benefits	0.55	0.913
	45	LSS2	Impacts	0.55	
	46	LSS3	Health	0.64	
	47	LSS4	Safety	0.73	
	48	LSS5	Labor patterns	0.64	
	49	LSS6	Acceptance	0.64	
	50	LSS7	Visibility*	0.64	
	51	LSS8	Social enterprise*	0.64	

*New Items from Expert.

Table 2: Summary of EFA Output

Construct	No. of Items before EFA	Items Dropped	Reason for Dropping	No. of Items after EFA
Digital transformation drivers	5	DV3 changing competitive landscape	Factor loading <0.5	4
Digital transformation objectives	8	–	Factor loading <0.5	8
Digital transformation success factors	10	–	Factor loading <0.5	10
Implications for digital transformation	3	–	Factor loading <0.5	3
Logistics sustainability in economics	11	LSE11 Application	Factor loading <0.5	10
Logistics sustainability in the environment	6	LSN1 Resource efficiency LSN2 Process energy	Factor loading <0.5	4
Logistics sustainability in society	8	LSS3 Health LSS4 Safety LSS8 Social enterprise	Factor loading <0.5	5
Total	51	7		44

the items and constructs of our measurement model. The Cronbach's value, which measures the reliability of the model variables, was between 0.745 and 0.922 (Table 4). Each construct and its respective subscales have values greater than 0.7, confirming the constructs' internal consistency.

The discriminant and convergent validities of the constructs were also determined. Three indices were used to assess concurrent validity: factor loading values should be more than 0.7, mean extracted variance (AVE) values should be more than 0.5, and composite reliability (CR) values should be more than 0.7, except for the digital transformation driver construct, the value of AVE is less than 0.5 (0.482); however, validity is still adequate due to composite reliability being higher than 0.6 (Fornell & Larker, 1981). The degree

Table 3: Descriptive Statistics

	Thai-Owned		Foreign-Owned		Joint Venture		All Respondents	
Primary Service	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Logistics service provider	41	17.4	38	28.6	34	19.2	113	20.7
Freight forwarder	54	23.0	34	25.6	57	24.3	145	26.6
Warehouse service	45	19.1	27	20.3	32	13.6	104	19.1
Transportation service	95	40.4	34	25.6	54	23.0	183	33.6
Total	235	100	133	100	177	100	545	100
Number of Employees								
1,000–2,000	21	9.2	23	17.0	25	13.8	69	12.7
100–500	77	33.6	34	25.2	69	38.1	180	33.0
500–1,000	32	14.0	21	15.6	27	14.9	80	14.7
Less than 100	80	34.9	22	16.3	38	21.0	140	25.7
More than 2,000	19	8.3	35	25.9	22	12.2	76	13.9
Total	229	100	135	100	181	100	545	100
Work Experience (years)								
2–5	84	37.0	39	27.5	65	36.9	188	34.5
6–10	36	15.9	40	28.2	45	25.6	121	22.2
<2	69	30.4	31	21.8	37	21.0	137	25.1
>10	38	16.7	32	22.5	29	16.5	99	18.2
Total	227	100	142	100	176	100	545	100
Annual Income (million Thai baht)								
1,000–2,000	15	6.5	16	11.6	14	8.0	45	8.3
100–500	53	22.9	16	11.6	52	29.5	121	22.2
2,000–3,000	17	7.4	11	8.0	14	8.0	42	7.7
3,000–4,000	9	3.9	15	10.9	21	11.9	45	8.3
4,000–5,000	12	5.2	23	16.7	18	10.2	53	9.7
500–1,000	36	15.6	17	12.3	24	13.6	77	14.1
>100	67	29.0	14	10.1	19	10.8	100	18.3
>5,000	22	9.5	26	18.8	14	8.0	62	11.4
Total	231	100	138	100	176	100	545	100.0

of factors that helps in distinguishing one construct from another is called discriminant validity. The criterion for sufficient discriminant validity is that the square root of AVE for each construct should be greater than the relation between that construct and another, confirming each construct's discriminant validity. Overall, in the context of divergent and convergent validity, a satisfactory construct validity level is indicated by test results, implying that the research constructs are a suitable fit for a structural model assessment.

5.3. Structural Model and Hypothesis Testing

The hypotheses underlying the proposed research model were tested and used to evaluate the structural model. IBM

Table 4: Summary of the Measurement Model and its Constructs

Dimension	No	Factor	Loading	*t*-value	SE	Cronbach's Alpha	CR	AVE
Digital transformation driver	1	DV1	0.736	–	–	0.745	0.787	0.482
	2	DV2	0.678	14.236	0.68			
	3	DV4	0.585	12.463	0.082			
	4	DV5	0.754	13.626	0.088			
Digital transformation objectives	5	OJ1	0.663	15.079	0.061	0.899	0.905	0.544
	6	OJ2	0.716	16.598	0.064			
	7	OJ3	0.783	18.089	0.061			
	8	OJ4	0.753	17.401	0.064			
	9	OJ5	0.804	18.601	0.062			
	10	OJ6	0.730	–	–			
	11	OB7	0.635	14.933	0.068			
	12	OJ8	0.799	17.504	0.062			
Digital transformation success factors	13	SF1	0.627	–	–	0.922	0.921	0.538
	14	SF2	0.772	15.972	0.072			
	15	SF3	0.731	14.563	0.079			
	16	SF4	0.700	14.078	0.078			
	17	SF5	0.789	14.471	0.083			
	18	SF6	0.713	14.145	0.079			
	19	SF7	0.784	14.73	0.085			
	20	SF8	0.778	15.174	0.08			
	21	SF9	0.678	13.684	0.075			
	22	SF10	0.731	14.478	0.075			
Implications for digital transformation	23	IP1	0.735	16.594	0.063	0.786	0.786	0.551
	24	IP2	0.779	15.91	0.062			
	25	IP3	0.711	–	–			
Logistics sustainability in economics	26	LSE1	0.791	–	–	0.918	0.862	0.611
	27	LSE2	0.763	18.234	0.055			
	28	LSE3	0.674	15.183	0.064			
	29	LSE4	0.682	15.426	0.062			
	30	LSE5	0.703	15.85	0.065			
	31	LSE6	0.738	16.366	0.062			
	32	LSE7	0.687	15.595	0.061			
	33	LSE8	0.709	16.084	0.059			
	34	LSE9	0.760	17.192	0.06			
	35	LSE10	0.703	15.9	0.061			
Logistics sustainability in environment	36	LSN3	0.781	–	–	0.844	0.862	0.761
	37	LSN4	0.781	18.61	0.053			
	38	LSN5	0.788	18.823	0.055			
	39	LSN6	0.774	15.257	0.059			

Table 4: (Continued)

Dimension	No	Factor	Loading	*t*-value	SE	Cronbach's Alpha	CR	AVE
Logistics sustainability in society	40	LSS1	0.806	–	–	0.913	0.865	0.562
	41	LSS2	0.707	17.899	0.051			
	42	LSS5	0.750	19.217	0.052			
	43	LSS6	0.682	16.839	0.055			
	44	LSS7	0.795	17.848	0.056			

Note: AVE: Average Variance Extracted; CR: Composite Reliability; SE: Standard Error.

Table 5: Hypothesis Testing

Hypothesis	Path	Loading	*t*-value	Result
(H1). DRIV creates a positive impact on DGSF	DGSF ← DRIV	0.305	5.219	Supported
(H2). OBJT has a positive impact on DGSF	DGSF ← OBJT	0.863	9.748	Supported
(H3). DGSF has a positive impact on LGST	LGST ← DGSF	0.891	10.001	Supported
(H4). LGST has a positive impact on LGSE	LGSE ← LGST	0.946	–	
(H5). LGST has a positive impact on LGSN	LGSN ← LGST	0.829	14.410	Supported
(H6) LGST has a positive impact on LGSS	LGSS ← LGST	0.948	16.547	Supported
(H7). DGSF has a positive impact on IMP	IMP ← DGSF	0.852	4.148	Supported

Amos software (version 22) was used to conduct a path analysis for investigating the causal model. This model's goodness-of-fit indicators are as follows: Root Mean Square Error of Approximation (RMSEA) = 0.052; Comparative Fit Index (CFI) = 0.958; Tucker-Lewis Index (TLI) = 0.947; Normed Fit Index (NFI) = 0.943; Goodness of Fit Index (GFI) = 0.916; df = 124; Chi-square = 313.705; Minimum discrepancy per degree of freedom CMIN/df = 2.530. These indicators met the required cut-off values, suggesting a good model fit. Table 5 summarises the results of hypothesis testing that indicate the variables' relationship with significance relationship.

It was revealed by the regression analysis results that perceived DRIV creates a positive impact on DGSF (SE = 0.56; $\beta = 0.305$; $p < 0.001$; supporting H1), while OBJT has a positive impact on DGSF (SE = 0.60; $\beta = 0.863$ $p < 0.001$; supporting H2). DGSF has a positive impact on LGST (SE = 0.69; $\beta = 0.891$ $p < 0.001$; supporting H3). For Hypotheses 4, 5, and 6, the SEM results also revealed that LGSE, LGSN, and LGSS have a significant positive influence on logistics sustainability (SE = 0.68, 0.63 and 0.88, respectively), with (SE = 0.98; $\beta = 0.946$, 0.829, and 0.948 $p < 0.001$; supporting H4, H5 and H6). Finally, DGSF has a positive impact on IMP (SE = 0.98; $\beta = 0.852$ $p < 0.001$; supporting H7).

6. Discussion and Conclusion

The research has explored and confirmed the influence of digital transformation on the Sustainability of Logistics Service Providers in Thailand. Digitalization and sustainability strategies should become a cornerstone of LSPs' business practices, and firms must employ digital policies to implement their sustainability responsibility initiatives. This DGSF can be an effective way for firms to be sustainable; initiatives like DRIV need to focus on adapting technology transfer from foreign countries, and OBJT concentrates on improving digital channels. The primary part of DGSF relies on growth in information system capabilities and developing a digital business strategy to enhance logistics sustainability by paying attention to saving logistics costs. Environment issues need the initiation of a policy to reduce pollution. And in respect of the Social factor, the corporations have to pay attention to the company's development benefits. Previous studies have revealed that businesses' success relies on how firms attempt to enhance digital transformation through the sustainability of the Logistics business. By adopting digital transformation approaches that can be viewed as part of a transformation strategy, companies can improve their competitive advantage and achieve sustainability. To the best of our knowledge,

few studies have provided empirical evidence on how digital transformation is necessary for logistics sustainability, especially during and after the fourth industrial revolution (Industry 4.0) and the COVID-19 pandemic. Our study aimed to provide a better understanding of the impact of digital transformation on LSPs in Thailand. The results show that digital transformation presents considerable opportunities for sustainability for stakeholders of logistics.

No studies have analyzed the impact of factors influencing the Sustainability of LSPs in Thailand. In this research, an effort was made to assess the impact of digital transformation on sustainability, thus making this study a stepping stone to future research. However, this research has some limitations. Initially, the outcomes of our study depended on a self-administered questionnaire and respondents' perceptions. The COVID-19 situation made it difficult for us to collect data on-site. The sample size was relatively small and comprised only Thailand participants, restricting the generalisability of our research findings. Consideration of larger sample sizes or other business sectors is recommended in future studies to provide more meaningful results. Second, this research did not test a specific type of digital platform. Future studies could compare differences in digital transformation functions among a wide range of sustainable policy areas.

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