DIGITAL TRANSFORMATION FACTORS INFLUENCING THE SUSTAINABILITY OF LOGISTICS SERVICE PROVIDERS IN THAILAND

Mr. Putthiwat Singhdong

จุฬาลงกรณ์มหาวิทยาลัย
CHULALONGKORN UNIVERSITY

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ปัจจัยทางดิจิทัลทรานส์ฟอร์เมชั่นที่ส่งผลต่อความยั่งยืนของผู้ให้บริการโลจิสติกส์ในประเทศไทย

นายพุทธิวัต สิงห์ดง

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วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรดุษฎีบัณฑิต
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By	Mr. Putthiwat Singhdong
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Thesis Advisor	Professor KAMONCHANOK SUTHIWARTNARUEPUT, Ph.D.
Thesis Co Advisor	Associate Professor PONGSA PORNCHAIWISESKUL, Ph.D.

Accepted by the GRADUATE SCHOOL, Chulalongkorn University in Partial Fulfillment of the Requirement for the Doctor of Philosophy

..... Dean of the GRADUATE SCHOOL
(Associate Professor THUMNOON NHUJAK, Ph.D.)

DISSERTATION COMMITTEE

..... Chairman
(Assistant Professor TARTAT MOKKHAMAKKUL, Ph.D.)

..... Thesis Advisor
(Professor KAMONCHANOK SUTHIWARTNARUEPUT, Ph.D.)

..... Thesis Co-Advisor
(Associate Professor PONGSA PORNCHAIWISESKUL, Ph.D.)

..... Examiner
(Associate Professor RAHUTH RODJANAPRADIED, Ph.D.)

..... Examiner
(Associate Professor Yong Yoon, Ph.D.)

..... External Examiner
(Associate Professor Thananya Wasusri, Ph.D.)

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งานวิจัยนี้มีจุดประสงค์เพื่อศึกษาปัจจัยทางดิจิทัลทรานส์ฟอร์เมชั่นที่มีอิทธิพลต่ออุตสาหกรรมผู้ให้บริการโลจิสติกส์ในประเทศไทย โดยกรอบการวิจัยเชิงทฤษฎีแบ่งออกเป็นสองส่วนส่วนแรกประกอบไปด้วย ส่วนที่หนึ่ง ปัจจัยที่เกี่ยวข้องกับดิจิทัลทรานส์ฟอร์เมชัน 4 ด้าน จำนวน 21 ปัจจัยประกอบไปด้วย ด้านแรงผลักดันให้เกิดดิจิทัลทรานส์ฟอร์เมชัน ด้านวัตถุประสงค์ที่ทำให้เกิดดิจิทัลทรานส์ฟอร์เมชัน ด้านผลกระทบที่เกิดจากดิจิทัลทรานส์ฟอร์เมชัน และด้านความสำเร็จจากดิจิทัลทรานส์ฟอร์เมชัน ส่วนที่สอง เกี่ยวข้องกับปัจจัยด้านความยั่งยืนของโลจิสติกส์ 3 ด้าน ซึ่งประกอบไปด้วย ปัจจัยด้านความยั่งยืนทางโลจิสติกส์ด้านเศรษฐกิจ ปัจจัยความยั่งยืนทางโลจิสติกส์ด้านสิ่งแวดล้อมและ ปัจจัยความยั่งยืนทางโลจิสติกส์ด้านสังคม จำนวน 23 ปัจจัย งานวิจัยนี้เป็นงานวิจัยชิงปริมาณ โดยใช้แบบสอบถามทางออนไลน์เป็นเครื่องมือในการเก็บข้อมูลและใช้เทคนิค โมเดลสมาการโครงสร้าง ในการวิเคราะห์ผล เพื่อทดสอบความสัมพันธ์และอิทธิพล จากกลุ่มตัวอย่างซึ่งถูกเก็บรวบรวมจากพนักงานในบริษัทที่เกี่ยวข้องกับดิจิทัลทรานส์ฟอร์เมชันของผู้ให้บริการโลจิสติกส์ในประเทศไทย จำนวน 545 ราย ผลการวิจัยพบว่าปัจจัยด้านแรงผลักดันให้เกิดดิจิทัลทรานส์ฟอร์เมชัน และปัจจัยด้านวัตถุประสงค์ที่ทำให้เกิดดิจิทัลทรานส์ฟอร์เมชัน มีอิทธิพลต่อปัจจัยความสำเร็จจและปัจจัยด้านผลกระทบที่เกิดจากดิจทัลทรานส์ฟอร์เมชัน ในขณะเดียวกันปัจจัยทางดิจิทัลทรานส์ฟอร์เมชันยังมีส่งผลกระทบต่อปัจจัยด้านความยั่งยืนทางโลจิสติกส์ ทั้ง 3 ด้าน ทั้งความยั่งยืนทางโลจิสติกส์ด้านเศรฐกิจ ความยั่งยืนทางโลจิสติกส์ด้านสิ่งแวดล้อมและ ความยั่งยืนทางโลจิสติกส์ด้านสังคมของ จากการศึกษางานวิจัยนี้ทำให้ทราบความสำคัญของปัจจัยต่างๆทางดิจิทัลทรานส์ฟอร์เมชันทีส่งผลให้เกิดความสำเร็จในธุรกิจโลจิสติกส์ และยังขยายความรู้เกี่ยวกับปัจจัยทางด้านดิจิทัลทรานส์ฟอร์เมชันที่ส่งผลกระทบต่อความยั่งยืนของธุรกิจผู้ให้บริการโลจิสติกส์ในประเทศไทย

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ปีการศึกษา	2563	ลายมือชื่อ อ.ที่ปรึกษาหลัก .....
		ลายมือชื่อ อ.ที่ปรึกษาร่วม .....

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This research explores and develops digital transformation factors influencing the logistics service-provider sector in Thailand while also examining the impact of 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 respondents who related with digital transformation implement in Logistics service provider companies in Thailand. The result shows that digital transformation drivers and objectives seem likely to impact success factors and digital transformation implications positively. Digital transformation success factors also positively impact logistics sustainability. In comparison, logistics sustainability significantly impacts 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

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Field of Study: Logistics and Supply Chain Management — Student's Signature .....

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Co-advisor's Signature .....

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CHAPTER 1

INTRODUCTION

1.1 Background and Problem Review

The application of digital technology within the logistics business shows a growing trend. Businesses in all industries are now embracing digital technologies, and also reforming their business paradigms to accommodate emerging digital transformation tendencies. They initiate new procedures, or amend their current ones, construct new company cultures, as well as implemented completely new consumer experiences in order to satisfy the customers' changing requirements and the demands of the market. Digital transformation in transportation and logistics enables businesses in this sector to leverage new technologies and maintain a competitive edge in an ever-growing market. These new technologies include: blockchain technology, the cloud, data analytics, machine learning, sensors, the web, and the Internet of Things (IoT). All of these can 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 more intelligent, enabled, efficient, and feasible digital logistics. To achieve authentic and real-time information exchange among supply chain stakeholders, it is necessary to adopt valuable technologies such as sensor-enabling technology, the IoT, and cloud-based database systems Schrauf and Berttram (2016). The integration of these technologies with the supply network provides easy access to consumer requirements by efficiently sharing the product's tracking information or that of service deliveries. This technological integration can typically entail high costs with slow diffusion (Korpela, Hallikas, & Dahlberg, 2017).

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Another goal of business is sustainability. Sustainable digital logistics will require firms to reconsider their digital business strategies and reorganize business operations throughout their supply chain to increase sustainability, including balanced and sustainable economic, environmental, and social development, representing complex inter-relationships In supply chain management and logistics, digital transformation entails changes in value creation through the application, of digital transformation technologies (DTT), strategy and process adaptations of enablers, for example, innovation, and also leadership which motivates the attainment of targets such as increased astuteness, greater productivity, and an approach that is more geared to more consumer requirements. The key motivations for manufacturers to invest in supply-chain management and logistics are to gain real-time product visibility, promote innovation, minimize operating costs, and better planning (Salam & Hoque, 2019).

The latest research suggests that digital transformation within supply- chain management and logistics is at present developing, but there is no distinct comprehension of its specific implications (Junge & Straube, 2020). It is the objective of the exploratory research describe to provide awareness of more sustainable supply-chain management and logistics. Specifically, this study aims to identify digital transformation factors influencing logistics sustainability and explore the effect of digital transformation on sustainable logistics and logistics service providers (LSPs) in Thailand.

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1.2 Research Objective

1. To identify digital transformation success factors that influence of logistics service provider businesses in Thailand.

2. To explore the effect of digital transformation on logistics sustainability in logistics service-provider companies in Thailand

1.3 The Range of this Study

This study concentrates on the effect of digital transformation on sustainable logistics and logistics service providers (LSPSs) in Thailand.

1.4 Contribution

The contribution this work makes is that it proposed to define the success features of digital transformation in the implementation of the logistics business, in order to satisfy the conditions of digital objects and to link them with the information layers and the structure. This study is valuable when specifying issues relevant to the adoption of digital transformation for more efficient applications, e.g., data integration and collaborative knowledge structures. With the focus on sustainability, these obstacles should also be identified in a structured manner. This would enable the natural progression of digital objects, which would also provide policymakers with indications regarding standardized requirements and funding areas, to maximize the advantages of digital transformation for even more sustainable practices. This research is connected to open data and applications, as well as the long-term implications of insignificant technology use.

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CHAPTER 2

LITERATURE REVIEW

2.1 Digital Transformation

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, Cartwright, & Yip, 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 also 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.

2.1.1 Digital Transformation Among Logistics Service Providers

Digitization disrupts logistics systems to the degree that it enables processes to be streamlined or increases in efficiencies. Logistics networks of businesses can become more environmentally sustainable by using advanced analytics (including hyper-connectivity, supercomputing, and big data). Companies use technology to save money and contribute to a more efficient and environmentally friendly manner of operation. A white paper published by the World Economic Forum shows the US$ 1.5 trillion in value to the logistics industry produced during 2025 (Weinelt, 2016). Digital logistics consists of four main elements: Technology, operation, organization, and expertise (Stuermer, Abu-Tayeh, & Myrach, 2017).

2.1.2 Factors regarding Digital Transformation

A systematics review found In total, 21 journals and 4 international conferences (Morakanyane, Grace, & O'Reilly, 2017) were seeking the quest on the basis of digitization publications and associated concepts was issued between 1 January 2010 and 6 December 2017. Only original papers written in English were included. While abstracts were obtained from the four submitted papers, it is only the conference papers were included (not conference series). Fifty-four journal articles and 128 conference papers contributed to the compound search strings. The focus was on empirical contributions; theoretical and philosophical contributions were omitted. They evaluated the 21 research-related contributions and separated the papers into three groups according to the type of valuable insights that the research may contribute: drivers and goals, success factors, and implications (Osmundsen, Iden, & Bygstad, 2018). Drivers and goals are responsible for the initiation of and effect of digital transformation. (Morakanyane et al., 2017), in the literature review, as outlined in the experiential indication of variables. Essential organizational elements for digital transformation are linked to success factors. Implications relate to the impacts of digital change faced by an enterprise (Morakanyane et al., 2017).

Table 2.1 Summary of Digital Transformation Factors

Dimension	No	Factor	Variable	Explanation	Studies
	1	DV1	Customer behaviors and expectations	Comportments or actions that people predict. When they interact with a business, customers have basic historical requirements, such as consistent service and equal pricing.	(Schmidt, Drews, & Schirmer, 2017), (Haffke, Kalgovas, & Benlian, 2017) (Berghaus & Back, 2017)

Drivers	2	DV2	Digital shifts in the industry	Transition in how customers work and deliver value. It is also a cultural transformation that enables organizations to continually challenge the status quo, experiment, and confront failure confidently.	(Berghaus & Back, 2017)
	3	DV3	Changing competitive landscape	They are changing business insight that identifies direct or indirect competitors while simultaneously helping them identify their core values, mission, niche market, vision, strengths, and weaknesses.	(Haffke et al., 2017) (Piccinini, Hanelt, Gregory, & Kolbe, 2015) (Berghaus & Back, 2017)
	4	DV4	Regulative changes	Any alteration of any existing statute, treaty, rule, policy or guideline or any governmental authority's interpretation or administration	(Berghaus & Back, 2017)
	5	OJ1	Ensure digital readiness	The possibility of people using information technology and digital literacy tools to help them evaluate online information.	(Berghaus & Back, 2017)
	6	OJ2	Digitally enhance products and services	The next step is digital services based on data built on the physical product and service's strength.	(Mocker & Fonstad, 2017)

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Objectives		OJ3	Embrace product innovation	Accept new product creation, improvements in the design of conventional goods, or new materials or machineries to produce selected products.	(Berghaus & Back, 2017)
	8	OJ4	Develop new business models	Identifies the company's services, places and anticipates the target market if only to attract investment, attract talent, and inspire management and staff.	(Berghaus & Back, 2017) ; (Mocker & Fonstad, 2017)
	9	OJ5	Improve digital channels	Develop a communication path which only handles digital signals. Both voice and video signals must be transmitted utilizing a digital channel from analog to digital.	(Isaksson & Hylving, 2017) (Berghaus & Back, 2017) (Bilgeri, Wortmann, & Fleisch, 2017) (Mocker & Fonstad, 2017)
	10	OJ6	Increase customer satisfaction	Expand the measurement of how satisfied customers are with a company's products, services, and capabilities	(Isaksson & Hylving, 2017) (Berghaus & Back, 2017) (Bilgeri et al., 2017) (Mocker &

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					Fonstad, 2017)
Success factors	11	SF1	A supportive organizational culture	supplied workers with psychological and social environments to promote health, security, and well-being. It also encourages employee development and success and deliberately fosters positive relations between workers, their tasks, and their organization	(Hartl & Hess, 2017) (Haffke et al., 2017)
	12	SF2	Well-managed transformation activities	Transformation tasks that the company typically participate in before, or during, digital transformation. Enhancing the digital channels of the company, that is, initiating, operating, and improving such channels, was one activity that was apparently significant in numerous case studies.	(Berghaus & Back, 2017).
	13	SF3	Leverage external and internal knowledge	Studying companies that were involved in the acquisitions and mergers achievements of digital technology-associated firms	(Piccinini et al., 2015); (Hildebrandt, Hanelt, Firk, & Kolbe, 2015); (Mueller & Renken, 2017); (Bilgeri et al.,

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					2017).
	14	SF4	Engage managers and employees	Employees working on digital transformation procedures should take part in these changes so that the transformation can attain its maximum capacity	(Horlacher, Klarner, & Hess, 2016); (Piccinini et al., 2015); (Mihailescu, Mihailescu, & Schultze, 2015); (Petrikina et al., 2017); (Mihailescu, Mihailescu, & Carlsson, 2017).
	15	SF5	Grow information system capabilities	A company's capability of coordinating and distributing resources together with other assets based on information systems	(Nwankpa & Roumani, 2016).
	16	SF6	Develop dynamic capabilities	Classifying and responding to opportunities by transforming the business, reconfiguring assets, and developing digital platform facilities	(Karimi & Walter, 2015); (Leischnig, Wölfl, Ivens, & Hein, 2017); (Berghaus & Back, 2017)

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	17	SF7	Develop a digital business strategy	Transforming and accomplishing the anticipated goals of digital transformation by stressing digital leadership skills, scalable and agile digital operations, digitally enabled emerging digital technologies, and consumers' digital experiences.	(Yeow, Soh, & Hansen, 2018) (Nwankpa & Roumani, 2016) (Schmidt et al., 2017);(Leischnig et al., 2017)
	18	SF8	Align business and information systems	Reduce gaps in alignment and respond to conflicts and modifications in environmental, organizational and information systems	(Yeow et al., 2018) (Nwankpa & Roumani, 2016); (Schmidt et al., 2017) (Leischnig et al., 2017)
Implications	19	IP1	Reforming an organization's information system	Discovering how physical and digital convergence and digital transformation influence major manufacturing firms; organizational frameworks.	(Haffke et al., 2017); (Piccinini et al., 2015);(Hylving & Schultze, 2013) (Haffke et al., 2017) (Isaksson & Hylving, 2017);(Mihailescu et al., 2017)

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	20	IP2	New business models	Changes in the business model are popular as a response to digital transformation in companies operating in an industry influenced in the new era by evolving digital technologies	(Hildebrandt et al., 2015) (Remane, Hanelt, Hildebrandt, & Kolbe, 2016);(Mocker & Fonstad, 2017)
	21	IP3	Affecting outcomes and performance	Company performance (assessed by profitability, client satisfaction, return on investment (R.O.I.) and sales growth in comparison with direct competitors) is influenced by the degree of creativity of businesses and organizations	(Nwankpa & Roumani, 2016)

Source: Adapt from (Osmundsen et al., 2018)

2.2 Logistics Sustainability

Digitization facilitates automating workflows and speeding up the production and distribution of documents. Table 2.2 illustrates a sustainable digital logistics ecosystem which indicates how digitalization affects logistics from a sustainable social, environmental, and economic perspective. The characteristics of the logistics sustainability dimensions are summarized as follows:

• **Economic**: an affordable mechanism that works effectively, provides coordinated resolutions and a mixture of choices in the mode of transport, and benefits the local economy.

• **Environmental**: reduced pollution, greenhouse gas emissions, and waste, as well as minimal non-renewable energy use, and the use of technologies that reuse and recycle their components.

• **Social**: essential individual/community access criteria to be satisfied safely and encourage healthier behavior and equality within and across generations.

Table 2.2 Summary of the Logistics Sustainability Dimension

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Dimension	ID.	Factor	Variable	Explanation	Studies
Economy	22	LSE1	Logistics cost	Changes in the cost reduction of logistics regarding transport, storage, inventory carrying and administration costs	(Monnet & Le Net, 2011); (Dougados, van Doesburg, Ghioldi, & KVJ, 2013) (Gubler, Arnold, & Coombs, 2014);(Schrauf & Berttram, 2016);(Weinelt, 2016)
	23	LSE2	Delivery time	Changes in enhancements in distribution, lead time and cycle time	(Monnet & Le Net, 2011); (Dougados et al., 2013) (Schrauf & Berttram, 2016);(Raab & Griffin-Cryan, 2011)
	24	LSE3	Transport delay	Changes in the number of deliveries that are delayed	(Monnet & Le Net, 2011) (Schrauf & Berttram, 2016) (Weinelt, 2016).
	25	LSE4	Inventory reduction	Reduction of inventory adjustments in the volume of inventory	(Dougados et al., 2013)
	26	LSE5	Damage/Loss	Changes in the number of damaged of missing items missing due to vandalism, accidents, and theft	(Monnet & Le Net, 2011)
	27	LSE6	Service Frequency	Utilization rate shifts, load factor, regular intervals	(Dougados et al., 2013); (Nowak, Maluck, Stürmer, & Pasemann, 2016)
	28	LSE7	Forecast precision	Changes in uncertain demands	(Dougados et al., 2013); (Stuermer et al., 2017)

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	ID.	Factor	Variable	Explanation	Studies
	29	LSE8	Reliability	Changes in the efficiency of logistics regarding, transport, warehouse storage, and inventory such as excellent order, expected delivery times	(Monnet & Le Net, 2011); (Dougados et al., 2013); (Gubler et al., 2014); (Schrauf & Berttram, 2016); (Weinelt, 2016)..
	30	LSE9	Flexibility	Changes in planning conditions, such as the number of unscheduled deliveries carried out without unnecessary delay	(Monnet & Le Net, 2011); (Schrauf & Berttram, 2016); (Weinelt, 2016).
	31	LSE10	Transport Volume	Changes in the overall amount of freight transported	(Monnet & Le Net, 2011)
	32	LSE11	Application	Suitable digitization applications in logistics processes	(Gubler et al., 2014)
Environment	33	LSN1	Resource efficiency	Consumption of non-renewable resources by using cars and transport services	(Monnet & Le Net, 2011); (Gubler et al., 2014); (Nowak et al., 2016)
	34	LSN2	Process energy	Changes in requirements for electricity	(Gubler et al., 2014) (Weinelt, 2016)

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	ID.	Factor	Variable	Explanation	Studies
	35	LSN3	Process emissions	Changes in CO_2, and other greenhouse gasses, and in fuel consumption	(Monnet & Le Net, 2011); (Gubler et al., 2014); (Nowak et al., 2016); (Weinelt, 2016).
	36	LSN4	Waste	Changes in the volume of recyclable waste	(Gubler et al., 2014) (Weinelt, 2016)
	37	LSN5	Pollutions	Modification of air, noise, and water pollution	(Monnet & Le Net, 2011); (Weinelt, 2016).
	38	LSN6	Land-use impact	Changes in the land area allocated to transport infrastructure and land loss rates	(Monnet & Le Net, 2011)
Society	39	LSS1	Development benefits	Reasonable open-source technical consequences for self-directed sustainable development	(Gubler et al., 2014);(Schrauf & Berttram, 2016)
	40	LSS2	Impacts	Social impacts created in logistics through digitization	(Gubler et al., 2014);(Nowak et al., 2016).
	41	LSS3	Health	Changes in diseases due to the impact of transport (noise, pollution)	(Monnet & Le Net, 2011).
	42	LSS4	Safety	Changes in the number of	(Monnet & Le Net, 2011);

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				fatalities and disabilities associated with accidents	(Schrauf & Berttram, 2016); (Weinelt, 2016).
	43	LSS5	Labor patterns	Changes in labor intensity, schemes for jobs and styles of work	(Monnet & Le Net, 2011); (Gubler et al., 2014); (Nowak et al., 2016)
	44	LSS6	Acceptance	Acceptance of digital apps in socio-economic, cultural, and business terms	(Gubler et al., 2014); (Schrauf & Berttram, 2016)

Source: adapted from (Kayikci, 2018).

2.3 Relevant Research on the Impact of Digital Transformation on Sustainable Logistics

Current research into how sustainability and digital transformation and sustainability frequently concentrate on the impact of the digital revolution on the three dimensions of sustainability: economic, environmental and social (Kayikci, 2018). Based on the assumption that resource utilization changes can be realized, digital transformation presents prospects for sustainability. They emphasize the impact of digital transformation on a company's scale and the challenges of existing-work replacement (Beier, Hansen, Helbrecht, & Behar, 2017). Digital transformation in logistics and supply chain management has not yet reached maturity (Kayikci, 2018), so the consequences of sustainability will be strengthened and altered. The most important effect of the case discussed is the economic dimension of sustainability. Which released in digital revolution's anticipated effects in economic, environmental, and social terms (Kayikci, 2018), while it is recommended that new technical principles based on digital transformation opportunities should be built into future studies (Beier et al., 2017).

Table 2.3 Summaries of Studies regarding Sustainability Aspects

Author	Journal	Technology	Capabilities
(Bäumer et al., 2017)	Journal of Industrial Ecology	Additive manufacturing	Decentralization
(Bechtsis, Tsolakis, Vlachos, & Iakovou, 2017)	Journal of Cleaner Production	Automation technologies	Autonomy
(Cerdas, Juraschek, Thiede, & Herrmann, 2017)	Journal of Industrial Ecology	Additive manufacturing	Decentralization
(Guo, Shen, & Chen, 2017)	Applied Sciences	Automation technologies, cloud computing	Real-time, autonomy
(Tien Bui, Pradhan, Lofman, & Revhaug, 2012)	Journal of Systems Science and Systems Engineering	Analytics, additive manufacturing	Autonomy
(Zhang, Liu, Liu, & Li, 2016)	International Journal of Production Research	Cloud computing, auto-identification technologies	Real-time, autonomy

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Source: (Junge & Straube, 2020)

2.4 Logistics Services Providers (LSPs)

LSPs are critical components of the global supply chain because they transport services and products services from suppliers to consumers. Globalization is now a principal driving force in the development of business strategies. During the past few decades, leading companies have been manufacturing products for the global market while also requiring global component sourcing. By delivering goods or services from suppliers to customers, LSPs occupy a significant function in the global supply chain. Globalization has become an important driver in forming business

strategies, and during the past few decades, leading companies have developed products for global market delivery while sourcing components from suppliers all over the world. (Banomyong & Supatn, 2011). External trade growth has occurred in both directions, i.e., imports and exports, with newly industrializing countries such as Indonesia, Malaysia, Singapore, and Thailand, 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 (Banomyong & Supatn, 2011; Tascioglu, 2015) defined LSPs as "Any business which provides logistics services including those businesses typically referred to as 3PL, 4PL, LLP". Such services could involve transport, provisioning, , packaging and warehouse storage. (Multaharju & Hallikas, 2015; Tascioglu, 2015) described third-party logistics (3PLs) as "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). (Lieb, Zanarini, Schmahl, Linehan, & Bohus, 2004) described 3PLs as "the use of external companies to perform logistics functions which have traditionally been performed within an organization". The tasks undertaken by a third-party company can embrace either the whole logistics procedure or chosen activities within it. It is certain that the application of LSPs is associated with outsourcing of businesses in a similar way to the driven paradigm of business competitiveness.

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2.5 Research Framework

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 collecting and analyzing quantitative data. This is an exploratory analysis, with the primary approach acting as an extensive literature review. The exploratory analysis analyzed all applicable current models and gathered data from previous studies on warehouse activity services and distribution in Thailand's LSPs, focusing on factors including digital transformation and logistics

sustainably. The results of the literature review were useful in establishing a conceptual paradigm.

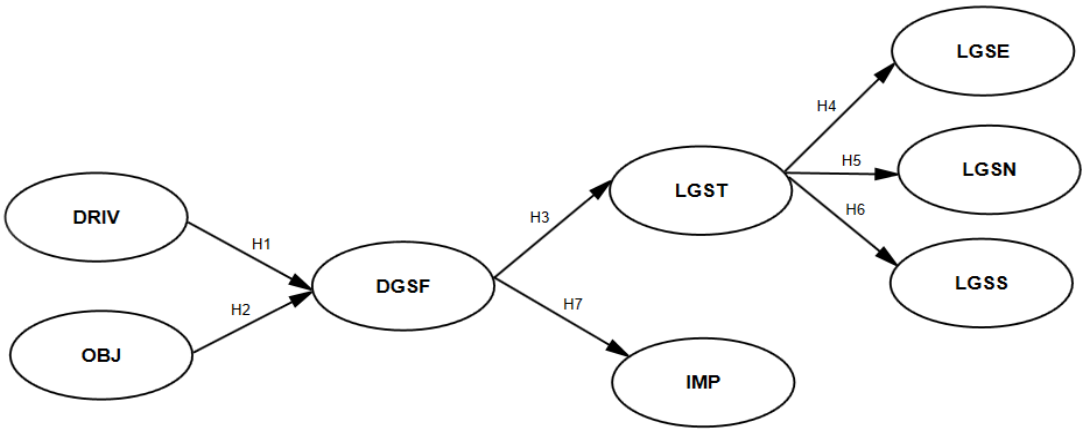

Figure 2.1 The proposed research framework

Remarks: DRI = Drivers in Digital Transformation, OBJ = Objectives in Digital Transformation, DGSF = Digital Transformation Success Factors, LGST = Logistics Sustainability = Logistics Sustainability in Economics, LSN = Logistics Sustainability in Environment, LSS = Logistics Sustainability in Society, and IMP = Implications in Digital Transformation

2.6 Research Hypothesis

The following research hypotheses were formulated concerning the link shown in Figure 2.1 between digital transformation factors and the sustainability of LSPSs 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. Drivers of digital transformation have a positive impact on digital transformation success factors.

H2. Objectives of digital transformation have a positive impact on digital transformation success factors.

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

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

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

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

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

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CHAPTER 3

RESEARCH METHODOLOGY

3.1 Research Design

The quantitative approach was conducted via a survey for this research. The survey involved a structured questionnaire comprising questions on the impact of digital transformation factors on the competitiveness of LSPs in Thailand. The survey research phase included the generation of hypotheses according to established theory and literature, sample, instrument and research design, data analysis and gathering, and inference-making (Bell & Bryman, 2007). The study questionnaire was produced in three phases:

Phase 1: the examination of literature review studies involved the description of the construct and the creation of a sample of items with which to operationalize each of the constructs. An exploratory study was undertaken at the initial step of the research design, which applied a literature review acting as the fundamental method. This study examined all current relevant paradigms and gathered data from previous studies regarding the dimensions of digital transformation and the three dimensions of logistics sustainability. The researcher was helped by the outcome of the literature review, in development of a conceptual paradigm as well as in devising the comprehensive research aims and questions, and also the hypotheses. The variables that were selected for the paradigm was operationalized and were mentioned in developing the research tools. Digital transformation features were being developed by a pool of new items. influencing the LSPs sector in Thailand while also examining the impact of sustainability factors associated with digital transformation. Following this, the items were categorized in accordance with the fundamental dimensions within the questionnaire.

Phase 2 concerned data gathering comprising four subsequent activities: pre-test, pilot test, enhancement of research tools, and the principal survey. The pre-test and pilot tests were conducted prior to the primary survey in order to guarantee that

the optimal research methods were created and utilized. The findings obtained by both of these activities were utilized to improve the measurement items within the survey, especially those concerning content reliability and validity. A primary survey was conducted subsequent to the refinement of the questionnaire being completed. This study utilized the principal survey and the cross-sectional data in order to test the suggested theoretical paradigm and hypotheses. Exploratory factor analysis (EFA) is a statistical method whose purpose is to decrease data to a smaller set of summary variables and also to investigate the hypothetical framework of the occurrences.

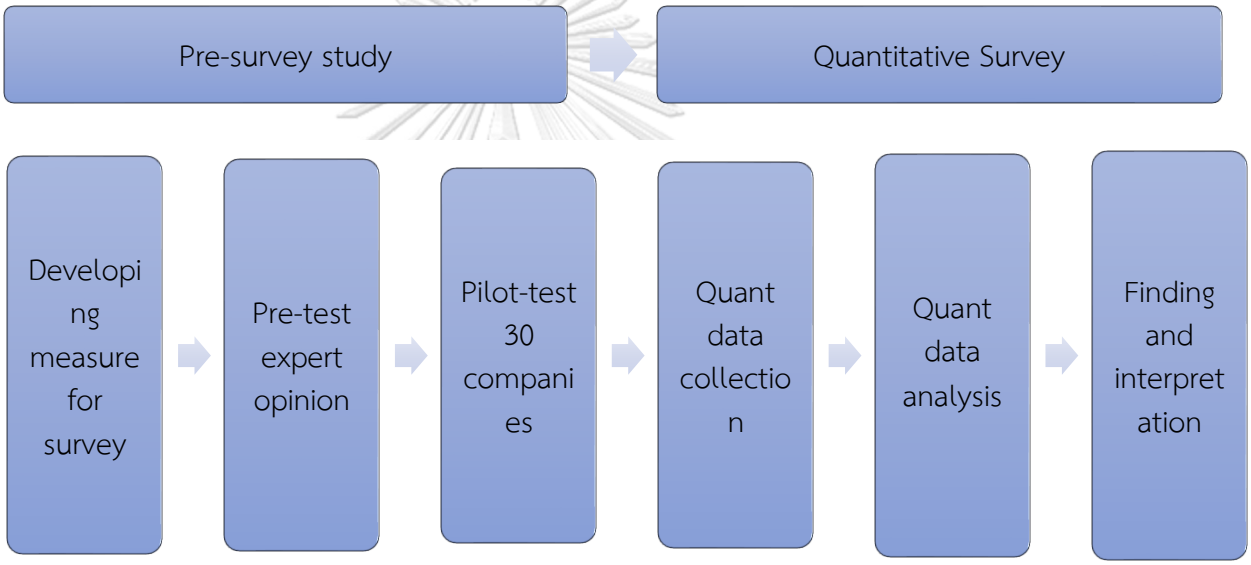
In Phase 3 statistical techniques were utilized in order to process and examine the gathered data which were screened in order to ensure that they had been entered correctly that no values were missing or that there were no free outliers, and also that there was a normal variable distribution. The goal of screening activities is to avoid model evaluation failure and crashing fitting programs (Kline, 2005). At this step, the cleaned data were subjected to the statistical analysis procedure, particularly confirmatory factor analysis (CFA) and covariance-based SEM. Based on previous studies, the techniques applied for conducting research ought to conform to the research questions (Blumberg, Cooper, & Schindler, 2008; Punch, 2003). Therefore, it was essential that a quantitative method, particularly the survey technique, was applied when conducting this research.

The last phase concerns thesis writing, which concentrates on clarifying results and reporting them academically. It is essential that a thesis is structured correctly and that it includes all the necessary stages phases, and particularly that it is readable. Since this study involved the investigation of the effects of digital transformation factors on the competitiveness of LSPs in Thailand, a questionnaire-based survey was considered to be necessary (Clarke, 1999; Neuman & Guggenheim, 2011). With regard to statistical analysis, SEM was applied in order to test and assess causal relationships between variables. Furthermore, it enables the researcher to

assess the strength of inter-relationships between these constructs or hidden ones (Gallagher, Ting, & Palmer, 2008).

A quantitative research design was used in this study. However, quantitative data obtained during a survey may not fully capture reality. Moreover, hypotheses that are based on theoretical predictions are tested by applying experiential study, and quantitative research is particularly appropriate to this type of inquiry. (Bryman, 2004; Creswell, 2009). The suggested research design is displayed in Figure 3.2

Figure 3.2 The suggested research design



Source: adapted from (Creswell & Zhang, 2009)

3.2 Population and Sample

The sample is a subset of the populace chosen for study, whereas the population of a study is a group from which conclusions may be obtained. However, the distribution of characteristics for the population and for the representative sample is the same. Furthermore, it is usual, in large-scale surveys, to apply probability sampling in order to attain a representative sample, whereas random selection is the key to this procedure (Forza, 2002). The sample size required for SEM depends on many factors, which include: mode size, fit index, amount of missing data distribution and reliability of variables, as well as the

strength of path parameters (Muthén, 2002; (Fritz & MacKinnon, 2007). Many studies have used G*Power for sample size estimation. In order to obtain an improved comprehension of G*Power. Moreover, who seeks a greater knowledge of G*Power and power estimation for other kinds of statistical analysis (such as ANOVA, ANCOVA and logistic regression) should refer to the G*Power for a moderation sample size.

3.3 Data Collection

This study utilized simple random sampling in order to identify particular research fields. These include a list of five well-known LSPs associations in Thailand, comprising 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). These associations were selected, because more than 80% of the LSPs in Thailand are members of them. Consequently, these five associations are sufficient to represent all LSPs companies in Thailand. Furthermore, simple random sampling was used to choose respondent companies according to the directories of the five LSPs associations. The simple random sampling method was applied in order to reduce the amount of bias by supplying an independent and equal opportunity for every member of the population (Kumar, Kawai, & Akira, 2011; Lohr, 2019).

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3.4 Questionnaire Design

The research questionnaire was developed according to the instrument creation technique as advocated by Churchill Jr (1979) and Haynes, Richard, and Kubany (1995), that involved two stages. The first stage concerned examining studies in the literature review by describing a construct and producing a sample of factors to operationalize each construct. The second stage involved instrument development and data collection. This study used questions formulated according to the Likert scale, which is frequently applied in similar research projects, and enables participants to display a favorable or unfavorable opinion toward the object of interest (Cooper and Schindler 2006). In both respondent-centered and stimulus-

centered studies, this scale is simple to create, accurate, and relevant (Meyer III, Walker, Emory, & Smith, 1985). In today's social sciences, the Likert scale is the most commonly used scaling tool.

A five-point scale was used in this study in order to provide options for participants to express their viewpoints. It is clear that a five-point range is equally good as any other range, and also that when a rating scale indicates an increase from five to seven points, or even to nine, this does not mean that the ratings are more reliable. (Hansen, 1999). Furthermore, Likert-type scale is recommended as a data collection technique for research that involves performance measurement, supply-chain practices and concerns (Swafford, Ghosh, & Murthy, 2006; Tan, Kumar, & Srivastava, 2002; Yusuf et al., 2004) as well as the introduction of SEM (Gronemus et al., 2010; May et al., 2011). Except for a participant's profile, all variables were measured by the application of a five-point Likert scale (i.e., 1 = Strongly Disagree, 2 =Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree).

3.5 Measurement

3.5.1 Content Validity

The primary goal of content validation during the early stages of instrument development is to reduce possible error variance related to the assessment instrument and to increase the likelihood of acquiring supportive construct validity indices in subsequent studies. (Hartmann, Barrios, & Wood, 2004). In most cases, content validity is determined by expert panels and judges and by literature reviews. (Straub, Boudreau, & Gefen, 2004). The application of content validity to authenticate the targeted construct varies according to how the construct is defined and how much agreement experts have on the domain and features of the construct. Haynes et al. (1995) claim content validity to be a multi-method qualitative and quantitative procedure. The quantitative approach used this study using validity methods by Objective Congruency Index (I.O.C.) techniques (Sireci, 1998) from academic and business experts in logistics industry . It is recommended that population and expert

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sampling are used to pre-test the initial pool of factors (Straub et al., 2004). Pre-testing an instrument involves content validity testing in order to consolidate factors that are measured qualitatively. A pilot study involves assessing and refining the instrument and investigating the internal consistency of the factors. After a pre-test with eleven industry and academic experts, they recommended additional factors.

Table 3.4 List of Industry and Academic Experts Consulted

No.	Expert's Name	Position	Company	Expert Type
1	Mr. Saphon Suksatit	General Manager in Transport	Bevchain Logistics Company Ltd.	Industry Expert
2	Mr Surasak Buranasompop	Director in Warehouse	DHL Supply Chain Thailand Company. Ltd.	Industry Expert
3	Mr. Damrongsit Kitivtee	General Manager	Yusen Logistics Thailand Company. Ltd.	Industry Expert
4	Mr. Panu Chudjerjeen	Deputy Vice President Transformation	SCBLIFE Assurance Public Company Ltd.	Industry Expert
5	Mr. Patiparn sajjasophon	Business Planning and Logistics Analysis Manager	Thai Beverage Logistics Company Ltd.	Industry Expert
6	Mr. Phob Pattarasakol	Transportation Director	Central Food Retail Group (CFG)	Industry Expert
7	Mr. Jedsada Thavornsak	Senior Professional Industry	Logistics Division Department of Industrial Promotion, Thailand	Academic Expert
8	Mr. Somchai Banlue-Sano	Executive Director	Thai International Freight Forwarders Association (TIFFA)	Academic Expert
9	Asst. Prof. Dr. Tartat Mokkhamakkul	Director in Logistics and Supply Chain Management	Chulalongkorn University, Thailand	Academic Expert

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		Program, Associate Deans in Chulalongkorn Business School		
10	Assoc. Prof. Dr. Nakorn Indra-payoong	Dean, Faculty of Logistics	Burapha University, Thailand	Academic Expert
11	Assoc. Prof. Dr. Chumpol Monthatipkul	Lecturer in Logistics and Supply Chain Management Program, Associate Deans in Graduate School of Management, and Innovation	King Mongkut's University of Technology Thonburi (KMUTT), Thailand	Academic Expert

3.5.2 Pilot Study

This pilot study involved evaluating and refining the tool and investigating the internal consistency of the factors. After a pre-test with eleven experts from industry and academia, the results showed one additional driver of digital transformation, namely technology transfer from other 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.

3.5.3 Reliability Test

Cronbach's alpha can be used to test the completed questionnaires' reliability (Gliem & Gliem, 2003). The alpha reliability is the degree to which the same result can be obtained for any measurement procedure under repeated conditions (Gliem & Gliem, 2003). By providing straightforward questions, the reliability of a questionnaire can be increased. The pilot study involved evaluating and refining the instruments and investigating the factors' internal consistency. Cronbach's alpha

coefficient as applied in order evaluate the reliability value of the scale, which should be above the acceptance level of 0.7.

3.5.4 Dimensionality Assessment

After questionnaires are completed by respondents, exploratory factor analysis (EFA) is used by applying principal axis factoring and varimax rotation with eigenvalues equal to or more than one (1) to determine and refine scale dimensionality. It is necessary to assess the dimensionality because it can help ensure that the measured items can effectively reflect the constructs derived from theory and the literature around 1998 suggested that the items with the factor loading ought to have a suitable value. Field et al. (2009) suggested that if the sample size exceeds 200, then the factor loading ought to be higher than 0.40 at the statistically significant level of 0.05. However, the factor loading must not be lower than 0.50 if the study sample size is less than 200. As a result, any item lower than the suggested value should be removed from the construct. The sample size can be either more or less than 200, and the sample size must be referred to as the variable number. Gronemus et al. (2010) recommended that the proportion of cases that are suitable with the number of variables should be equal to 5 per variable. (5:1). In addition, Kaiser-Meyer-Olkin and Bartlett's Test of Sphericity was employed for exploratory factor analysis. This test can help to determine the appropriateness of the sample used in exploratory factor analysis, which should be more than 0.50. McGee and Kaiser (1975) and Hair (2006) noted that if the value of Kaiser-Meyer-Olkin is less than 0.50, then the data are not yet ready for exploratory factor analysis and more data should be collected.

3.5.5 Convergent Validity

Convergent validity is important as it can help to assess whether the items in a construct share the proportion of variance in common and whether they can be used for further analysis (Gronemus et al., 2010). To investigate convergent validity, numerous values of the measures were employed. The first is about the goodness-of-fit measure, where the researcher considers the chi-square probability level (p-

value), relative chi-square (CMIN/df), goodness-of-fit index (GFI), root mean square error of approximation (RMSEA), root mean square residual (RMR), Tucker-Lewis index (TLI), normed fit index (NFI), and adjusted goodness-of-fit (AGFI), as advocated by Hair et al. (2010) and Arbuckle (2011). In running confirmatory factor analysis (CFA), the modification indices (MLS) are employed to modify the construct when the construct does not fit with the goodness-of-fit measure (Sukortprommee, 2013). The second is about multiple square correlations (MSCs), which define the reliability of the proportion of the total variation and estimates of the communality of a variable explained by the model. The MSCs consider standardized estimates of more than 0.30 (Aykan & Nalçacı, 2018; Sukortprommee, 2013). However, the preferred value should be more than 0.50 to identify construct validity and item reliability (Gronemus et al., 2010).

3.6 Model Evaluation

Structural equation modelling (SEM) refers to a class of statistical paradigms which explain the links between multiple variables. (Gronemus et al., 2010). It examines the structure of relationships between unobservable constructs, or what are sometimes referred to as "latent factors," which are represented by multiple variables. Several of the unique attributes of SEM have been described.by Kline (2005) and Gronemus et al. (2010) The primary goal of any multivariate technique is to increase the researcher's capacity for explanation and statistical effectiveness. For example, multivariate analysis of variance, multiple regression, discriminant analysis and factor analysis supply the researcher with effective tools for addressing a variety of managerial and theoretical issues. (Gronemus et al., 2010). However, all of them have the same limitation in their ability to look only at one relation at a time. While these techniques are capable of handling multiple dependent variables, they represent only one relationship between dependent and independent variables. None of the multivariate techniques discussed previously is capable of addressing a collection of interrelated questions in a comprehensive manner. However, SEM is capable of

examining a series of dependent relationships concurrently. It has been deemed an advantageous technique for testing theories which include multiple equations with dependent relationships. This means that it can be used to account for instances in which a hypothesized dependent variable becomes an independent variable in a subsequent dependent one. (Hair, Anderson, Babin, & Black, 2010); (Kline, 2005). None of the other techniques discussed above enables us to simultaneously assess measurement properties and test critical theoretical relationships.

SEM typically comprises two sub-models: a) a measurement paradigm and b) a structural paradigm. The measurement model shows how a group of observed variables (or indicators) represent a series of hidden constructs (or factors). Confirmatory factor analysis (CFA) is generally applied in order to assess the paradigm. CFA is a kind of factor analysis in which the researcher must a priori specify the number of factors and which of the indicators load on such factors (Hair et al., 2010). Factor loading is an estimate which shows the strength of connection between the indicator and its represented construct. Loading estimates ideally should be at least 0.5 (Gronemus et al., 2010). The structural paradigm defines the connections between hidden constructs The chi-square test is the most fundamental fit index, which evaluates the differences between observed and estimated covariance matrices. If the observed and estimated covariance matrices are equal, the model fit is perfect, or the chi-square test is not statistically significant. Nevertheless, chi-square statistics are compassionate to sample size and the complexity of the model (i.e., numbers of parameters to be estimated) (Hair et al. 2010). Hence, the fitness of the model is determined by using a combination of several model fit measures. Suggestions were made by Kline (2005), e.g., the chi-square model; the Steiger-Lind root mean square error (RMSEA), with its 90% confidence interval; the Bentler comparative fit index (CFI); and the standardized root mean square residual (SRMR). Gronemus et al. (2010) provided a guideline for fit indices for a sample size of less than 250 and a number of observed variables of more than 30. According to the

guideline, an RMSEA of less than 0.08 is acceptable and less than 0.05 is a perfect fit. A CFI value more than 0.9 indicates a good fit and a value more than 0.95 indicates a very good fit, while an SRMR value of less than 0.09 indicates an acceptable fit. Normed chi-square is another indicator, which is the ratio of the chi-square statistic to the degrees of freedom, where a ratio between 2.0 and 5.0 is an acceptable fit, and a ratio of less than 2 indicates a good fit. The following chapter discusses data preparation for the structural model and respondent demographic analysis.

Table 3.5 Model-fit index

Category	**Acceptance Level**	**Description**
Chi-square probability level (p-value)	p>0.05	The p-value must be greater than 0.05. The higher the p-value is, the better the model's suitability.
Relative chi-square (CMIN/df)	<3 or not >5	CMIN/ df must be < 3, or not >5; if closer to 0, the model's suitability is increased.
Goodness-of-fit index (GFI)	>0.90	GFI must be >0.90, which, if it is closer to 1, the model's suitability increases
Adjusted goodness of fit (AGFI)	>0.90	AGFI must be >0.90.
Root mean square error of approximation (RMSEA)	<0.08	RMSEA must be <0.08, which if it is closer to 0, the model's suitability increases
Root mean square residual (RMR)	<0.08	RMR must be <0.08.
Comparative fit index (CFI)	>0.90	CFI must be >0.90
Tucker-Lewis index (TLI)	>0.90	TLII must be >0.90
Normed fit index (NFI)	>0.90	NFI must be >0.90

Source :(Hair et al., 2010)

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CHAPTER 4
RESULTS ANALYSIS AND DISCUSSION

This chapter commences with a short description of the demographic characteristics of the individuals and organizations that comprised the study's sample. Data analysis must be performed before the data can be examined. This includes evaluating the impact of missing data, detecting, and managing outliers, testing the data for significant deviations from normality, and reliability tests for all constructs and non-response bias. Following data preparation, validity testing is performed. Statistical tests are conducted in order to attain the validity requirements of the SEM for confirmatory factor analysis (CFA) and exploratory factor analysis (EFA) in order to make sure all of the models have construct validity. (Byrne et al., 2010; Hair, Sarstedt, Pieper, & Ringle, 2012) Following that, SEM analysis is used to validate the complete structural model.

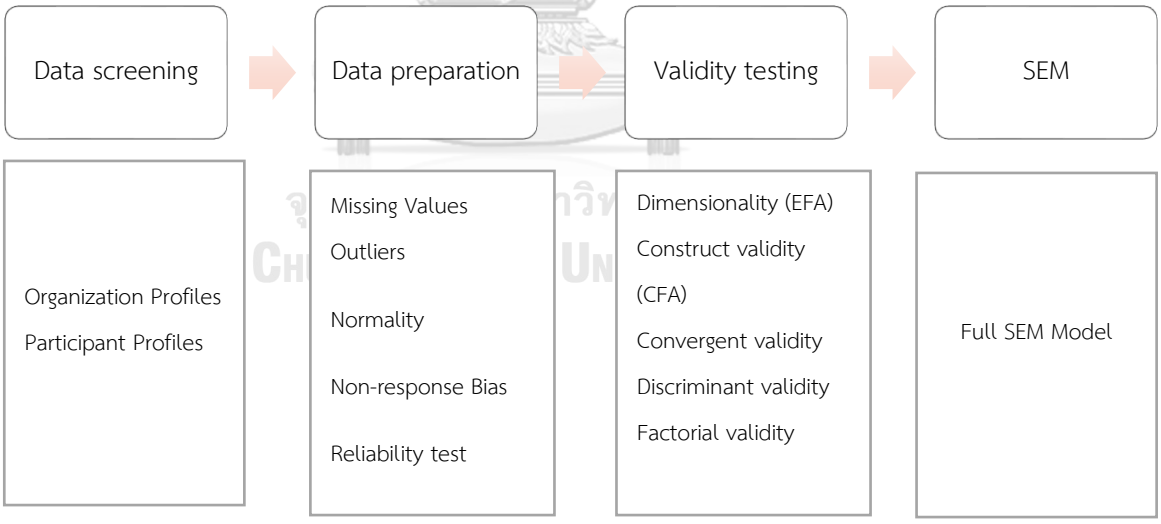

Figure 4.3 A Flowchart of Model Validation

4.1 Data Screening

The data for this research were gathered in LSPs in Thailand from a online-based questionnaire which was delivered to the recognized LSPs companies in Thailand using the drop-off and collect method; this involved the distribution of surveys by hand, and they were collected following completion (Brown, 1993). A total of 545 questionnaires were completed. The final version was translated into Thai by a certified linguistic specialist accredited translator. During the initial phase, the dataset obtained was analyzed by applying Statistics software. This purpose of this software was to screen the data with regard to coding and by checking normality and outliers. Considerable endeavor was made in order to prevent any data entry errors in SPSS by utilizing its attribute of defining acceptable values and labels for each variable. The data were verified by checking for extreme value or outliers. The Mahalanobis distance (Mahalanobis, 1936) is a statistical method which may be applied to assess the distance of a point is from the center of a multivariate normal distribution. Furthermore, on a case-by-case basis from 650 Case to 545 final valid questionnaire runs for descriptive statistics. The data were confirmed on a case-by-case basis and verified for descriptive statistics.

4.2 Descriptive Statistics

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4.2.1 Respondent's Demographic Information

Data were collected through a self-completed online questionnaire distributed to target participants is LSPs employees whose associated in digital transformation development. In order to identify the particular 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 were utilized for the data analysis. The primary service offered was transportation services 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 4.6).

Table 4.6 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	No	%	No	%	No	%	No	%
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)	No	%	No	%	No	%	No	%
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)	No	%	No	%	No	%	No	%
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

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>5,000	22	9.5	26	18.8	14	8.0	62	11.4
Total	231	100	138	100	176	100	545	100.0

4.3 Data Preparation

4.3.1 Assessment of Missing Values

In research regarding questionnaire surveys, where several issues are left unanswered, there is a problem of missing values. Proper treatment is necessary to solve this issue, depending on the nature of the missing values. One solution is to eliminate these, a practice that is considered to be acceptable and is considered to improve the data structure as a whole. (Fidell, Tabachnick, Mestre, & Fidell, 2013). However, a systematic pattern could generate partial results if the missing values are fixed. As a result of the drop-and-collect approach, the researcher was able to collect questionnaires and double-check with participants in person if any questions remained unanswered. As a result, a double-check procedure was used to achieve a high level of accuracy during the data entry process. The initial check entailed verifying each entry on an individual basis. Descriptive statistics for continuous data were generated and verified in the second check which included maximum and minimum values, frequency distribution and standard deviations and means.

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4.3.2 Assessment of Outliers

The expression “outliers” indicates data points which have different value that are either greater or less than other data in the same set. These are known as "abnormal" until it is thought that they may belong to the same group, and if this is found to be the case, their Impact on the measurement error is established (Alkasadi et al., 2019; Belsley, Kuh, & Welsch, 2005). It is calculated using Difference in Fits (DFFITS), which can be found in statistical software packages for data analysis. A general cut-off for DFFITS to consider is 2 (Li & Valliant, 2011). The result of the degree of freedom Fittest revealed that no cases were being displayed as an outlier. This implies that it was thought that their data belong to the same group, which can

lead to a measurement error. Therefore, the data set may be utilized for further analysis.

4.3.3 Assessment of Normality

After examining the data for outliers and missing values, it was determined whether any significant deviations from normality existed. Normality measures whether the data are distributed generally over the entire population sample. There should be no scores that are excessively high or low scores from a small number of respondents because this could skew the overall result (Hair et al., 2010). A significant variation from the normal distribution can cause all resulting statistical tests to be false because many of the statistical tests were developed on the presupposition that the data distribution is normal. In most cases, the evaluation of univariate normality for all variables is sufficient, particularly with a significant sample size such a, ≥200 observations (Hair, 2006). Moreover, a large sample size reduced the detrimental impact of non-normality. (Kline, 2005);(Blunch, 2012) (El-Basyouny & Sayed, 2013).Therefore, this section evaluates the normality of all individual variables

As SEM is a covariance-based analysis, the problem of kurtosis is of more significant concern than skewness (DeCarlo, 1997; West, Finch, & Curran, 1995). Where non-normal data are present, this inflates the chi-square value and also underestimates other goodness-of-fit (GOF) indices that are generated by the maximum likelihood (ML) AMOS (Byrne, 2001). Kurtosis and skewness of a normal distribution usually have zero values; however, if they do not, this indicates indicate a departure from normality. Nevertheless, small variations from zero cause no problems, particularly for a large sample size (N≥ 200); therefore, significant variations ought to be considered appropriately. The cut-off values of kurtosis and skewness ought to be within the range of +1 to –1 if data are distributed normally (Lewis-Beck, Nadeau, & Elias, 2008). Nevertheless, (Hair, 2006) suggests a broader range of +3 to –3, as supported by Rosenberg and Kline (2010). Table 4.7 indicates the results of the normality test which show that, while all values for the items are within the

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rigorous range of values, and satisfy the wider range of +3 to –3 range for kurtosis (Hair, 2006). Consequently, the experiential measures of kurtosis and skewness for all 51 metric variables showed no multivariate non-normality issues within the dataset.

Table 4.7 Results of Normality Distribution Tests

Variable	N	Minimum	Maximum	Mean	Skewness	Kurtosis
DV1	545	2.00	5.00	4.4477	-0.865	-0.273
DV2	545	2.00	5.00	4.3927	-0.821	-0.231
DV3	545	2.00	5.00	4.4716	-1.136	0.781
DV4	545	1.00	5.00	4.0716	-0.530	-0.455
DV5	545	1.00	5.00	4.2752	-0.843	0.226
OJ1	545	2.00	5.00	4.4018	-0.827	-0.131
OJ2	545	1.00	5.00	4.3743	-0.969	0.557
OJ3	545	2.00	5.00	4.4165	-0.918	0.033
OJ4	545	2.00	5.00	4.3468	-0.818	-0.151
OJ5	545	2.00	5.00	4.3890	-0.878	0.044
OJ6	545	2.00	5.00	4.5193	-1.158	0.332
OJ7	545	2.00	5.00	4.4037	-1.051	0.040
OJ8	545	2.00	5.00	4.5174	-1.214	0.770
SF1	545	2.00	5.00	4.2972	-0.624	-0.689
SF2	545	2.00	5.00	4.3468	-0.656	-0.471
SF3	545	2.00	5.00	4.3633	-0.799	-0.315
SF4	545	2.00	5.00	4.3670	-0.784	-0.453
SF5	545	2.00	5.00	4.4128	-0.881	-0.169
SF6	545	2.00	5.00	4.3394	-0.765	-0.225
SF7	545	1.00	5.00	4.3725	-0.940	0.283
SF8	545	2.00	5.00	4.3835	-0.815	-0.341
SF9	545	2.00	5.00	4.4550	-0.983	-0.160
SF10	545	2.00	5.00	4.4202	-0.808	-0.411
LSE1	545	2.00	5.00	4.3596	-0.679	-0.656

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Variable	N	Minimum	Maximum	Mean	Skewness	Kurtosis
LSE2	545	2.00	5.00	4.3266	-0.740	-0.323
LSE3	545	1.00	5.00	4.2550	-0.727	-0.308
LSE4	545	2.00	5.00	4.2642	-0.686	-0.480
LSE5	545	2.00	5.00	4.2165	-0.657	-0.580
LSE6	545	2.00	5.00	4.2550	-0.713	-0.263
LSE7	545	1.00	5.00	4.2330	-0.760	0.142
LSE8	545	1.00	5.00	4.3505	-0.883	0.213
LSE9	545	1.00	5.00	4.2789	-0.743	-0.068
LSE10	545	1.00	5.00	4.2807	-0.838	0.286
LSE11	545	2.00	5.00	4.2936	-0.608	-0.641
LSN1	545	1.00	5.00	4.2624	-0.793	0.113
LSN2	545	2.00	5.00	4.1560	-0.478	-0.827
LSN3	545	2.00	5.00	4.2532	-0.660	-0.654
LSN4	545	2.00	5.00	4.2367	-0.604	-0.651
LSN5	545	2.00	5.00	4.2037	-0.647	-0.575
LSN6	545	2.00	5.00	4.3046	-0.631	-0.608
LSS1	545	2.00	5.00	4.3303	-0.622	-0.763
LSS2	545	1.00	5.00	4.2936	-0.827	0.425
LSS3	545	2.00	5.00	4.1908	-0.626	-0.537
LSS4	545	2.00	5.00	4.2165	-0.706	-0.495
LSS5	545	2.00	5.00	4.2550	-0.713	-0.263
LSS6	545	2.00	5.00	4.2330	-0.641	-0.496
LSS7	545	2.00	5.00	4.3339	-0.661	-0.622
LSS8	545	1.00	5.00	4.1945	-0.781	-0.103
IP1	545	2.00	5.00	4.3156	-0.672	-0.683
IP2	545	2.00	5.00	4.3835	-0.859	-0.293
IP3	545	1.00	5.00	4.3284	-0.902	0.073

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4.3.4 Reliability Testing

It is essential that reliability testing is applied in order to guarantee that any measurement used in a survey is accurate (Straub et al., 2004). This concerns finding measures which indicate the accurate scores for the surveyed items by investigating the phenomenon of interest (Straub et al., 2004). The present research evaluated the measurement's internal consistency and also tested its reliability by calculating Cronbach's alpha for each measurement within a dimension by utilizing IBM Spessartites Software Version 21 (Churchill Jr, 1979; Hair, 2006). The cut-off value for Cronbach's alpha is acceptable when it is more than 0.60 for internal consistency in exploratory research or more than 0.70 for internal consistency within confirmatory research (Straub et al., 2004). Table 6.8 shows the measures of reliability as tested by applying Cronbach's alpha. The results reveal that Cronbach's alpha coefficient scores ranged from 0.88 to 0.97 across all factors. Therefore, these results demonstrate a good level of internal consistency. 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 than 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 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 depicted in Table 4.8

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Table 4.8 Summary of the measurement model and its constructs

Construct	No.	Item	Item 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	

Construct	No.	Item	Item criteria	IOC	Cronbach's alpha
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 organization'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	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	

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	35	LSE9	Flexibility	0.73	
	36	LSE10	Transport volume	0.64	
	37	LSE11	Application	0.64	
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 variable from a logistics expert*

The results show one in digital transformation driver, construct there are two new variables: technology transfer from other countries and digital transformation. Two new factors for the digital transformation objectives construct, namely, reducing operation costs and competitive advantage. Additionally, the digital transformation success factors construct also has two new variables: leadership vision and information technology acceptance. Concerning Logistics sustainability construct in terms of the economic and environmental factor remained the same as previous studies. In comparison, logistics sustainability in social factors found two new factors, namely visibility and social enterprise. After All, the implications for digital transformation remained at three factors. The results revealed a total of 51 factors. Cronbach's alpha coefficient was used to check reliability. Its value was 0.517 for digital transformation driver, 0.844 for digital transformation objectives, 0.803 for

digital transformation success factors, and 0.820 for digital transformation implications. The logistics sustainability dimension values were 0.905 for logistics sustainability in economics, 0.876 for logistics sustainability in environment, and 0.913 for logistics sustainability in society. These values were more than 0.70 (except digital transformation drivers).

The results show the impact of seven additional factors, giving a total of seven more factors after conducting in-depth interviews and verifying each factor with the selected experts. This research also verified each factor's validity using the index of item-objective, in which all factors were more than 0.5. The questionnaire's reliability was verified using a pilot test conducted among 30 representative individuals, with an alpha coefficient value of 0.95. The survey results showed that all 51 factors are appropriate, and that the large-scale questionnaire survey can be used to examine the research hypothesis. The next stage of this research therefore used a large-scale survey; this survey was subject to SEM analysis at this stage of the research. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were undertaken in order to guarantee that all of the model's constructs acquired construct validity.

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4.4. Assessment of Dimensionality Through EFA

The examination of dimensionality is essential to assess the measurement attributes of a construct. Its objective is to supply an improved comprehension of the factor structure among a set of variables. In order to evaluate dimensionality, EFA was employed to investigate and detect each construct's substrata (sub-dimensions) (Straub et al. 2004). This concerns a statistical method in summarizing any correlations among the variables within a dataset (Henson & Roberts 2006). This form of analysis is of assistance in determining whether a theoretical construct is a unique or a multidimensional factor (Holmes-Smith 2010). EFA is used to develop and authenticate the instrument scale in a study, which includes data reduction or removal of poor item variables. EFA is increasingly recognized as a valuable

instrument by organizational researchers for refining measures and assessing construct validity (Conway & Huffcutt, 2003). The aims of exploratory factor analysis (EFA) in this study were to (Pett, Lackey, & Sullivan, 2003; Thompson, 2005) to Investigate the structure of the relationships between variables, to Identify and evaluate the one-dimensionality of a theoretical construct, and reduce the number of variables.

The EFA is heuristic; therefore, investigators have no previous hypothesis with regard to the nature or number of variables (Gogtay et al., 2004; Pett et al., 2003; Swisher, Beckstead, & Bebeau, 2004), it can be run in a restricted paradigm in order to establish the sub-factors that underly a series of items which measure each theoretical construct of nomological network connections (Kline, 2010). Factor dimensionality investigates the constructs as being independent of theoretical connections; therefore, Straub et al. (2004) recommended running EFA separately for each group of items posited to portray a given theoretical construct. As shown in the conceptual framework section in Chapter 3, in the current research, the research model has seven theoretical constructs. Thus, seven separate EFA models were operated.

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Table 4.9 Dimensionality Assessment via the EFA Method

Item	DRV	OBJ	DGSF	IMP	LSE	LSE	LSS
DV1	0.632						
DV2	0.622						
DV3	0.421*						
DV4	0.716						
DV5	0.571						
OJ1		0.517					
OJ2		0.559					
OJ3		0.735					
OJ4		0.68					
OJ5		0.768					
OJ6		0.583					

OJ7		0.577					
OJ8		0.518					
SF1			0.577				
SF2			0.685				
SF3			0.633				
SF4			0.651				
SF5			0.651				
SF6			0.768				
SF7			0.672				
SF8			0.666				
SF9			0.65				
SF10			0.64				
IP1				0.7			
IP2				0.532			
IP3				0.754			
LSE1					0.595		
LSE2					0.727		
LSE3					0.682		
LSE4					0.707		
LSE5					0.618		
LSE6					0.635		
LSE7					0.692		
LSE8					0.633		
LSE9					0.643		
LSE10					0.615		
LSE11					0.494*		
LSN1						0.371*	
LSN2						0.365*	
LSN3						0.524	
LSN4						0.509	
LSN5						0.751	
LSN6						0.541	
LSS1							0.612
LSS2							0.623
LSS3							0.216*

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LSS4							0.245*
LSS5							0.491
LSS6							0.542
LSS7							0.626
LSS8							0.266*

*Deleted item

EFA is a statistical method that is utilized in order to reduce data set to a smaller group of summary variables and to examine the ' underlying theoretical framework of the phenomena. It is used to detect the structure of the relationship between the respondent and the variable. In this study, the inter-relationships among the four dimensions of digital transformation and the three dimensions of logistics sustainability were examined using EFA to establish the fundamental dimensionality of the digital transformation and logistics sustainability construct. The result of a The *Kaiser-Meyer-Olkin* (KMO) value near to 1.0 and Bartlett's test significance near zero indicates that the data are suitable and adequate for continuing with the reduction procedure (Hoque & Awang, 2016).

Table 4.10 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	LSE11Application	Factor loading <.5	10

Logistics sustainability in the environment	6	LSN1 Resource efficiency LSN2 Process energy	Factor loading <.5	4
Logistics sustainability in society	8	LSS3 Health LSS4 Safety LSS8 Social enterprise	Factor loading <.5	5
Total	51	7		44

The output shown in Table 4.9 indicates that seven components or dimensions were acquired using the EFA technique, which suggests a dropped item when the factor loading value is less than 0.5 (Mvududu & Sink, 2013). Table 4.10 summarizes the EFA output. Overall, the EFA process dropped seven items under the seven dimensions of digital transformation and logistics sustainability constructs, while 44 items were considered for confirmatory factor analysis (CFA).

4.5 Assessment of Dimensionality Through CFA

The EFA results indicate that CFA is used to authenticate a data set by confirming the fundamental structure theoretically (Byrne et al., 2010; Maron et al., 1996). CFA enables a method of assessing the construct validity of each construct of interest. Construct validity evaluates the degree to which a series of measured items indicate the fundamental factor paradigm that such items are intended to evaluate (Gronemus et al., 2010). The construct validity concentrates on measuring separate constructs. Tests were initially conducted for each factor in the model. In the case of the higher-order paradigm, discriminant and convergent validity were the focus, and, lastly the factorial validity was tested for the full measurement paradigm (Lewis, Templeton, & Byrd, 2005). A summary of the factorial, discriminant and convergent validity is provided in the next section, which also indicates the results of the measurement paradigm and construct validity.

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4.5.1. Convergent Validity

Convergent validity evaluates the degree to which the items that comprise the constructs converge or have a proportion of variance in common (Gronemus et al., 2010; Straub et al., 2004). In CFA AMOS, it is possible to evaluate the convergence validity of a construct by using either one of the following measures or a combination of them: Goodness-of-fit (GOF) measures; squared multiple correlation (SMC), which is a function of the size of the standardized factor loadings (SFL); average variance extracted (AVE), and construct reliability (CR) (Gronemus et al., 2010; Straub et al., 2004). **The considerations for paradigm re-specification and the different measures of convergent validity are addressed in the next section.**

4.5.2 Goodness-Of-Fit (GOF)

In Statistics, GOF is used to compares the goodness of fit between reality and theory (Hair et al. 2010). As the covariance matrices between these becomes closer, the theory fits the data in a better way. This means that GOF indicates the ability of a paradigm to represent data. However, the paradigm must be re-specified if the GOF indicates a bad fit of the theorized paradigm. Furthermore, the CFA technique to the extent to which the covariance matrix corresponds to the observed sample covariance matrix (Marsh, Balla, & McDonald, 1988). It conducts a statistical test of the whole paradigm simultaneously in order to establish whether it fits with the data (Van Mantgem et al., 2009). However, when conducting SEM, the model-fit is critical. A good model-fit initially shows a high correspondence between the relationship represented in the paradigm and the data, and secondly, it authenticates the paradigm for research (Byrne et al., 2010).

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4.6 One-factor Congeneric Model Analysis

4.6.1 Measurement Model of Drivers of Digital Transformation (DV)

The drivers of digital transformation (DV) were assumed to consist of four items, DV1, DV2, DV4, and DV5. Figure 4.1 shows the CFA results for the suggested one-

factor congeneric paradigm, the measures for which are summarized in Table 5.2. Investigation of the results of the GOF measures indicated that the model fits appropriately with its measures, and that the values in all categories of fit indices are acceptable.

Figure 4.4 Adjusted Model of Drivers of Digital Transformation (DV)

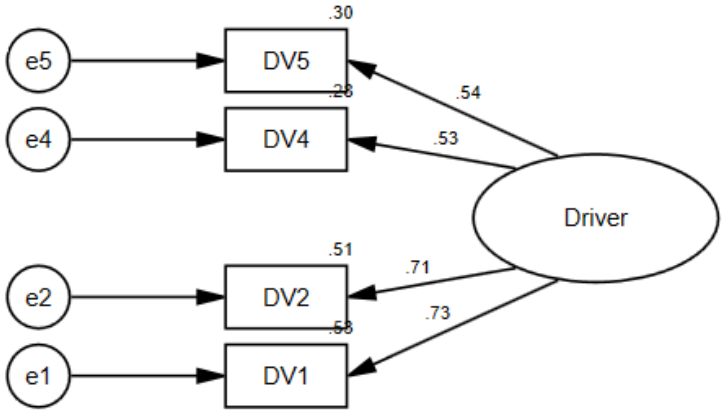

Table 4.11 GOF for the First Order of Drivers of Digital Transformation (DV)

Chi-square		Absolute Fit Indices		Incremental Fit Indices	
p-value	0.278	RMSEA	0.018	CFI	1.000
CMIN/df	1.175	RMR	0.004	TLI	0.998
		GFI	0.999	NFI	
		AGFI	0.989		

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4.6.2 Measurement Model Objectives of Digital Transformation (OJ)

It was assumed that the objectives of digital transformation (OJ) comprised eight items. Figure 4.2 shows the CFA results for the suggested one-factor congeneric paradigm, and Table 4.2 summarizes the GOF measures for this. Investigation of the results of the GOF measures indicated that the paradigm fits appropriately with its measures, and that in all categories of fit indices it has acceptable values.

Figure 4.5 Adjusted Model of the Objectives of Digital Transformation (OJ)

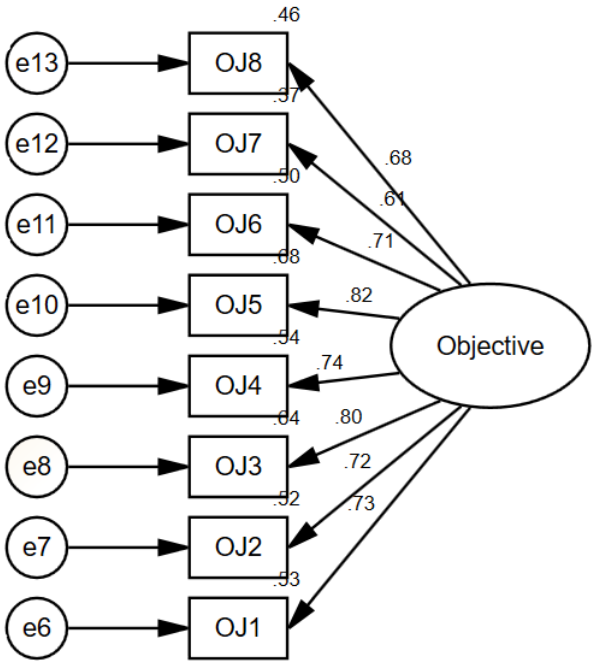

Table 4.12 GOF for First-Order of Objectives of Digital Transformation (OJ)

Chi-square		Absolute Fit Indices		Incremental Fit Indices	
p-value	0.001	RMSEA	0.50	CFI	0.989
CMIN/df	2.347	RMR	0.11	TLI	0.982
		GFI	0.982	NFI	0.982
		AGFI	0.962		

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4.6.3 Measurement Model of Digital Transformation Success Factors (SF)

It was assumed that the digital transformation success factors comprised 10 items. Figure 4.3 shows the CFA results for the suggested one-factor congeneric paradigm, and Table 4.3 summarizes the GOF measures for this. Investigation of the results of the GOF measures indicated that the paradigm fits appropriately with its measures, and also that in all classifications of fit indices, it has acceptable values.

Figure 4.6 Adjusted Model of Digital Transformation Success Factors (SF)

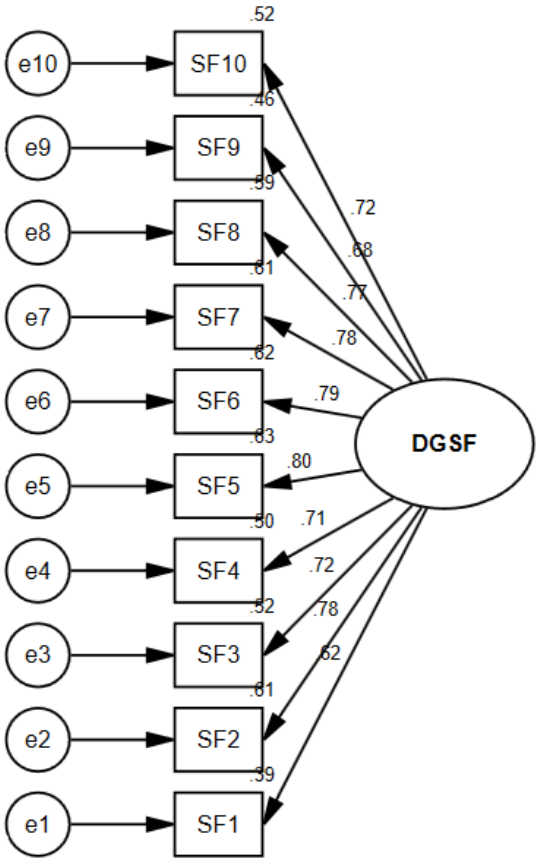

Table 4.13 GOF for First-Order Digital Transformation Success Factors (SF)

Chi-square		Absolute Fit Indices		Incremental Fit Indices	
p-value	0.00	RMSEA	0.48	CFI	0.987
CMIN/df	2.261	RMR	0.12	TLI	0.981
		GFI	0.974	NFI	0.976
		AGFI	0.955		

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4.6.4 Measurement Model of Implications of Digital Transformation (IMP)

It was assumed that the implications of digital transformation comprised three items. Figure 4.4 shows the CFA results for the suggested one-factor congeneric paradigm, and Table 4.4 summarizes the GOF measures for this. Investigation of the results of the GOF measures indicated that the paradigm fits with its measures correctly, and that in all categories of fit indices has acceptable values.

Figure 4.7 Adjusted Model of Implications of Digital Transformation (IP)

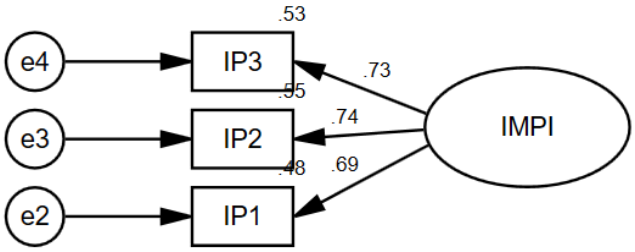

Table 4.14 GOF for First-Order Implications of Digital Transformation (IP)

Chi-square		Absolute Fit Indices		Incremental Fit Indices	
p-value	0.41	RMSEA	0.77	CFI	0.993
CMIN/df	4.193	RMR	0.33	TLI	0.979
		GFI	0.995	NFI	0.991
		AGFI	0.970		

4.6.5 Measurement Model of the Economic Impact of Logistics Sustainability (LSE)

The economic impact of logistics sustainability (LSE) was assumed to comprise ten items. Figure 4.4 shows the CFA results for the proposed one-factor congeneric model. Table 4.4 summarizes the GOF measures for this paradigm. Investigation of the results of the GOF measures indicated that the model fits correctly with its measures, and that in all categories of fit indices, it has acceptable values

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Figure 4.8 Adjusted Model of the Economic Impact of Logistics Sustainability (LSE)

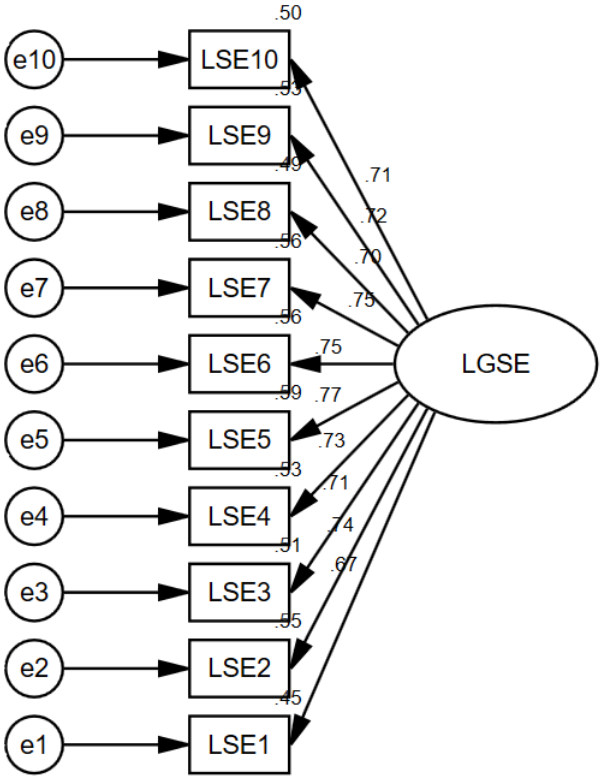

Table 4.15 GOF for the First-Order Economic Impacts of Logistics Sustainability (LSE)

Chi-square		Absolute Fit Indices		Incremental Fit Indices	
p-value	0.00	RMSEA	0.62	CFI	0.978
CMIN/df	3.078	RMR	0.16	TLI	0.968
		GFI	0.965	NFI	0.967
		AGFI	0.937		

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4.6.6 Measurement Model of the Environmental Impact of Logistics Sustainability (LSE)

It was assumed that the environmental impact of logistics sustainability (LSE) comprised four items. Figure 4.6 shows the CFA results for the suggested one-factor congeneric model, and Table 4.6 summarizes the GOF measures for this paradigm. Investigation of the results of the GOF measures indicated that the paradigm fits

properly with its measures, and that in all categories of fit indices, it has acceptable values.

Figure 4.9 Adjusted Model of the Environmental Impact of Logistics Sustainability (LSE)

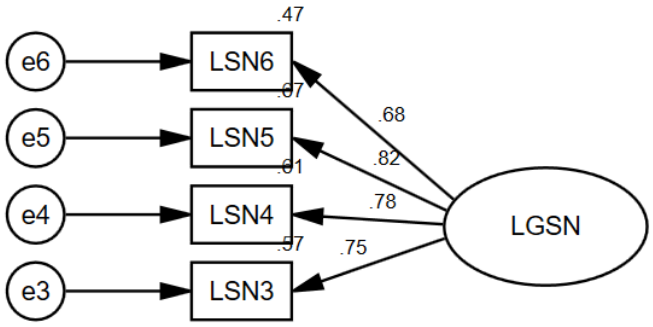

Table 4.16 GOF for the First-Order Environmental Impacts of Logistics Sustainability

Chi-square		Absolute Fit Indices		Incremental Fit Indices	
p-value	0.375	RMSEA	0.000	CFI	1.000
CMIN/df	0.982	RMR	0.005	TLI	1.000
		GFI	0.998	NFI	0.998
		AGFI	0.991		

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4.6.7 Measurement Model of the Social Impact of Logistics Sustainability (LSS)

It was assumed that the social impact of logistics sustainability (LSS) comprised five items. Figure 4.7 shows the CFA results for the suggested one-factor congeneric paradigm, and Table 4.7 summarizes the GOF measures for this. Investigation of the results of the GOF measures indicated that the paradigm fits correctly with its measures, and that in all categories of fit indices, as it has acceptable values.

Figure 4.10 Adjusted Model of the Social Impact of Logistics Sustainability (LSE)

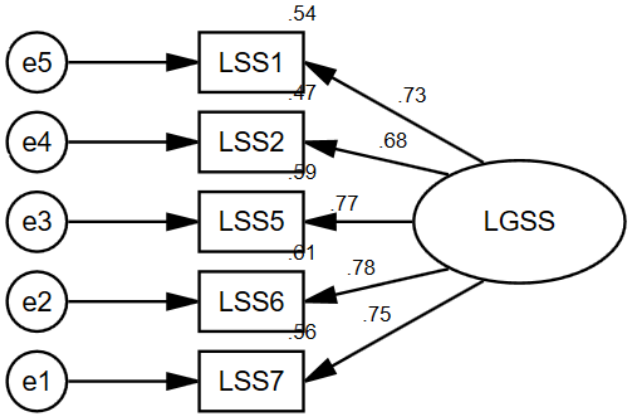

Table 4.17 GOF for the First-Order Social Impacts of Logistics Sustainability

Chi-square		Absolute Fit Indices		Incremental Fit Indices	
p-value	0.14	RMSEA	0.063	CFI	0.993
CMIN/df	3.139	RMR	0.009	TLI	0.982
		GFI	0.991	NFI	0.989
		AGFI	0.965		

4.6.8 Factorial Validity Through the Full Measurement Model

Factorial validity tests whether a series of variables represents a fundamental pattern within the data (Straub et al., 2004). To conduct factorial validity was further undertaken for the complete measurement of digital transformation. Confirmatory factor analysis was applied in order to assess the association between constructs and their retained objects. To assess the presumed relationships among the variables, a total goodness-of-fit test was conducted, along with individual tests for significance. This model contained 44 observable and seven hidden variables. Table 4.8 outlines the items and constructs of this measurement model. The Cronbach's value, which measures the reliability of the paradigm variables, was between 0.745 and 0.922 (Table 4.18). Each construct and its respective subscales had values of more than 0.7, confirming the internal consistency of the constructs.

The convergent and discriminant validities of the constructs were also determined. Three indices were used to assess concurrent validity: factor loading values ought to be greater than 0.7, mean extracted variance (AVE) values ought to be greater than 0.5, and the composite reliability (CR) values ought to exceed 0.7. Except for the digital transformation driver construct, the value of AVE was less than 0.5 (0.482); however, the validity was still adequate due to the CR being more than 0.6 (Fornell & Larker, 1981). The degree 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 ought to be greater than the relationship between that construct and another, confirming the discriminant validity of each construct. Overall, in the convergent and divergent validity context, a satisfactory construct validity level was shown by the results of the test implying that the research constructs were a suitable fit for a structural model assessment.

Table 4.18 Summary of Results for the Final Full Measurement Model

Dimension	No.	Factor	Loading	t-value	SE	Cronbach's alpha	CR	AVE
Digital transformation drivers	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	OJ7	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			

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	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			
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

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The initial model was formed and used to test the hypotheses. The model fit indices were employed to ensure whether the model can be empirically formed. If there is a need to modify the model, modification indices (MI) are required (Oort, 1998; Sanders et al., 2015). According to the study, the results related to model-fit indices, standardized estimates, errors, t-values (critical ratio, CR), p-values, total effects, direct effects, and indirect effects, and are presented as follows.

From the study, it was found that the first final paradigm contained some unacceptable values: a p-value of 0.000, CMIN/df of 3.023, GFI of 0.822, AGFI of 0.802, RMSEA of 0.061, CFI of 0.881, TLI of 0.874, and NFI of 0.833. Due to the occurrence of some unacceptable values, modification of the model was performed. After conducting model modification by correlating possibly correlated items, the adjusted model consequently gained better model-fit indices: p-value of 0.00, CMIN/df of 1.339, GFI of 0.922, AGFI of 0.901, RMSEA of 0.025, RMR of 0.017, CFI of 0.983, TLI of 0.979, and NFI of 0.9935. This meant that this data set could be used for further analysis. Accordingly, the details of the adjusted model are shown in the figure and tables

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Figure 4.11 Full Adjustment model

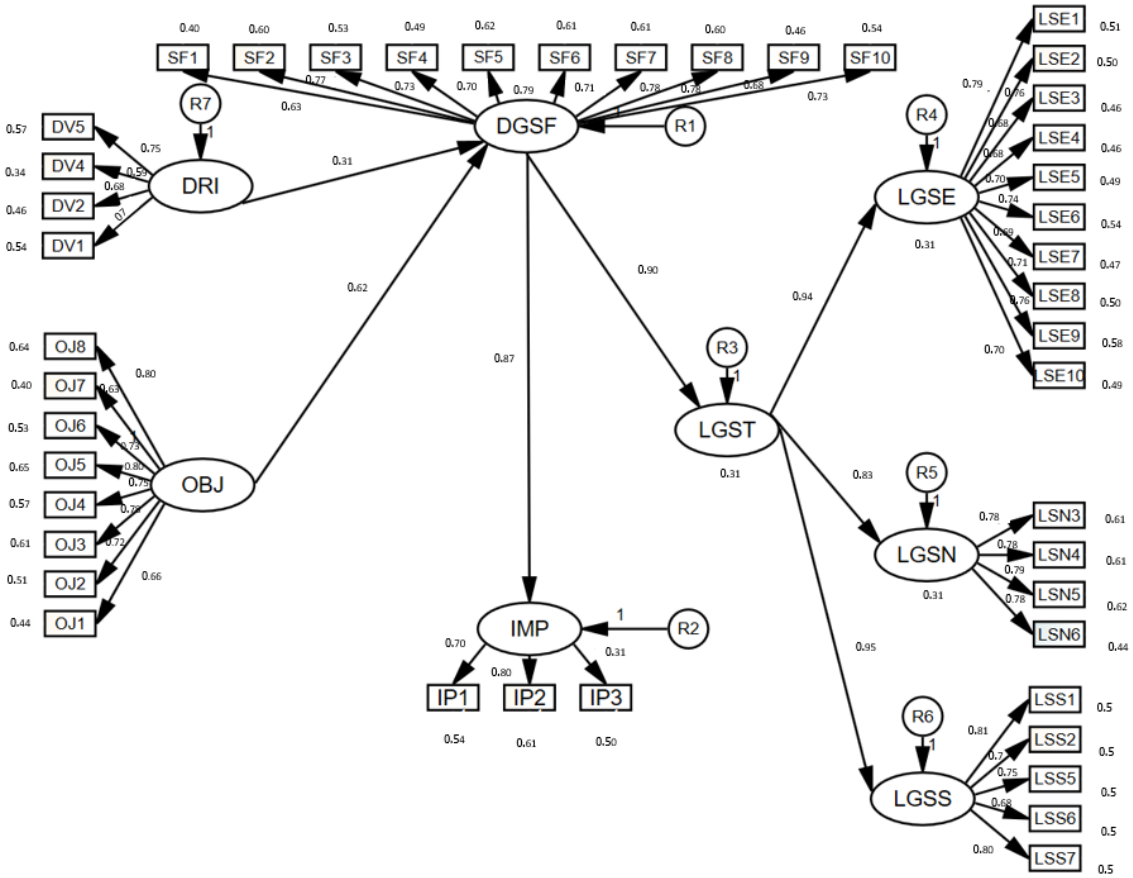

Table 4.19 GOF for Adjust Measurement Model

Chi-square		Absolute Fit Indices		Incremental Fit Indices	
p-value	0.00	RMSEA	0.025	CFI	0.983
CMIN/df	1.339	RMR	0.017	TLI	0.979
		GFI	0.922	NFI	0.935
		AGFI	0.901		

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4.7. Structural Model and Hypothesis Testing

The hypotheses at the basis of the suggested research paradigm were tested and applied on order to evaluate the structural model. IBM Amos software (version 22) was used to conduct a path analysis for examining the causal paradigm whose goodness-of-fit indicators are indicated below. 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; and minimum discrepancy per degree of freedom (CMIN/df) = 2.530. These indicators met the required cut-off values, implying a good model fit. Table 5 outlines the results of hypothesis testing that show the relationships of the variables with significance.

Table 4.20 Hypothesis Testing.

Hypothesis	Path	Loading	t-value	Result
(H1). DRIV creates a positive impact on DGSF	DGSF <--- DRIV	0.310	5.283	Supported
(H2). OBJT has a positive impact on DGSF	DGSF <--- OBJT	0.619	9.733	Supported
(H3). DGSF has a positive impact on LGST	LGST <--- DGSF	0.904	14.769	Supported
(H4). LGST has a positive impact on LGSE	LGSE <--- LGST	0.944	-	
(H5). LGST has a positive impact on LGSN	LGSN <--- LGST	0.830	16.566	Supported
(H6) LGST has a positive impact on LGSS	LGSS <--- LGST	0.945	16.547	Supported
H7). IMP has a positive impact on DGSF	IMP <--- DGSF	0.869	13..086	Supported

The results of the regression analysis indicated that perceived DRIV creates a positive impact on DGSF (SE = 0.56; β = 0.310; $p < 0.001$; supporting H1), while OBJT has a positive impact on DGSF (SE = 0.60; β = 0.619 $p < 0.001$; supporting H2). DGSF has a positive impact on LGST (SE = 0.69; β = 904 $p < 0.001$; 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 β = 0.944, 0.830, and 0.945, $p < 0.001$, supporting H4, H5 and H6 respectively). Finally, IMP has a positive impact on DGSF (SE = 0.98; β = 0.852 $p < 0.001$; supporting H7).

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4.7.1 Total Effect, Direct Effect, and Indirect Effect of the Studied Model According to the Hypothesis

Table 4.21 Total Effect, Direct Effect, and Indirect Effect of the Studied Model

Construct	OBJT			DRIV			DGSF			LGST		
	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE
DGSF	0.619	-	0.619	0.31	0	0.31	-	-	-	-	-	-
LGST	-	0.56	0.56	-	0.28	0.28	0.904	0	0.904	-	-	-
IMP	-	0.538	0.538	-	0.269	0.269	0.869	0	0.869	-	-	-
LGSS	-	0.529	0.529	-	0.265	0.265	-	0.854	0.854	0.945	-	0.945
LGSN	-	0.465	0.465	-	0.233	0.233	-	0.751	0.751	0.83	-	0.83
LGSE	-	0.528	0.528	-	0.264	0.264	-	0.854	0.854	0.944	-	0.944

DE = direct effect; IE = indirect effect; and TE = total effect

From the table, it can be seen that the study indicates that OBJT has a standardized direct effects and total effect on DGSF, with a standardized estimate of 0 .6 1 9 . OJBT also has a standardized indirect effect and total effect, with a standardized estimate of 0.56 for LGST, 0.538 for IMP, 0.529 for LGSS, 0.465 for LGSN, and 0.528 for LGSE. For the DRIV construct the outcome demonstrates that DRIV has standardized direct effects and a total effect on DGSF, with a standardized estimate of 0.310. DRIV also has standardized indirect effects and total effect, with a standardized estimate of 0.28 for LGST, 0.263 for IMP, 0.529 for LGSS, 0.233 for LGSN, and 0.264 for LGSE. furthermore, the DGSF dimension has standardized direct effects and total effect on LGST, with a standardized estimate of 0 .904 and IMP of 0.869. DGSF also has a standardized indirect effect and total effect, with a standardized estimate of 0.854 for LGSS, 0.751 for LGSN, and 0.264 for LGSE. To sum up, the LGST construct has standardized direct effects and a total effect on LGSS, with a standardized estimate of 0.619, 0.83 for LGSN, and 0.944 for LGSE.

4.8 Discussion

4.8.1 Identifying Drivers of Digital Transformation (DV)

Table 4.22 Factor influencing Drivers of Digital Transformation

Construct	Item	Item criteria	Factor Loading	R^2
Digital transformation drivers	DV4	Regulatory changes	0.754	0.569
	DV1	Customer behavior and expectations	0.736	0.542
	DV2	Digital shifts in the industry	0.678	0.460
	DV5	Technology transfer from other countries	0.663	0.440

From this research, it was found that for digital transformation drivers in LSPs in Thailand, the greatest influencing requirement to concentrate on DV4 (regulatory changes) which loading is equal to 0.754 and consistent to with the studies (Berghaus & Back, 2017), followed by DV1 (customer behavior and expectations), the loading of which is equal to 0.736, and is consistent with many studies in the review that confirm (Schmidt et al., 2017),(Haffke et al., 2017),and (Berghaus & Back, 2017). The third is DV2 (digital shifts in the industry), for which the loading of 0.678 was also consistent with that found in other studies (Berghaus & Back, 2017). The final factor for the digital transformation drivers, DV 5, was digital shifts in technology transfer from other nations, which was a new feature recognized by logistics experts.

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4.8.2 Identifying Objectives of Digital Transformation (OJ)

Table 4.23 Factors influencing objective of digital transformation

Construct	Item	Item criteria	Factor Loading	R^2
Digital transformation objectives	OJ5	Improve digital channels	0.804	0.646
	OJ8	Competitive advantage	0.799	0.638
	OJ3	Embrace product innovation	0.783	0.613
	OJ4	Develop new business models	0.753	0.567
	OJ6	Increase customer satisfaction	0.73	0.533
	OJ2	Digitally enhance products	0.716	0.513

	OJ1	Ensure digital readiness	0.663	0.440
	OJ7	Reduce operation costs	0.635	0.403

According to the results, OB5 (improve digital channels), is the digital transformation objective variable with greatest influence, having a loading equal to 0.804, which was consistent with other studies (Isaksson & Hylving, 2017); (Bilgeri et al., 2017; Mocker & Fonstad, 2017). The second for is OB8 (competitive advantage), which was another new factor identified from the expert interviews, with a loading of 0.799. Intended for OB3 (embrace product innovation), OB4 (develop new business models), and OB6 (increase customer satisfaction), were third, fourth, and fifth, with loadings of 0.783, 0.753, and 0.73, respectively. This shows that LSPS need to accept they must improve using new materials or components to operate their service. They also need to identify a company's services, places, and anticipate their target market while also expanding the measurement of how satisfied customers. Furthermore, OJ2 (digitally enhance products), OJ1 (ensure digital readiness) and OJ7 (reduce operation costs) are in the sixth, seventh, and eighth places, with loadings of 0.716, 0.663, and 0.635, respectively. This can indicate that three of the six aims of digital transformation variables are significance crucial for LSPs in Thailand.

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4.8.3 Identifying Digital Transformation Success Factors (SF)

Table 4.24 Factors influencing the success of digital transformation

Construct	Item	Item criteria	Factor Loading	R^2
Digital transformation success factors	SF5	Grow information system capabilities	0.789	0.623
	SF7	Develop a digital business strategy	0.784	0.615
	SF8	Align business and information systems	0.778	0.605
	SF2	Well-managed transformation activities	0.772	0.596
	SF3	Leverage external and internal knowledge	0.731	0.534
	SF10	Information technology acceptance	0.731	0.534
	SF6	Develop dynamic capabilities	0.713	0.508
	SF4	Engage managers and employees	0.7	0.490

	SF9	Leadership vision*	0.678	0.460
	SF1	A supportive organizational culture	0.627	0.393

The results indicate the digital transformation success factors still contain remain the in total 10 variables as literature review. It can be seen that some items have a very high impact. There are eight factors with a factor loading more than 0.7, including SF5 (grow information system capabilities) with a loading factor of 0.789; SF7 (develop a digital business strategy) at 0.784; SF8 (align business and information systems) at 0.778; SF2 (well-managed transformation activities) at 0.772; SF3 (leverage external and internal knowledge) at 0.731; and SF10 (information technology acceptance), which was a new variable noted by the logistics experts, at 0.731; SF6 (develop dynamic capabilities) at 0.713; and SF4 (engage managers and employees) at 0.7. Additionally, SF9 (leadership vision), which was also a new variable identified from the expert interviews had a loading of 0.678 and SF1 (a supportive organizational culture) had loading of 0.627. It can be inferred that to be success in digital transformation in logistics, LSPS must concentrate on all component 3 digital transformation achievement factors.

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4.8.4 Identifying the Implications of Digital Transformation (IP)

Table 4.25 Factors influencing the implications of digital transformation

Construct	Item	Item criteria	Factor Loading	R^2
Implications for digital transformation	IP2	New business model	0.779	0.607
	IP1	Reforming an organization's information system	0.735	0.540
	IP3	Effect outcome and performance	0.711	0.506

The results show that the highest influencing variable that represents the implications of digital transformation is IP2 (new business model), with a loading of

0.779. IP1 (reforming an organization's information system) was in second place, with a loading of 0.735, while the third was IPS (effect outcome and performance), with a loading of 0.711. This could be considered to suggest that digital transformation can initiate the business paradigm, modify the firm's information system, thereby affecting the outcome and implementation.

4.8.5 Identifying Economic Impacts of Logistics Sustainability (LSE)

Table 4.26 Factor influencing economic impact of logistics sustainability

Construct	Item	Item criteria	Factor Loading	R^2
Logistics sustainability – economics	LSE1	Logistics costs	0.791	0.626
	LSE2	Delivery time	0.76	0.582
	LSE9	Flexibility	0.76	0.578
	LSE6	Frequency of service	0.738	0.545
	LSE8	Reliability	0.709	0.503
	LSE10	Transport volume	0.703	0.494
	LSE5	Loss/damage	0.703	0.494
	LSE7	Forecast accuracy	0.687	0.472
	LSE4	Inventory reduction	0.682	0.465
	LSE3	Transport delays	0.674	0.454

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The results indicate that the effect of the economic impact of logistics sustainability is particularly high. There are seven factors with a factor loading of more than 0.7. The largest influence is LSE1 (logistics costs), with a loading of 0.791, which is consistent with many studies in the review which confirms (Monnet & Le Net, 2011) (Dougados et al., 2013; Gubler et al., 2014),;(Schrauf & Berttram, 2016); and (Weinelt, 2016). This is followed by LSE2 (delivery time) LSE9 (flexibility) with loadings of 0.76; LSE6 (frequency of service), with a loading of 0.738; LSE8 (reliability), with a loading of 0.709; and LSE 10 (transport volume), with a loading of 0.703; LSE5 (loss/damage), with a loading of 0.703. Moreover, there are three variables with loading factors between 0.674 and 0.687, comprising LSE7 (forecast accuracy), at 0.687; LSE4 (inventory reduction), at 0.682; and LSE 3 (transport delay) at 0.674 This

highlights that all 10 variables in the economic construct are essential for sustainability in LSPs in Thailand.

4.8.6 Identifying the Environment Impact of Logistics Sustainability (LSN)

Table 4.27 Factors influencing environment impact of logistics sustainability

Construct	Item	Item criteria	Factor Loading	R^2
Logistics sustainability – environment	LSN5	Pollution	0.788	0.621
	LSN3	Process emissions	0.781	0.610
	LSN4	Waste	0.781	0.610
	LSN6	Land-use impact	0.774	0.599

The results demonstrate that the top two most significant variables for the environmental impact of logistics sustainability are LSN5 (pollution) and LSN3 (process emissions), with loadings of 0.788 and 0.781, respectively. Another two variables, LSN4 (waste) and LSN6 (land-use impact) are third and fourth, with a high influence at 0.781 and 0.774, respectively. It can be seen therefore that digital transformation will also improve the environmental impact for LSPs in Thailand.

4.8.7 Identifying the Social Impact of Logistics Sustainability (LSS)

Table 4.28 Factors influencing social impact of logistics sustainability

Construct	Item	Item criteria	Factor Loading	R^2
Logistics sustainability – society	LSS1	Development benefits	0.806	0.650
	LSS7	Visibility	0.795	0.632
	LSS5	Labor patterns	0.75	0.563
	LSS2	Impacts	0.707	0.500
	LSS6	Acceptance	0.682	0.465

Similarly to other studies, this study revealed that the factors having the greatest effect on the social impact of logistics sustainability are LSS1 (development benefits),as same as (Gubler et al., 2014) (Schrauf & Berttram, 2016), having a loading

of 0.806. LSS7 (visibility), which was a new variable identified from the experts' opinions, and LSS5 (labor patterns) and LSS2 (impacts) came in second, third, and fourth place, with high impact loadings of 0.795, 0.75, and 0. 707, respectively. The fifth highest impact is LSS6 (acceptance), with a moderate impact at a loading of 0.682.

4.8.9 Proposed Strategy for LSPs

Research Objective 1: To identify digital transformation success factors influencing LSPs in Thailand

Drivers of digital transformation (DV) in logistics service providers (LSPs).

Regarding the drivers of digital transformation (DV) in logistics service provider businesses in Thailand, the study found that regulatory changes factors are strong influence on DV. LSPs compelled the companies to reconsider and transform how they conduct their business. Likewise, they have a considerable effect on changing consumer expectations and behavior LSPs need to update themselves on digital movements happening in the industry. whereas digital shifts in the industry also moderate significance (Berghaus & Back, 2017) this can be regarded as internal or external triggers for logistics businesses participating in digital transform, and for changes within the competitive landscape. However, product innovation associated with the creating of new products, embrace enhancements in the design of well-established products, or components or materials to produce. However, these variables were dropped out due to the LSPs business is a service provider which does not need to produce the merchandise. Moreover, the study also found a new DV variable, including technology transfer from other countries. This was gleaned from the interviews with logistics experts and is probably similar for LSPs in other countries, particularly developing countries with their technical know-how.

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Objective of Digital Transformation (OJ) in LSPs

In terms of the objective of determining the influence of digital transformation (OJ), the study found it is essential for the logistics service provider businesses in Thailand to enhance their digital effectiveness. LSPs need to understand how well their digital channels work with their customers' entire journey and expectations of an effortless and personalized experience. Also looking at Competitive advantage an increasing number of LSPs, are focusing their efforts on their core competencies. However, these opportunities also make it more difficult for LSPs to decide where to maximize future growth opportunities are critical to their survival. Furthermore, LSPs should embrace product innovation. The innovation of logistics innovation can range from being very basic to be particularly complicated and can be utilized for internal operations, which emphasize increasing the effectiveness of an LSPs and its services with operations with business partners (Flint, Larsson, Gammelgaard, & Mentzer, 2005)

The development of new business models is also a critical objective. LSPs business paradigm would be that of the yield innovators. Yield innovators have led logistics outsourcing utilizing asset-based services; for example, freight forwarding, inbound and outbound transportation and warehousing (Vivaldini, Pires, & Souza, 2012). LSPs need to streamline their operations to bring down costs, improve accuracy, reduce waste, and deliver their customers' services to increase customer satisfaction. LSPs should be aware of when products are expected to arrive and cooperate with other LSPs to improve efficiency and reduce bottlenecks or delays for digitally improved products -a further than. LSPs need to guarantee digital preparedness, which means that they have a desire to ensure they are attentive to changing contexts, thereby enabling them to act quickly whenever necessary.

Lastly, new variables identified by the experts' interview on reduce operation cost, which in digital transformation, will help businesses recognize waste. Such expense is derived from multiple areas which include the cost of fuel for transportation, price increases of raw materials in the commodity markets; labor and salary expenses, both within an LSP's companies and third parties; fees required by freight forwarders and other logistics providers; as well as utility, storage, leasing and operational fees; and expenses of software and infrastructure.(Vivaldini et al., 2012)

Digital Transformation Success Factors (SF) in LSPs

The results reveal that the success factor of digital transformation is the LSPs in Thailand significantly increases information system capabilities' ability to coordinate and distribute resources in combined with other resources based on information systems help achieve a digital transformation. LSPs have to align these changes with their strategies. Numerous corporations have accepted the necessity to fuse their information system strategy with their business strategy into what is referred to as a digital business strategy. This involves developing a digital business strategy and aligning information and business systems. It also concerns reducing gaps in alignment and responding to modifications and conflicts within organizational, environmental and information systems which are important for LSPs.

Another task is well-managed transformation activities, i.e., transformation tasks that a company typically participates in before, or during, digital transformation. Enhancing a company's digital channels, which means initiating, operating, and improving them, was one activity that seemed to be significant in many case studies. This was also to enhance and leverage internal and external knowledge by studying the companies involved in the mergers and acquisitions of digital technologically associated firms.

Furthermore, the critical success factor for digital in logistics businesses is information technology acceptance that is not only about looking for the most advanced or disruptive technologies and finding a gap to implement them in the company but also about finding a gap to implement them in the company but also about finding the technology that best fits the company's objective and how to implement this effectively. LSPs businesses are required to develop dynamic abilities which enable a firm to recognize and respond to opportunities by reconfiguring resources, constructing digital platform capabilities, and generally transforming the LSPs (Karimi & Walter, 2015; Leischnig et al., 2017). Managers and employees should be engaged in the transformation of a corporation. Information and decision silos should be destroyed to make a company open and much more collaborative, so it is vital that employees also actively participate in the process. Leadership vision is a

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significant influence, because it is of help in comprehending the importance of digital transformation and is proactively involved with it, meaning the success of the project can be much greater. Incorporating specific profiles with extensive digital knowledge to lead the process, such as a Chief Digital Director (CDO), has proven to be a factor that multiplies the chances of success. Finally, the supportive organizational culture within an LSPs helps to supply the psychological and social conditions which optimize the well-being, safety, and health. This can support the development of employees and intentionally construct positive relationships between businesses and employees.

Implications of Digital Transformation (IP) on LSPs

This study revealed the Implications of digital transformation for LSPs. The most significant variable is the new business model, which was similar to (Mocker & Fonstad, 2017) study of an motor company experiencing a digital transformation. For LSPs businesses, at present, the crisis caused by the COVID-19 pandemic will result in similar changes to existing ecosystems. New ways of serving customers will emerge, as will new supply chain opportunities have adapted for a world with closed borders. It is possible that the new offerings can lead to the development of new partnerships, or the requirement to access new digital markets or platforms in which LSPs have not yet participated. Reforming an organization's information system is also an essential factor. (Bilgeri et al., 2017) investigated how the integration of the digital and world as well as digital transformation have an impact on the organizational frameworks of large manufacturing firms. Following their multiple case studies of such companies, the authors recognized organizational matters associated with digital transformation. These are portrayed in the uncertainty of how and where to assign and align digital capability within organizational frameworks (Berghaus & Back, 2017). Moreover, many of these found in other experiential studies in this review. Finally, for effective outcome and performance variables, LSPs learning digitally embedded business procedures gain increased performance advantages from their information system abilities, while digital coordination with other parties can reduce costs through monitoring, transparency and communication (Nwankpa &

Roumani, 2016). These authors found that LSPs businesses that had experienced a digital transformation have matured and can leverage digital technology in a better way to improve a firm's performance.

Research Objective 2: To examine the logistics sustainability impact from digital transformations in logistics service provider businesses in Thailand

The study found that influence on economic logistics sustainability show remains as literature review total for ten variables. The most important factors are the logistics expenses, with digital transformation which can cause changes in LSPs businesses, thereby attaining cost savings of logistics regarding storage, transport, inventory carrying, and administration expenses. New physical delivery concepts (e.g., autonomous trucks, drones, 3D printing) can reduce operational expenses. Although it is not anticipated that they will reach the mass market during the next ten years, such technologies will help firms reduce their expenditure from many aspects, including maintenance, insurance, and fuel. Last-mile logistics will be revolutionized by drones and will allow logistics firms more efficient delivery services in rural locations and urban ones. Logistics firms will experience a double benefit by adopting of drones. They will also be able to apply a premium charge and quicker deliveries (Weinelt, 2016). Flexibility changes in planning conditions; for instance, the proportion of unscheduled shipments are undertaken without unnecessary delay. Furthermore, information can be obtained from the gathered data by using analytics' capabilities, and the use of the frequency of service rate movements loads regular factor intervals. This research helped to detect connections between numerous data points, which allow gains in operational efficiency to be identified across the value chain reliability is subject to change in the efficiency of logistics with concerning 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). With regard to 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 in order 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 environment impact for LSPs company has four variables are remain from previous research, which all items are significance impacts to LSPs. To begin with pollution, LSPs consume non-renewable resources by using cars and transport services (Monnet & Le Net, 2011). Furthermore, the following variable, which is process emissions, LSPs needs to the implementation of changes in fuel consumption, such as CO^2, and other greenhouse gases. The massive increase in the cost of gas (economic indicator) and the requirement to reduce CO^2 emission which causes global climate warming (environmental indicators) means that logistic concepts and transport issues are now of major significance. Transportation is a significant contributor to the energy and GWP (global warming potential) profile of components. Long-distance transportation sometimes produces the most significance CO^2 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 Thailand 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.

Lastly, the social impact of logistics sustainability (LSE) in LSPs. Similar remarks as for the social indicators apply here. With regard to development benefits, reasonable open-source technical consequences for self-directed sustainable development are of particular importance for LSPs. Furthermore, with regard to labor patterns, changes in labor intensity, plans for jobs, and styles of work is also significance for social impact. Impacts variables about impacts created in logistics through digitization Acceptance of digital applications in socio-economic, cultural, and business terms. The study shows that when LSP companies in Thailand use digital transformation to improve their business, they must consider how to objective by developing a communication path which only handles digital signals. Digital transformation also helps LSPs to accomplish sustainability strategy in three dimensions: in economics, by changes in the cost reduction of logistics regarding storage, transport, inventory carrying and expenses of administration for the environment, by modification of air, noise, and water pollution; and for social, by 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 Thailand.

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CHAPTER 5

CONCLUSIONS

5.1 Conclusions

This research explored and developed the digital transformation factors influencing the logistics service-provider (LSPs) sector in Thailand, while also examining the impact of sustainability factors associated with digital transformation. Divided into two parts, Part one of the theoretical study framework covered 21 factors relating to logistics, including drivers, objectives, implications, and success factors. The second part concerned 23 factors associated with logistics sustainability, including economic, environmental, and social aspects. This quantitative experiential research was undertaken through an online questionnaire instrument; additionally, a structural equation modeling (SEM) method was applied in order to test the proposed paradigm. The findings from 545 samples collected between August and November 2020 from respondents working in LSPs companies in Thailand showed that digital transformation drivers and objectives seem likely to positively impact success factors and implications in digital transformation. Digital transformation success factors also positively impact logistics sustainability. In comparison, logistics sustainability has a significant impact on Thailand's LSPs sector's social, environmental and aspects. Lastly, this research highlighted the significance of digital transformation success factors and extends the existing knowledge of digital transformation factors and their possible effect on logistics sustainability.

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Furthermore, the results of this study imply the impact of digital transformation on the sustainability of LSPs in Thailand. Digitalization and sustainability strategies should become a cornerstone of LSPs' business practices, and firms must apply digital policies to execute their sustainability responsibility innovativeness. This Digital transformation success factors (DGSF) can be an efficient method for companies to be sustainable. This involves initiatives like DRIV need to focus on adapting technology transfer from other countries, while OBJT concentrates on improving digital channels. The primary part of the 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. Environmental issues need the initiation of a policy to reduce pollution, while with respect to the social factor, corporations must 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.

In my understanding, some studies have provided experiential 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. This study aimed to give an improved comprehension of the effect of digital transformation on LSPs in Thailand.

5.2 Limitations and Further Research

This research had a small number of restrictions. Firstly, the results of the study were dependent on a self-administered questionnaire and the perceptions of the participants, as the COVID-19 situation made it difficult to collect data on-site. The sample size was relatively small and comprised only participants from Thailand, restricting the generalizability of the research findings. Consideration of larger sample sizes or other business sectors is recommended any studies conducted in the future, should give more accurate results. This research did not test a particular kind of digital platform. Some of this research included factors relating to government policy. Future studies could compare differences in digital transformation functions among a wide range of sustainable policy areas or focus on government planning development.

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5.3 Recommendations

The results of this research indicate the future structural direction of industry. Organizations are expanding to a global level, and both international and domestic investment companies have a tendency to utilize digital transformation technology extensively. This will facilitate excellent planning, thereby reducing the cost of activities. This will be another powerful trend in the future of the logistics business in Thailand. Consequently, it represents a strategy that business organizations ought to study and rapidly understand how to supply competitive benefits and business opportunities. In order to develop this link effectively, all industrial systems need to be restructured. Formulation of policy and the development of strategies of the logistics industry, particularly the central unit, ought to explore the whole picture in order to operate a policy that is associated with the sustainability of services. The potential of competition development of the digital transformation is to develop a stronger connection, thus having an impact on the seriousness of logistics industry competition. Consequently, a new format of operations needs to be studied. This would result in the strength and interoperation of the digital technology in order to improve the competitive proficiency of corporations on the global stage.

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REFERENCES

Alkasadi, N. A., Ibrahim, S., Abuzaid, A., Yusoff, M. I., Hamid, H., Zhe, L. W., & Abd Razak, A. (2019). Outlier Detection in Multiple Circular Regression Model using DFFITC Statistic. *Sains Malaysiana, 48*(7), 1557-1563.

Andal-Ancion, A., Cartwright, P. A., & Yip, G. S. (2003). The digital transformation of traditional business. *MIT Sloan Management Review, 44*(4), 34.

Aykan, S., & Nalçacı, E. (2018). Assessing theory of mind by humor: The humor comprehension and appreciation test (tom-hcat). *Frontiers in psychology, 9*, 1470.

Banomyong, R., & Supatn, N. (2011). Supply chain assessment tool development in Thailand: An SME perspective. *Int. J. of Procurement Management, 4*, 244-258. doi:10.1504/IJPM.2011.040368

Bäumer, T., Worm, D., Müller, P., Zimmermann, S., Popovic, T., & Pagel, C. (2017). So Tell Me What You Want, What You Really Really Want. In *Handbook of Theory and Practice of Sustainable Development in Higher Education* (pp. 63-76): Springer.

Bechtsis, D., Tsolakis, N., Vlachos, D., & Iakovou, E. (2017). Sustainable supply chain management in the digitalisation era: The impact of Automated Guided Vehicles. *Journal of Cleaner Production, 142*, 3970-3984.

Beier, P., Hansen, L. J., Helbrecht, L., & Behar, D. (2017). A how-to guide for coproduction of actionable science. *Conservation Letters, 10*(3), 288-296.

Bell, E., & Bryman, A. (2007). The ethics of management research: an exploratory content analysis. *British journal of management, 18*(1), 63-77.

Belsley, D. A., Kuh, E., & Welsch, R. E. (2005). *Regression diagnostics: Identifying influential data and sources of collinearity* (Vol. 571): John Wiley & Sons.

Berghaus, S., & Back, A. (2017). *Disentangling the fuzzy front end of digital transformation: Activities and approaches*.

Berman, B. (2012). 3-D printing: The new industrial revolution. *Business horizons, 55*(2), 155-162.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Bilgeri, D., Wortmann, F., & Fleisch, E. (2017). How digital transformation affects large manufacturing companies' organization.

Blumberg, B., Cooper, D. R., & Schindler, P. S. (2008). *Business research methods* (Vol. 2): McGraw-Hill Higher Education London.

Blunch, N. (2012). *Introduction to structural equation modeling using IBM SPSS statistics and AMOS*: Sage.

Brown, R. B. (1993). Meta-competence: a recipe for reframing the competence debate. *Personnel Review*.

Byrne, M., Soars, N. A., Ho, M. A., Wong, E., McElroy, D., Selvakumaraswamy, P., . . . Davis, A. R. (2010). Fertilization in a suite of coastal marine invertebrates from SE Australia is robust to near-future ocean warming and acidification. *Marine biology, 157*(9), 2061-2069.

Cerdas, F., Juraschek, M., Thiede, S., & Herrmann, C. (2017). Life cycle assessment of 3D printed products in a distributed manufacturing system. *Journal of Industrial Ecology, 21*(S1), S80-S93.

Churchill Jr, G. A. (1979). A paradigm for developing better measures of marketing constructs. *Journal of marketing research, 16*(1), 64-73.

Clarke, A. (1999). *Evaluation research: An introduction to principles, methods and practice*: Sage.

Conway, J. M., & Huffcutt, A. I. (2003). A review and evaluation of exploratory factor analysis practices in organizational research. *Organizational research methods, 6*(2), 147-168.

Creswell, J. W., & Zhang, W. (2009). The application of mixed methods designs to trauma research. *Journal of Traumatic Stress: Official publication of the international society for traumatic stress studies, 22*(6), 612-621.

DeCarlo, L. T. (1997). On the meaning and use of kurtosis. *Psychological methods, 2*(3), 292.

Dougados, M., van Doesburg, R., Ghioldi, S., & KVJ, S. (2013). The Missing Link. Supply Chain and Digital Maturity. *Capgemini Consulting, White Paper*.

El-Basyouny, K., & Sayed, T. (2013). Depth-based hotspot identification and multivariate

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

ranking using the full Bayes approach. *Accident Analysis & Prevention, 50*, 1082-1089.

Fidell, S., Tabachnick, B., Mestre, V., & Fidell, L. (2013). Aircraft noise-induced awakenings are more reasonably predicted from relative than from absolute sound exposure levels. *The Journal of the Acoustical Society of America, 134*(5), 3645-3653.

Field, R., Hawkins, B. A., Cornell, H. V., Currie, D. J., Diniz-Filho, J. A. F., Guégan, J. F., . . . Oberdorff, T. (2009). Spatial species-richness gradients across scales: a meta-analysis. *Journal of biogeography, 36*(1), 132-147.

Flint, D. J., Larsson, E., Gammelgaard, B., & Mentzer, J. T. (2005). Logistics innovation: a customer value-oriented social process. *Journal of business logistics, 26*(1), 113-147.

Forza, C. (2002). Survey research in operations management: a process-based perspective. *International journal of operations & production management*.

Fritz, M. S., & MacKinnon, D. P. (2007). Required sample size to detect the mediated effect. *Psychological science, 18*(3), 233-239.

Gallagher, D., Ting, L., & Palmer, A. (2008). A journey into the unknown; taking the fear out of structural equation modeling with AMOS for the first-time user. *The Marketing Review, 8*(3), 255-275.

Gliem, J. A., & Gliem, R. R. (2003). *Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales*.

Gogtay, N., Giedd, J. N., Lusk, L., Hayashi, K. M., Greenstein, D., Vaituzis, A. C., . . . Toga, A. W. (2004). Dynamic mapping of human cortical development during childhood through early adulthood. *Proceedings of the National Academy of Sciences, 101*(21), 8174-8179.

Gronemus, J. Q., Hair, P. S., Crawford, K. B., Nyalwidhe, J. O., Cunnion, K. M., & Krishna, N. K. (2010). Potent inhibition of the classical pathway of complement by a novel C1q-binding peptide derived from the human astrovirus coat protein. *Molecular immunology, 48*(1-3), 305-313.

Gubler, M., Arnold, J., & Coombs, C. (2014). Reassessing the protean career concept:

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Empirical findings, conceptual components, and measurement. *Journal of Organizational Behavior, 35*(S1), S23-S40.

Guo, X., Shen, C., & Chen, L. (2017). Deep fault recognizer: An integrated model to denoise and extract features for fault diagnosis in rotating machinery. *Applied Sciences, 7*(1), 41.

Haffke, I., Kalgovas, B., & Benlian, A. (2017). *The transformative role of bimodal IT in an era of digital business.* Paper presented at the Proceedings of the 50th Hawaii International Conference on System Sciences.

Hair, J. F. (2006). *Multivariate data analysis*. United State: Kennesaw State University.

Hair, J. F., Anderson, R. E., Babin, B. J., & Black, W. C. (2010). Multivariate data analysis: A global perspective (Vol. 7). In: Upper Saddle River, NJ: Pearson.

Hair, J. F., Sarstedt, M., Pieper, T. M., & Ringle, C. M. (2012). The use of partial least squares structural equation modeling in strategic management research: a review of past practices and recommendations for future applications. *Long range planning, 45*(5-6), 320-340.

Hansen, B. E. (1999). Threshold effects in non-dynamic panels: Estimation, testing, and inference. *Journal of econometrics, 93*(2), 345-368.

Hartl, E., & Hess, T. (2017). The role of cultural values for digital transformation: Insights from a Delphi study.

Hartmann, D. P., Barrios, B. A., & Wood, D. D. (2004). Principles of behavioral observation.

Haynes, S. N., Richard, D., & Kubany, E. S. (1995). Content validity in psychological assessment: A functional approach to concepts and methods. *Psychological assessment, 7*(3), 238.

Hildebrandt, B., Hanelt, A., Firk, S., & Kolbe, L. (2015). Entering the digital era–the impact of digital technology-related m&as on business model innovations of automobile oems.

Horlacher, A., Klarner, P., & Hess, T. (2016). Crossing boundaries: organization design parameters surrounding CDOs and their digital transformation activities.

Hylving, L., & Schultze, U. (2013). Evolving the modular layered architecture in digital innovation: The case of the car's instrument cluster.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Isaksson, V., & Hylving, L. (2017). *The Effect of Anarchistic Actions in Digital Product Innovation Networks: The Case of "Over the Air" Software Updates.* Paper presented at the Proceedings of the 50th Hawaii International Conference on System Sciences.

Junge, A. L., & Straube, F. (2020). Sustainable supply chains–digital transformation technologies' impact on the social and environmental dimension. *Procedia Manufacturing, 43*, 736-742.

Karimi, J., & Walter, Z. (2015). The role of dynamic capabilities in responding to digital disruption: A factor-based study of the newspaper industry. *Journal of Management Information Systems, 32*(1), 39-81.

Kayikci, Y. (2018). Sustainability impact of digitization in logistics. *Procedia Manufacturing, 21*, 782-789.

Kline, T. (2005). *Psychological testing: A practical approach to design and evaluation*: Sage.

Korpela, K., Hallikas, J., & Dahlberg, T. (2017). *Digital supply chain transformation toward blockchain integration.* Paper presented at the proceedings of the 50th Hawaii international conference on system sciences.

Kumar, H., Kawai, T., & Akira, S. (2011). Pathogen recognition by the innate immune system. *International reviews of immunology, 30*(1), 16-34.

Leischnig, A., Wölfl, S., Ivens, B., & Hein, D. (2017). From digital business strategy to market performance: insights into key concepts and processes.

Lewis-Beck, M. S., Nadeau, R., & Elias, A. (2008). Economics, party, and the vote: Causality issues and panel data. *American Journal of Political Science, 52*(1), 84-95.

Lewis, B. R., Templeton, G. F., & Byrd, T. A. (2005). A methodology for construct development in MIS research. *European Journal of Information Systems, 14*(4), 388-400.

Lieb, K., Zanarini, M. C., Schmahl, C., Linehan, M. M., & Bohus, M. (2004). Borderline personality disorder. *The Lancet, 364*(9432), 453-461.

Lohr, S. L. (2019). *Sampling: design and analysis*: CRC Press.

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

Mahalanobis, P. C. (1936). *On the generalized distance in statistics*.

Maron, B. J., Mueller, F. O., Shirani, J., Poliac, L. C., Mathenge, R., & Roberts, W. C. (1996). Sudden death in young competitive athletes: clinical, demographic, and pathological profiles. *Jama, 276*(3), 199-204.

Marsh, H. W., Balla, J. R., & McDonald, R. P. (1988). Goodness-of-fit indexes in confirmatory factor analysis: The effect of sample size. *Psychological bulletin, 103*(3), 391.

May, P. A., Tabachnick, B. G., Gossage, J. P., Kalberg, W. O., Marais, A.-S., Robinson, L. K., . . . Hoyme, H. E. (2011). Maternal risk factors predicting child physical characteristics and dysmorphology in fetal alcohol syndrome and partial fetal alcohol syndrome. *Drug and alcohol dependence, 119*(1-2), 18-27.

McGee, Z. A., & Kaiser, A. B. (1975). Aminoglycoside therapy of gram-negative bacillary meningitis. *New England Journal of Medicine, 293*(24), 1215-1220.

Meyer III, W. J., Walker, P. A., Emory, L. E., & Smith, E. R. (1985). Physical, metabolic, and hormonal effects on men of long-term therapy with medroxyprogesterone acetate. *Fertility and Sterility, 43*(1), 102-109.

Mihailescu, M., Mihailescu, D., & Carlsson, S. (2017). Understanding Healthcare Digitalization: A Critical Realist Approach.

Mihailescu, M., Mihailescu, D., & Schultze, U. (2015). The generative mechanisms of healthcare digitalization.

Mocker, M., & Fonstad, N. O. (2017). How AUDI AG is Driving Toward the Sharing Economy. *MIS Quarterly Executive, 16*(4).

Monnet, J.-M., & Le Net, E. (2011). Assessment of logistics concept to sustainability: Development of a common approach to transport issues. In: Torikatu: European Forest Institute.

Morakanyane, R., Grace, A. A., & O'Reilly, P. (2017). Conceptualizing Digital Transformation in Business Organizations: A Systematic Review of Literature. *Bled eConference, 21*.

Mueller, B., & Renken, U. (2017). Helping employees to be digital transformers–the olympus. connect case.

Multaharju, S., & Hallikas, J. (2015). Logistics service capabilities of logistics service

จุฬาลงกรณ์มหาวิทยาลัย
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provider. *International Journal of Logistics Systems and Management 5, 20*(1), 103-121.

Mvududu, N. H., & Sink, C. A. (2013). Factor analysis in counseling research and practice. *Counseling Outcome Research and Evaluation, 4*(2), 75-98.

Neuman, W. R., & Guggenheim, L. (2011). The evolution of media effects theory: A six-stage model of cumulative research. *Communication Theory, 21*(2), 169-196.

Nowak, G., Maluck, J., Stürmer, C., & Pasemann, J. (2016). The era of digitized trucking. Transforming the logistics value chain. *PWC, White Paper*.

Nwankpa, J. K., & Roumani, Y. (2016). IT capability and digital transformation: A firm performance perspective.

Osmundsen, K., Iden, J., & Bygstad, B. (2018). *DIGITAL TRANSFORMATION DRIVERS, SUCCESS FACTORS, AND IMPLICATIONS*.

Petrikina, J., Krieger, M., Schirmer, I., Stoeckler, N., Saxe, S., & Baldauf, U. (2017). Improving the readiness for change-Addressing information concerns of internal stakeholders in the smartPORT Hamburg.

Pett, M. A., Lackey, N. R., & Sullivan, J. J. (2003). *Making sense of factor analysis: The use of factor analysis for instrument development in health care research*: sage.

Piccinini, E., Hanelt, A., Gregory, R., & Kolbe, L. (2015). Transforming industrial business: the impact of digital transformation on automotive organizations.

Punch, K. F. (2003). *Survey research: The basics*: Sage.

Raab, M., & Griffin-Cryan, B. (2011). Digital transformation of supply chains. *Creating Value–When Digital Meets Physical, Capgemini Consulting*.

Remane, G., Hanelt, A., Hildebrandt, B., & Kolbe, L. (2016). Changes in digital business model types–a longitudinal study of technology startups from the mobility sector.

Rosenberg, N., & Kline, S. J. (2010). An overview of innovation. *Studies on science and the innovation process: Selected works of Nathan Rosenberg*, 173-203.

Schmidt, J., Drews, P., & Schirmer, I. (2017). Digitalization of the banking industry: A multiple stakeholder analysis on strategic alignment.

Schrauf, S., & Berttram, P. (2016). Industry 4.0: How digitization makes the supply chain

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

more efficient, agile, and customer-focused. *Strategy&. Recuperado de https://www. strategyand. pwc. com/media/file/Industry4. 0. pdf*.

Sireci, S. G. (1998). The construct of content validity. *Social indicators research, 45*(1), 83-117.

Straub, D., Boudreau, M.-C., & Gefen, D. (2004). Validation guidelines for IS positivist research. *Communications of the Association for Information systems, 13*(1), 24.

Stuermer, M., Abu-Tayeh, G., & Myrach, T. (2017). Digital sustainability: basic conditions for sustainable digital artifacts and their ecosystems. *Sustainability science, 12*(2), 247-262.

Sukortprommee, S. (2013). *The effect of corporate brand personality on customer-contact employee's prosocial behavior and the mediating effect of brand identification in Japanese automotive service sector.* Rajamangala University of Technology Thanyaburi. Faculty of Business ...,

Swafford, P. M., Ghosh, S., & Murthy, N. (2006). The antecedents of supply chain agility of a firm: scale development and model testing. *Journal of Operations management, 24*(2), 170-188.

Swisher, L. L., Beckstead, J. W., & Bebeau, M. J. (2004). Factor analysis as a tool for survey analysis using a professional role orientation inventory as an example. *Physical Therapy, 84*(9), 784-799.

Tan, P.-N., Kumar, V., & Srivastava, J. (2002). *Selecting the right interestingness measure for association patterns.* Paper presented at the Proceedings of the eighth ACM SIGKDD international conference on Knowledge discovery and data mining.

Tascioglu, M. (2015). Sustainable supply chain management: A literature review and research agenda. *Journal of Management Marketing and Logistics, 2*(1).

Thompson, J. N. (2005). *The geographic mosaic of coevolution*: University of Chicago Press.

Tien Bui, D., Pradhan, B., Lofman, O., & Revhaug, I. (2012). Landslide susceptibility assessment in vietnam using support vector machines, decision tree, and Naive Bayes Models. *Mathematical problems in Engineering, 2012*.

Van Mantgem, P. J., Byrne, J. C., Stephenson, N. L., Daniels, L. D., Franklin, J. F., Fulé, P. Z., . . . Taylor, A. H. (2009). Widespread increase of tree mortality rates in the

จุฬาลงกรณ์มหาวิทยาลัย
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western United States. *Science, 323*(5913), 521-524.

Vivaldini, M., Pires, S. R., & Souza, F. B. d. (2012). Improving logistics services through the technology used in fleet management. *JISTEM-Journal of Information Systems and Technology Management, 9*(3), 541-562.

Weinelt, B. (2016). Digital transformation of industries: logistics industry. In.

West, S. G., Finch, J. F., & Curran, P. J. (1995). Structural equation models with nonnormal variables: Problems and remedies.

Yeow, A., Soh, C., & Hansen, R. (2018). Aligning with new digital strategy: A dynamic capabilities approach. *The Journal of Strategic Information Systems, 27*(1), 43-58.

Yusuf, S., Hawken, S., Ôunpuu, S., Dans, T., Avezum, A., Lanas, F., . . . Varigos, J. (2004). Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *The Lancet, 364*(9438), 937-952.

Zhang, Y., Liu, S., Liu, Y., & Li, R. (2016). Smart box-enabled product–service system for cloud logistics. *International Journal of Production Research, 54*(22), 6693-6706.

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APPENDIX A

จุฬาลงกรณ์มหาวิทยาลัย
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แบบสอบถามงานวิจัย

เรื่อง ปัจจัยทางดิจิตอลทรานส์ฟอรเมชั่นที่ส่งผลต่อความยั่งยืนของผู้ให้บริการโลจิสติกส์ในประเทศไทย

เรียน ผู้ตอบแบบสอบถาม

แบบสอบถามฉบับนี้สร้างขึ้นเพื่อประเมินความคิดเห็นของท่านทีมีต่อความสอดคล้องด้านปัจจัยทางดิจิตอลทรานฟอรเมชันที่ส่งผลต่อความยั่งยืนของผู้ให้บริการโลจิสติกสในประเทศไทย เพื่อนำผลการวิเคราะห์ไปจัดทำข้อเสนอแนะ เพื่อสนับสนุนการใช้ระบบดิจิตอลและเทคโนโลยีมาพัฒนาของผู้ให้บริการโลจิสติกส์ในประเทศไทย

แบบสอบถามนี้เป็นส่วนหนึ่งในการจัดทำวิทยานิพนธ์หลักสูตรวิทยาศาตรดุษฎีบัณฑิต สาขาการจัดการโลจิสติกส์และโซ่อุปทาน จุฬาลงกรณ์มหาวิทยาลัย ดังนั้นข้อมูลในแบบสอบถามจะไม่มีการเผยแพร่ชื่อบุคคล และสถานประกอบการโดยเด็ดขาด ทั้งนี้ข้อมูลที่ได้รับจากแบบสอบถามนี้จะนำไปใช้อ้างอิงและเผยแพร่เพื่อการศึกษาเท่านั้น

<u>คำชี้แจง</u>

1. แบบสอบถามเพื่อการวิจัยแบ่งออกเป็น 5 ส่วนดังนี้
   ส่วนที่ 1 คำถามทั่วไปของผู้ตอบแบบสอบถาม
   ส่วนที่ 2 แรงผลักดันและวัตถุประสงค์ที่ให้เกิดดิจิตอลทรานฟอร์เมชัน
   ส่วนที่ 3 ปัจจัยที่ส่งผลต่อความสำเร็จของดิจิตอลทรานฟอร์เมชัน
   ส่วนที่ 4 ผลที่เกิดขึ้นจากใช้ดิจิตอลทรานฟอร์เมชัน
   ส่วนที่ 5 ปัจจัยอื่น ๆ (ถ้ามี)
2. กรุณาตอบแบบสอบถามทุกข้อตามความเป็นจริง โดยผู้วิจัยขอรับรองว่าคำตอบของท่านจากเก็บเป็นความลับ และจะไม่มีผลกระทบใด ๆต่อผู้ตอบและสถานประกอบการทั้งสิ้น

ขอบพระคุณเป็นอย่างสูงสำหรับความร่วมมือ

นายพุทธิวัต สิงห์ดง

หลักสูตรการจัดการโลจิสติกส์และโซ่อุปทาน (หลักสูตรนานาชาติ)

บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย

E-mail: tuaputthiwat@gmail.com

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<u>แบบสอบถามตอนที่ 1 คำถามทั่วไปของผู้ตอบแบบสอบถาม</u>

1) บริษัทของท่านให้บริการด้านโลจิสติกส์ใดเป็นหลัก

☐ ผู้ให้บริการทางด้านขนส่ง (Transportation service)

☐ ผู้ให้บริการจัดการคลังสินค้า (warehouse service)

☐ ผู้ให้บริการรับจัดส่งสินค้าระหว่างประเทศ (Freight forwarder)

☐ ผู้ให้บริการด้านโลจิสติกส์ครบวงจร (Logistics service provider)

2) บริษัทของท่านมีจำนวนพนักงานเท่าไหร่

☐ น้อยกว่า 50 คน ☐ 50-100 คน

☐101-150 คน ☐ 151-200 คน

☐ มากกว่า 200 คน

3) ท่านทำงานตำแหน่งใดในบริษัท

☐ เจ้าหน้าที่ฝ่ายหาร ☐ เจ้าหน้าที่ผู้บริหารระดับสูง

☐ ผู้ช่วยผู้จัดการ ☐ ผู้จัดการ

☐ ผู้จัดการอาวุโส ☐ หัวหน้าหน่วย

☐ หัวหน้าแผนก ☐ รองผู้อำนวยการ

☐ ผู้อำนวยการ ☐ อื่น ๆโปรดระบุ.....

4) ท่านทำงานในแผนกสาขาใดในบริษัท

☐ ทรัพยากรบุคคลล ☐ จัดซื้อ

☐ เทคโนโลยีสารสนเทศ ☐ บริการลูกค้า

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☐ ปฏิบัติติการ ☐ ขนส่ง

☐ อื่น ๆ โปรดระบุ.....

5) ท่านมีประสบการ์ทำงานในธุรกิจโลจิสติกส์เป็นระยะเวลานานเท่าไหร่

☐ น้อยกว่า 2 ปี ☐ 2-5 ปี

☐ 6-10 ปี ☐ มากกว่า 10 ปี

6) บริษัทของท่านมีลักษณะการถือครองหุ้นแบบใด

☐ สัญชาติต่างประเทศ

☐ สัญชาติไทย

☐ กิจการร่วมค้า

7) ลักษณะของธุรกิจของลูกค้าที่ให้บริการ

☐ การเกษตร ☐ อาหารและเครื่องดื่ม

☐ อุสาหกรรมสินค้าอุปโภค ☐ อุตสาหกรรมยานยนต์

☐ อุตสาหกรรมพลังงาน ☐ วัสดุอุตสาหกรรมและเครื่องจักร

☐ อุตสาหกรรมเทคโนโลยี ☐ อุตสาหกรรมค้าปลีก

☐ ปิโตรเคมีและเคมีภัณฑ์ ☐ ธุรกิจอื่น ๆ โปรดระบุ

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8) เทคโนโลยีและนวัตกรรมใดที่ท่านได้ใช้หรือกำลังจะใช้ในธุรกิจของท่าน (ตอบได้มากกว่า 1 ข้อ)

☐ Physical Internet standard ☐ IT standard

☐ Data analytics ☐ Cloud logistics

☐ Blockchain ☐ Robotics and automation

☐ Autonomous Vehicles ☐ Drones

☐ 3-dprintinng ☐ อื่น ๆ โปนดระบุ.....

9) บริษัทของท่านมีรายได้ต่อปีเท่าไหร่ (หลักล้านบาท)

☐ 1 - 100 ☐ 100-250

☐ 250- 500 ☐ 500-1,000

☐ 1,000-1,500 ☐ มากกว่า 1,500

ตอนที่ 2 แรงผลักดันและวัตถุประสงค์ที่ให้เกิดดิจิตอลทรานฟอร์เมชันในผู้ให้บริการโลจิสติกส์

1) ท่านคิดว่าปัจจัยใดสอดคล้องเป็นส่วนที่เป็นผลักดันให้เกิดดิจิตอลทรานฟอร์เมชันในบริษัท

ปัจจัย		ระดับความสองคล้อง				
		1 ไม่สอดคล้อง	2	3	4	5 สอดคล้องอย่างยิ่ง
1	พฤติกรรมและความคาดหวังของลูกค้า					
2	การปรับเปลี่ยนทางดิจิตอลของอุตสาหกรรม					
3	การเปลี่ยนแนวทางในการแข่งขันทางธุรกิจ					
4	การเปลี่ยนแปลงทางกฎระเบียบ					

ตอนที่ 3 ปัจจัยความสำเร็จของการใช้ดิจิตอลทรานฟอร์เมชันในผู้ให้บริการโลจิสติกส์

2) ท่านคิดว่าปัจจัยใดบ้างที่มีความสอดคล้องปัจจัยความสำเร็จดิจิตอลทรานฟอร์เมชัน

ปัจจัย		ระดับความสองคล้อง				
		1 ไม่สอดคล้อง	2	3	4	5 สอดคล้องอย่างยิ่ง
1	การมีวัฒนธรรมเกื้อกูลกันในองค์กร					
2	การเปลี่ยนแปลงต่างๆที่มีการจัดการเป็นระบบ					
3	การเพิ่มความรู้ทั้งภายในและภายนอกของพนักงาน					
4	การ ให้พนักงานระดับจัดการและพนักงานทั่วไปมีส่วนร่วม					
5	เพิ่มความสามารถทางระบบข้อมูล					
6	การพัฒนาความสามารถเชิงพลวัต					
7	พัฒนากลยุทธของธุรกิจทางดิจิตอล					
8	ความสอดคล้องระหว่างธุรกิจและระบบสารสนเทศ					

ตอนที่ 4 ผลกระทบที่เกิดขึ้นจากใช้ดิจิตอลทรานฟอร์เมชันในผู้ให้บริการโลจิสติกส์

3) ท่านคิดว่าผลกระทบด้านความยั่งยืนด้านเศรฐกิจใดเกิดจากดิจิตอลทรายฟอร์เมชัน

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ปัจจัย		ระดับความสองคล้อง				
		1 ไม่สอดคล้อง	2	3	4	5 สอดคล้องอย่างยิ่ง
1	การเปลี่ยนแบบในด้านการประหยัดค่าใช้จ่ายทางด้านโลจิสติกส์					
2	การเปลี่ยนแปลงทางด้านการปรับปรุงการจัดส่งสินค้า					
3	การเปลี่ยนแปลงทางด้านจำนวนการขนส่งที่ล่าช้า					
4	การเปลี่ยนแปลงทางปริมาณสินค้าคงคลัง					
5	การเปลี่ยนแปลงทางจำนวนสินค้าที่สูญหายหรือเสียหาย ถูกขโมย หรือ เกิดอุบัติเหตุ					
6	การเปลี่ยนแปลงทางด้านอัตราการใช้งาน (อัตราการบรรทุก)					
7	การเปลี่ยนแปลงทางด้านความไม่แน่นอนของอุปสงค์					
8	การเปลี่ยนแบบในด้านคุณภาพของการขนส่ง การจัดเก็บสินค้า การสต๊อกสินค้า					
9	การเปลี่ยนแปลงทางด้านเงื่อนไขการวางแผน เช่น จำนวนร้อยละของการจัดส่งที่ไม่ได้					
10	การแปลี่ยนแปลงในด้านปริมาณการขนส่งสินค้าทั้งหมด					
11	แอพพลิเคชั่นที่เหมาะสมที่จะทำให้กระบวนการขนส่งสินค้าเป็นระบบดิจิตอล					

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5) ท่านคิดว่าผลกระทบด้านความยั่งยืนด้านสิ่งแวดล้อมใดเกิดจากดิจิตอลทรานฟอร์เมชัน

ปัจจัย		ระดับความสองคล้อง				
		1 ไม่สอดคล้อง	2	3	4	5 สอดคล้องอย่างยิ่ง
1	การนำทรัพยากรที่ไม่สามารถนำกลับมาใช้ใหม่ได้ในการการใช้ยานพาหนะและระบบขนส่ง					
2	การเปลี่ยนแปลงทางข้อกำหนดของพลังงาน					
3	การเปลี่ยนแปลงในการใช้เชื้อเพลิง การปล่อยการคาร์บอนไดออกไซด์ และก๊าซเรือนกระจก					
4	การเปลี่ยนแปลงในปริมาณขยะรีไซเคิล					
5	การเปลี่ยนแปลงในอากาศ เสียงรบกวน และมลภาวะทางน้ำ					
6	การเปลี่ยนแปลงในพื้นที่ที่จัดขึ้นเพื่อเป็นศูนย์การขนส่งและอัตราการสูญเสียพื้นดิน					
7	การใช้เทคโนโลยีโอเพ่นซอร์สสำหรับการพัฒนาตัวเองแบบยั่งยืน					

6) ท่านคิดว่าผลกระทบด้านความยั่งยืนด้านสังคมใดเกิดจากดิจิตอลทรายฟอร์เมชัน

ปัจจัย		ระดับความสองคล้อง				
		1 ไม่สอดคล้อง	2	3	4	5 สอดคล้องอย่างยิ่ง
1	ผลกระทบทางสังคมที่เกิดจากการจัดการรขนส่งและจัดเก็บสินค้าด้วยระบบดิจิตอล					
2	การเปลี่ยนแปลงทางสุขภาพที่เกิดจากผลข้างเคียงของการขนส่ง (มลภาวะ, เสียงรบกวน)					
3	การเปลี่ยนแปลงในอัตราการเสียชีวิตและบาดเจ็บจากอุบัติเหตุ					
4	การเปลี่ยนแปลงในอัตราความเข้นข้นในการใช้แรงงาน แผนการจ้างงาน และ ประเภทของงาน					
5	การยอมรับของเศรษฐกิจสังคม ชุมชน และตลาด ในการนำดิจิตอลมาใช้					

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7) ท่านคิดว่าดิจิติลทรานฟอร์เมชันส่งผลให้เกิดความเปลี่ยนแปลงนผู้ให้บริการโลจิสติกส์

ปัจจัย		ระดับความสองคล้อง				
		1 ไม่สอดคล้อง	2	3	4	5 สอดคล้องอย่างยิ่ง
1	ทำให้เกิดการปฏิรูประบบสารสนเทศในองค์กร					
2	ทำให้เกิดโมเดลธุรกิจใหม่					
3	ทำให้มีผลกระทบกับผลลัพธ์และประสิทธิภาพการดำเนินงาน					

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

APPENDIX B

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University

ที่ อว64.25/ลจด280/63

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
ถนนพญาไท ปทุมวัน กทม. 10330

24 สิงหาคม 2563

เรื่อง ขอความอนุเคราะห์เก็บข้อมูลแบบสอบถาม

เรียน นายกสมาพันธ์โลจิสติกส์ไทย

ด้วย นายพุทธิวัต สิงห์ดง รหัสประจำตัว 6087791820 นิสิตระดับปริญญาเอก หลักสูตรวิทยาศาสตรดุษฎีบัณฑิต สาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย ได้ทำการศึกษาและจัดทำวิจัยทางด้านการจัดการด้านโลจิสติกส์ เรื่อง "ปัจจัยทางดิจิทัลทรานส์ฟอร์เมชั่นที่ส่งผลต่อความยั่งยืนของผู้ให้บริการโลจิสติกส์ในประเทศไทย" โดยมี ศาสตราจารย์ ดร.กมลชนก สุทธิวาทนฤพุฒิ (อาจารย์ที่ปรึกษาหลัก) และ รองศาสตราจารย์ ดร.พงศา พรชัยวิเศษกุล (อาจารย์ที่ปรึกษาร่วม)

ทั้งนี้ได้ทำการประสานกับสมาคมขนส่งสินค้าไทยเบื้องต้นแล้ว เพื่อขอความอนุเคราะห์ในการประสานงานกับสมาชิกของสมาคมเพื่อเก็บแบบสอบถาม นำเสนอหลักการวิจัยและประโยชน์ที่จะได้รับ โดยนิสิตผู้วิจัยจะได้ประสานงานในรายละเอียดต่อไป

ในการนี้ หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย จึงขอความอนุเคราะห์ดังกล่าว โดยนิสิต นายพุทธิวัต สิงห์ดง หมายเลขโทรศัพท์ 083-064-6298- อีเมล์ tuaputthiwat@gmail.com เป็นผู้ประสานงาน หลักสูตรฯ หวังเป็นอย่างยิ่งจะได้รับความอนุเคราะห์จากท่าน และขอขอบคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

(นายพุทธิวัต สิงห์ดง)
นิสิตหลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน

(ผู้ช่วยศาสตราจารย์ ดร. ธารทัศน์ โมกขมรรคกุล)
ผู้อำนวยการหลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
โทร. 02–2183113-4 โทรสาร. 02-251-2354

ที่ อว64.25/ลจต279/63

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์
และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
ถนนพญาไท ปทุมวัน กทม. 10330

24 สิงหาคม 2563

เรื่อง ขอความอนุเคราะห์เก็บข้อมูลแบบสอบถาม

เรียน นายกสมาคมขนส่งสินค้าและโลจิสติกส์ไทย

ด้วย นายพุทธิวัต สิงห์ดง รหัสประจำตัว 6087791820 นิสิตระดับปริญญาเอก หลักสูตรวิทยาศาสตรดุษฎีบัณฑิต สาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย ได้ทำการศึกษาและจัดทำวิจัยทางด้านการจัดการด้านโลจิสติกส์ เรื่อง "ปัจจัยทางดิจิทัลทรานส์ฟอร์เมชั่นที่ส่งผลต่อความยั่งยืนของผู้ให้บริการโลจิสติกส์ในประเทศไทย" โดยมี ศาสตราจารย์ ดร.กมลชนก สุทธิวาทนฤพุฒิ (อาจารย์ที่ปรึกษาหลัก) และ รองศาสตราจารย์ ดร.พงศา พรชัยวิเศษกุล (อาจารย์ที่ปรึกษาร่วม)

ทั้งนี้ได้ทำการประสานกับสมาคมขนส่งสินค้าและโลจิสติกส์ไทยเบื้องต้นแล้ว เพื่อขอความอนุเคราะห์ในการประสานงานกับสมาชิกของสมาคมเพื่อเก็บแบบสอบถาม นำเสนอหลักการวิจัย และประโยชน์ที่จะได้รับ โดยนิสิตผู้วิจัยจะได้ประสานงานในรายละเอียดต่อไป

ในการนี้ หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย จึงขอความอนุเคราะห์ดังกล่าว โดยนิสิต นายพุทธิวัต สิงห์ดง หมายเลขโทรศัพท์ 083-064-6298- อีเมล์ tuaputthiwat@gmail.com เป็นผู้ประสานงาน หลักสูตรฯ หวังเป็นอย่างยิ่งจะได้รับความอนุเคราะห์จากท่าน และขอขอบคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

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(นายพุทธิวัต สิงห์ดง)
นิสิตหลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน

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(ผู้ช่วยศาสตราจารย์ ดร.ธารทัศน์ โมกขมรรคกุล)
ผู้อำนวยการหลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
โทร. 02-2183113-4 โทรสาร. 02-251-2354

ที่ อว64.25/ลจต281/63

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์
และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
ถนนพญาไท ปทุมวัน กทม. 10330

25 สิงหาคม 2563

เรื่อง ขอความอนุเคราะห์เก็บข้อมูลแบบสอบถาม

เรียน นายกสมาคมไทยโลจิสติกส์และการผลิต

ด้วย นายพุทธิวัต สิงห์ดง รหัสประจำตัว 6087791820 นิสิตระดับปริญญาเอก หลักสูตรวิทยาศาสตรดุษฎีบัณฑิต สาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย ได้ทำการศึกษาและจัดทำวิจัยทางด้านการจัดการด้านโลจิสติกส์ เรื่อง "ปัจจัยทางดิจิทัลทรานส์ฟอร์เมชั่นที่ส่งผลต่อความยั่งยืนของผู้ให้บริการโลจิสติกส์ในประเทศไทย" โดยมี ศาสตราจารย์ ดร.กมลชนก สุทธิวาทนฤพุฒิ (อาจารย์ที่ปรึกษาหลัก) และ รองศาสตราจารย์ ดร.พงศา พรชัยวิเศษกุล (อาจารย์ที่ปรึกษาร่วม)

ทั้งนี้ได้ทำการประสานกับสมาคมไทยโลจิสติกส์และการผลิต เบื้องต้นแล้ว เพื่อขอความอนุเคราะห์ในการประสานงานกับสมาชิกของสมาคมเพื่อเก็บแบบสอบถาม นำเสนอหลักการวิจัยและประโยชน์ที่จะได้รับโดยนิสิตผู้วิจัยจะได้ประสานงานในรายละเอียดต่อไป

ในการนี้ หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย จึงขอความอนุเคราะห์ดังกล่าว โดยนิสิต นายพุทธิวัต สิงห์ดง หมายเลขโทรศัพท์ 083-064-6298- อีเมล์ tuaputthiwat@gmail.com เป็นผู้ประสานงาน หลักสูตรฯ หวังเป็นอย่างยิ่งจะได้รับความอนุเคราะห์จากท่าน และขอขอบคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

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(นายพุทธิวัต สิงห์ดง)
นิสิตหลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน

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(ผู้ช่วยศาสตราจารย์ ดร. ธารทัศน์ โมกขมรรคกุล)
ผู้อำนวยการหลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
โทร. 02-2183113-4 โทรสาร. 02-251-2354

ที่ อว64.25/ลจด282/63

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
ถนนพญาไท ปทุมวัน กทม. 10330

25 สิงหาคม 2563

เรื่อง ขอความอนุเคราะห์เก็บข้อมูลแบบสอบถาม

เรียน นายกสมาคมตัวแทนขนส่งสินค้าทางอากาศไทย

ด้วย นายพุทธิวัต สิงห์ดง รหัสประจำตัว 6087791820 นิสิตระดับปริญญาเอก หลักสูตรวิทยาศาสตรดุษฎีบัณฑิต สาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย ได้ทำการศึกษาและจัดทำวิจัยทางด้านการจัดการด้านโลจิสติกส์ เรื่อง "ปัจจัยทางดิจิทัลทรานส์ฟอร์เมชั่นที่ส่งผลต่อความยั่งยืนของผู้ให้บริการโลจิสติกส์ในประเทศไทย" โดยมี ศาสตราจารย์ ดร.กมลชนก สุทธิวาทนฤพุฒิ (อาจารย์ที่ปรึกษาหลัก) และ รองศาสตราจารย์ ดร.พงศา พรชัยวิเศษกุล (อาจารย์ที่ปรึกษาร่วม)

ทั้งนี้ได้ทำการประสานกับสมาคมตัวแทนขนส่งสินค้าทางอากาศไทยเบื้องต้นแล้ว เพื่อขอความอนุเคราะห์ในการประสานงานกับสมาชิกของสมาคมเพื่อเก็บแบบสอบถาม นำเสนอหลักการวิจัยและประโยชน์ที่จะได้รับ โดยนิสิตผู้วิจัยจะได้ประสานงานในรายละเอียดต่อไป

ในการนี้ หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย จึงขอความอนุเคราะห์ดังกล่าว โดยนิสิต นายพุทธิวัต สิงห์ดง หมายเลขโทรศัพท์ 083-064-6298- อีเมล์ tuaputthiwat@gmail.com เป็นผู้ประสานงาน หลักสูตรฯ หวังเป็นอย่างยิ่งจะได้รับความอนุเคราะห์จากท่าน และขอขอบคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

.....

(นายพุทธิวัต สิงห์ดง)
นิสิตหลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน

.....

(ผู้ช่วยศาสตราจารย์ ดร. ธารทัศน์ ไมกขมรรคกุล)
ผู้อำนวยการหลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
โทร. 02-2183113-4 โทรสาร. 02-251-2354

ที่ อว64.25/ลจต278/63

หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์
และโซ่อุปทาน (สหสาขาวิชา/นานาชาติ)
บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย
ถนนพญาไท ปทุมวัน กทม. 10330

24 สิงหาคม 2563

เรื่อง ขอความอนุเคราะห์เก็บข้อมูลแบบสอบถาม

เรียน ผู้อำนวยการสำนักพัฒนาและส่งเสริมธุรกิจบริการ กรมส่งเสริมการค้าระหว่างประเทศ กระทรวงพาณิชย์

ด้วย นายพุทธิวัต สิงห์ดง รหัสประจำตัว 6087791820 นิสิตระดับปริญญาเอก หลักสูตรวิทยาศาสตรดุษฎีบัณฑิต สาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย ได้ทำการศึกษาและจัดทำวิจัยทางด้านการจัดการด้านโลจิสติกส์ เรื่อง "ปัจจัยทางดิจิทัลทรานส์ฟอร์เมชั่นที่ส่งผลต่อความยั่งยืนของผู้ให้บริการโลจิสติกส์ในประเทศไทย" โดยมี ศาสตราจารย์ ดร.กมลชนก สุทธิวาทนฤพุฒิ (อาจารย์ที่ปรึกษาหลัก) และ รองศาสตราจารย์ ดร. พงศา พรชัยวิเศษกุล (อาจารย์ที่ปรึกษาร่วม)

จากการที่กรมส่งเสริมการค้าระหว่างประเทศ กระทรวงพาณิชย์ ได้มีการจัดการประชุมวิชาการนานาชาติด้าน โลจิสติกส์และการค้าระหว่างประเทศ "Trade Logistics Symposium 2020" ระหว่างวันที่ 27 – 28 สิงหาคม 2563 ณ ห้อง Auditorium อาคาร True Digital Pak ซึ่งทางนิสิตผู้วิจัยเห็นว่าผู้เข้าร่วมประชุมครั้งนี้สอดคล้องกับกลุ่มตัวอย่างที่ต้องการเก็บข้อมูลในการทำวิจัยคือผู้ให้บริการโลจิสติกส์ในประเทศไทยที่สนใจในการนำดิจิทัลมาเปลี่ยนแปลงในธุรกิจ จึงใคร่ขอความอนุเคราะห์เก็บแบบสอบถามจากผู้ที่เข้าร่วมในการจัดการประชุมวิชาการดังกล่าวทั้งนี้นิสิตผู้วิจัยจะได้ประสานงานในรายละเอียดต่อไป

ในการนี้ หลักสูตรสหสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน (นานาชาติ) บัณฑิตวิทยาลัย จุฬาลงกรณ์มหาวิทยาลัย จึงขอความอนุเคราะห์ดังกล่าว โดยนิสิต นายพุทธิวัต สิงห์ดง หมายเลขโทรศัพท์ 083-064-6298- อีเมล์ tuaputthiwat@gmail.com เป็นผู้ประสานงาน หลักสูตรฯ หวังเป็นอย่างยิ่งจะได้รับความอนุเคราะห์จากท่าน และขอขอบคุณมา ณ โอกาสนี้

ขอแสดงความนับถือ

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(นายพุทธิวัต สิงห์ดง)
นิสิตหลักสูตรวิทยาศาสตร์ดุษฎีบัณฑิตสาขาวิชาการจัดการโลจิสติกส์และโซ่อุปทาน

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(ผู้ช่วยศาสตราจารย์ ดร. ธารทัศน์ ไมกขมรรคกุล)
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โทร. 02-2183113-4 โทรสาร. 02-251-2354

VITA

NAME	Putthiwat Singhdong
DATE OF BIRTH	03 October 1984
PLACE OF BIRTH	Ubon Ratchathani
INSTITUTIONS ATTENDED	Bachelor of Science, Major: Printing technology King Mongkut University of Technology Thonburi ,Bangkok Thailand Master of Art, Transport & Logistics Management University of Greenwich, London United kingdom
HOME ADDRESS	Pathum thani Thailand
AWARD RECEIVED	Now he currently working as lecturers in Logistics/Supply Chain Management with expertise in areas as diverse as services / manufacturing operations, supply chain management, logistics and operations strategy. He's particularly interested in a strategic and empirically focussed teacher and researcher

จุฬาลงกรณ์มหาวิทยาลัย
Chulalongkorn University