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永續發展導向提升數位轉型意願：通過數位協作以建立相對優勢

Sustainability Orientation Enhances Digital Transformation Intention in Shipping Operators: Through Digital Collaboration and Building Relative Advantage

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摘要

本研究建立概念性研究架構並且實證評估永續發展導向、利用數位化協作以提升海運經營業者的相對優勢。使用結構化問卷收集臺灣 146 家海運港口運營商、航運公司、航運代理和承攬運送業的數據，並使用驗證性因素分析(CFA)確定永續發展導向、數位化協作、相對優勢的主要構面，以提升海運業者的數位轉型意願。透過結構方程模型(SEM)來檢驗研究假設。我們確認，永續發展導向對於數位化協作有顯著正向影響，這又有助於提高組織在數位化轉型中的相對優勢和意願。最後本研究討論了理論貢獻和管理意涵，希望有助於海運相關業者的數位轉型。

關鍵字：永續導向、數位化協作、相對優勢、數位轉型意願

Abstract

This paper presents a study utilizing a conceptual framework empirically to evaluate the advantages which can be obtained by developing an orientation towards sustainability, using new opportunities to collaborate digitally, and attempting to transform maritime operations. This study used a structured questionnaire to gather data from 146 shipping operators including port operators, shipping companies, shipping agencies, and shipping

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forwarders in Taiwan, and used a confirmatory factor analysis (CFA) to identify the main dimensions of sustainability orientation, digital collaboration, relative advantage, and digital transformation intention in these organizations. A structural equation model (SEM) was then used to test the study's research hypotheses. We confirm that sustainability orientation and digital collaboration had a positive impact on relative advantage. Moreover, digital collaboration and relative advantage had a positive impact on shipping organization's intention to undergo digital transformation. Theoretical contributions and managerial implications are presented to help maritime operators to transform their digital operations.

Keywords: Sustainability orientation, Digital collaboration, Relative advantage, Digital transformation intention

1. INTRODUCTION

Over the years, the concept of sustainable development has become increasingly important and attracted more attention from scholars and practitioners (Gaziulusoy et al., 2013). Shippers are eager to get faster, more streamlined and transparent logistics services. Improvements in the shipping logistics are set up can play an important role in establishing greater economic sustainability (Evangelista et al., 2010; Anttonen et al., 2013). In response to the requirements of relevant stakeholders and the current global call for sustainability, companies are being required to adjust their strategic orientation, resource allocation and capacity development (Roxas and Coetzer, 2012). Therefore, developing a sustainability orientation can be seen as the result of the pressure imposed by the institutional environment on the operation of the enterprise, which causes the enterprise to consider both environmental protection and social welfare in addition to economic efficiency considerations.

Today, we are experiencing a new wave of digitalization as a convergence in digital technology (i.e. the Internet of Things, big data, cloud computing, blockchain development, and artificial intelligence) (Legner et al., 2017). The amount of data generation, sharing, storage, and analysis

grows exponentially every year. We are moving towards a digital ecosystem that include the digitalization of processes, organizations and industries. This phenomenon is being termed the fourth industrial revolution, and all industries are facing challenges to upgrade and transform their operations (Kayikci, 2018). Enterprises are being confronted with higher requirements for automation, intelligence, and the efficiency of their transportation, logistics, warehousing and loading/unloading operations. As a result, companies have adopted proposals to explore and implement new digital technologies (Matt et al., 2015).

The shipping industry has huge digital potential, especially in the business and technology sectors (Lambrou et al., 2019). For example, Maersk Tankers launched a new digital business (i.e. SimBunker). This digital business factors in speed and shipping routes to reduce carbon dioxide emissions, reduce fuel costs and optimize ship revenue. Through the application of 5G, unmanned ships can collect a large amount of data and instantly communicate that data to other ships, to the infrastructure of an organization and to other facilities. Sharing information can help maintain the safety and security of the maritime shipping logistics because of 5G's high-speed and low latency combined with artificial intelligence, cloud computing and automation control technologies (Wróbel et al., 2020; Balci, 2021). Digital technology can help all sectors (such as energy, transportation, and industry) to decarbonize at an unprecedented and faster speed, and promote a circular economy involving increased sharing, can improve the efficient use of resources and energy, and can help organizations monitor and conserve the ecological environment in which they operate (Mercader-Moyano and Esquivias, 2020). Digital transformation makes it possible for organizations to develop intelligent, customized and flexible production/service, and to optimize transportation, warehousing, and customs clearance operations (Gruchmann et al., 2020; Tijan et al., 2021). Despite all the benefits, there is a lack of research to investigate how shipping operators are committed to sustainable development, leveraging digital technologies to collaborate, and reap the relative benefits and advantages to invest in digital transformation. The purpose of this study is to investigate the sustainability orientation and digital collaboration of maritime shipping operators under the

megatrends of sustainable development and digital technology application, and the possible challenges that shipping operators are concerned about in the process of digital transformation. Such research would help us identify seemingly important relationships and provide guidance to shipping operators to develop a sustainability orientation and digitalization practices.

The conceptual model of this study is shown in Figure 1. The study is organized as follows: The first section provides an overview of this study, research questions and objectives. The second section reviews the research in sustainability orientation, digital collaboration, digital transformation, and lays out six research hypotheses. The third section introduces the research methods used in the research, including sampling, measurement and methods of analysis. The fourth section presents the results of the study. The fifth section presents the study's findings and discusses their implications for maritime shipping. Finally, the limitations of the study with regard to further research is discussed.

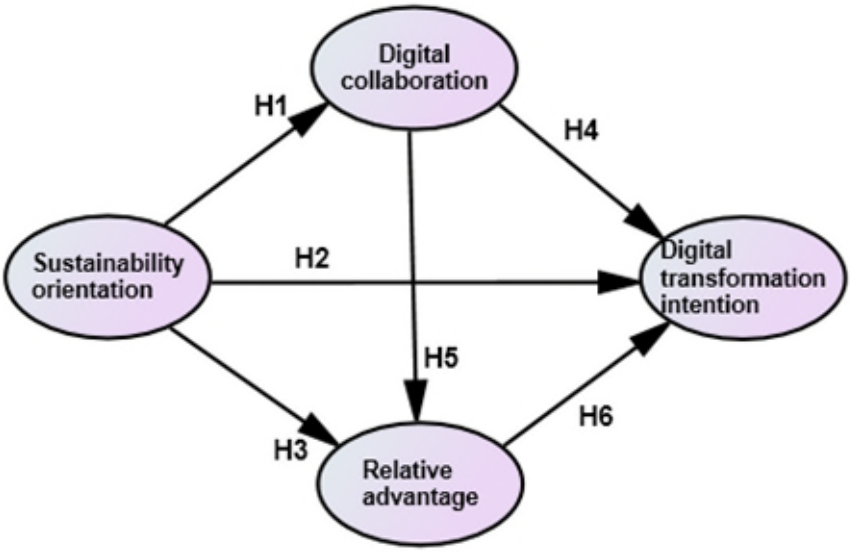


Figure 1 The conceptual model

2. LITERATURE REVIEW

2.1 Institutional theory

Institutional theory asserts that organizations must conform to institutional norms to gain legitimacy, so the institutional environment affects organizational behavior, which in turn leads to isomorphism among organizations (Boon et al., 2009). An Institution is a set of norms that are taken for granted and followed in an organizational environment, exerting external pressure on companies to guide how to understand reality, regulate appropriate behavior, and guide how to succeed (DiMaggio and Powell, 1983; Scott, 1987). Organizations will be considered legitimate when they act in accordance with the system and exhibit expect and appropriate behavior. Survival and development is possible because it realizes and maintains its legitimacy among its stakeholders (Krell et al., 2016). Due to the increasingly far-reaching influence of enterprises on the economy, society and the environment, their drive for continuous growth and profit has caused global changes. The sustainability orientation of enterprises has also become a widely accepted social responsibility of enterprises (Roxas and Coetzer, 2012). In 2015, the United Nations formulated 17 core sustainable development goals (SDGs) and their sub-indexes (Hák et al., 2016). Therefore, sustainable development has become a global common goal. The implementation of these SDGs is set to run from 2016 to 2030. The United Nations hopes to enable governments, businesses and organizations of all countries to work together to contribute to sustainable development. The maritime logistics industry must comply with international conventions such as the United Nations, the European Union, and IMO, especially the requirements of today's sustainable initiatives. Therefore, the sustainability orientation, operation behavior and practice of maritime logistics industry must also comply with relevant regulatory, normative and cognitive standards. It not only obtains legitimacy in the institutional environment, but also makes its operation strategy low-risk and stable, and has gained the support of the public and investors.

2.2 Sustainability orientation

An orientation towards sustainability is defined as the relative degree of a company's commitment to, and participation in, intra/inter organizational activities to ensure that multiple organizational functions are

aligned with one another to advance better efficiency and corporate governance, provide more environmentally friendly service processes, and contribute to the development and well-being of society (Vătămănescu et al., 2017; Silva et al., 2019). By strengthening corporate governance, independent committees of audit, nomination, budget, and compensation can be set up on the board of directors to strengthen the functions of the board of directors and protect the company's business integrity for stakeholders. In terms of social sustainability, in the 1970s, in addition to taking corporate health and safety responsibilities for employees at work into consideration (Gimenez et al., 2012; Sancha et al., 2016; Haleem et al., 2017), people realized the importance of corporate ethics and social responsibility.

The Global Reporting Initiative (GRI) is a non-profit international organization that develops global universal sustainability reporting standards. Its fourth generation (G4) guidelines, issued in May 2013, are designed to establish globally recognized sustainability reporting guidelines. A specific reporting requirement for the logistics and transportation industry was developed in 2006, with guidance on the transparent disclosure of economic, environmental and social indicators (Piecyk and Björklund, 2015). As a result, tens of thousands of companies have published corporate sustainability reports to demonstrate management performance as part of their efforts to improve their external image and to use these reports as a tool for communicating with stakeholders. Of course, this creates pressure on related players in a shipping logistics supply chain, all of whom are pressured to show their sustainability orientation and that they are keeping up with this trend. Establishing and maintaining corporate legitimacy is important because the success and survival of a company depends on its relationships with different stakeholder groups and the resources they provide (Hahn and Lülfs, 2014).

Shipping logistics partners can work together as volunteers, providing services to disadvantaged groups and social welfare agencies, participating in and giving back to society. With regard to environmental sustainability, a company can consider energy and resource management issues as challenges and opportunities for the company, and include them in the company's

strategic goals for improving environmental protection, and pollution and waste reduction (Roehrich et al., 2017). The importance of sustainability is increasing as a major driver of innovation (Nidumolu et al., 2009; Adams et al., 2012). In recent years many companies are moving towards "digitalization" in response to rapid developments in science and technology, environmental issues, the need for social responsibility, increases in corporate governance regulations and the gradual expansion of the scope of many businesses (Messerli et al., 2019). Today, especially in the business environment, it is necessary to meet the expectations of both internal and external stakeholders, including suppliers, customers and the public (Denktas-Sakar and Karatas-Cetin, 2012). Organizations are using innovative technology to change existing business or operating models in order to create value and sustainable business advantages (Clark et al., 2015) by creating closer interactions between customers and partners and thereby improving the processes of shipping logistics (Parviainen et al., 2017).

Because digitalization has broken the boundaries of companies and made more resources available through network collaboration (Lusch and Nambisan 2015), therefore, digital collaboration on the web has become a driving force for value creation (Bharadwaj et al., 2013). Sabbagh et al. (2012) confirmed that digitalization has a significant impact on the economy (i.e., growth in GDP per capita, job creation and innovation). In addition, as a country transitions to a more advanced stage, the economic impact of digitalization is accelerating. In terms of social impact, increasing digitalization has greatly promoted the social well-being of developed economies. As countries become more digital, many social well-being aspects (i.e. health and education and overall living standards) are improving. In terms of governance, higher levels of digitalization can make governance more transparent, increase participation, and increase a government's ability to disseminate information. Overall, analysis by Sabbagh et al. (2012) shows that digitalization and collaboration clearly has a positive impact on economic development, social well-being, and government efficiency and governance. Therefore, companies with an orientation towards sustainability can build relative advantages and deepen digital transformation through digital collaboration. Thus, it is postulated that:

H1: Sustainability orientation is positively associated with digital collaboration in the shipping context

H2: Sustainability orientation is positively associated with intentions to engage in digital transformation in the shipping context

H3: Sustainability orientation is positively associated with relative advantage in the shipping context

2.3 Digital collaboration

In an era of disruptive innovation and digital technology, industry boundaries are gradually blurred, and the vertical and horizontal interoperability of enterprises become a focus of concern and shipping logistics collaboration becomes a key consideration. The development of technological innovation accelerates digitalization. Digitalization has been described as a manifold sociotechnical phenomenon involving the use of digital technologies for connecting individuals, systems, organizations, products and services, and societal contexts (Coreynen et al., 2017; Legner et al., 2017). In the digital environment, companies realize that they need to participate in network collaboration and create value with digitally connected partner companies (Koch and Windsperger, 2017), so the capacity of digital collaboration has become increasingly important (Verhoef et al., 2019). Digital collaboration differs from traditional collaboration in that it connects a wider range of participants through a digital network platform. Almost all participants can keep up with change, communicate instantly, contribute their wisdom and skills, and find solutions together (Abrams et al., 2003). A company's ability to digital collaboration with relevant parties in the supply chain network not only helps the company to greatly stimulate value creation (McIntyre and Srinivasan, 2017), but is also a critical ingredient in efforts to undertake digital transformation (Verhoef et al., 2019).

Closely connected networks of members can use collective intelligence to cultivate social relationships that promote knowledge and skill sharing and collaboration, such as the establishment of internal and external social capital connections based on expectations and trust (Coleman, 1988; Putnam, 2000). With the support of digitalization, traditional industries have collaborated and

reconfigured, and realized new business opportunities that exceed the goals of any single organization (Adner, 2006). Digital collaboration requires the development of digital platforms, tools, and media infrastructures to be used by employees and supply chain partners to find solutions, locate resources and take advantage of new opportunities for providing better logistical services. For example, at the end of 2018, shipping operators including Evergreen Group, Yang Ming Marine Transport Corporation, COSCO Shipping Lines, CMA CGM S.A., Shanghai International Port Group, Orient Overseas Container Line, Hutchison Port Group, Singapore International Port Group, Dubai Global Port Group, and Cargo Smart, a digital software solution provider, signed a letter of intent to build a global shipping blockchain business network (Balci and Surucu-Balci, 2021). Through online digital collaboration, multi-party ecological partners will be able to communicate and collaborate efficiently. A permanent online social co-creation organization has been established by this group of companies. It is their expectation that by using the most advanced technologies of the era, such as artificial intelligence, the Internet of Things, big data and cloud computing, they will be able to use digital means to transform their processes of collaboration.

With the expansion of internal operation interoperability in the shipping industry and the development of in-depth collaboration with external alliances, carriers' business strategies will gradually evolve from being relatively isolated standardized maritime services into a more comprehensive, customized full-service logistical system. Digitalization permeates all aspects of life (economic, social and environmental), creating new ways for communication and collaboration and benefiting from the advantages which ensue. The heavy use of digital devices and our growing reliance on digital devices clearly demonstrates that the expansion of digitalization is a contemporary need and that this phenomenon has great potential for changing socio-economic growth, and thereby forming a symbiotic relationship with sustainable development (Bhutani and Paliwal, 2015). Digital strategies affect economic, environmental and social issues (Aksin-Sivrikaya and Bhattacharya, 2017). Digital collaboration has become an important tool that simplifies the functions and processes in various fields such as management, and the implementation

of regulations, planning and operations in the socio-economic field, thereby ultimately enriching the quality of life. Thus, it is postulated that:

H4: Digital collaboration is positively associated with relative advantage in the shipping context

H5: Digital collaboration is positively associated with intentions to engage in digital transformation in the shipping context

2.4 Relative advantage

Overall, the shipping industry today appears to be well suited for a reorientation to the establishment of sustainable operations. Compared with traditional logistics operations, the digitalization of maritime shipping logistics is likely to result in three relative advantages (i.e. increased resource efficiency, reduced pollution and waste, and better health and safety logistics). Therefore, we define the relative advantage of maritime supply chain digitalization as having the potential to help economic efficiency, social development, and environmental friendliness. Research consistently finds that a perception of relative advantage has a positive effect on users' intentions to use the system (Cheung et al., 2007). For example, due to the requirements of the IMO 2020 sulphur fuel cape and the advancement of technology, ships will use low-sulphur fuel oil, clean-burning LNG fuel, or install desulfurizer “scrubbers”, which will produce better environmental performance and improve sustainability. Providing high efficiency and better environmental performance through high levels of digitalization and connectivity is a strong support for this trend. The advantages of pursuing a policy of sustainability will also increase the intention of shipping operators to adopt new technologies and drive transformation. Thus, we postulate that:

H6: Relative advantage is positively associated with efforts to engage in digital transformation in the shipping context

2.5 Digital transformation

At present, many inefficient operations and processes still exist in international trade, and this situation continues to happen. The basic documentation of world trade operations such as letters of credit and bills of lading have not changed much. Nevertheless, the pace of scientific

publishing related to digital transformation is getting faster and faster, mainly focusing on digital technology or other relative issues, usually in the medical, transportation, education, retail, manufacturing, smart cities or public services fields and in government affairs (Parviainen et al., 2017). However, published reports related to digital transformation is still scarce in the field of maritime shipping logistics. To discuss an organization's intention to engage in digital transformation, we refer to Parviainen et al. (2017), and define "digital transformation" as: in order to adapt to business changes and market demands, companies abandon outdated practices and integrate digital technology into all areas of the operating environment inside and outside the organization to create new or adjust existing business processes, corporate culture, and customer experience, leading to the way companies operate and the value it provides to customers has changed radically.

Digital transformation involves the interoperability of digital technologies in all areas of a business, and requires the realization of digitalization capabilities to support the transformation of the business model of the entire organization, especially where that transformation affects operating processes, resources, the organization's stakeholders, and in all aspects of human society within the organization. This requires a major change in habits and working methods, and is dependent on collaboration and in-depth interaction (Henriette et al., 2015). Digital innovations in the fields of artificial intelligence, blockchain, the Internet of Things and big data are rapidly revealing their potential application in maritime logistics. They can help create new business opportunities and optimize logistics processes (UNCTAD, 2019). Digital transformation requires the interoperability and application of multidisciplinary knowledge, which is highly dependent on collaboration (Heilig et al., 2017). Since the maritime industry often involves cross-border transportation, transporting goods from an owner to a customer requires going through numerous links and many data exchanges. In the process, a lot of manpower and material resources are consumed, and a great amount of effort is made to ensure the accuracy and timeliness of data interaction, which increases transaction costs. The International Maritime Organization has developed its vision for a digital information environment for transportation. In particular, the EU has been very active in promoting

various initiatives (Lind et al., 2018) to create a new generation of people-oriented, safe, healthy, and environmentally friendly, smart, green systems of shipping logistics.

3. METHODOLOGY

3.1 Sample

The study's target sample was comprised of maritime port corporations, shipping companies, shipping agencies, and shipping forwarders engaged in shipping operations in Taiwan. A questionnaire was issued to 502 respondents. Initial issuance elicited 92 usable responses. A follow-up release was made 4 weeks later, and another 54 valid questionnaires were received. As a result, 146 valid questionnaires were collected, accounting for 29.1% of the target sample.

3.2 Measures

The measures of sustainability orientation, digital collaboration, relative advantages, and digital transformation intention in this study were drawn from relevant studies (Appendix A). In order to ensure validity, we met with the president of a shipping company, the chairman of a shipping agency, a shipping forwarder and a senior researcher of the Taiwan International Port Corporation to discuss ways to improve the design of the questionnaire. These interviews led to minor changes to the wording of some questions and to the examples provided in some measurement items. After modification, the validity of the content was confirmed and the tool was sent to the respondents in the main sample for data collection. Appendix A list the final measurement items. Respondents answered all questions using a 5-point Likert scale from 1 = totally disagree to 5 = fully agree.

3.3 Data analysis methods

First, descriptive statistics, exploratory factor analysis, and item total correlation analysis were used to summarize the sustainability orientation, digital collaboration, relative advantages, digital transformation intention attributes into smaller, more manageable sets of potential factors or dimensions. A confirmatory factor analysis was used to examine unidimensionality, convergent validity, discriminant validity, and construct reliability. A structural equation modelling

approach was subsequently used to test the research hypotheses. All analyses were carried out using the SPSS 20.0 for Windows and AMOS 20.0 statistical packages.

4. ANALYSIS AND RESULTS

4.1 Respondent profile

Table 1 lists the characteristics of the questionnaire respondents and the companies to whom the study's questionnaire were sent. The figures reveal that the participants comprised vice presidents and those with higher positions (38.4%), managers and assistant managers (28.8%), directors and vice directors (28.8%), and sales representatives (4.0%). Overall, senior managers are shown to play the most important role in anchoring sustainability-oriented strategies and have the most influence in collaborative decision-making processes related to supply chain partners. Senior managers have the most influence because the beliefs, attitudes, intentions, and prejudices of a company's owners and senior managers largely determine their company's strategic position, direction and operation. More than 95% of the responses in this study came from individuals at the director/vice director level or above, which supports the reliability of the findings. As shown in Table 1, most respondents represented shipping forwarders (46.5%) and shipping companies (19.9%). The main departments represented by the respondents were management departments (46.6%) and sales department (23.2%), followed by operation departments (19.9%). Regarding respondent seniority, more than 90 per cent of the respondents (92.5%) had more than 5 years' experience in their companies.

Table 1 Profile of respondents (n=146)

Characteristics of respondents		Frequency	%
Job title	Vice president or above	56	38.4
	Manager/assistant manager	42	28.8
	Director/vice director	42	28.8
	Sales representative	6	4.0
Department	Operation	29	19.9
	Management	68	46.6

	Human resources	15	10.3
	Sales	34	23.2
Seniority	Less than 5 years	11	7.5
	6-10 years	43	29.4
	11-15 years	19	13.0
	16-20 years	14	9.6
	More than 20 years	59	40.5
Company category	Port corporation	15	10.3
	Shipping company	29	19.9
	Shipping agency	34	23.3
	Shipping forwarders	68	46.5
Ownership	Local firm	118	80.8
	Foreign-local firm	10	6.9
	Foreign-owned firm	18	12.3
Numbers of employee	Less than 100	102	69.9
	101 - 300	11	7.5
	301 - 500	9	6.2
	Over 500	24	16.4

4.2 Instrument reliability and validity

To examine the unidimensionality of the measurement items, a confirmatory factor analysis (CFA) was conducted using AMOS 20 software. Table 2 and Table 3 present the CFA factor loadings. The average variance extracted (AVE) values for all constructs were higher than 0.50 (Fornell and Larcker, 1981). The results revealed acceptable fit according to the following model fit indices: chi-square / degrees of freedom = 2.219, p = 0.000, comparative fit index = 0.963 (a value exceeding 0.90 indicates that the research model has reasonably good fit (Hu and Bentler, 1999), root mean square residual = 0.027 (a value of 0.05 or lower indicates an acceptable model (Byrne, 1998).

In this study, CFA was used to obtain convergent and discriminant validity. Convergent validity can be tested using significant t-values for factor loadings (Dunn et al., 1994). In Table 2, all factor loadings of the model in this study are greater than 0.50 and the CR is greater than 1.96, thus meeting the requirements of convergent validity. In Table 3, the AVE for each construct was greater than the level of correlation squared involving each construct (Segars and Grover, 1998), thus confirming discriminant validity.

Table 2 Results of confirmatory factor analysis

Latent variables	Unstandardized factor loading	Completely standardized factor loading	Standard error[a]	Critical ratio[b]
ξ1: Sustainability orientation (SO)				
SO1	1.000	.772	--[c]	--
SO2	1.177	.944	.092	12.801***
SO3	1.181	.947	.092	12.824***
η1: Digital collaboration (DC)				
DC1	1.000	.904	--[c]	--
DC2	.995	.905	.072	13.917***
DC3	.826	.677	.088	9.352***
η2: Relative advantage (RA)				
RA1	1.000	.925	--[c]	--
RA2	.933	.858	.059	15.770***
RA3	1.005	.950	.050	20.254***
η3: Digital transformation intention (DTI)				
DTI1	1.000	.924	--[c]	--
DTI2	1.000	.947	.050	19.981***
DTI3	.898	.856	.057	15.636***

Note: [a.] S.E. is an estimate of the standard error of the covariance; [b.] C.R. is the critical ratio obtained by dividing the estimate of the covariance by its standard error. ***Correlation is significant at the 0.001 level; [c.] Indicates a parameter fixed at 1.0 in the original solution.

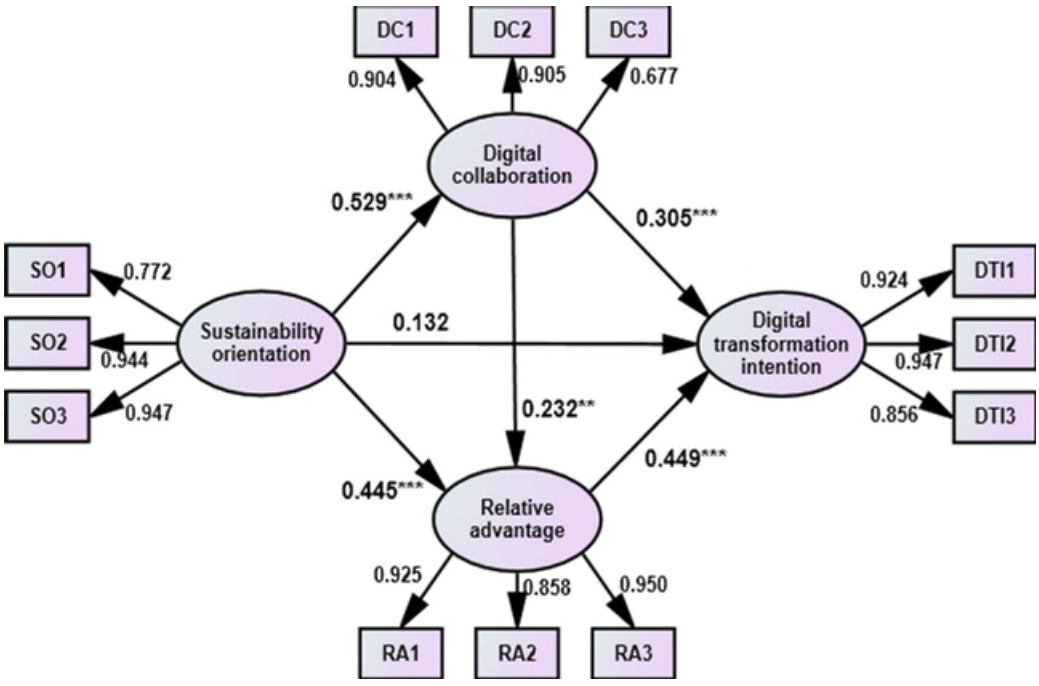
Table 3 Comparison of AVE and squared correlations

Construct	SO	DC	RA	DTI
SO	**0.795**			
DC	0.281	**0.698**		
RA	0.292	0.185	**0.831**	
DTI	0.270	0.270	0.384	**0.828**

Note: AVE are on the diagonal; square correlations are off-diagonal.

4.3 Hypotheses testing

The sustainability orientation, digital collaboration, relative advantage, and digital transformation intention variables were analyzed simultaneously in the structural equation model. The results of testing the hypotheses 1-6 are shown in Figure 2.



Note: **Correlation is significant at the 0.01 level; ***Correlation is significant at the 0.001 level.

Figure 2 Estimated structural equation model

Results indicated that sustainability orientation exerted a positive influence on both digital collaboration (H1, $\beta 1 = 0.529$, $p < 0.001$) and relative advantage (H3, $\beta 3 = 0.445$, $p < 0.001$). Digital collaboration had a positive influence on both digital transformation intention (H4, $\beta 4 = 0.305$, $p < 0.001$) and relative advantage (H5, $\beta 5 = 0.232$, $p < 0.01$). Relative advantage exerted a positive influence on digital transformation intention (H6, $\beta 6 = 0.449$, $p < 0.001$). However, sustainability orientation was not positively associated with digital transformation intention (H2, $\beta 2 = 0.132$, $p > 0.05$), therefore, (H2) was not supported in this study.

5. CONCLUSIONS AND IMPLICATIONS

This study analyzed sustainability orientation, digital collaboration, relative advantage, and digital transformation intention in a bundling conceptual model. This study empirically tests how these variables affect the intent of digital transformation, with the aim of assisting the maritime shipping logistics to be more environmentally friendly, more socially responsible and more efficient by means of innovative technologies and digital collaboration. We developed measures and conducted an exploratory analysis, a confirmatory analysis, and a structural equation modelling approach to test our hypotheses empirically. The findings indicated that sustainability orientation positively influences digital collaboration (H1) and relative advantage (H3), but is not positively associated with digital transformation intention (H2) in this study; digital collaboration positively influences digital transformation intention (H4) and relative advantage (H5); and relative advantage positively influences digital transformation intention (H6).

First, the research results show that the more shipping operators in Taiwan adopt a sustainability orientation the more they are willing to become involved in digital transformation. Second, the advantages of digital collaboration play a very important role in shaping shipping operators' digital transformation intention. In addition, an orientation towards sustainability can not directly increase the intention to take on the digital transformation, but it can indirectly increase the intention to become involved in digital transformation by digital collaboration and demonstrating sustainability-orientation's relative

advantages. Third, in this study, in addition to having a sustainability orientation, shipping operators must also be willing to involve themselves in digital collaboration if they wish to establish relative advantages over other companies. In the shipping industry, positive priority is given to sustainability orientation. This process begins with internal policies and digitally collaborates with supply chain partners on sustainable development practices to establish relative advantages. Therefore, the CEO and executive management team must set the tone for the entire organization when making sustainability orientation a priority in the company's business strategy. Leaders must communicate vision and execution, and on strategic priorities, unite employees and departments to turn sustainability orientation into practical business value for the economy, the environment, and society. Therefore, sustainability-oriented companies (for example, companies that incorporate ESG into strategic planning) think about the use of resources and make good use of technological tools as an assistant for companies to establish relative advantages, introduce digital collaboration, and then facilitate digital transformation.

Fourth, the research model also demonstrates the important effect that having a sustainability orientation has on digital transformation intention. In today's environment where science and technology are advancing by leaps and bounds, and stakeholders are increasingly demanding that development be sustainable, a company must work closely with supply partners to meet various challenges in a rapidly changing environment. Adopting a sustainability orientation is a pragmatic approach involving economic, social, and environmental elements. We believe that for global companies digital transformation will soon become necessary for survival, and can no longer just be an option.

6. LIMITATIONS AND FUTURE RESEARCH

This research was limited in certain respects and further research is needed in order to address these limitations. First, in this study, data collection was limited to Taiwanese shipping logistics-related operators. It is suggested that future research can use samples from other industries or different countries to verify the results. Second, another valuable direction for future

research may be to do more in-depth research of multiple ways to develop platforms, and education and training in digital collaboration, since it is so important to digital transformation intention. Third, our results do not imply that the model used in our research is the only effective model to promote the digital transformation of the maritime shipping logistics. It would also be helpful if additions to institutional theory could be made to examine whether coercive, normative, or mimetic approaches are more likely to convince organizations to develop orientations towards sustainability.

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APPENDIX A.

Construct measurements	Loading
Sustainability orientation (SO)	
(Mean=3.963, S.D.= 0.684, Cronbach α=0.913, CITC range=0.827~0.946)	
(Key references: Kuckertz and Wagner, 2010; Sung and Park, 2018; Shou et al., 2019)	
SO1. My company is always moving towards better efficiency and governance.	0.919
SO2. My company strives to provide customers with more environmentally friendly shipping logistics.	0.870
SO3. My company is committed to make greater contributions to the development and welfare of society.	0.772
Digital collaboration (DC)	
(Mean=3.943, S.D.= 0.862, Cronbach α=0.858, CITC range=0.636~0.801)	
(Key references: Orellana, 2017; Koch and Windsperger, 2017; Elia et al., 2020)	
DC1. My company collaborates with partners through digital platforms and tools.	0.864
DC2. My company leverages the collective intelligence in a digitally virtual way to streamline business processes, data collection and analysis.	0.883
DC3. My company works with partners in a digital virtual community to find solutions and take advantage of new opportunities.	0.774
Relative advantage (RA)	
(Mean=4.046 , S.D.= 0.714, Cronbach α=0.936, CITC range=0.891~0.936)	
(Key references: Meyer et al., 1997; Denis et al., 2002; Glover et al., 2014; Shou et al., 2019)	
RA1. My company makes energy and resource management more efficient compared to traditional shipping logistics operations.	0.884

RA2. My company reduces pollution emission and waste compared to traditional shipping logistics operations.	0.883
RA3. My company provides higher health and safety logistics processes compared to traditional shipping logistics operations.	0.912
Digital transformation intention (DTI)	
(Mean=3.630, S.D.= 0.835, Cronbach α=0.93, CITC range=0.887~0.932)	
(Key references: Venkatesh and Davis, 2000)	
DTI1. My company will adopt digital transformation.	0.947
DTI2. My company will work with shipping logistics partners to drive digital transformation.	0.952
DTI3. My company will try to make digital transformation a regular part of the work.	0.923