Digital Transformation Factors Influencing the Sustainability of Logistics Service Providers in Thailand: A Conceptual Framework

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Abstract— This research aims to explore and develop digital transformation s factors influencing the logistics service provider sector in Thailand and examine logistics sustainability factors associated with logistics. This theoretical study framework is divided into two parts. Part one covers 21 factors relating to digital transformation, including drivers, objectives, implications, and success factors. The second part concerns 23 factors associated with logistics sustainability, including economic, environmental, and social factors. This total of 44 potential factors generated from previous studies in the literature review was combined with opinions gathered from interviews with a group of business and academic logistics experts, using a semi-structured interview method to explore and verify the proposed factors. And using by index of item-objective congruence (IOC) to verify the validity measurement s. the survey results show which all variable higher than 0.5 and revealed an additional seven factors thus giving a total 51 factors are applicable to examine and answer the research question.

Keywords- digital transformation; logistics sustainability; logistics service providerscomponent;

I. INTRODUCTION

According to the latest articles published on digital transformation in logistics and sup-ply chain management is currently evolving; there is still no clear understanding of the concrete implications. This exploratory research paper intends to provide insights into more sustainability in logistics and supply chain management [27] It also aims to iden-tify digital transformation factors influencing logistics sustainability and examine the impact of digital transformation logistics sustainability on logistics service providers in Thailand. The study is based on a case study-qualitative research methodology involving two stages. involved examining studies in the literature review in-volving defining the construct and producing a sample of factors to operationalize each construct. Stage two involved instrument development and estimate causal relation-ships among data in logistics service provider businesses providing warehouse and dis-tribution services in Thailand.

II. FACTORS INVOLVING DIGITAL TRANSFORMATION

In total, 21 journals and four international conferences were looking for factors that involve digital transformation and similar concept [36]. The search based on digitization publications and related concepts was published between January 1, 2010 and December 6, 2017. Only original English papers were included. While paper abstracts were obtained from the four submitted papers, only conference papers were included (and not series). In total, 54 journal articles and 128 conference papers contributed to the com-pound search strings. They concentrated on empirical contributions, and theoretical and philosophical contributions were omitted. They evaluated the 21

research-related contributions and grouped the papers into three groups based on which research may con-tribute useful insights: drivers and goals, success factors, and implications

Table 1 Summary of Digital Transformation Factors

Dimension	Factor	Variable	Studies
Drivers	DV1	Customer behaviors and expectations	Schmidt et al. (2017) Haffke et al. (2017) Berghaus et al. (2017)
	DV2	Digital shifts in the industry	Berghaus et al. (2017)
	DV3	Changing competitive landscape	Haffke et al. (2016) Piccinini et al. (2015) Berghaus et al. (2017)
	DV4	Regulative changes	Berghaus et al. (2017)
Objectives	OB1	Ensure digital readiness	Berghaus et al. (2017)
	OB2	Digitally enhance products and services	Mocker And Fonstad (2017)
	OB3	Embrace product innovation	Berghaus et al. (2017)
	OB4	Develop new business models	Berghaus et al. (2017)
	OB5	Improve digital channels	Berghaus et al. (2017) Bilgeri et al. (2017) Mocker and Fonstad (2017)
	OB6	Increase customer satisfaction	Isaksson and Hylving (2017) Berghaus et al. (2017) Bilgeri et al. (2017) Mocker and Fonstad (2017)
Success factors	SF1	A supportive organizational culture	Hartl and Hess (2017) Haffke et al. (2017)
	SF2	Well-managed transformation activities	Berghaus et al. (2017)
	SF3	Leverage external and internal knowledge	Piccinini et al. (2015) Hildebrandt et al. (2015) Mueller and Renken (
	SF4	Engage managers and employees	Horlacher et al. (2016) Mihailescu et al. (2015) Petrikina et al. (2017)
	SF5	Grow information system capabilities	Nwankpa and Roumani (2016)
	SF6	Develop dynamic capabilities	Karimi (2015) Leischnig et al. (2017) Berghaus et al. (2017)
	SF7	Develop a digital business strategy	Yeow et al. (2018) Nwankpa and Roumani (2016); Schmidt et al. (2017); Leischnig et al. (2017)
	SF8	Align business and information systems	Yeow et al. (2018) Nwankpa and Roumani (2016); Schmidt et al. (2017);
Implications	IP1	Reforming an organization's information system	Haffke (2016);; Hylving and Schultze (2013); Haffke et al. (2017); Isaksson and Hylving (2017);
	IP2	New business models	Hildebrandt et al. (2015) Remane et al. (2016) Mocker and Fonstad (2017)
	IP3	Affecting outcomes and performance	Nwankpa and Roumani (2016)

Source: Adapt from Osmundsen et al. 2018.

III. LOGISTICS SUBSTANTIALITY

Digitization facilitates automating workflows and speeding up the production and distribution of documents. Table 2. depicts a sustainable digital logistics ecosystem that shows how digitization impacts logistics from a sustainable economic, environmental, and social perspective. The characteristics of the sustainability dimensions are summarized as follows: Economic: an affordable mechanism that works effectively, provides collaborative solutions and a mixture of choices in the mode of transport, and benefits the local economy. Environmental: decreased greenhouse gas emissions, pollution, and waste, minimized non-renewable energy use and the use of technologies that reuse and recycle their components. Social: an essential individual/community access criterion to be met safer and encourage

Table 2 Summary of Logistics Sustainability Dimension

Dimension	Factor	Variable	Studies
Economy	LSE1	Logistics cost	Monnet and Le Net (2011);]Dougados et al. (2013); [Gebler et al. (2014
	LSE2	Delivery time	Monnet and Le Net (2011);Dougados et al. (2013) Schrauf and Berttram (2016); Raab and Griffin-Cryan, (2011); Weinelt (2016)
	LSE3	Transport delay	Monnet and Le Net (2011); Schrauf and Berttram (2016); Weinelt (2016)
	LSE4	Inventory reduction	Dougados et al. (2013)
	LSE5	Loss/damage	Monnet and Le Net (2011)
	LSE6	Frequency of service	Dougados et al. (2013); Nowak et al. (2016)
	LSE7	Forecast accuracy	Dougados et al. (2013); Schrauf and Berttram (2016)
	LSE8	Reliability	Monnet and Le Net (2011); Dougados et al. (2013); Gebler (2014); Schrauf and Berttram, (2016);
	LSE9	Flexibility	Monnet and Le Net (2011) Berttram, (2016); Weinelt (2016)
	LSE10	Transport volume	Monnet and Le Net (2011)
	LSE11	Application	Gebler et al. (2014)
Environment	LSN1	Resource efficiency	Monnet and Le Net (2011); Gebler et al. (2014); Nowak et al. (2016)
	LSN2	Process energy	Gebler et al. (2014); Weinelt (2016)
	LSN3	Process emissions	Monnet and Le Net (2011); Gebler et al. (2014); Nowak et al. (2016) Weinelt (2016)
	LSN4	Waste	Gebler et al. (2014); Weinelt (2016)
	LSN5	Pollutions	Monnet and Le Net (2011); Weinelt (2016)
	LSN6	Land use impact	Monnet and Le Net (2011)
Society	LSS1	Development benefits	Gebler (2014); Schrauf and Berttram (2016)
	LSS2	Impacts	Gebler (2014); Nowak et al.

			(2016)
	LSS3	Health	Monnet and Le Net (2011);
	z LSS4	Safety	Monnet and Le Net (2011); Schrauf and Berttram (2016); Weinelt (2016)
	LSS5	Labor patterns	Monnet and Le Net (2011); Gebler et al. (2014); Nowak et al. (2016)
	LSS6	Acceptance	Gebler (2014); Schrauf and Berttram (2016)

Source: adapted from Kayikci 2018

IV. REsEARCH MEDTHLOGY

The research questionnaire was developed based on the instrument creation methods suggested by Churchill (1979) and Haynes (1995), involving three stages. Stage 1 involved examining studies in the literature review involving defining the construct and producing a sample of factors to operationalize each construct. The use of population and expert sampling is recommended for pre-testing the initial pool of factors (Straub et al. 200 4Pre-testing the instrument involves content validity testing to consolidate factors measured qualitatively; the pilot study involves appraising and purifying the instruments and examining the factors' internal consistency. After a pre-test with 11 industry and academic experts, additional factors were recommended by A validity test of the survey instrument was conducted, using item-objective congruency index (IOC) techniques [48]. by academic and business experts. The measurement factors were refined and improved by the application of the feedback. item- s. All committees had to choose only one answer as the given mark from three choices. Total points for each item required a consistency value equal to or above 0.50 [2].

No.	Expert Name List	Company	Expert Type
1	Mr. Saphon Suksatit	Bevchain Logistics Company Ltd.	Industry Expert
2	Mr. Surasak Buranasompop	DHL Supply Chain Thailand Company Ltd.	Industry Expert
3	Mr. Damrongsit Kitivtee	Yusen Logistics Thailand Company Ltd.	Industry Expert
4	Mr. Panu Chudjerjeen	SCB LIFE Assurance Public Company Ltd.	Industry Expert
5	Mr. Patiparn sajjasophon	Thai Beverage Logistics Company Ltd.	Industry Expert
6	Mr. Phob Pattarasakol	Central Food Retail Group	Industry Expert
7	Mr. Jedsada Thavornsak	Logistics Division Department of Industrial Promotion, Thailand	Academic Expert
8	Mr. Somchai Banlue-Sano	Thai International Freight Forwarders Association	Academic Expert
9	Asst. Prof. Dr. Tartat Mokkhamakkul	Chulalongkorn University, Thailand	Academic Expert
10	Assoc. Prof. Dr. Nakorn Indra-payoong	Burapha University, Thailand	Academic Expert
11	Assoc. Prof. Dr. Chumpol Monthatipkul	King Mongkut's University of Technology Thonburi (KMUTT), Thailand	Academic Expert

V. CONCLUSION

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 by the selected experts This research also verified each factor's validity by item-objective congruency index (In-dex of item ObjectiveOC), by according to which all factors were higher than 0.5. The questionnaire's reliability was verified by using a pilot test conducted from 30 rep-resentative samples, with the alpha coefficient value of 0.95. The survey results show that all 51 factors are appropriate for the large-scale questionnaire to examine the re-search hypothesis. The nNext stage of this research will use a lLarge- scale survey, to and this survey will be subject to Structural Equation Modeling (S.E.M. analysis) at thatis stagee of the research . Exploratory fFactor aAnalysis (E.F.A.) and cConfirmatory fFactor aAnalysis (C.F.A.) were executed performed to ensure that all the model's con-structs possessed construct validity

REFERENCES

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

[2] Angsuchoti, S.; Vijitwannna, S.; Pinyopanuwat, R. Analysis statistics for social and behavior science: Technique [sic] for LISREL program. 2014

[3] Baumer, E.P.; Brubaker, J.R. Post-userism. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, May 6-11 **2017;**Denver,Co,USA pp. 6291–6303.

[4] Bechtsis, D.; Tsolakis, N.; Vlachos, D.; Iakovou, E. Sustainable supply chain management in the digitalisation era: The impact of automated guided vehicles. *J. Clean. Prod.* **2017**, *142*, 3970–3984.

[5] Beier, P.; Hansen, L.J.; Helbrecht, L.; Behar, D. A how-to guide for co-production of actionable science. *Conserv. Lett.* **2017**, *10*, 288–296.

[6] Bell, Emma, and Alan Bryman. "The ethics of management research: an exploratory content analysis." British journal of management 18.1 **2007**: 63-77.

[7] Berman, Barry. "3-D printing: The new industrial revolution." Business horizons 55.2 **2012**: 155-162.

[8] Berghaus, Sabine and A. Back. "Disentangling the Fuzzy Front End of Digital Transformation: Activities and Approaches." ICIS **2017**.1-17

[9] Bilgeri, D.; Wortmann, F.; Fleisch, E. How digital transformation affects large manufacturing companies' organization. **2017**.

[10] Cerdas, F.; Juraschek, M.; Thiede, S.; Herrmann, C. Life cycle assessment of 3D printed products in a distributed manufacturing system. *J. Ind. Ecol.* **2017**, *21*, S80–S93.

[11] Churchill Jr, Gilbert A. "A paradigm for developing better measures of marketing constructs." Journal of marketing research 16.1 **1979**: 64-73.

[12] Collins, L.; Ellis, S.R. (Eds.) *Mobile Devices: Tools and Technologies*; CRC Press: Boca Raton, FL, USA, 2015.

[13] Cooper, Donald R., Pamela S. Schindler, and Jianmin Sun. Business research methods. Vol. 9. New York: Mcgraw-hill, **2006**.

[14] Dougados, M.; van Doesburg, R.; Ghioldi, S.; KVJ, S. The Missing Link. Supply Chain and Digital Maturity. *Capgemini Consult. White Paper* **2013**.

[15] Frank, Alejandro G., et al. "Servitization and Industry 4.0 convergence in the digital transformation of product firms: A business model innovation perspective." Technological Forecasting and Social Change 141 **2019:** 341-351.

[16] Gebler, M.; Uiterkamp AJ, S.; Visser, C. A global sustainability perspective on 3D printing technologies. *Energy Policy* **2014**, *74*, 158–167.

[17] Gliem, Joseph A., and Rosemary R. Gliem. "Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales." Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education, 2003.

[18] Gubler, M.; Arnold, J.; Coombs, C. Reassessing the protean career concept: Empirical findings, conceptual components, and measurement. *J. Organ. Behav.* **2014**, *35*, S23–S40.

[19] Guo, X.; Shen, C.; Chen, L. Deep fault recognizer: An integrated model to denoise and extract features for fault diagnosis in rotating machinery. *Appl. Sci.* **2017**, *7*, 41.

[20] Haffke, I.; Kalgovas, B.J.; Benlian, A. The Role of the CIO and the CDO in an Organization's Digital Transformation. **2016**.

[21] Haffke, I.; Kalgovas, B.; Benlian, A. The transformative role of bimodal IT in an era of digital business. In Proceedings of the 50th Hawaii International Conference on System Sciences, January 2017.

[22] Haynes, Stephen N., David Richard, and Edward S. Kubany. "Content validity in psychological assessment: A functional approach to concepts and methods." Psychological assessment 7.3 **1995:** 238.

[23] Hartl, E.; Hess, T. The role of cultural values for digital transformation: Insights from a Delphi study. **2017**.

[24] Hildebrandt, B.; Hanelt, A.; Firk, S.; Kolbe, L. Entering the digital era–the impact of digital technology-related m&as on business model innovations of automobile OEMs. **2015**.

[25] Horlacher, A.; Klarner, P.; Hess, T. Crossing boundaries: Organization design parameters surrounding CDOs and their digital transformation activities. **2016**.

[26] Hylving, L.; Schultze, U. Evolving the modular layered architecture in digital innovation: The case of the car's instrument cluster. **2013**.

[27] Junge, A.L.; Straube, F. Sustainable supply chains–digital transformation technologies' impact on the social and environmental dimension. *Procedia Manuf.* **2020**, *43*, 736–742.

[28] Kayikci, Y. Sustainability impact of digitization in logistics. *Procedia Manuf.* **2018**, *21*, 782–789.

[29] Karimi, J.; Walter, Z. The role of dynamic capabilities in responding to digital disruption: A factor-based study of the newspaper industry. *J. Manag. Inf. Syst.* **2015**, *32*, 39–81.

[30] Korpela, Kari, Jukka Hallikas, and Tomi Dahlberg. "Digital supply chain transformation toward blockchain integration." proceedings of the 50th Hawaii international conference on system sciences. **2017.**

[31] Isaksson, V.; Hylving, L. The Effect of Anarchistic Actions in Digital Product Innovation Networks: The Case of "Over the Air" Software Updates. In Proceedings of the 50th Hawaii International Conference on System Sciences, January **2017.**

[32] Leischnig, A.; Wölfl, S.; Ivens, B.; Hein, D. From digital business strategy to market performance: Insights into key concepts and processes. **2017**.

[33] Mihailescu, M.; Mihailescu, D.; Carlsson, S. Understanding Healthcare Digitalization: A Critical Realist Approach. **2017**.

[34] Mihailescu, M.; Mihailescu, D.; Schultze, U. The generative mechanisms of healthcare digitalization. **2015**.

[35] Mocker, M.; Fonstad, N.O. How AUDI AG is Driving Toward the Sharing Economy. *MIS Q. Exec.* **2017**, *16.4*

[36] Morakanyane, R.; Grace, A.A.; O'Reilly, P. Conceptualizing Digital Transformation in Business Organizations: A Systematic Review of Literature. *Bled eConference* **2017**, *21*.

[37] Monnet, J.M.; Le Net, E. Assessment of logistics concept to sustainability: Development of a common approach to transport issues. **2011**.

[38] Mueller, B.; Renken, U. Helping employees to be digital transformers–the Olympus. connect case. **2017**.

[39] Nowak, G.; Maluck, J.; Stürmer, C.; Pasemann, J. The era of digitized trucking-Transforming the logistics value chain. PwC. **2016**.

[40] Osmundsen, K.; Iden, J.; Bygstad, B. Digital Transformation: Drivers, Success Factors, and Implications. In Proceedings of the MCIS, September 2018; p. 37.

[41] Nwankpa, J.K.; Roumani, Y. IT capability and digital transformation: A firm performance perspective. **2016**.

[42] Piccinini, E.; Hanelt, A.; Gregory, R.; Kolbe, L. Transforming industrial business: The impact of digital transformation on automotive organizations. **2015**.

[43] Petrikina, J.; Krieger, M.; Schirmer, I.; Stoeckler, N.; Saxe, S.; Baldauf, U. Improving the readiness for change-Addressing information concerns of internal stakeholders in the smartPORT Hamburg. **2017**.

[44] Raab, M.; Griffin-Cryan, B. Digital transformation of supply chains. Creating Value–When Digital Meets Physical, Capgemini Consulting. **2011**.

[45] Remane, G.; Hanelt, A.; Hildebrandt, B.; Kolbe, L. Changes in Digital Business Model Types–A Longitudinal Study of Technology Startups from the Mobility Sector. **2016**.

[46] Saengchai, S.; Jermsittiparsert, K. Improving Sustainability Performance through Internet of Things Capability in Thailand: Mediating Role of IoT Enabled Supply Chain Integration. *Int. J. Supply Chain Manag.* **2019**, *8*, 572–584.

[47] Schmidt, J.; Drews, P.; Schirmer, I. Digitalization of the banking industry: A multiple stakeholder analysis on strategic alignment. **2017**.

[48] Sireci, S.G. The construct of content validity. *Soc. Indic. Res.* **1998**, *45*, 83–117.

[49] Straub, Detmar, Marie-Claude Boudreau, and David Gefen. "Validation guidelines for IS positivist research." Communications of the Association for Information systems 13.1 **2004**: 24.

[50] Stuermer, M.; Abu-Tayeh, G.; Myrach, T. Digital sustainability: Basic conditions for sustainable digital artefacts and their ecosystems. *Sustain. Sci.* **2017**, *12*, 247–262.

[51] Schrauf, Stefan, and Philipp Berttram. "Industry 4.0: How digitization makes the supply chain more efficient, agile, and customer-focused." Strategy&. Recuperado de https://www. strategyand. pwc. com/media/file/Industry4. 0. pdf (2016).

[52] Tien, J.M. The next industrial revolution: Integrated services and goods. *J. Syst. Sci. Syst. Eng.* **2012**, *21*, 257–296.

[53] Weinelt, B. Digital transformation of industries: Logistics industry. **2016**.

[54] Van Marwyk, K.; Treppte, S. Logistics Study on Digital Business Models. *Roland Berg. White Paper* **2016**.

[55] Yeow, A.; Soh, C.; Hansen, R. Aligning with new digital strategy: A dynamic capabilities approach. *J. Strateg. Inf. Syst.* **2018**, *27*, 43–58.

[56] Zhang, Y.; Liu, S.; Liu, Y.; Li, R. Smart box-enabled product-service system for cloud logistics. *Int. J. Prod. Res.* **2016**, *54*, 6693–6706.