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The Exclusive Relation of Digital Transformation and Sustainability: A Systematic Literature Review of Its Antecedents

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Abstract

The industrial revolution 4.0, or known as the fourth phase of the industrial revolution, has led the digital evolution into a broader discipline beyond the technology itself. The purpose of this research is to explore and looking for better understanding of the relation between digital transformation trough industrial revolution 4.0 and its impact to sustainabiltity practice. Therefore, this study focused on the relation between digital transformation and sustainability, carried out with a systematical review study for nine years of research 2016-2024 and 82 selected peer-reviewed high ranked journals as the subject of studies. It is found that there is a strong and mutually beneficial relationship between Digital Transformation and Sustainability (DTS). This study also found that there are 13 potential themes to be studied further in relation to digital transformation and sustainability practice relationship. In conclusion there is strong influece between digital transformation as the hearth of industrial 4.0 era to a more sustainable practice for the better future. Therefore, this study may give a clearer picture of the digital transformation and sustainability practice (DTS) and future study that need further study.

Keywords: *Digital Transformation, Sustainability, Digitalization, Industry Revolution 4.0.*

INTRODUCTION

Since the relase of Bruntland Report, a report released by world commission and development in 1987, inquiries about sustainability have been reiterated and become an important topic. The Bruntland Report specifically reported sustainable future issues that include economic, environmental, and social issues (Development, 1987). Elkington (1998) is among the researchers that promote the sustainability issue, for instance, through his book 'Cannibals With Forks' and states that sustainability consists of three important dimensions, which are economic, social, and environment. These dimensions will determine the firm performance criteria in the future.

Along with the sustainability concerns, recently industry revolution 4.0 or commonly called Digital Transformation (DT) that

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leads to the disruption of many industrial factors, including the financial sector, technological, social, as well as the shift of business paradigm has appeared (Vrchota et al., 2019a). The effect and impact of the industry revolution 4.0 to sustainability are still unknown. Will it bring a successful and more sustainable planet, people and profit?. Or may they lead into a more disasterous effect that may lead into an unsuccessful sustainability practice whereas sustainability practice requires a trade-off between economic, social, and environmental or commonly called Triple Bottom Line (TBL) performance (Svensson et al., 2018). Therefore, it is important to explore more on the relation, effect and interaction between DT and TBL, as well as antecedent or themes that may have a high influence to the relation between DT and TBL.

LITERATURE REVIEW

Digital Transformation

Vial (2019) noted that Digital Transformation as a new evolution of information system does not only involved in the narrow world of technology, but it also engages broader actors into the DT circle, including societies and industries in the use of technology for better performance as well as to generate possibilities of new value creation along with the supply chain. These phenomena were also noted by Krotov (2017); the internet of things through DT will create socio-technical phenomena that involve the technological environment, physical environment, and socio-economic environment.

Therefore, Digital Transformation through the use of a technological environment, which includes the Internet of Things, Cloud Computing, Mobile Network, Platform, and the others, will create a continuous interaction between humans and machines that profoundly creates a new business and value creation along the supply chain.

Sustainability

The Triple Bottom Line (TBL) has become a consensus as to the dimensions of sustainability, which involve economic performance, social performance, and environmental performance (Sivarajah et al., 2019). Elkington (1998) explained that economic performance refers to companies' capabilities in gaining profit, whereas social performance correlates to the interaction of companies toward the communitiy and their employees,, and environmental performance relates to a company's interaction with its environment through their business operation.

Moreover, sustainability based on the Bruntland Report (Development, 1987) has become a world agenda, as noted in the UN's sustainable development agenda, which reports that countries and companies must follow sustainable guidance for its business sustainability.

METHOD

The goal for this research is to determine the correlation of DT and the sustainability based on research made in the past decade, and confirming relevant results on those two topics. The approach of the study used a systematic literature review, which functioned as a method of identifying, appraising, criticizing the relevant research for then to be synthesized, analyzed to identify what has been studied in the relevant research and potential development for future studies (Snyder, 2019)

Therefore, with the following questions, this research aims to determine the relationship between of DT and sustainability within these last nine years:

RQ1: Is there a mutual relation between Digital Transformation and sustainability?

RQ2: What are the antecedents that given major influence to Digital Transformation and Sustainability Practice

The methodology used to analyze the research was content analysis methodology, in which the references came from the text that had been analyzed to answer the research question (krippendorff, 2012). Therefore, the current study used NVIVO as a content analysis tool. This research article followed the PRISMA (Preferred Reporting Items For Systematic Reviews and Meta-Analyses) methodology guide (Liberati et al., 2009), where the data were collected from the selection of articles.

The literature identification method was used as the first step of the systematical literature review. Firstly, the keywords inputted were "*digital transformation*" and "*sustainability*". These keywords were then searched in reputable international journal search engines from Scopus and Proquest databases. The searches were limited to Scopus indexed journal only with the rank of Q4 at the minimum and Q1 at the highest. The journal rank can found at www.scimagojr.com. Other criteria of the journal selection were written in English, conducted between 2015 to 2020, and had been through proper peer-review. The criteria were to ensure the quality of the analyzed journals.

Secondly, journal studies that follow the requirements have been chosen and included, whereas those which did not fulfill the requirements are have been omitted. The excluded journals were those which were indexed at the Scopus index database, nor written in English and peer reviewed, such as proceeding material. Journals that were irrelevant to the digital transformation and sustainability topics were also excluded. Thirdly, the journals collected were further analyzed for the synthesis process. The NVIVO was used for the synthesis process, as suggested by Krippendorff (2012), for content analysis and qualitative research methods. In the synthesis process, the study's themes, variables, and related issues were identified. After that, the themes, variables, and related issues as well the related potential future studies were concluded.

RESULTS AND DISCUSSION

Following the research methodology, first, a search query at Scopus and Proquest database was conducted. From the Scopus indexed database, 38 journal articles related to the keywords of digital transformation and sustainability were found. From the total of 50, the articles that fulfilled the assigned criteria were 38 articles, which were then selected. As from the Proquest database, 136 related journal articles were found. Out of 136 journal articles, 44 articles selected according the criteria of sustainability and digital transformation. The rest of the excluded articles were either inaccessible, irrelevant to the topics, or not written in English. The short listed paper are presented at Table 1.

Table 1. Short Listed Articlces on Sustainability and Digital Transformation

No	Author	Year	Journal	Reference
1	Gill, Karamjit S	2016	AI and Society	(Gill, 2016)
2	Hoe, Siu Loon	2016	Journal of Information, Communication and Ethics in Society	(Hoe, 2016)
3	Gudowsky, Niklas; Peissl, Walter	2016	European Journal of Futures Research	(Gudowsky & Peissl, 2016)
4	Purnomo, Fredy; Meyliana; Prabowo, Harjanto	2016	Journal of Telecommunication, Electronic and Computer Engineering	(Purnomo et al., 2016)
5	McRostie, Donna	2016	Library Management	(McRostie, 2016)
6	Kathan, Wolfgang; Matzler, Kurt; Veider, Viktoria	2016	Business Horizons	(Kathan et al., 2016)
7	Iskandar, Karto; Jambak, Muhammad Ikhwan; Kosala, Raymondus; Prabowo, Harjanto	2017	Procedia Computer Science	(Iskandar et al., 2017)
8	Schlüter, Nadine; Sommerhoff, Benedikt	2017	International Journal of Quality and Service Sciences	(Schlüter & Sommerhoff , 2017)
9	Constantinescu, Lucretia Mariana; Panagoret, Ioana	2017	Revista de Management Comparat Internaţional	(Constantinescu & Panagoret, 2017)
10	Heilig, Leonard; Lalla-Ruiz, Eduardo; Voß, Stefan	2017	NETNOMICS: Economic Research and Electronic Networking	(Heilig et al., 2017)
11	Martin, Guy; Kinross, James; Hankin, Chris	2017	BMJ (Online)	(Martin et al., 2017)
12	Neven, Louis; Peine, Alexander	2017	Societies	(Neven & Peine, 2017)
13	Bifulco Marco;	2017	International Journal of	(bifulco ma

	Mitrano, Cristina; D'Audia Anna, Francesco; Tregua		Public Sector Management	rco ; Mitrano, cristina ; D'Audia Anna, 2017)
14	Centobelli, Piera; Cerchione, Roberto; Esposito, Emilio	2017	Sustainability (Switzerland)	(Centobelli et al., 2017)
15	Beier, Grischa	2018	Applied Sciences	(Beier et al., 2018)
16	Pappas, Ilias O; Mikalef, Patrick; Giannakos, Michail N; Krogstie, John; Lekakos, George	2018	Information Systems and e-Business Management	(I. O. Pappas et al., 2018)
17	Chambers, Ruth; McKinney, Rudy; Schmid, Marc; Beaney, Paul	2018	Primary Health Care	(Chambers et al., 2018)
18	Neligan, Adriana	2018	Intereconomics	(Neligan, 2018)
19	Bieser, Jan C. T.; Hilty, Lorenz M.	2018	Epic Series in Computing	(Bieser & Hilty, 2018)
20	Bonilla, Silvia H; Silva, Helton R O; da Silva, Marcia Terra; Gonçalves, Rodrigo Franco; Sacomano, José B	2018	Sustainability (Switzerland)	(Bonilla et al., 2018)
21	Nain Chopra, Kamal	2018	Journal of Internet Banking and Commerce	(Nain Chopra, 2018)
22	Beier, Grischa; Niehoff, Silke; Xue, Bing	2018	Applied Sciences (Switzerland)	(Beier et al., 2018)
23	Yang, Shanshan; Raghavendra, M R.Aravind; Kaminski, Jacek; Pepin, Helene	2018	Applied Sciences (Switzerland)	(Yang et al., 2018)
24	David-West, Olayinka; Umukoro, Immanuel Ovemeso; Onuoha, Raymond Okwudiri	2018	Journal of Intellectual Capital	(David-West et al., 2018)
25	Broadbent, Stefana; Cara, Francesco	2018	Sustainability (Switzerland)	(Broadbent & Cara, 2018)
26	Hsu, Che Chuan; Tsaih, Rua Huan; Yen, David C	2018	Sustainability (Switzerland)	(Hsu et al., 2018)
27	Garcia-Muiña, Fernando E; González-Sánchez, Rocío; Ferrari, Anna Maria;	2018	Social Sciences	(F. E. Garcia-Muiña et al., 2018)

	Settembre-Blundo, Davide			
28	Wesumperuma, Ashini; Ginige, Athula; Gunawardana, Upul	2018	Journal of Information, Communication and Ethics in Society	(Wesumperuma et al., 2018)
29	Müller, Julian Marius; Kiel, Daniel; Voigt, Kai Ingo	2018	Sustainability (Switzerland)	(Müller et al., 2018)
30	Kwon, Hyunji; Kim, Seokyoung; Yang, Jongmin	2018	Development and Society	(Kwon et al., 2018)
31	Müller, Julian Marius	2019	Sustainability	(Müller, 2019)
32	Akande, Adeoluwa; Cabral, Pedro; Casteleyn, Sven	2019	Information Systems Frontiers	(Akande et al., 2019)
33	Kovacs, Oliver	2019	Social Sciences	(Kovacs, 2019)
34	Bernardi, Roberta; Exworthy, Mark	2019	Information Systems Journal	(Bernardi & Exworthy, 2019)
35	Savastano, Marco; Amendola, Carlo; Bellini, Francesco; D'Ascenzo, Fabrizio	2019	Sustainability (Switzerland)	(Savastano et al., 2019)
36	Tumelero, Cleonir; Sbragia, Roberto; Evans, Steve	2019	Journal of Cleaner Production	(Tumelero et al., 2019)
37	Türkeli, Serdar; Schophuizen, Martine	2019	Social Sciences	(Türkeli & Schophuize, 2019)
38	Birkel, Hendrik S; Veile, Johannes W; Müller, Julian M; Hartmann, Evi; Voigt, Kai Ingo	2019	Sustainability (Switzerland)	(Birkel et al., 2019)
39	El-Haddadeh, Ramzi	2019	Information Systems Frontiers	(El-Haddadeh, 2019)
40	Fehér, Péter; Varga, Krisztián	2019	Society and Economy	(Fehér & Varga, 2019)
41	Benotsmane, Rabab; Kovács, György; Dudás, László	2019	Social Sciences	(Benotsmane et al., 2019)
42	Vrchota, Jaroslav; Volek, Tomas; Novotná, Martina	2019	Social Sciences	(Vrchota et al., 2019b)
43	Arrigoni, Gabriella; Schofield, Tom; Trujillo Pisanty, Diego	2019	Museum Management and Curatorship	(Arrigoni et al., 2019)

44	Kettunen, Petri; Mäkitalo, Niko	2019	European Journal of Futures Research	(Kettunen & Mäkitalo, 2019)
45	Al-Htaybat, Khaldoon; Hutaibat, Khaled; von Alberti-Alhtaybat, Larissa	2019	Journal of Intellectual Capital	(Al-Htaybat et al., 2019)
46	Kosareva, Olga A; Eliseev, Mikhail N; Cheglov, Vyacheslav P; Stolyarova, Alla N; Aleksina, Svetlana B	2019	EurAsian Journal of BioSciences	(Kosareva et al., 2019)
47	Thun, Sylvi; Kamsvåg, Pål F; Kløve, Birgit; Seim, Eva A; Torvatn, Hans Y	2019	Nordic Journal of Working Life Studies	(Thun et al., 2019)
48	Phusavat, Kongkiti; Hidayanto, Achmad Nizar; Kess, Pekka; Kantola, Jussi	2019	Journal of Workplace Learning	(Phusavat et al., 2019)
49	Hafeez, Khalid; Alghatas, Fathalla M; Foroudi, Pantea; Nguyen, Bang; Gupta, Suraksha	2019	Information Technology and People	(Hafeez et al., 2019)
50	Kar, Arpan Kumar; et all; Ilavarasan, Vigneswara; Gupta, M. P.; Janssen, Marijn; Kothari, Ravi	2019	Information Systems Frontiers	(Kar et al., 2019)
51	Kar, Arpan Kumar; et all; Ilavarasan, Vigneswara; Gupta, M. P.; Janssen, Marijn; Kothari, Ravi	2019	Information Systems Frontiers	(Kar et al., 2019)
52	Mygal, Valeriy; Mygal, Galyna	2019	Information & Security: An International Journal	(Mygal & Mygal, 2019)
53	Kurniawati, Amelia; Wiratmadja, Iwan Inrawan; Sunaryo, Indryati; Ari Samadhi, T M A	2019	2019 IEEE 6th International Conference on Industrial Engineering and Applications, ICIEA 2019	(A. Kurniawati et al., 2019)
54	Parida, Vinit; Sjödin, David; Reim, Wiebke	2019	Sustainability (Switzerland)	(Parida et al., 2019a)
55	Parida, Vinit; Sjödin, David; Reim, Wiebke	2019	Sustainability (Switzerland)	(Parida et al., 2019a)
56	Sivarajah, Uthayasankar; Irani, Zahir; Gupta, Suraksha; Mahroof, Kamran	2019	Industrial Marketing Management	(Sivarajah et al., 2020)

57	Etter, Michael; Fieseler, Christian; Whelan, Glen	2019	Journal of Business Ethics	(Etter et al., 2019)
58	Shpak, Nestor; Odrekhivskyi, Mykola; Doroshkevych, Kateryna; Sroka, Włodzimierz	2019	Social Sciences	(Shpak et al., 2019)
59	Ahl, Amanda; Goto, Mika; Yarime, Masaru	2019	Sustainability Science	(Ahl et al., 2019)
60	Mart, Alejandro; Aguayo-gonz, Francisco	2019	Sustainability (Switzerland)	(Mart & Aguayo-gonz, 2019)
61	Ávila-Gutiérrez, María Jesús; Martín-Gómez, Alejandro; Aguayo-González, Francisco; Córdoba-Roldán, Antonio	2019	Sustainability (Switzerland)	(Mart & Aguayo-gonz, 2019)
62	Ukko, Juhani; Nasiri, Mina; Saunila, Minna; Rantala, Tero	2019	Journal of Cleaner Production	(Ukko et al., 2019)
63	Russel, Kory C; Hughes, Kelvin; Roach, Mary; Auerbach, David; Foote, Andrew; Kramer, Sasha; Briceño, Raúl	2019	Frontiers in Environmental Science	(Russel et al., 2019)
64	Case, Thomas; Dick, Geoffrey; Granger, Mary J; Akbulut, Asli Y	2019	Journal of Information Systems Education	(Case et al., 2019)
65	D Anguí-Sánchez J Sotelo-González, F Cabezuelo-Lorenzo	2019	Revista Latina de Comunicación Social	(D Anguí-Sánchez J Sotelo-González, 2019)
66	Pencarelli, Tonino	2019	Information Technology and Tourism	(Pencarelli, 2019)
67	Gbadegeshin, Saheed A	2019	Technology Innovation Management Review	(Gbadegeshin, 2019)
68	Ruohomaa, Heikki; Salminen, Vesa; Kunttu, Iivari	2019	Technology Innovation Management Review	(Ruohomaa et al., 2019)
69	Vial, Gregory	2019	Journal of Strategic Information Systems	(Vial, 2019)
70	Chronéer, Diana; Ståhlbröst, Anna; Habibipour, Abdolrasoul	2019	Technology Innovation Management Review	(Chronéer et al., 2019)
71	Gil-Gomez,	2020	Economic Research-	(Gil-Gomez

	Hermenegildo; Guerola-Navarro, Vicente; Oltra-Badenes, Raul; Lozano-Quilis, José Antonio; All, Gil-Gomez; et		Ekonomska Istrazivanja	et al., 2020)
72	Sivarajah, Uthayasankar; Irani, Zahir; Gupta, Suraksha; Mahroof, Kamran	2020	Industrial Marketing Management	(Sivarajah et al., 2020)
73	Kurniawati, Elya; Idris, Idris; Handayati, Puji; Osman, Sharina	2021	Entrepreneurship and Sustainability Issues	(E. Kurniawati et al., 2021)
74	Esses, Diána; Csete, Mária Szalmáné; Németh, Bálint	2021	Sustainability (Switzerland)	(Esses et al., 2021)
75	Pînzaru, Florina; Dima, Alina Mihaela; Zbuchea, Alexandra; Vereş, Zoltan	2022	Amfiteatru Economic	(Pînzaru et al., 2022)
76	Bashynska, Iryna; Mukhamejanuly, Sabit; Malynovska, Yuliia; Bortnikova, Maryana; Saiensus, Mariia; Malynovskyy, Yuriy	2023	Sustainability (Switzerland)	(Bashynska et al., 2023)
77	Chatzistamoulou, Nikos	2023	Ecological Economics	(Chatzistamoulou, 2023)
78	Mujianto, Mujianto; Hartoyo, Hartoyo; Nurmalina, Rita; Yusuf, Eva Z.	2023	Sustainability (Switzerland)	(Mujianto et al., 2023)
79	Lin, Boqiang; Xie, Yongjing	2024	Environmental Impact Assessment Review	(Lin & Xie, 2024)
80	Huang, Guangyu; Shen, Liqiong	2024	Sustainability (Switzerland)	(Huang & Shen, 2024)
81	Tilley, Alexander; Dam Lam, Rodolfo; Lozano Lazo, Denise; Dos Reis Lopes, Joctan; Freitas Da Costa, Dede; De Fátima Belo, Maria; Da Silva, Joaquina; Da Cruz, Gilberto; Rossignoli, Cristiano	2024	Environmental Science and Policy	(Tilley et al., 2024)

The cluster nodes of the selected journal articles can be seen in Table 2. Where the second, content analyses using NVIVO Pro 12

software was conducted. Cluster analysis with Jaccard's likelihood index was carried out to find the relationship between the two main nodes of digital transformation and sustainability as well as themes relationship clusters using Jaccard's coefficient index. The Jaccard's coefficient index score had to be above 0.75 of Jaccard's likelihood index. Thus, 13 theme clusters were obtained, which correlated to the main nodes of digital transformation and sustainability. The relationship's main nodes are shown in Table 3 and Figure 1. On the other hand, the relationship between the main nodes to theme clusters is presented in Table 3 and Figure 2.

Table 2. Selected Journal Articles

No	Database Source	Studies Found	Studies Selected
1	Scopus	50	38
2	Proquest	136	44

Table 3. Main Nodes Relationship Index

Main Nodes	Digital Transformation	Sustainability
Digital Transformation		0.98
Sustainability	0.98	

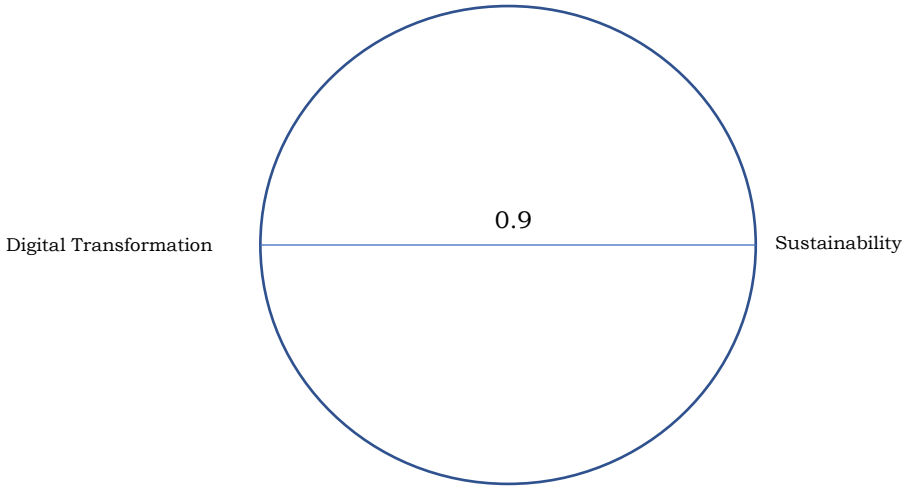


Figure 1. Relationship Between the Two Main Nodes based on Jaccard's Coefficient

Table 3. Most Discussed Issues of the Main Nodes

Main Node	Indicators
Digital Transformation	- Digital Innovation - Digital Services - Digital Economy - Digital Platform - Digital Disruption - Digital Business Model - Digital Capabilities - Business Model Transformation - Digital Transformation Model - Radical Transformation - Smart Technologies

	- Innovative System - Innovation Process - Transformation Process - Value Co-creation Process - Data Science - Business Model Innovation - Innovation Services - Business Innovation - Business Sustainability Model - Business Agility - Smart Product - Sustainability Impacts - Ideation
Sustainability	- Sustainable Practice - Sustainability Impacts - Sustainable Value Creation - Sustainable Development Goals - Social Sustainability - Sustainable Value - Technological Innovation - Technological Advancement - Disruptive Technologies - Digital Technologies - Digital Platform - Digital Innovation - Business Model Innovation - Sustainable Business Model

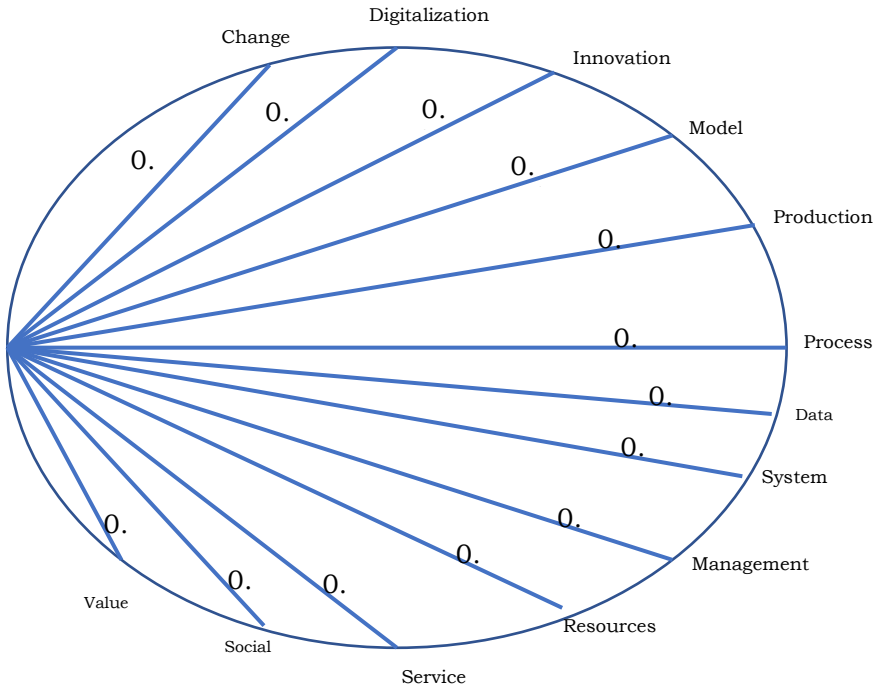
Table 4. Relationship Between Main Nodes of Sustainability (a) and Between 13 Theme Clusters Found, and Digital Transformation (b) Using Jaccard's Coefficient Index

No	Theme Clusters	Sustainability Main Node (a)	Digital Transformation Main Node (b)	Related Indicators
1	Data	0.91	0.92	- Data Sharing - Data Science - Data Actors
2	Digitalization	0.91	0.92	- Digital Innovation - Digital Platform - Digital Economy - Digital Business Model - Digital Capabilities - Digital Involvement - Digital Literacy - Digital Divide - Digital Collective
3	Process	0.89	0.91	- Co-Creation Process

				- Decision Making Process - Digitalization Process - Innovation Process - Process Eco-Innovation - Socio-Technical Process - Value Co-Creation Process
4	System	0.89	0.91	- Cyber-Physical System - Social System
5	Change	0.88	0.89	- Climate Change - Change Management - Changing Business Model - Social Change - Rapid Changes - Disruptive Change - Cultural Change
6	Model	0.83	0.85	- Business Model Innovation - Circular Business Model - Digital Business Model - Disruptive Business Model - Platform Business Model
7	Value	0.83	0.82	- Value Chain - Value Creation Process - Value Co-Creation - Social Value
8	Production	0.82	0.83	- Autonomous Production - Circular Products - Connected Products - Product Innovation
9	Management	0.82	0.83	- Change Management - Digital Innovation

				Management - Innovation Management - Dynamic Capabilities - Management Process
10	Service	0.8	0.82	- Digital Services - Service Innovation - Modern Service Economy - Digital Service Business
11	Social	0.79	0.8	- Social Impact - Social Values - Social Capital - Social Innovation - Social Value Creation - Well-Being
12	Resource	0.77	0.79	- Economic Resources - Psychological Resources - Sharing Resources - Cultural Resources
13	Innovation	0.76	0.77	- Digital Innovation - Business Model Innovation - Disruptive Innovation - Innovation Management - Service Innovation - Adaptive Capability Innovation - Innovation Practices - Collaborative Innovation - Open Innovation

Digital


Digitalization
Change
Innovation
Model
Production
Process
Data
System
Management
Resources
Service
Social
Value
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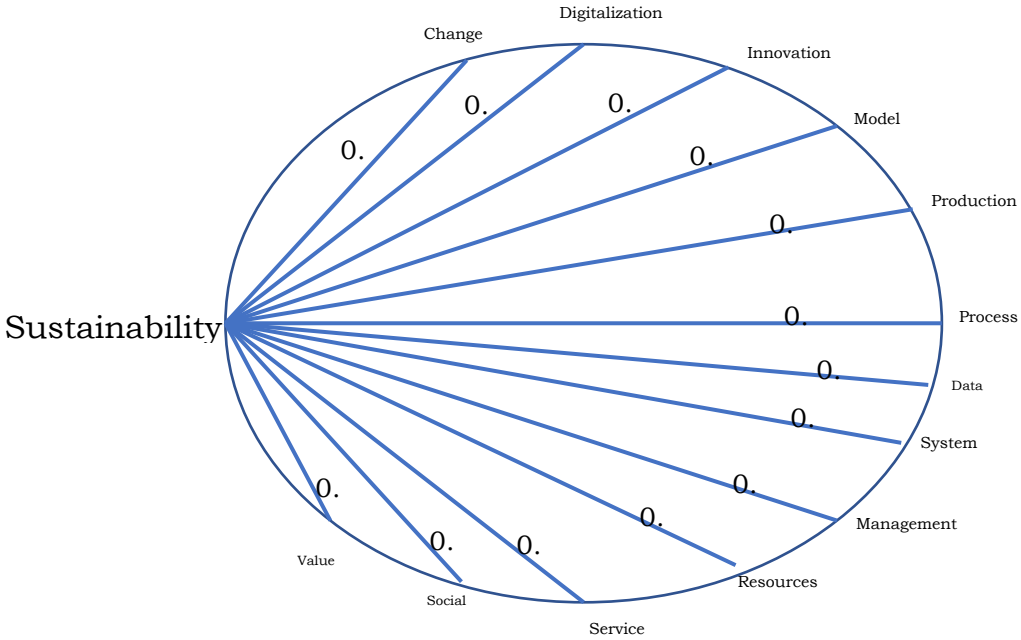

Figure 2. Relation Between the Main Nodes and 13 Themes Clusters based on Jaccard's Coefficient Index

Proven by this study, a link between Digital Transformation and sustainability did exist. Jaccard's coefficient index score between the two main nodes was 0.98 out of the 1.00. Moreover, the study's content analysis using NVIVO software showed a strong similarity between DT and sustainability. While as for the most discussed themes related to DT and Sustainability can be seen in Table 4.

Digital Transformation and sustainability did co-relate to one another. It could be seen by the relationship among stakeholder within the supply chain that included all the actors such as companies, government, policies, even the end-user under one single platform (Savastano, 2019; D Anguí-Sánchez, F Cabezuelo-Lorenzo, 2019; Parida, Sjödin and Reim, 2019). The use of digital technology can increase the result of dynamic capability where the stakeholders in a co-creation process have created an innovative innovation process also a value co-creation among stakeholders (Djap, 2019; Pencarelli, 2019). The value co-creation is found in the supply-chain process, whereby it can be applied for its traceability, production and delivery activities from corresponding actors across the suppliers, intermediaries, up to the end-user. This traceability process will closely monitor the sustainability practice from the number of production material resources consumed, whether within the sustainability threshold or not, to create intimate interaction between suppliers and end-users. These activities will lead to a more sustainable company financial performance.

The theme indicators related to the sustainability node according to the Jaccard's coefficient score achieved were 0.91 for the "*data*" theme as the highest relation, and "*innovation*" theme with the score of 0.76 as the lowest relation. While for the Digital Transformation node, it

did relate to "*data*" and "*digitalization*" theme as the Jaccard's coefficient score was 0.92, which was the highest relation, and the "*innovation*" theme was the lowest with Jaccard's coefficient score of 0.77.

According to Pappas (2018), data in sustainability and Digital Transformation is highly regarded as the central role to the success of sustainability and digital transformation. One of the identified indicators is data actor, which is considered part of the company resources other than process and technology to achieve company competitive advantage (I. O. ; et all Pappas, 2018). Pappas (2018) also noted that the role of data actor is important for creating a data-driven culture where the decision is made not based on instinct but based on the insight of data analytics.

The decision-making process based on big data and data analysis is called data science (Kar, 2019). Other than data actor and data science, it is important for companies or organizations willing to share their data to all of the stakeholders and the supply chain, which includes the end-users as value delivery is their responsibility in preserving the environment in their sustainability practice (Beier, 2018; Beier, Niehoff and Xue, 2018)(Beier et al., 2018). Therefore, the role of data in data collection, storage, and retraction will involve all stakeholders' interaction that means humans and organizations will play an important role within the process.

As shown in Table 3, the digitalization effort is the effort of transforming the physical works into the cyber world. This initiative provides the model of Digital Transformaion and Sustainability that can hire and cooperate, organize, engage in digital transformation activities to utilize big data, along with to create a more sustainable community (Beier, 2018).

The "*process*" theme related to Digital Transformation and sustainability is important since the Digital Transformation process requires manual digitalization into the cyber world or often called physical to the cyber world. For instance, the manual calculation works will be replaced by sensors and artificial intelligence, where the decision-making process will be based on situational conditions (Bifulco, 2017). In conclusion, Digital Transformation will impact sustainability practice since raw material will be optimal, and company financial performance will be achieved.

The DTS efforts cannot be separated from the value creation efforts of all stakeholders within the supply chain. Since DTS will create openness and transparency through big data collected from all activities within the supply chain, it will create a consensus between all stakeholders as a value co-creation that will benefit all actors in sustainability efforts (I. O. ; et all Pappas, 2018).

Despite the benefits of digital transformation to company sustainability, the company must also be aware that the digital environment is not error-free. Therefore, an early risk plan must be planned, and human resources with competencies to operate the

operation process must also be considered (El-Haddadeh, 2019; Kovacs, 2019).

"*Change*" is also one of the important themes in Digital Transformation and sustainability since "*change*" will affect not only one or two actors but also the fundamental change from the cultural change up to change of management. The digital transformation era will continuously change and find a new way for better sustainability in economic, social, and environmental performance that potentially creates a disruptive situation to the existing operation (Schlüter and Sommerhoff, 2017; Savastano, 2019; Kettunen and Mäkitalo, 2019).

The "*model*" theme covers the business model related to DT and sustainability topics. It must create a new business model that can adapt and comply with the Digital Transformation environment. In a new business model, dynamic capabilities to adapt and connect all the actors within the supply chain to the digital world will be needed. This new business model can become a business model platform or another disruptive business model that changes stakeholders' interaction. To conclude, this new way of business will impact company sustainability performance (Garcia-Muiña, 2018; Yang, Shanshan, 2018; David-West, 2018).

The "*product*" theme surrounding DT and sustainability can be explained by how DT and sustainability have changed the product's essence. The new mindset in the Digital Transformation era, where products that are currently owned by the customer are no more fully the company's business. It was found that companies try to monitor the customers' owned products constantly. Despite the company's purpose of monitoring the pre-owned product, it is useful for predictive maintenance and product enhancement and the better customer experience in the future (Pappas, 2018; Türkeli and Schophuizen, 2019). Therefore, DT will lead the company into a circular product economy that ultimately supports its sustainability performance.

At the "*service*" theme, the DT world data collected from big data operation will eventually create a situation where data will work as valuable resources for the company's competitive advantage and support sustainability goals. Therefore, this data will be considered as a service or called a digital service to the organization (I. O.; et all Pappas, 2018).

The "*resource*" theme discusses the importance of resources, including the economic capital resource, as a resource to achieve a competitive advantage by utilizing any means of new digital technology (Parida et al., 2019b). Therefore, one of the important issues in this particular theme is the psychological resource as an important resource because creative thinking will work hand in hand with digital technology through innovation to deal with uncertainty (Kwon, 2018).

"*Innovation*" theme had the weakest score of 0.77 for sustainability and 0.77 for Digital Transformation. Although innovation is among the lowest score of the identified 13-theme, it still in an acceptable score range of above 0.75. Innovation can be considered as

the orientation toward digital transformation and sustainability since innovation requires the collaboration of all actors, from the company, NGO, customers, government, and all stakeholders to form a collaborative innovation through the use of digital technology towards a sustainable innovation (All, 2019).

CONCLUSION

As the conclusion of this study, DTS are co relate and have a high influence to one another. Dynamic capabilities, collaboration, engagement, and cooperation between actors are indeed important indicators for Digital Transformation and the sustainability process. Also, the 13 themes related to DTS place the human factor as an important role in the Digital transformation process for sustainability performance and can be studied further where this themes may be proven as antecedents of the DTS. This literature review study also found the fact that Resource Base View theory as the basic theory for DTS through the company's resources and capabilities will support the competitive advantage efforts. This competitive advantage includes dynamic capabilities, psychological resources, entrepreneurial capabilities, as well as cultural transformation.

Regarding the limitation of this study, the study does require a wider range of journal articles beyond the Scopus and ProQuest database. Despite the limitation of this study, it opens research opportunities for further study that will emphasize human actors' roles, including its psychological, well-being, entrepreneurship, and human capabilities to support Digital Transformation transition and sustainability performance.

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