The effects of institutional pressures on shipping digital transformation in Taiwan

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Abstract

Purpose – The purpose of this study is to empirically evaluate the impact of coercive pressure, normative pressure and mimetic pressure on digital transformation and benefits in the maritime shipping context.

Design/methodology/approach – The authors collect data from a survey of 119 shipping companies, shipping agencies, port corporations and shipping forwarders in Taiwan and apply a structural equation model to test the research hypotheses.

Findings – Four conclusions can be drawn: First, digital transformation mainly results from coercive pressure and mimetic pressure. Second, another positive and important source of pressure for shipping digital transformation is the fact that competitors are gradually undergoing digital transformation and have gained recognition from customers. Third, shipping professional organizations and association (e.g. IACS, IAPH, Baltic International Maritime Commission) must keep up with the trend toward digital transformation and put forward guidelines and recommendations that can be followed in order to lead the maritime shipping industry. Fourth, digital transformation has great potential to help deliver the benefits (i.e. improve efficiency, relationship with customers and sustainability).

Originality/value – This research explores the digital transformation of the shipping industry through the lens of institutional theory. The results show that digital transformation is mainly due to coercive pressure and mimetic pressure. Digital transformation has been found to bring benefits that can help shipping operators allocate their resources effectively, thereby increasing operational efficiency, improving relationships with customers and enhancing sustainability.

Keywords Institutional pressures, Maritime shipping, Digital transformation

Paper type Research paper

1. Introduction

During the current prevention and control phase of the COVID-19 pandemic, shipping logistics plays a decisive role in ensuring the stability of the global transportation of medical and civilian products. Similarly, the epidemic has also acted as a "catalyst" for the shipping industry to upgrade to digitalization and transformation. Traditional maritime shipping operations mainly rely on telephone, fax and e-mail for manual booking and document delivery. It usually takes a lot of time and manpower. The process is cumbersome, the error rate is high, and the efficiency is low. Therefore, in the context of such a huge business volume in the maritime industry, special emphasis is placed on the collaborative decision-making (Lai *et al.*, 2020) and operation connectivity (Lin *et al.*, 2020) between supply chain partners. New digital technologies have not only brought opportunities to change the rules of the game, but

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have also led to threats to survival (Sebastian *et al.*, 2017). Stakeholders in the shipping value chain are increasingly asking their business partners to carry out digital operations. The supply chain can only survive with the goal of satisfying customers. These services all rely on digital technology applications and collaboration among supply chain partners. In the past two decades, with the growth of the global population, the popularization of e-commerce, the development of various digital technologies, and the threat of climate change on the Earth, the maritime industry has been in a key position to promote digital transformation (Heilig *et al.*, 2017). Digital transformation is a fundamental organizational change triggered and shaped by the widespread of digital technologies (Hanelt *et al.*, 2020; Hemerling *et al.*, 2018). Organization has the inertia to maintain the original system; however, external pressures are often the causes of organizational change (DiMaggio and Powell, 1983; Wedlin and Sahlin, 2017; Mergel *et al.*, 2019). These external pressures may come from the government, competitors, customers and nongovernmental organizations (DiMaggio and Powell, 1983). Maritime authorities, professional organizations and associations, classification societies, shipping companies, port corporations, shipping forwarders, and inland logistics companies have already carried out digital research and demonstration applications in shipping supply chain. Today, in compliance with international conventions, requirements of normative professional organizations, and customers' needs for faster and more streamlined shipping services, the shipping industry is facing tremendous pressures to improve efficiency, energy conservation, and sustainability.

In this research, "shipping digital transformation" is defined as the processes shipping-related companies use when investing in digital infrastructure and facilities, adopting digital technology applications, empowering talented digital personnel, and helping organizations meet customer needs. For example, they can share ship navigation and cargo delivery trajectories with customs in real time through the internet of Things, so that the goods can be quickly cleared and reduce the inventory of the cargo owner. The maturity and integration of these digital technologies and applications will have benefits for ship design and ship operations, including improving operational efficiency in an effort to gain a competitive advantage, enhancing safety, and energy savings and carbon reduction, thus protecting the marine environment more effectively and achieving UN sustainable development goals. Because once the leading companies in the shipping supply chain implement digital transformation, supply chain partners will be under pressure to upgrade digital infrastructure and facilities, software, and operations to maintain their collaborative relationships. In addition, professional associations and organizations related to the maritime shipping industry have increased normative pressure on the promotion of and guidelines for digital transformation, encouraging companies to abide by professional standards to gain the trust of customers and stakeholders. Meanwhile, faced with the uncertainty of the COVID-19 epidemic, as well as the demonstration effects of competitors' digital transformation, untransformed companies are facing tremendous mimetic pressure in the maritime shipping context. The perceptions of a company's decision makers related to this external situation will affect their evaluations depending on the source or strength of the pressure they are being subjected to (Zhu and Lin, 2019). Therefore, the external environment and institutional pressure may shape a company's digital transformation on the basis of institutional isomorphism (Hinings *et al.*, 2018).

This research is an attempt to reveal the external pressures (i.e. coercive pressure, normative pressure, and mimetic pressure) that affect implementation of digital transformation, as well as to provide a discussion of a firm's digital transformation practices and the resulting benefits from a maritime shipping perspective. In the maritime shipping context, this study defines coercive pressure as the pressure perceived by maritime shipping operators from the United Nations, European Union and IMO to promote digital transformation of shipping services. Normative pressure is defined as the pressure perceived by maritime shipping operators from professional associations such as the International Association of Classification Societies (IACS), the International Association of Ports and Harbors (IAPH), and the Baltic and International Maritime Council (BIMCO) to promote digital transformation of shipping services. Mimetic pressure is defined as the pressure perceived by maritime shipping operators from competitors have undergone digital transformation and thus have gained customer recognition and more competitive. Thus, this study draws on relevant literature in order to develop a research model (Figure 1) to test the effects of coercive, normative, and mimetic pressures on digital transformation and benefits. Section 2 explores the literature on institutional pressure and digital transformation, and four research hypotheses are proposed. The third part introduces the research methods. Section 4 introduces the results of the empirical analysis. Section 5 discusses the impact of the results on maritime shipping. Finally, the limitations of the study and suggestions for further research are provided.

2. Literature review and hypotheses

2.1 External pressures

Institutions, which include regulatory agencies, law firms, professional associations, interest groups, and competitors, put external pressures on companies that affect their decisions and choices (Oliver, 1991; DiMaggio and Powell, 1983; Scott, 1987). Companies not only have to face competition to improve efficiency, but more importantly, they must achieve and maintain their legitimacy among stakeholders in order to survive and develop. Institutional pressure from legal authority, norms, and uncertainty will both control and constrain organizational decisions and choices (Krell *et al.*, 2016; Greenwood *et al.*, 2011). Maritime shipping operators not only abide by legal requirements (such as international conventions of the United Nations, the European Union and the IMO) and conform to the operating standards of professional associations, but they also imitate the advanced successful strategies of competitors in order to conform to laws, gain professional recognition, and become competitive (Gosain, 2004). "In sociology, an isomorphism is a similarity of the processes or structure of one organization to those of another, be it the result of imitation or independent development under similar constraints" (Boselie *et al.*, 2009). The institutional isomorphism introduced by DiMaggio and Powell (1983) emphasized the crucial significance of coercive, mimetic and normative isomorphism in organizations to explain the significant similarities between organizational structures. They developed a theoretical approach to

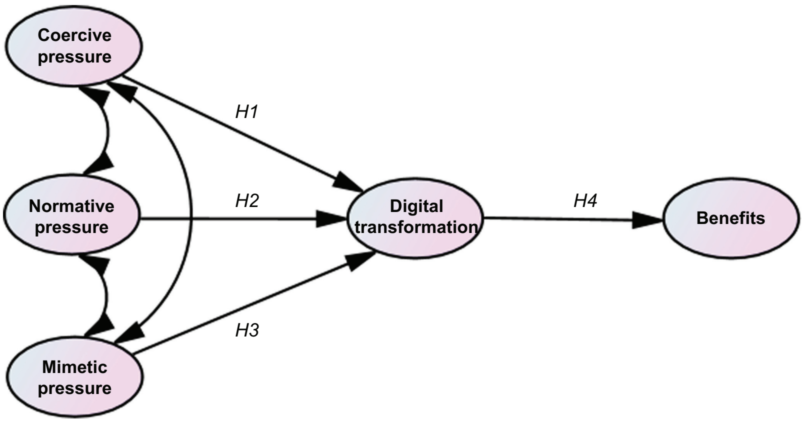


Figure 1.
Conceptual research model

identify three types of institutional pressures. Institutional theory is an important theory explaining the influence of external institutional forces on decision-making. It has been thoroughly discussed and verified in the field of social sciences (Gosain, 2004). Because of three institutional pressures related to coercion, normative, and mimetic isomorphic forces, companies are able to ensure legitimacy (Kolk and Perego, 2010; Martínez-Ferrero and García-Sánchez, 2017). Therefore, institutional pressures are different in nature and can be divided into coercion, normative, and mimetic pressures (Latif *et al.*, 2020). It is believed that coercive pressure mainly comes from political influence and an organization's need for legitimacy, such as implemented regulations or laws or dependence on other organizations. Normative pressure mainly comes from the common responsibilities and standards established in professional networks that are typically related to specialization and require organizations and their members to take actions to meet specific criteria. Mimetic pressure is a response to environmental uncertainty.

2.1.1 Coercive pressure. Coercive pressure comes from powerful regulatory agencies (Liang *et al.*, 2007) that require compliance. Specific enforcement mechanisms include, for example, international conventions or government regulations that use their influence to shape organizational behavior (Guler *et al.*, 2002). The UN, EU, and IMO supervise the maritime industry. They formulate rules and put forward requirements that companies must comply with because these organizations must comply legally and must adapt both socially and economically (Cordella and Tempini, 2015). In 2018, the United Nations published the "Transformations to achieve the Sustainable Development Goals," calling on the world to start transformation actions based on the United Nations "2030 Agenda for Sustainable Development." In 2019, "The Digital Revolution and Sustainable Development: Opportunities and Challenges" explored how the six key transformations can be accelerated digitally (Sachs *et al.*, 2019; ElMassah and Mohieldin, 2020). The Ministerial Conference of the United Nations OECD, UNCTAD and other international conferences have included digital transformation in the discussion and put forward recommendations to promote digital transformation.

"Digital transformation is the key to Europe's future prosperity and resilience. The European Commission has proposed the Digital Europe Programme, which is the European Union's plan to accelerate recovery and promote digital transformation in Europe" (European Commission, 2021). The European Parliament prioritizes digital transformation and strengthens Europe's capabilities in new digital technologies to achieve digital governance and public services, enhance people's digital skills, and create new opportunities for businesses and consumers (European Parliament, 2021). The EU actively invests in shaping the digital economy, from promoting digital investment to reforming EU laws, to improve the coordination and exchange of best practices among member states. A series of measures have been taken in the fields of digitalization of industry and public services, investment in digital infrastructure and services, research projects, cybersecurity, e-commerce, copyright and data protection legislation, etc., to ensure a sufficiently advanced regulatory framework (European Commission, 2019).

It is more important than ever to promote the digitalization of shipping. The shipping supply chain needs to realize the post-COVID recovery, strengthen the flexibility of the global supply chain, and realize the digitalization of trade and customs procedures. IMO is working hard to ensure the digital transformation of shipping-while ensuring safety, promoting environmental protection and managing cybersecurity risks. The collaboration among all relevant stakeholders in shipping, ports and logistics is important for promoting the digitalization of shipping, improving its efficiency and sustainability, and promoting trade and economic prosperity (Lim, 2020). For example, in order to ensure that the International Maritime Traffic Facilitation Convention (FAL Convention) remains up-to-date and relevant, since April 2019, the IMO Facilitation Committee (FAL Committee) has required a system for electronic information exchange between ships and ports (International Maritime Organization, 2019).

In response to the trend of digital transformation of the maritime industry, the Taiwan government and the state-owned Taiwan International Ports Corporation plan to introduce artificial intelligence, blockchain, Internet of Things, big data and other technologies to lead maritime industry services and innovations. Therefore, they proposed a project for Trans-SMART (Transform Sustainable, Modern and Advanced ports with Revolutionary Technology), a blueprint for the development of smart ports, with the vision of safety, efficiency, and sustainability. Looking to the future, the industry must be digitalized into a smart and efficient fleet. We therefore speculate that:

H1. Coercive pressure is positively related to digital transformation in the context of maritime shipping.

2.1.2 Normative pressure. Normative pressure comes from the specifications of professional organizations and associations (Krell *et al.*, 2016) as well as the appropriate behavioral standards established for relevant members of an industry (Berrone *et al.*, 2013) in order to carry out professional operations (DiMaggio and Powell, 1983). Because it is beneficial to be recognized as compliant with industry professional organizations (Krell *et al.*, 2016; Zhu, 2016), it also helps supply chain partners and stakeholders to become recognized as professionals and in turn improves the company's reputation (Oliver, 1991). Shipping professional associations and organization (such as IACS, IAPH, BIMCO, etc.) promote digital transformation and formulate relevant guidelines and recommendations, which will accelerate the digital transformation of the maritime shipping industry. For example, IACS is meeting the challenges of digital transformation of shipping and has launched multiple projects to help the industry adapt to the latest changes in markets, regulations and technology. This includes, first of all, that IACS has reviewed all relevant resolutions to determine which standards pose potential regulatory obstacles to autonomous ship operations. The second is that IACS has established an industry working group focused on cyber security to share the latest and best practices. Third, IACS is also reviewing and promoting the use of modern digital technology. Finally, IACS reviewed its internal procedures to ensure that the services provided by members keep up with regulatory developments and meet the highest quality standards. This will gradually transform IACS into a more advanced, more transparent, and more effective service to protect lives, property and the environment (Wee, 2018). The International Association of Ports and Harbors (IAPH) stated that due to the impact of COVID-19 in many countries around the world, ports and shippers are actively seeking uninterrupted operations. Therefore, in order to promote cooperation between stakeholders in the maritime supply chain and governments, it is necessary to accelerate digital port system to digitize all processes and increase resilience in the shipping industry (WPSP, 2020).

The establishment of a globally recognized electronic bill of lading standard is a crucial step for the successful digital transformation of the shipping industry. With the assistance of institutions such as the International Chamber of Commerce (ICC) and the Digital Container Shipping Association (DCSA), BIMCO has formulated a global electronic bill of lading (eBL) standard, and encourage regulatory agencies, banks, carriers and insurance companies to accept and adopt this standard (Jorgensen, 2021). In 2019, the Baltic International Maritime Commission (BIMCO) considered the threat of cyber-attacks (for example, Maersk was hit by the NotPetya malware in June 2017), and this clause deals with cybersecurity risk incidents that affect one of the parties' ability to fulfill their contractual obligations (Bryant, 2019), it is considered to be of great significance in the digital transformation era of the shipping industry. We therefore speculate that:

H2. Normative pressure is positively related to digital transformation in the context of maritime shipping.

2.1.3 Mimetic pressure. When companies face uncertainties associated with huge, long-term technical investments (e.g. digital transformation), they generally imitate the successful choices and behaviors of their competitors, who serve as role models (DiMaggio and Powell, 1983) for responses to uncertainty (Teo *et al.*, 2003), which may lead to mimetic isomorphic processes (Hinings *et al.*, 2018). The external competitive conditions faced by a company (e.g. the differentiation strategies of competitors, changes in customer preferences, etc.) affect the adoption of new technological innovations by logistics companies (Soosey and Hyland, 2004). Some companies have successfully developed the technical and management capabilities necessary to reap digital transformation benefits (Fitzgerald *et al.*, 2014).

In 2019, the Digital Container Shipping Association (DCSA), jointly established by the world's four largest container liner companies: Maersk, MSC, Hapag-Lloyd, and ONE. The DCSA sets technology standards and interoperability to achieve global collaboration intended to make shipping services easy to use, flexible, efficient, reliable, and environmentally friendly. According to a survey conducted by the Wärtsilä Marine Business, almost 70% of shipping companies are currently seeking digital solutions. Although the maritime industry lags behind in digital transformation due to its high complexity, it is also undergoing rapid progress. The integration of a variety of digital technology applications is optimizing the operation of the maritime shipping supply chain (Quitzau *et al.*, 2018; Papageorgiou, 2020). "Digital transformation is reinvigorating the shipping industry through new applications to streamline operations, customer experience, and efficiency" (Papageorgiou, 2020). Faced with the digitalization trend, environmental issues, customer demands for better logistics service, and the desire to remain competitive, especially when competitors have gained competitiveness due to digital transformation and have gained customer recognition and appreciation (Shim *et al.*, 2018), other players will tend to believe that imitation may lead to similar benefits. We therefore speculate that:

H3. Mimetic pressure is positively related to digital transformation in the context of maritime shipping.

2.2 Digital transformation and benefits

Although digital transformation has recently aroused extensive discussion, there is currently no consensus as to its definition (Osmundsen *et al.*, 2018). Researchers regard it as a strategy (Kane *et al.*, 2015), a process (Morakanyane *et al.*, 2017; Cichosz, 2018) or a business model (Henriette *et al.*, 2016), as well as a key driver of economic success (Gregor and Hevner, 2015). Today, digital transformation has evolved into a strategic transformation process that is not only in the IT field, but also includes digital infrastructure investment and digital technology application, digital talent training and empowerment, and changes in organizational structure to respond to digital operations. As digital technology matures, it gradually integrates blockchain, AI, big data, and IoT (Sebastian *et al.*, 2017; Ismail *et al.*, 2017) to improve business operations, decision-making, organizational structure, and the customer experience, which leads to the formation of a new business model (Ismail *et al.*, 2017). This model will support marketing and operations that initially relied solely on intuition and industry experience to complete work efficiently and effectively through digital feedback and insight analyses, and will also lead to adjustments in business models (Hess *et al.*, 2016; Henriette *et al.*, 2016).

Digital transformation is a change process based on digital technology that meets the needs of partners and customers in an unprecedented way in terms of business operations, business processes, and value creation (Liber *et al.*, 2016; Reinartz *et al.*, 2019). Through the automation, digitalization, customization, and transparency, a large number of activities and processes are seamlessly connected as the source of value creation. That is, effective application of digital connections and communications between partners in the value chain

(Nwankpa and Roumani, 2016), allowing customers to participate in the emerging digital innovation process (Aral and Weill, 2007), enhancing interaction and co-creating value added services (Reinartz *et al.*, 2019). For example, artificial intelligence (AI) can be used to analyze huge datasets, reduce the chance of error, make correct decisions more efficiently in a short time than has been possible in the past, and is highly reliable. Therefore, the adoption of AI technology in the shipping industry will assist in the completion of repetitive, time-consuming processes and predictive maintenance of ships, and the loading/unloading of equipment, thereby saving labor costs, improving efficiency, and increasing revenue. Digital transformation provides customers with real-time inquiries and quotations, space booking, customs clearance, and inland delivery services, which have reduced cost and increasing productivity (Mubarak *et al.*, 2019), improved logistics efficiency and competitiveness (Schwertner, 2017; Cichosz, 2018; Erceg and Damoska-Sekulowska, 2019; Cichosz *et al.*, 2020), improved business models (Berman and Marshall, 2014; Schallmo *et al.*, 2020), enhanced relationships with customers (Morakanyane *et al.*, 2017; Nowicka, 2020; Lima and Pacheco, 2021), and led to sustainable logistics and business performance (Lambrou *et al.*, 2019; Junge, 2019; Mubarak *et al.*, 2019) that surpass the traditional limitations. Thus, we propose that:

H4. Digital transformation is positively related to benefits in the context of maritime shipping.

3. Methodology

3.1 Sample

The service network of upstream, midstream, and downstream companies in the maritime shipping supply chain will form mutual collaboration and operating standards because of common goals. In order to effectively promote the digital transformation of the shipping industry, companies must be pressured to invest and accelerate the digital transformation of the entire industry. From the perspective of "supply chain," every participant in the shipping industry must be included in order to avoid disconnection of the shipping supply chain and improve visibility and collaboration. This study is aimed toward empirically testing the influences of institutional pressure on digital transformation in the shipping industry. A survey of shipping carriers, shipping agencies, shipping port corporations, and shipping freight forwarders engaged in maritime shipping in Taiwan was conducted. The Directory of the National Association of Chinese Shipowners (NACS), Members of the International Ocean Freight Forwarders and Logistics Association (IOFFLA) in Taiwan, and Taiwan International Ports Corporation (including 7 international commercial ports in Taiwan, namely port of Keelung, port of Kaohsiung, port of Taichung, port of Hualien, port of Taipei, port of Su'ao, and port of Anping) were used as surveyed sources for this study. The survey was conducted, by systematic sampling of NACS and IOFFLA, in the form of a return envelope, mailed to 503 respondents in 2020. Because 23 respondents left the company, or their company ceased to exist, the potential effective population size was reduced to 480. The total number of replies available was 119. Therefore, the overall response rate of the study was 24.8%.

3.2 Measures

In order to ensure validity, this research refers to previous scholarly research (see Appendix) and discussions with shipping experts. Therefore, coercive pressure, normative pressure, mimetic pressure, digital transformation, and benefit measurement items were modified from previous studies and the suggestions of shipping executives to improve the design of the questionnaire, which utilized a 5-point Likert scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*.

4. Analysis and results

4.1 Respondent profile

The author summarized the descriptive statistical characteristics of the respondents (Table 1). 90% of respondents were actually engaged in the company's business operations and decision-making (vice directors or above), so the survey results can be said to be reliable. Nearly 90% of the respondents had worked in the shipping industry for more than 5 years and thus had enough experience to complete the questionnaire, which also enhanced their confidence in answering. Comparison of differences in respondents' perceptions of DT1, DT2, and DT3 (see Appendix) based on different types of companies, analysis of variance (ANOVA) was performed. Results revealed no statistically significant differences ($F = 1.737$, $p = 0.080$) for port corporation, shipping company, shipping agency, and ocean freight forwarder at the 5% significance level. They have same perspective for the digital transformation.

4.2 Exploratory factor analysis (EFA) results

An exploratory factor analysis and a principal component analysis with a VARIMAX rotation were used to reduce three coercive pressure attributes, three normative pressure attributes, three mimetic pressure attributes, three digital transformation attributes, and three benefit attributes to the underlying factors. Appendix shows that all the constructs were reliable because the Cronbach alpha values were all greater than 0.7 (Nunnally, 1978), and the corrected item-total correlations (CITCs) were greater than 0.5 (Kerlinger, 1986). Based on the agreement levels of the respondents, the results indicated that operators in the maritime supply chain show a high degree of agreement with digital transformation (mean = 3.846) and its benefits (mean = 4.092) and they agreed with the degree of coercive, normative, and mimetic pressure, in that order.

Table 1.
Profile of respondents (n = 119)

Characteristics of respondents		Frequency	%
Job title	Vice president or above	51	42.9
	Manager/assistant manager	40	33.6
	Director/vice director	16	13.4
	Sales representative	12	10.1
Department	Operations	15	12.6
	Management	72	60.5
	Sales	21	17.6
	Information	11	9.3
Seniority	Less than 5 years	14	11.8
	6–10 years	19	15.9
	11–15 years	14	11.8
	16–20 years	12	10.1
	More than 20 years	60	50.4
Company category	Port corporation	21	17.6
	Shipping company	23	19.3
	Shipping agency	26	21.9
	Ocean freight forwarder	49	41.2
Ownership	Local firm	93	78.1
	Foreign-local firm	9	7.6
	Foreign-owned firm	17	14.3
Numbers of employee	Less than 100	75	63.0
	101–1,000	25	21.0
	More than 1,000	19	16.0

4.3 Instrument reliability and validity

The confirmatory factor analysis (CFA) was used to confirm that the latent variables and underlying items were consistent with the hypotheses based on theories or previous analytical research. Table 2 shows the results for the confirmatory factor analysis conducted using AMOS 18.0 to analyze model fits, followed by testing the validity and reliability. Several common indices including the chi-square/d.f. = 1.422, goodness of fit index (GFI) = 0.884, adjusted goodness of fit index (AGFI) = 0.832, comparative fit index (CFI) = 0.982, normed fit index (NFI) = 0.943, root mean square residual (RMR) = 0.040, and root mean square error of approximation (RMSEA) = 0.060 were adopted for the purpose of determining the model fits. Convergent validity was used to test whether the measure was able to represent what the construct was intended to. It examines whether latent variables can be well interpreted by their items. Average variance extracted (AVE) was calculated to analyze convergent validity, for which the threshold for the AVE should be above 0.5 (Fornell and Larcker, 1981). The results in Table 2 confirm convergent validity. In the contrast to convergent validity, discriminant validity is used to test whether two latent variables are uncorrelated. Discriminant validity is measured by observing a matrix composed of the square root of the AVE (in the diagonal of the correlation matrix) and the correlations between the latent variables (off-diagonal) (Segars and Grover, 1998). Diagonal values should be larger than the off-diagonal values in the corresponding rows and columns in order to show good discriminant validity. The results in Table 3 confirm discriminant validity.

Latent variables	Unstandardized factor loading	Completely standardized factor loading	Standard error[a]	Critical ratio[b]
ξ1: Coercive pressure				
CP1	1.000	0.956	–[c]	–
CP2	0.982	0.921	0.051	19.300***
CP3	0.952	0.908	0.052	18.332***
ξ2: Normative pressure				
NP1	1.000	0.977	–[c]	–
NP2	0.986	0.963	0.033	29.806***
NP3	0.988	0.972	0.031	31.991***
ξ3: Mimetic pressure				
MP1	1.088	0.936	–[c]	–
MP2	1.039	0.972	0.044	23.607***
MP3	0.961	0.972	0.046	23.573***
ξ4: Digital transformation				
DT1	1.000	0.685	–[c]	–
DT2	1.465	0.870	0.179	8.198***
DT3	1.356	0.850	0.168	8.074***
ξ5: Benefits				
BE1	1.000	0.855	–[c]	–
BE2	0.904	0.807	0.089	10.172***
BE3	0.968	0.880	0.087	11.181***

Note(s): [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
Fit indices: χ^2/d.f. = 1.422, p = 0.007, GFI = 0.884, AGFI = 0.832, CFI = 0.982, NFI = 0.943, IFI = 0.982, RMR = 0.040, RMSEA = 0.060

Table 2. Results of the confirmatory factor analysis

4.4 Hypotheses testing

The coercive pressure, normative pressure, mimetic pressure, digital transformation, and benefit variables were analyzed simultaneously in the structural equation model (the results in Table 4). Figure 2 presents the results for estimating the structural model. Hypothesis 1 (H1), Hypothesis 3 (H3), and Hypothesis 4 (H4) were significantly supported. However, normative pressure was not positively associated with digital transformation; therefore, Hypothesis 2 (H2) was not supported in this study.

Table 3. Comparison of the AVE and squared correlations

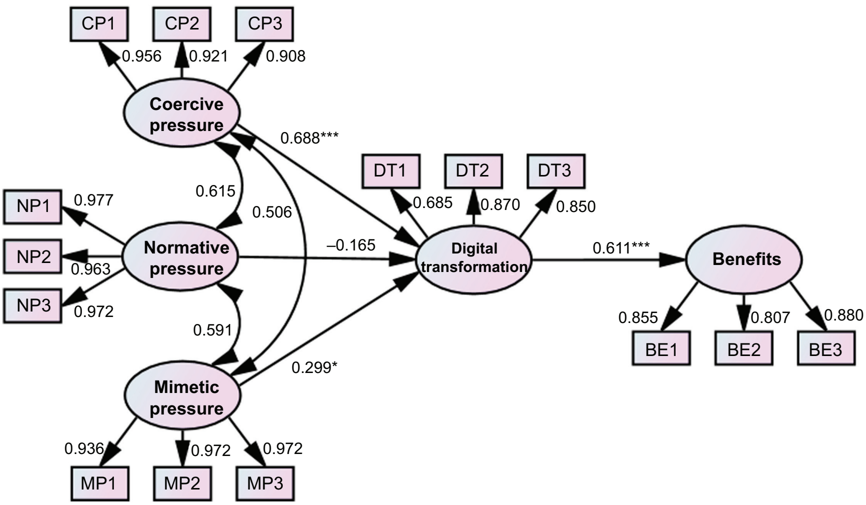
Construct	CP	NP	MP	DT	BE
CP	*0.862*				
NP	0.384	*0.942*			
MP	0.260	0.348	*0.922*		
DT	0.462	0.176	0.260	*0.650*	
BE	0.025	0.137	0.230	0.281	*0.719*

Note(s): AVE are on the diagonal; square correlations are off-diagonal

Table 4. Results (standardized) of hypotheses 1–4 tests using SEM

	Estimate (β)	p	Outcome
H1: Coercive pressure → Digital transformation	0.688 (β_1)	***	Supported
H2: Normative pressure → Digital transformation	−0.165 (β_2)	0.115	Not supported
H3: Mimetic pressure → Digital transformation	0.299 (β_3)	**	Supported
H4: Digital transformationi → Benefits	0.611 (β_4)	***	Supported

Note(s): *** significant at the 0.001 level; ** significant at the 0.01 level



Note(s): ***Correlation is significant at the 0.001 level; **Correlation is significant at the 0.01 level

Figure 2. Estimated structural equation model

5. Conclusion and discussion

In this study, through the lens of institutional theory, a coercive, normative, and mimetic pressure bundling model was constructed for the purpose of achieving maritime shipping digital transformation and in turn obtaining benefits. A structural equation modeling analysis was employed to test the research hypotheses. Four conclusions can be addressed that are worthy of discussion based on the empirical results. First, the results show that operators in the maritime shipping agreed that digital transformation mainly is due to coercive pressure (e.g. UN, EU, IMO) and mimetic pressure because the United Nations, the European Union and the International Maritime Organization attach great importance to international logistics. In addition, in order to promote the Sustainable Development Goals (SDG), the United Nations also vigorously advocates digital transformation. The European Union (EU) has also promoted digital transformation of the service industry to accelerate the free flow of human resources, services, and capital. The International Maritime Organization (IMO) urges maritime shipping operations and supervision to become digitized to improve efficiency, safety, and sustainability.

Second, another positive and important source of pressure for shipping digital transformation is the fact that competitors are gradually undergoing digital transformation and have gained recognition from customers. Maritime shipping operators generally agree that digital transformation will bring benefits (e.g. enhancing efficiency, improving relationships with customers, and improving sustainability). This is due to the fact that some leading companies who continue to undergo digital transformation have obtained good effects, thus enabling other companies to recognize the benefits of digital transformation and leading to pressure to imitate. Third, normative shipping professional organizations and association (e.g. IACS, IAPH, and BIMCO) must keep up with the trend toward digital transformation and put forward guidelines and recommendations that can be followed in order to lead the maritime shipping industry. Fourth, digital transformation has great potential to help deliver the benefits (i.e. improve efficiency, relationship with customers, and sustainability). Especially when the COVID-19 epidemic is raging, we need to harness the benefits of digital transformation for shipping. The positive correlation between digital transformation and benefits means that maritime operators can invest in digital infrastructure and facilities, adopt digital technology applications, and empower digital talents and organizations to obtain the benefits of transformation.

Overall, the results show that the perspective of institutional pressure provides meaningful insights into the digital transformation of the maritime shipping industry. In this regard, maritime shipping operators clearly agree that coercive pressure and mimetic pressure significantly affect digital transformation. However, it is necessary to strengthen the normative pressure of shipping professional organizations and associations in promoting digital transformation. Shipping professional organizations and associations need to face the trend of digital transformation as soon as possible, establish consistent technical and operational standards, digital transformation guidelines and recommendations, and even establish common platform services to guide the digital transformation process in order to provide customers with better shipping services.

6. Limitations and future research

Our results suggest that the institutional theory is an appropriate theoretical lens for addressing the development of digital transformation in a maritime shipping context. Although its objectives have been made clear and bring meaning into the booming field of digital transformation and the associated benefits, the author pointed out some limitations in the research process, which may be helpful to readers and guide future research. First, the conceptual model suggesting a link between institutional pressures, digital transformation, and benefits should also be applicable to other industries. It is necessary to check the robustness and generalizability of the model used in this work to other industries in order to verify the findings and compare the sources of the forces driving digital transformation in different industries. Secondly, our results do not mean that this is the only effective model that can be used to evaluate maritime shipping digital transformation although the hypothetical model and empirical results of this research provide meaningful management implications. Third, a static view was adopted in this research to study digital transformation in the maritime shipping industry and did not involve or predict the dynamic evolution of digital transformation. In the future, longitudinal methods can be used to test the conceptual model to lead to a better understanding of how to more effectively promote the development of digital transformation. Fourth, future research can do more in-depth study on how professional associations and organizations in the maritime industry promote digital transformation, and explore the difficulties they face and solutions. Lastly, the COVID-19 pandemic has also revealed the vulnerability of digitally immature organizations, and the world's major economies have been severely impacted, regardless of whether they are the real economy or the financial market, and it is recommended that follow-up studies can explore the impact of global pandemics and public health emergencies on digital transformation.

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Appendix

	Loading
Coercive pressure	
(Mean = 3.711, S.D. = 0.736, Cronbach α = 0.947, CITC range = 0.903–0.941)	
key references: Huo *et al.* (2013), Yang (2018), Zhu *et al.* (2013)	
CP1. United Nations promotes digital governance and operations	0.899
CP2. The European Union promotes digital transformation of service industries	0.894
CP3. The International Maritime Organization promotes the digitalization of shipping service	0.856
Normative pressure	
(Mean = 3.655, S.D. = 0.749, Cronbach α = 0.972, CITC range = 0.922–0.950)	
key references: Huo *et al.* (2013), Yang (2018), and Zhu *et al.* (2013)	
NP1. International Association of Classification Societies (IACS) guidelines and recommendations for digital transformation	0.884
NP2. International Association of Ports and Harbors (IAPH) guidelines and recommendations for digital transformation	0.883
NP3. The Baltic and International Maritime Council (BIMCO) guidelines and recommendations for digital transformation	0.897
Mimetic pressure	
(Mean = 3.563, S.D. = 0.801, Cronbach α = 0.*980,* CITC range = 0.951–0.962)	
Key references: Lambrou *et al.* (2019), Huo *et al.* (2013), Yang (2018), and Zhu *et al.* (2013)	
MP1. Our competitors have undergone digital transformation and thus have gained customer recognition	0.888
MP2. Our competitors have undergone digital transformation as a way to differentiate themselves	0.916
MP3. Our competitors have undergone digital transformation and are therefore more competitive	0.924
Digital transformation	
(Mean = 3.846, S.D. = 0.721, Cronbach α = 0.842, CITC range = 0.603–0.768)	
key references: Holmström and Partanen (2014), Schmidtke *et al.* (2018), Ustundag and Cevikcan (2017), Sebastian *et al.* (2017), Vey *et al.* (2017), Hemerling *et al.* (2018)	
DT1. My company invests in digital infrastructure and facilities for digital operation	0.870
DT2. My company adopts digital technology applications for digital operations	0.869
DT3. My company empowers talented personnel and organizations to achieve digital operation	0.772
Benefits	
(Mean = 4.092, S.D. = 0.615, Cronbach α = 0.0.881, CITC range = 0.725–0.813)	
key references: Kane *et al.* (2015), WEF (2016), Sebastian *et al.* (2017), Morakanyane *et al.* (2017), Kayikci (2018), and Lambrou *et al.* (2019), Papageorgiou (2020)	
BE1. Digital transformation helps my company improve its relationship with customers	0.861
BE2. Digital transformation helps my company improve efficiency	0.805
BE3. Digital transformation helps my company improve sustainability	0.919

Table A1. Construct measurement

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