

DIGITAL TRANSFORMATION FACTORS DETERMINE SUSTAINABILITY IN BINH TRI THIEN' LOGISTICS PROVIDERS WITH SEM BAYESIAN

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Abstract:

This study utilizes Bayesian SEM to assess the sustainability impacts of digitization within logistics providers in the Binh Tri Thien area. The research investigates the characteristics of digitization and associated technologies within the logistics network, examines how the adoption of digitization has reshaped logistics processes, and identifies the benefits derived from digital transformation.

A survey involving 243 logistics providers encompassing transportation services, warehouse services, freight forwarders, and logistics service providers was conducted. The quantitative analysis method employed evaluates the influence of digital transformation on sustainability across three dimensions: economic, environmental, and social. The study validates three hypotheses outlined in the literature through structural equation modeling (SEM) analysis utilizing a Bayesian approach.

The findings of the analysis lead to the proposal of implications aimed at assisting providers in enhancing the efficiency and speed of digital transformation implementation. This, in turn, can bolster competitiveness, elevate participation in global supply chains, and meet the demands of logistics globalization in today's digital economy.

Key words: Sustainability, Digital transformation, Logistics providers, Bayesian SEM

CÁC YẾU TỐ CHUYỂN ĐỔI SỐ QUYẾT ĐỊNH TÍNH BỀN VỮNG TRONG CÁC NHÀ CUNG CẤP LOGISTICS BÌNH TRÍ THIÊN

Tóm tắt:

Nghiên cứu này sử dụng Bayesian SEM để đánh giá tác động của số hóa đến tính bền vững của các nhà cung cấp dịch vụ hậu cần tại khu vực Bình Trị Thiên. Nghiên cứu này điều tra các đặc điểm của số hóa và các công nghệ liên quan trong mạng lưới hậu cần, xem xét cách áp dụng số hóa đã định hình lại các quy trình hậu cần và xác định những lợi ích thu được từ chuyển đổi số.

Một cuộc khảo sát liên quan đến 243 nhà cung cấp dịch vụ hậu cần bao gồm các dịch vụ vận tải, dịch vụ kho bãi, công ty giao nhận hàng hóa và nhà cung cấp dịch vụ hậu cần đã được tiến hành. Phương pháp phân tích định lượng được sử dụng để đánh giá ảnh hưởng của chuyển đổi số đến tính bền vững trên ba chiều: kinh tế, môi trường và xã hội. Nghiên cứu xác thực ba giả thuyết được nêu trong tài liệu thông qua phân tích mô hình phương trình cấu trúc (SEM) sử dụng phương pháp tiếp cận Bayesian.

Những phát hiện của phân tích dẫn đến đề xuất về các hàm ý nhằm hỗ trợ các nhà cung cấp nâng cao hiệu quả và tốc độ triển khai chuyển đổi số. Đổi lại, điều này có thể thúc đẩy khả năng cạnh tranh, nâng cao sự tham gia vào chuỗi cung ứng toàn cầu và đáp ứng nhu cầu toàn cầu hóa hậu cần trong nền kinh tế số ngày nay.

Từ khóa: Tính bền vững, Chuyển đổi số, Nhà cung cấp dịch vụ Logistics, Bayesian SEM

1. Introduction

Amid the ongoing advancement in the technology and information sector, companies, including logistics providers, are leveraging technology as a strategic tool to ensure their sustainability and continued relevance. (Kayikci Y. , 2018).

The competitive landscape driven by connectivity and information abundance (E. Chang, M. West, and M. Hadzic, 2006) underscores the criticality of digital transformation across industries. As industries transition into the digital era, they face uncertainties, complexities, and ambiguities, compelling them to adopt emerging information technologies comprehensively to address individual needs and global challenges, enhancing competitiveness in a globally interconnected market. Collaboration emerges as a crucial strategy in overcoming industry challenges, particularly within the supply chain and logistics sector, where collaborative efforts optimize operational efficiency and performance.

Sustainability stands as a fundamental objective for businesses, prompting firms to rethink their digital strategies and restructure business operations throughout the supply chain to bolster sustainability encompassing economic, environmental, and social dimensions. In the realm of supply chain management and logistics, digital transformation involves value creation through the application of digital transformation technologies (DTT), strategic and process adaptations, such as innovation and leadership that foster enhanced astuteness, productivity, and alignment with consumer requirements. Manufacturers' motivations for investing in supply chain management and logistics include real-time product visibility, innovation promotion, cost reduction, and improved planning (Sumona Salam, Abu Shams Mohammad Mahmudul Hoque, 2019).

The primary aim of the exploratory research outlined is to enhance the understanding of logistics and supply chain management in a more definitive manner. In the specific context of the Binh Tri Thien area, logistics providers are actively enhancing their awareness and implementing digital transformation in their business operations. However, many providers in this region encounter barriers during the transformation process, such as a lack of digital skills and human resources, inadequate information technology platforms for effective transformation, and a deficiency in digital mindset or culture within enterprises. Overcoming these challenges necessitates significant organizational changes to ensure continued growth and sustainability within the evolving digital landscape. Hence, the research team has proposed a study titled “Digital Transformation Factors Determine Sustainability in Binh Tri Thien’ Logistics Providers”. The study aims to identify the digital transformation factors influencing logistics sustainability and delve deeper into understanding the impact of digital transformation on logistics and logistics service providers (LSP) within the Binh Tri Thien area, adopting a Bayesian approach and a more profound exploration of digital transformation and sustainability.

2. Literature review

2.1. Theoretical Background

The theoretical basis for this study is based on New Information Technologies (NIT) theory. By implementing new technologies that align with an enterprise’s culture (Verhoef, et al., 2021) and environment, NIT assists businesses in transforming their technological, production, and operational processes. NIT refers to many resources, factors, and barriers affecting the digital transformation process, as well as to advantages and disadvantages when implementing digital transformation in enterprises (Shashi, Centobelli, Cerchione, & Ertz, 2020). Adebanjo et al. (Adebanjo, Teh, & Ahmed, 2018) proposed an approach to understanding change and innovation activities within an enterprise that emphasizes the importance of environmental factors and corporate culture. The approach highlights the relationship between changes and the aspects of the enterprise that remain unchanged. Furthermore, Greenwood et al. (Hinings, Gegenhuber, & Greenwood, 2018) analyzed digital transformation activities in enterprises, which included various levels such as social, professional, organizational, and employee-related aspects. The analysis covered planning, digitizing structures, and computerizing business operations. Ferreira et al. (Ferreira, Fernandes, & Ferreira, 2019) focused on the factors influencing the adoption of new digital processes in

enterprises, in which sustainability and market share growth, enterprise environment, investment capital for technology, and field of activities significantly influence the adoption of new digital processes.

In addition, the article also mentions the theories guiding the digital transformation process and the factors affecting digital transformation activities in enterprises by Molinillo and Japutra, including information systems theory (IS), diffusion of innovations theory (DOI), the technology organization environment (TOE) framework, and institutional theory.

Current research on sustainability, digital transformation and sustainability often focuses on the impact of the digital revolution on three dimensions of sustainability: economic, environmental, and social. Based on the assumption that changes in resource use can be implemented, digital transformation brings about sustainable development. Beier, Hansen, Helbrecht, & Behar, 2017 highlighted the impact of digital transformation on the company scale and the ways in which jobs will replace existing jobs, and recommended guidelines for new techniques based on digital transformation opportunities into future research. Kayikci, 2018 (Kayikci Y. , (2018) presented the sustainability aspects that need to be reflected: (i) Economic: affordable systems that operate efficiently, provide reasonable solutions, and combine multiple single-load operation methods Select and support the local economic base. (ii) Environment: reduce greenhouse gas emissions, pollution, and waste, minimize consumption of non-renewable energy sources, and use technologies that reuse and recycle components its. (iii) Society: individual/communities' need for access to facilities is met safely and supports good lives and work within and across systems. Digital transformation in logistics and supply management has not yet reached maturity, so sustainability will be reinforced and transformed.

2.2. Digital Transformation

Digital transformation (DT) is gaining popularity in academics and practice, but its definition remains ambiguous (Morakanyane et al., 2017; Osmundsen et al., 2018). Scholars consider it a strategy (Bharadwaj et al., 2013; Kane et al. Research has focused on processes (Hansen et al., 2011; Berman and Marshall, 2014; Morakanyane et al., 2017; Cichosz, 2018; Hausberg et al., 2018; EC, 2018) and business models (Henriette et al., 2016). Fitzgerald et al. (2014) stress the utilization of new digital technology to drive significant business gains. DT refers to significant developments in information, computer, communication, and networking technologies (Bharadwaj et al., 2013), rather than a particular technology. Advanced technologies that integrate physical and digital systems (EC, 2018). Importantly, not all technologies inside DT must be digital. Mathauer and Hofmann (2019) suggest that even non-digital technologies, such as delivery vans, forklift trucks, and conveyers, can become part of DT by incorporating new technology components that allow for tracking of location and speed. According to Morakanyane et al. (2017), individuals in DT should leverage their digital capabilities.

Creating value is regarded as a primary outcome of DT. Value encompasses operational efficiency, improved customer experiences, enhanced business models, strategic differentiation, competitive advantage, stakeholder connections, and expenses, savings, etc. (Berman and Marshall, 2014; Morakanyane et al., 2017)

According to Marakanyane et al. (2017) and Cichosz (2018), digital transformation is an ongoing process that varies based on the digital maturity of the implementing company. Digital maturity refers to an organization's ability to adapt to a digital business environment (Kane et al., 2017). Westerman et al. (2014) proposed that organizations with higher digital maturity had better corporate success. According to their study, digital maturity is divided into two categories: (1) digital capabilities, which refer to the intensity of digital activities, and (2) transformation

management capabilities, which address managerial characteristics that drive digital transformation (e.g., leadership, culture, change management, and governance).

Digital transformation, a private-sector phenomenon, has mainly been associated with using emerging technologies to maintain viability in the Internet era. Both online and offline services and products are distributed. The transformation of online services has increased flexibility and automation by standardization (Andal-Ancion, 2003). Some define digital transformation as a process of updating business models according to consumer demands using the latest technologies (Berman, 2012). The effects of digital transformation strategies include market delivery changes and new ways of direct customer interactions, such as adapting goods and services to changing customer needs through social media. Digitization can be seen as the development of network economies in which the core business model provides a platform for interactions between external suppliers and consumers.

In summary, regardless of the definition used, digital transformation for enterprises involves transitioning from a traditional to a digital model of business by implementing advanced technologies to change work processes, operational methods, management activities, corporate culture, and so on, resulting in new opportunities, values, and increased profits. As a result, based on a comprehensive overview of perspectives on digital transformation from both domestic and international studies, as well as the practical implementation of digital transformation in Vietnam, this study follows the perspective that digital transformation is the process of changing mindset, perception, models, and traditional business methods to digital models using information technology. Thus, the essential essence of digital transformation in enterprises consists of: Transformation of perspective, technology, and business models/management approaches inside the enterprises.

2.3. Digital Transformation in Logistics Service Providers

Digital transformation used digital technology to change business models and create opportunities, revenue, and new values (Samuel Ribeiro-Navarrete, Botella-Carrubi, Palacios-Marqués, & Orero-Blat, 2021). The concept of digital transformation in the enterprise involves moving from a conventional business model to a digital one. Digital conversions are the rethinking of how organizations gather people, data, and processes to create new values. Digital transformation is resetting the mindset of the data, processes, and people to create new value. Swen and Reinhard thought that digital transformations integrate digital technology into business operations to change how business models fundamentally operate and provide new values to customers (Swen & Reinhard, 2020). It is a change in managing processes, procedures, and culture based on effective digital platforms and business targets. The current business industry is facing a significant challenge from the process of integration of the digital transition and the COVID-19 pandemic challenge going on globally. Transformation is an essential solution that helps businesses improve their competitiveness, increase labor productivity, make the business sustainable, and integrate with the global economy. That can be interpreted as using digital technology to create or modify business processes, cultures, and existing customer experiences to meet the requirements of market and business changes.

Muhammad and Anton (2022) defined digital transformation in the logistics industry as identifying and integrating digital technology to enhance business efficiency, management capacity, and corporate governance processes. This involves incorporating digital technology into existing processes and modifying the overall thinking, strategy, and corporate governance approach. The demand for the management of internal operations of logistics enterprises includes the management of the sales and customer database, monitoring and managing the internal work process, archiving, analyzing data, and reporting. The activities involved in chain management include implementing

and processing direct orders within the system, managing, and monitoring the system, exchanging, and connecting data, providing tailored services to meet each customer's individual needs, and integrating the entire software into the service chain. For logistics providers, transforming the digital sector is the process of applying technology to optimize the production, supply, and transport of products, increase the value of the data, and decrease the customer's cost. By applying software management tools to manage software, order management software, and for warehouse management, logistics service operations can be optimized for cost while improving data management efficiency (Osden, 2020). Logistics enterprises participate in the transformation process when they do the following: invest in their infrastructure; use new technology and social networks; implement software support software; and store data, technology, and data-processing activities to exchange information on electronic channels.

2.4. Sustainability

Sustainability is made up of three pillars: the economy, society, and the environment. These principles are also informally referred to as "the 3 Ps": profit, people, and planet. By finding a balance among them, logistics can provide the best service while still enforcing and assuring a more conscious use of resources.

"Sustainable Logistics and Supply Chain" is an evolving concept in the world of logistics practice that can be described as an integral transformation of logistics strategies, structures, processes, and systems towards a more rational and effective use of resources in supply-chain activities, ranging from the supply of raw materials to the transformation processes, the storage, the packaging, the distribution and the management of the end of the lifecycle of products. Sustainable logistics is becoming more and more relevant in the transition from a linear economic model (based on extraction, transformation, distribution, and consumption cycles) to a circular model of economy, whose main goal is to extend the products life and rationalize the use of resources over time.

Green logistics applies a three-dimensional life cycle approach as opposed to the traditional one-dimensional, economics-only-focused approach. Following the three-dimensional approach does not necessarily mean that the level of effort and time will increase by three. However, as the organisation reduces its impact on the environment and supports positive social behaviours, there may be a return on overall "value for money."

Current research on sustainability, digital transformation and sustainability often focuses on the impact of the digital revolution on three dimensions of sustainability: economic, environmental, and social. Based on the assumption that changes in resource use can be implemented, digital transformation offers sustainable prospects. Beier, Hansen, Helbrecht, & Behar, 2017 highlight the impact of digital transformation on a company scale and the challenges of replacing existing jobs and recommend the introduction of new engineering principles build on digital transformation opportunities into future research. Kayikci, 2018 presented the sustainability aspects that need to be reflected: (i) Economic: an affordable system that operates efficiently, provides collaborative solutions, and combines multiple modes of transport options and supports the local economy. (ii) Environment: reduce greenhouse gas emissions, pollution, and waste, minimize consumption of non-renewable energy sources, and use technologies that reuse and recycle its components. (iii) Social: individual/communities' basic access needs are met safely and support good and equitable lifestyles within and between generations. Digital transformation in logistics and supply chain management has not yet reached maturity, so sustainability will be reinforced and transformed. The most important impact of the cases discussed is the economic aspect of sustainability.

3. Research Methodologies

3.1. Proposing Research Models and Hypotheses

DT in supply chain management affects logistics providers' sustainability in several ways. First, DT may increase sustainability in economics by leading to better economic results. Moreover, it could have a positive environmental impact by controlling emissions and the whole product line and transportation. Finally, it could have a social impact by allowing information sharing with all stakeholders. Based on the literature review, the paper proposed hypothesis below:

* Financial data and flows are one of the primary cornerstones of sustainable supply chain management (Mentzer, et al., 2002). However, in the preceding decade, academics began to construct analytical models to learn how to plan, monitor, and regulate money flows inside supply chains (Raghavan & Mishra, 2011). According to the literature review, DT may help with supply chain management, which is the third pillar of sustainability. Furthermore, by applying the transaction cost theory, they may have a better understanding of the product, information, and money flows that must be controlled, as this theory examines all costs and information between partners. In this method, leaders would be able to produce superior economic outcomes and assist their organization in meeting its financial goals.

*DT offers information technology resources for supply chain management that promote environmental sustainability. Blockchain technology (BT) may minimize resource usage and carbon gas emissions through rework and recall, such as blockchains. This approach can ensure stakeholders that green products are ecologically friendly (Rosencrance, 2017). Big data analytics (BDA) and Internet of things (IoT) offer comprehensive information on CO2 emissions, enabling companies and partners to monitor pollution and positively influence the environment (Deegan, 2019).

The environmental pillar has a beneficial impact on financial flows as buyers choose green products from firms that prioritize the environment and society. Furthermore, some partners want to work exclusively with green firms.

* The literature assessment suggests that emerging information technologies, such as BT, can give traceability across the supply chain, promoting social sustainability by ensuring human rights. According to the legitimacy hypothesis, each corporation or organization must convince all its stakeholders that it is legitimate. Legitimacy may be a valuable resource for enterprises in the supply chain, helping them survive and gain a competitive edge. (Deegan, 2019)

DT, particularly Internet of things (IoT) technology, enables real-time information sharing across supply chain stakeholders and society, promoting transparency and social responsibility. New technologies have the potential to develop this resource inside the chain and promote social sustainability.

Hypothesis 1: Cognitive transformation of Digital transformation has positive impact on Sustainability-economics.

Hypothesis 2: Cognitive transformation of Digital transformation has positive impact on Sustainability-environment.

Hypothesis 3: Cognitive transformation of Digital transformation has positive impact on Sustainability-society.

Hypothesis 4: Tecnological transformation of Digital transformation has positive impact on Sustainability-economics.

Hypothesis 5: Tecnological transformation of Digital transformation has positive impact on Sustainability-environment.

Hypothesis 6: Tecnological transformation of Digital transformation has positive impact on Sustainability-society.

Hypothesis 7: Business model transformation of Digital transformation has positive impact on Sustainability-economics.

Hypothesis 8: Business model transformation of Digital transformation has positive impact on Sustainability-environment.

Hypothesis 9: Business model transformation of Digital transformation has positive impact on Sustainability-society.

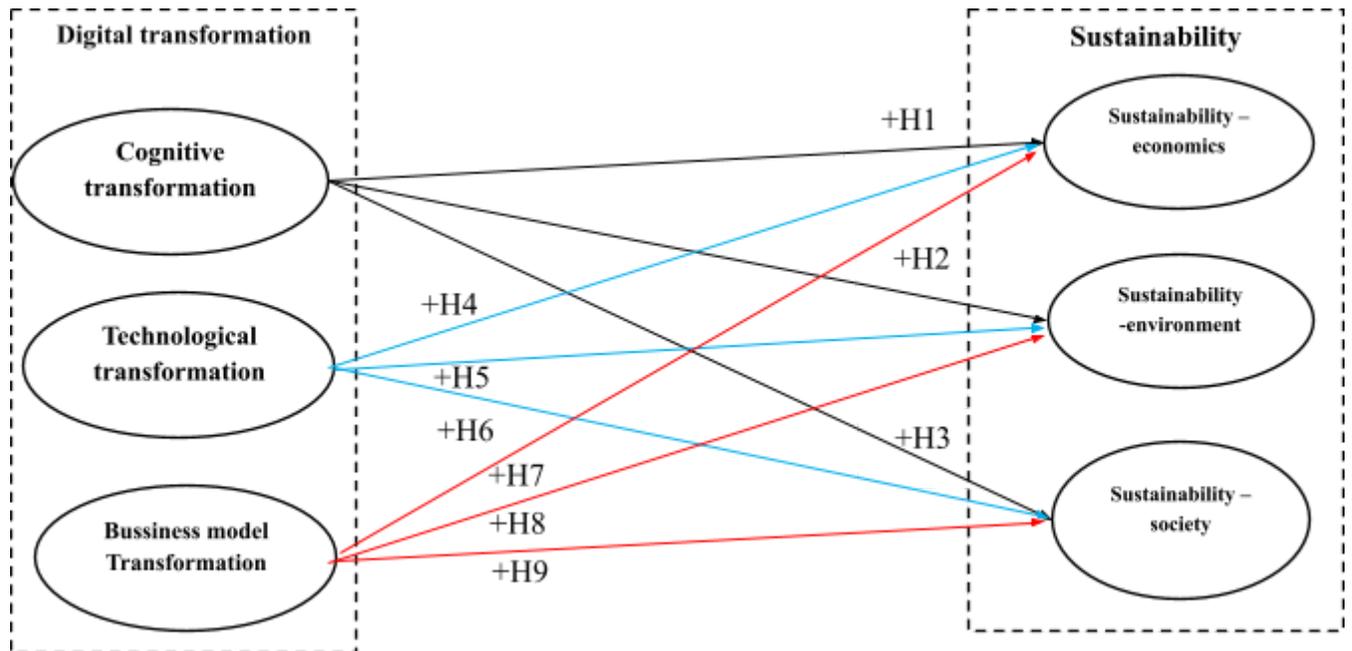


Figure. 1. Proposed research model

3.2. Research Methodologies

The study uses SEM model analysis to estimate and evaluate the impact of Digital Transformation of Logistics provider on sustainability on a sample size of 243. It provides the estimation strength of all hypothesized relationships between variables in a theoretical model (Jr, Black, Babin, & Anderson, 2010). While the traditional approach involves frequentist estimation of SEMs, this poses significant hurdles for low sample cases, which are likely to be found in Latin America studies (either due to small populations of interest or insufficient funding for larger research undertakings). Our approach allows for a flexible, easy to implement, and robust algorithm. We follow a fully Bayesian approach to the estimation of this model which has multiple advantages: (a) It allows for a more direct interpretation of the latent variables in the model as random variables in a Bayesian fashion, rather than fixed point estimates, (b) It provides a natural and flexible approach to overcoming low samples and missing data, two problems likely to appear in research on emerging economies, and (c) It allows flexible incorporation of prior beliefs on the basis of existing literature (although we chose not to undertake this route, and specified the model with a flat, uninformative prior, the model can easily incorporate this information through the prior specifications). Our Bayesian approach links the unknown latent variables, assumed observed with error, because of the hypothesized model relationship in Figure 1, and provides a network-with-error structure which allows for simple estimation of the parameters of interest, that is, latent variables and relationships. The interpretability is direct since the posterior distribution of the latent variables account for both the information -and lack there of- contained in the observed-with-error data, as well as providing distributions, marginal and joint, of the variables of interest, rather than estimators

of those. This approach has been proven useful in other sciences in more complex applications, such as traffic engineering (G. Molina, 2005.), where observed-with-error flows provide information about unobserved, latent flows and relationships between those based on an existing relationship network.

The measurements were developed based on a comprehensive investigation of existing literature. The survey was divided into two sections: the first section was designed to collect information on logistics providers' demographic profile, whereas the second section contained measurements on theoretical constructs for the present study. All the constructs are measured reflectively, and the participants were requested to specify the degree of their agreement/disagreement with each statement using a five-point Likert scale, where "1" shows a strongly disagreement and "5" strongly illustrates agreement. The items that composed the survey covered the five axes discussed above, namely, competition, customers, data, innovation, and sustainability. The constructs and items used in the questionnaire are displayed on table 1.

Table 1. Constructs and items

Construct	No.	Item	Item criteria	Source
Cognitive transformation	1	CT1	Importance of digital transformation	(Yoon, 2013), (Vogelsang, 2019), (ULAS, 2019); Gamache et al (2019); Sandkuhl et al (2019); Viral (2019); Isensee (2020); Loon Hoe, S. (2020); Cichosz, M. (2020); Abed (2020); Putthiwat et al (2021);
	2	CT2	Influence of digital transformation	
	3	CT3	Understanding and Application of policy	
	4	CT4	Trends of digital transformation	
	5	CT5	Employee's knowledge	Bharadwaj et al (2018), Tarute et al (2018); Putthiwat et al(2021); Wilaisa Koolyong (2018);
	6	CT6	Employee's Understanding of digital transformation	
Technological transformation	7	TT1	Updating technological solutions	Ministry of Information and Communications (2021)
	8	TT2	Application of new technology	
	9	TT3	Integration capability	(Muhammad and Anton, October 2022), (Samuel Ribeiro-Navarrete, Botella-Carrubi, Palacios-Marqués, & Orero-Blat, 2021), (Osden, 2020)
	10	TT4	Upgrading and innovating	
	11	TT5	Process of data collection	
Bussiness model Transformation	12	BMT1	Digization of Bussiness model	Nyandore (2016); Nair et al (2019); Viral (2019); Gamache et al (2019); Isensee (2020), Ministry of Information and Communications (2021)
	13	BMT2	Digital internal management process	
	14	BMT3	Digital internal information sharing process	
	15	BMT4	Digital service management process	

Sustainability – economics	16	SE1	Logistics costs	(Monnet, 2011); (Dougados, 2013), (Gubler, 2014); (Schrauf, 2016); (Weinelt, 2016)
	17	SE2	Delivery time	(Monnet, 2011), (Dougados, 2013), (Schrauf & Bertram, 2016);
	18	SE3	Transport delays	(Monnet, 2011), (Schrauf & Bertram, 2016) (Weinelt, 2016).
	19	SE4	Inventory reduction	(Dougados, 2013)
	20	SE5	Loss/damage	(Monnet, 2011)
	21	SE6	Frequency of service	(Dougados, 2013), (Nowak, Maluck, Stürmer, & Pasemann, 2016)
	22	SE7	Transport volumes	(Monnet, 2011)
Sustainability –environment	23	SEN1	Resource efficiency	(Monnet, 2011), (Gubler, 2014), (Nowak et al., 2016)
	24	SEN2	Process energy	(Gubler et al., 2014) (Weinelt, 2016
	25	SEN3	Process emissions	(Monnet & Le Net, 2011); (Gubler et al., 2014); (Nowak et al., 2016); (Weinelt, 2016).
	26	SEN4	Waste	(Gubler et al., 2014) (Weinelt, 2016)
	27	SEN5	Pollution	(Monnet & Le Net, 2011); (Weinelt, 2016).
	28	SEN6	Land-use impact	(Monnet & Le Net, 2011)
Sustainability – society	29	SS1	Development benefits	Gubler et al., 2014); (Schrauf & Bertram, 2016)
	30	SS2	Impacts, Visibility	(Gubler et al., 2014); (Nowak et al., 2016).
	31	SS3	Health & Safety	(Monnet & Le Net, 2011).
	32	SS4	Labor patterns	(Monnet & Le Net, 2011); (Gubler et al., 2014); (Nowak et al., 2016)
	33	SS5	Acceptance	(Gubler, 2014) (Gubler et al., 2014); (Schrauf & Bertram, 2016)

(Source: Compiled by the authors' team)

4. Result

4.1. Descriptive Statistics

The selection criterion for responding firms was that the firms must be logistics providers in Binh Tri Thien area including transportation service, warehouse service, freight forwarder and logistics service provider. These logistics providers deal more with digital capabilities and are the most digital according to Gandhi et al. (2016).

Table 2. Sample characteristics.

Characteristics of logistics provider	Number of logistics provider	Ratio of logistics provider (%)
Primary service		
Transportation service	83	34.2
Warehouse service	72	29.6
Freight forwarder	51	21.0
Logistics service provider	37	15.2
Number of employees		

Less than 100	96	39.5
100-200	102	42.0
>200	45	18.5
Work experience (years)		
2-5	109	45.0
6-10	89	36.6
<2	33	13.6
>10	12	4.8
Total	243	100

(Source: Data processing)

In view of time constraints and the absence of database that we can take as reference, the sampling technique used in this study was a non-probability convenience sampling method. The survey was conducted between October 2023 and December 2023. Contacts of firms were acquired from the internet. Sample characteristics are presented in table 2.

First, phone calls were made to identify the right respondents and to get their emails. Next, emails with a cover letter and the online link to the survey were sent to the potential respondents. The target sample size in this study was 250. We achieved a response rate of about 97 per cent yielding a final sample of 243.

4.2. Properties of the Scales

Descriptive analysis, reliability and validation of each variable were conducted to evaluate the properties of the scales. Subsequently we evaluated the hypothesized model using Bayesian approach.

The analysis of item-total correlations showed positive and significant relationships between all the items of each scale and the total scale, which suggests that all items measure the same construct. In fact, Cronbach's alpha coefficients were at least 0.785 and, in each case, removing any item reduces the value of alpha coefficients, which demonstrates an excellent internal consistency (Table 3). Regarding construct validity of instruments, the correlation matrices values were greater than 0.231 and the anti-image correlation matrices values were close to zero.

Table 3. Properties if the scales

Scale	N	Mean	SD	α	Correlation matrix					
					CT	TT	BMT	SE	SEN	SS
CT	243	3.7862	0.66289	0.849	1	0.231**	0.328* *	0.309* *	.356*	0.336
TT	243	4.3111	0.56539	0.811	0.231**	1	0.182* *	0.141*	0.440	0.477
BMT	243	3.7171	0.65669	0.837	0.328**	0.182**	1	0.251* *	0.431	0.372
SE	243	3.8269	0.65677	0.855	0.309**	0.141*	0.251* *	1	0.128*	0.331
SEN	243	3.9628	0.63394	0.795	0.356*	0.440	0.431	0.128*	1	0.482* *

SS	243	3.2757	0.46872	0.785	0.336	0.477	0.372	0.331	0.482*	1
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M = mean, SD = standard deviation, α = Cronbach's alpha

(Source: Data processing)

4.3. Structure Equation Model Bayesian Estimation

Table 4. Estimated results using SEM Bayesian

Regression weights	Mean	S.E.	S.D.	C.S.	95% confidence level		Result of hypothesis
SE<--CT	0.984	0.002	0.07	1	0.854	1.13	Confirmed
SE<--TT	1.213	0.003	0.083	1.001	1.064	1.393	Confirmed
SE<--BMT	0.797	0.003	0.064	1.001	0.676	0.927	Confirmed
SS<--CT	0.806	0.004	0.116	1.001	0.595	1.048	Confirmed
SS<--TT	1.048	0.005	0.119	1.001	0.833	1.297	Confirmed
SS<--BMT	0.859	0.004	0.116	1.001	0.646	1.101	Confirmed
SEN<--CT	1.019	0.004	0.105	1.001	0.827	1.236	Confirmed
SEN<--TT	0.855	0.004	0.104	1.001	0.669	1.073	Confirmed
SEN<--BMT	1.172	0.005	0.122	1.001	0.955	1.434	Confirmed

(Source: Data processing)

The proposed model hypothesized 9 relations between variables. Results showed positive and significant relations between eight pairs of variables (measured as those linear relationship variables β with the central 95% high probability density interval -HPD to the right of zero).

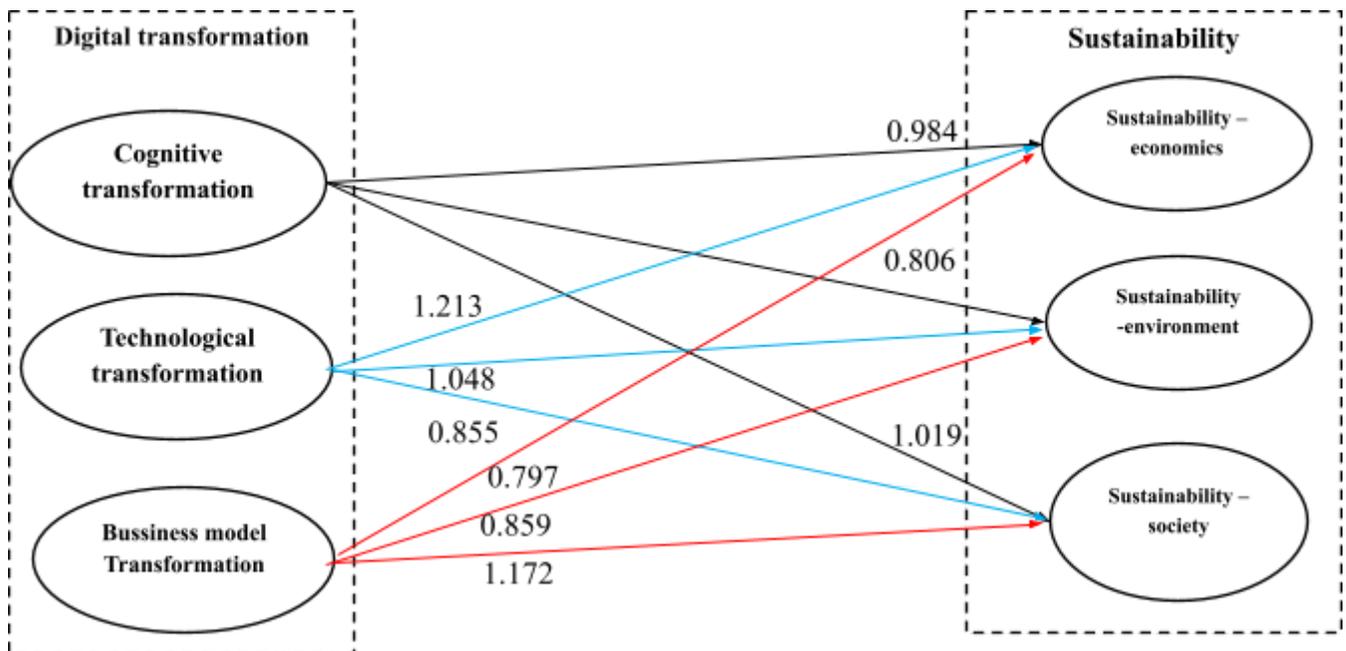
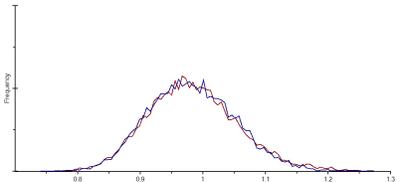
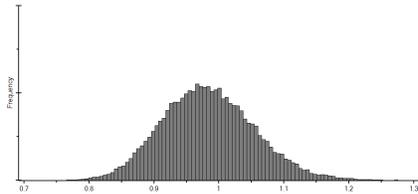


Figure 2. Bayesian estimation model

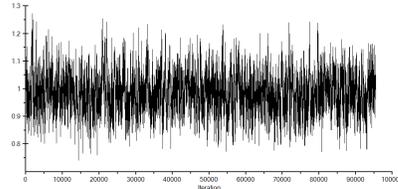
*For the Cognitive Transformation and Sustainability – economics



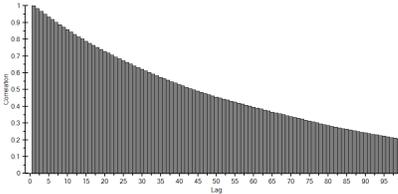
Polygon



Histogram



Trace

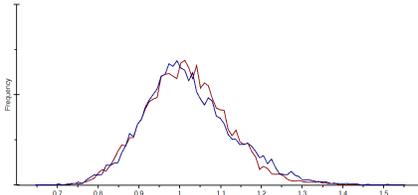


Autocorrelation

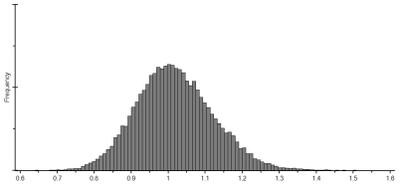
Chart 1. Posterior distribution chart (First and last) relationship between Cognitive Transformation and Sustainability – economics

With a 95% confidence interval, the true value coefficient of Cognitive Transformation will be in the range of 0.854-1.13, so the true value will be greater than 0, so H_1 is accepted. That means Cognitive Transformation affects Sustainability – economics.

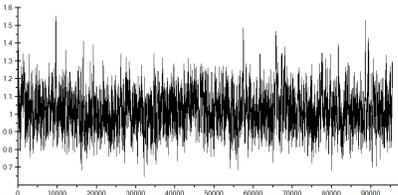
*For the Cognitive Transformation and Sustainability – environment



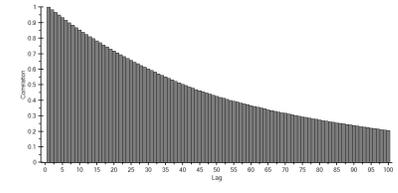
Polygon



Histogram



Trace

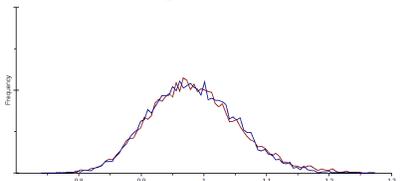


Autocorrelation

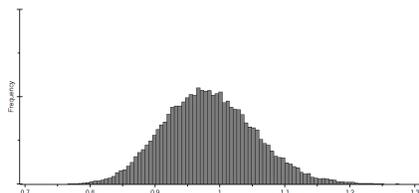
Chart 2. Posterior distribution chart (First and last) relationship between Cognitive Transformation and Sustainability – environment

With a 95% confidence interval, the true value coefficient of Cognitive Transformation will be in the range of 0.827-1.236, so the true value will be greater than 0, so H_2 is accepted. That means Cognitive Transformation affects Sustainability – environment.

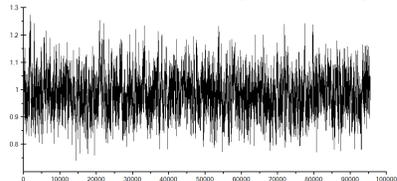
*For the Cognitive Transformation and Sustainability – society



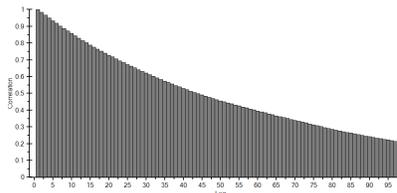
Polygon



Histogram



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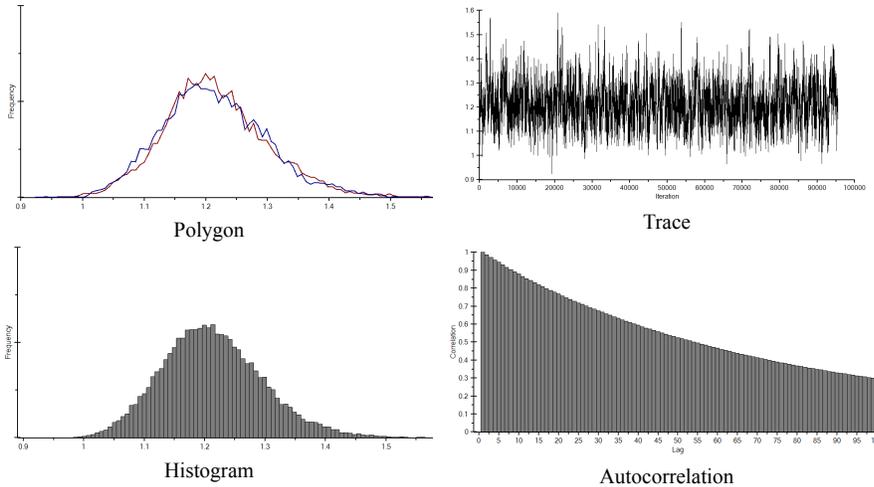
Autocorrelation

With a 95% confidence interval, the true value coefficient of Cognitive Transformation will be in the range of 0.595-1.048, so the true value will be greater than 0, so H_3 is accepted. That means Cognitive Transformation

Chart 3. Posterior distribution chart (First and last) relationship between Cognitive Transformation and Sustainability – society

affects Sustainability – society.

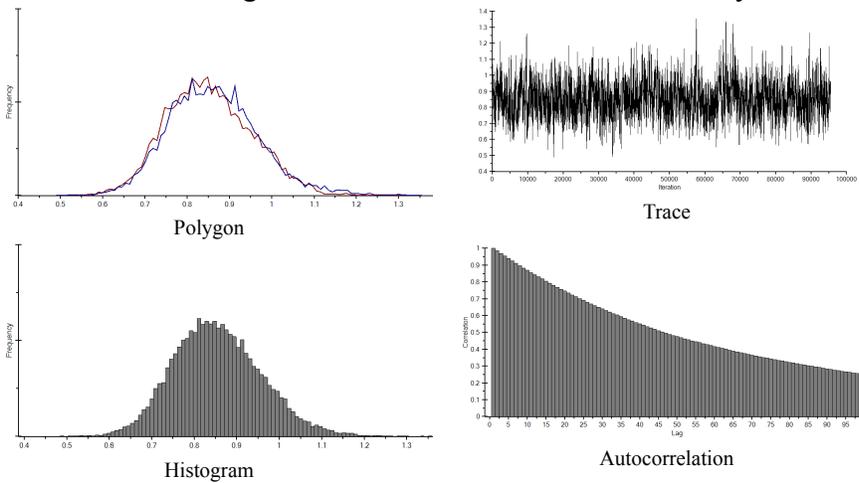
***For the Technological Transformation and Sustainability – economics**



With a 95% confidence interval, the true value coefficient of Cognitive Transformation will be in the range of 1.046-1.393, so the true value will be greater than 0, so H_4 is accepted. That means Technological Transformation affects Sustainability – economics.

Chart 4. Posterior distribution chart (First and last) relationship between Technological Transformation and Sustainability – economics

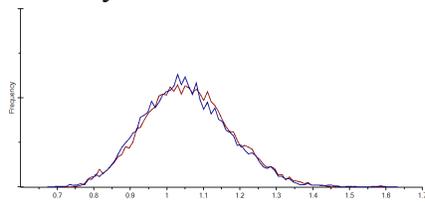
***For the Technological Transformation and Sustainability – environment**



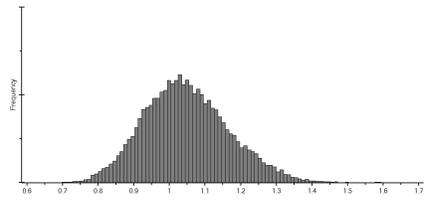
With a 95% confidence interval, the true value coefficient of Cognitive Transformation will be in the range of 0.669-1.073, so the true value will be greater than 0, so H_5 is accepted. That means Technological Transformation affects Sustainability – environment.

Chart 5. Posterior distribution chart (First and last) relationship between Technological Transformation and Sustainability – environment

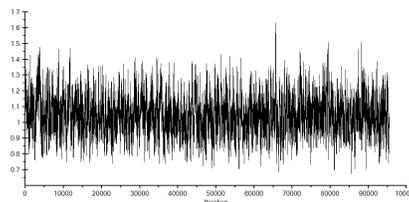
*For the Technological Transformation and Sustainability – society



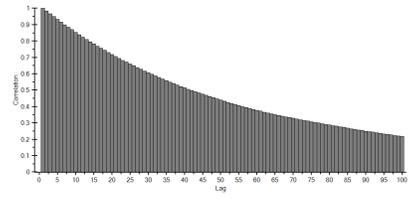
Polygon



Histogram



Trace

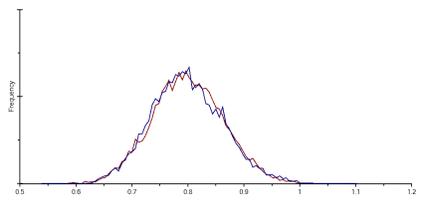


Autocorrelation

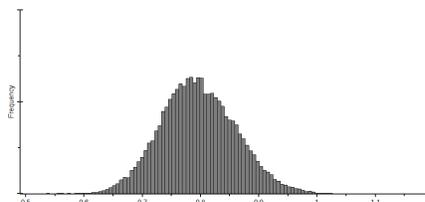
Chart 6. Posterior distribution chart (First and last) relationship between Technological Transformation and Sustainability – society

With a 95% confidence interval, the true value coefficient of Cognitive Transformation will be in the range of 0.833-1.297, so the true value will be greater than 0, so H_6 is accepted. That means Technological Transformation affects Sustainability – society.

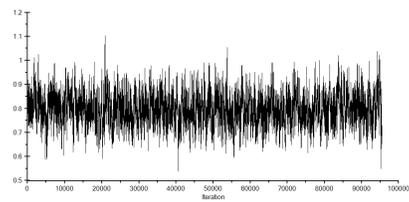
*For the Business model Transformation and Sustainability – economics



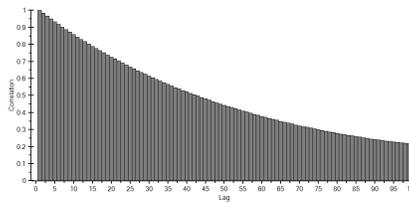
Polygon



Histogram



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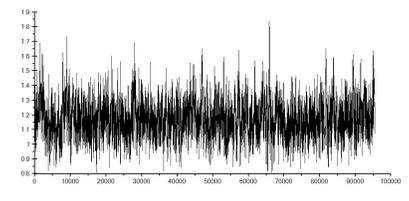
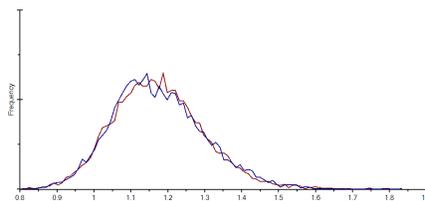


Autocorrelation

Chart 7. Posterior distribution chart (First and last) relationship between Business model Transformation and Sustainability – economics

With a 95% confidence interval, the true value coefficient of Cognitive Transformation will be in the range of 0.676-0.927, so the true value will be greater than 0, so H_7 is accepted. That means Business model Transformation affects Sustainability – economics.

*For the Business model Transformation and Sustainability – enviroment



With a 95% confidence interval, the true value coefficient of Cognitive

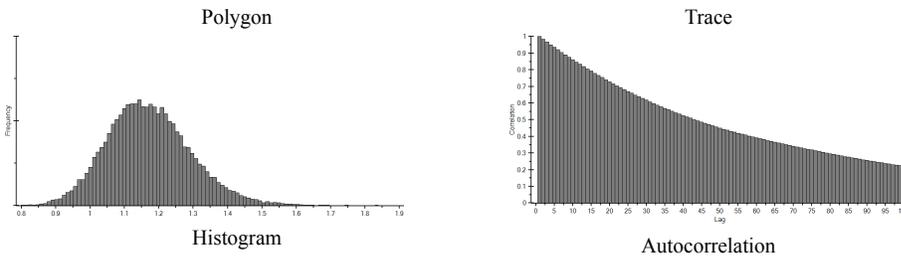


Chart 8. Posterior distribution chart (First and last) relationship between Business model Transformation and Sustainability – environment

Transformation will be in the range of 0.955-1.434, so the true value will be greater than 0, so H_8 is accepted. That means Business model Transformation affects Sustainability – environment.

*For the Business model Transformation and Sustainability – society

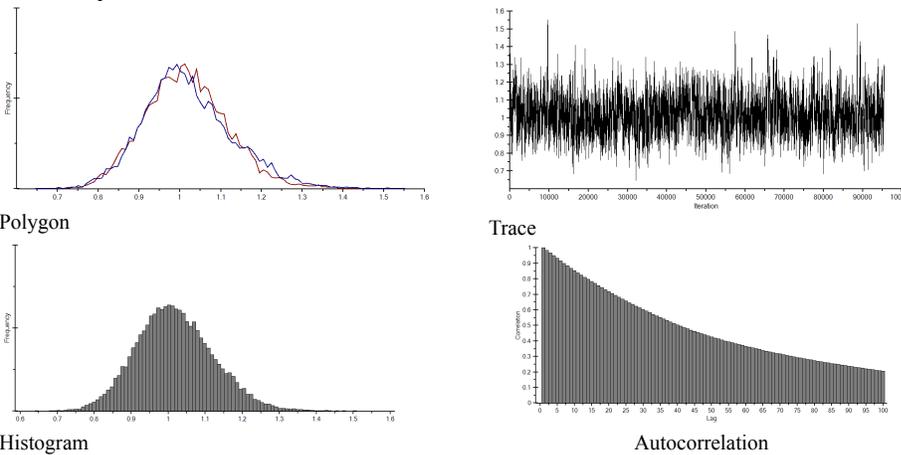


Chart 9. Posterior distribution chart (First and last) relationship between Business model and Sustainability – society

With a 95% confidence interval, the true value coefficient of Cognitive Transformation will be in the range of 0.646-1.101, so the true value will be greater than 0, so H_9 is accepted. That means Business model Transformation affects Sustainability – society.

4.4. Discussion

The findings show that the economic benefit of logistics sustainability is particularly significant. There are four factors with factor loading greater than 0.7. SE1 (logistics costs) has the greatest effect, with a loading of 0.838, which is consistent with numerous studies in the review that indicate (Monnet, 2011) ((Dougados, 2013) (Gubler, 2014)); (chrauf & Bertram, 2016); and (Weinelt, 2016). This is followed by SE2 (delivery time) with a loading of 0.775; SE6 (frequency of service), with a loading of 0.745; SE 7 (transport volume), with a loading of 0.716; and SE5 (loss/damage), with a loading of 0.68. Furthermore, three variables have loading factors between 0.678 and 0.675, including SE4 (inventory loss) at 0.678 and SE 3 (transport delay) at 0.675. This demonstrates that all seven elements in the economic construct are critical for the sustainability of LSPs in the Binh Tri Thien region. The study discovered that the effect on economic logistics sustainability stays as a total of seven factors from the literature evaluation. The most critical variables are logistics expenditures, which may be reduced through digital transformation in LSP enterprises, resulting in cost reductions in storage, transportation, inventory carrying, and administration charges. New physical delivery technologies, such as autonomous vehicles, drones, and 3D printing, have the

potential to lower operating costs. Although such technologies are unlikely to reach the mainstream market in the next ten years, they will help businesses save money on maintenance, insurance, and gasoline. Drones will transform last-mile logistics, enabling logistics organizations to provide more efficient delivery services in both rural and urban areas. Drone use will provide logistics businesses with a twofold benefit. They will also be able to add a premium fee and provide faster delivery (Weinelt, 2016). Flexibility varies with planning conditions; for example, the proportion of unplanned shipments is completed without excessive delay. Furthermore, information may be acquired from the gathered data utilizing analytics capabilities, and the frequency of service rate movements is loaded at regular intervals. This research helped to detect connections between numerous data points, allowing gains in operational efficiency to be identified across the value chain reliability is subject to change in the efficiency of logistics regarding warehousing, inventory, and transport; for example, e.g., excellent order expected delivery times. Analytics abilities ought to be used to derive information from data that are gathered. This result facilitates the recognition of connections between numerous data points, which enable increased operations to be identified across the value chain (Weinelt, 2016) transport volume changes in the overall volume of freight transported means logistics companies stand to gain by utilizing shared transport. Shared transport platforms will enable logistics firms to enhance their margins by raising their utilization rates and reducing empty backhauls (Weinelt, 2016). Regarding loss and damage, changes the number of items missing or damaged due to vandalism, accidents, and theft. Concerning forecast accuracy, there are changes in uncertainties in demand. As a response to changing consumer demand, it will be necessary to develop new logistics concepts. It may also be necessary to apply strategies to enterprises areas such as city logistics. The purpose of this is to respond to the ever-increasing demand for deliveries in urban locations or same-day delivery to satisfy growing consumer expectations of increasingly faster deliveries. Inventory reduction involves inventory adjustments in the volume of inventory. Concerning transport, changes in the number of delayed deliveries.

For the environment effect of LSPs companies, four variables have survived from prior studies, all of which have significant impacts on LSPs. To start with pollution, LSPs utilize non-renewable resources by utilizing automobiles and transportation services (Monnet, 2011). Transportation is a significant contributor to the energy and GWP (global warming potential) profile of components. Long-distance transportation sometimes produces the most significant CO₂ emission phase of the wood products lifecycle. (Weinelt, 2016). The third variable is waste, which is related to how to change the volume of recyclable waste, another essential part. The last variable that which important for the environmental impact of LSPs in Binh Tri Thien area is the land-use impact, which means that LSPs also emphasizes deviations in the land area that is allocated to transport infrastructure and the rates of land loss. The results demonstrate tis the top two most significant variables for the environmental impact of logistics sustainability are SEN5 (pollution) and SEN 3 (process emissions), with loadings of 0.841 and 0.715, respectively. Another two variables, SEN 4 (waste) and SEN 6 (land-use impact) are third and fourth, with a high influence at 0.713 and 0.643, respectively. It can be seen therefore that digital transformation will also improve the environmental impact for LSPs in Binh Tri Thien area.

Finally, consider the social impact of logistical sustainability (SS) in LSPs. Similar observations apply to the social indices. In terms of development advantages, LSPs prioritize suitable open-source technological implications for self-directed sustainable development. Furthermore, changes in labor patterns, employment goals, and work styles all have a large societal influence. Variables affecting the influence of digitalization on logistics Acceptance of digital applications in socioeconomic, cultural, and corporate contexts. The study demonstrates that when LSP enterprises in the Binh Tri Thien area employ digital transformation to better their company, they must examine

how to achieve their goals by building a communication channel that solely handles digital signals. Digital transformation also assists LSPs in achieving their sustainability strategy in three dimensions: economics, by reducing logistics costs for storage, transport, inventory carrying, and administration expenses; environmental, by modifying air, noise, and water pollution; and social, by providing reasonable open-source technical results for self-directed sustainable development. Furthermore, digital transformation can also help in the implementation of changes in the business model in LSPs in Binh Tri Thien area. Similarly to other studies, this study revealed that the factors having the greatest effect on the social impact of logistics sustainability are SS1 (development benefits), as same as (Gubler et al., 2014) (Schrauf & Bertram, 2016), having a loading of 0.849. SS2 (impacts & visibility), which was a new variable identified from the experts' opinions, and SS4 (labor patterns) and SS3 (health & safety) came in second, third, and fourth place, with high impact loadings of 0.798, 0.694, and 0.592, respectively. The fifth impact is SS5 (acceptance), with a moderate impact at a loading of 0.557.

5. Implication and Conclusion

5.1. Implication

This study explored the sustainability impact of digitization in logistics and answered what are the digitization characters and associated technologies in logistics network, how the adoption of digitization changed the logistics processes, and which benefits have been obtained through digitization. The most existing literature pointed out the sustainability implications of digitization from solely transport perspective and they failed to employ a broad case of logistics. Therefore, this study represents a new approach to understand the sustainability implications from a logistics perspective. Digitization in logistics has still not reached the maturity level, as it is still in an early maturation phase. For this reason, sustainability implications can be improved and changed over the years with the maturity level of digitization.

The study result showed that the using digital technologies and applications in logistics within logistics providers had a huge sustainability impact, especially the sustainability impact of digitization with respect of economic implication was more important than the other dimensions, although evaluation of some impacts of criteria were unclear from participants. In terms of logistics cost, delivery time, delay, inventory issues, a great potential of digitization in logistics can be seen. Beside this, studies showed that the social implications of digitization (improved health outcomes, lower accident rates) have generally poor impact. Safety and health matters could be improved with the digitization in logistics, whereas digitization was seen as potential threats with respect to labor patterns, therefore the acceptance of fully digitization was also less. The environmental implications of digitization had most impacts on reducing waste, pollution, and emission of greenhouse gases. Digitization is expected to create far more value for society than economy, in this instance, businesses, regulators and policymakers will need to collaborate to maximize value for business and wider society (Yang, Duan, Feng, & Mishra, 2021).

5.2. Conclusion.

This literature review revealed that there is a limited amount of academic research and case studies in the field of SSCM that explores all three dimensions of sustainability. In addition, according to (Birkel & Müller, 2021), there is a limited number of studies which examine the relationship of all the three pillars with the DT of supply chains. Most studies focus on the financial impact, which constitutes a high concern of companies. In contrast, the combination of the social pillar of sustainable supply chains with IT is something relatively new and difficult to understand and analyze (Seuring & Müller, 2008), (Thöni & Tjoa, 2017)). Moreover, the impact of this combination (the three pillars and digital transformation) on the performance of a company or its supply chain is still unclear. This paper argues that there is a need for more academic research, both

at a theoretical level and of real case studies, to examine and analyze practices related to the three pillars of SSCM and to sustainability strategies that may lead to competitive advantages.

Every business requires, at a strategic inflection point, a total re-anchor of how value is created and captured. Digital transformation comes nowadays as a saver from the predictability of red ocean business strategies and an immune system from the disruption risks of cutting-edge technologies. It is a way to perfect the customer experience, redefine competition, exploit the huge potential of big data, embrace innovation, and redefine the value proposition. This paper tries to discuss how to exploit the potential of digital transformation to find the requested equilibrium between economy, society and environment.

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