

The effects of inter- and intraorganizational factors on the adoption of electronic booking systems in the maritime supply chain

Abstract

Digitalization is currently reshaping business models and providing more opportunities for cross-border supply chains. Maritime transportation occupies a crucial position in the global supply chain and information systems are playing an increasingly important role in the industry. In contrast with information systems used in other industries, interorganizational information systems in the maritime industry may involve a greater number of organizational users, including manufacturers, customers, shipping lines and customs and port authorities from different countries. Therefore, the adoption of container e-booking systems in the maritime supply chain is complex and with limited scrutiny in academia. This study explored the use of e-booking systems in the maritime supply chain and, in particular, the factors influencing the adoption of such systems at the organizational level. The study aimed to close the gap between the general understanding of the adoption of information systems and the adoption of e-booking systems in a specific context, namely the maritime supply chain. We conducted an exploratory multi-case study of eight firms across multiple tiers of the maritime supply chain. We employed a qualitative approach to investigate this issue at the maritime supply chain level, rather than the firm level. The study focused on inter- and intraorganizational factors. The results suggest that adoption is influenced by several factors, including pressure from trade partners, pressure from leading organizations, as well as organizational compatibility, and so forth. Furthermore, the identified factors have different levels of impact across organizational tiers in the shipping chain. This study offers insights that are relevant to both researchers and practitioners in the maritime transportation industry and may help to accelerate the digitalization of the industry.

Keywords:

E-booking systems; Information systems; Adoption; Maritime supply chain; Inter and intra-organizational factors.

1. Introduction

Technological advances enable enterprises to improve their efficiency and service quality (Gupta et al., 2020; Lacka et al., 2020). Having developed over several centuries, modern maritime transportation enables goods to be conveyed efficiently and at a low cost (Wang et al., 2020; Yang, 2019). It has long served as the main transportation method for international trade (United Nations Conference on Trade and Development [UNCTAD], 2019). Digitalization has transformed business and partnership models in many industries, including maritime transportation, by enabling improved information visibility, efficiency and performance (UNCTAD, 2019; Liu et al., 2020). The maritime industry is in the process of transitioning from the traditional freight logistics system to a digitalized logistics system (Orji et al., 2020). Digitalization can benefit shipping lines, forwarders, shippers, consignees, government offices and other organizations by allowing them to be more competitive (Yang, 2019). However, the maritime supply chain is still in the early stages of digitalization (Sanchez-Gonzalez et al., 2019; WTO, 2019). In addition to the digital platforms provided by leading organizations (e.g., Maersk Spot), an increasing number of tech start-ups are specializing in technological innovations that facilitate better communication and information sharing in the maritime supply chain (e.g., Flexport). Therefore, it is crucial for managers to better understand the

adoption of technological innovations in this context.

Maritime transportation involves cooperation between many organisations with diverse preferences, meaning that the interorganizational communication process is inevitably complex (Yuen and Thai, 2017; Zeng et al., 2020). Organizations in the supply chain employ different operations systems (Yuen and Thai, 2017), so the process of container booking is still largely manual. A large number of documents from different organizations need to be transferred for a single shipment, which leads to a high error rate and inefficiency (White, 2018). Electronic booking (e-booking) systems for container space improve interorganizational communication efficiency and increase information sharing. They allow multiple stakeholders, such as shippers, forwarders and shipping lines, to input booking-related information and share this information with other supply-chain partners.

Some industry pioneers have started to evaluate and test such systems. For instance, in 2020, Maersk proposed two new information systems: Maersk Spot and Maersk Flow. The former provides direct container e-booking services for forwarders and shippers (Maersk_a, 2020), whereas the latter enables the sharing of booking information (e.g., order status) and documents (Maersk_b, 2020). Though some of these pioneers, such as Maersk, have succeeded by gaining a high market share, the majority have failed or are struggling (e.g., Onetouch). The rate of adoption of such information and communication technologies (ICT) is relatively low (Harris et al., 2015). Low adoption rates are preventing organizations in the maritime supply chain from realizing the potential benefits of information systems (Acciaro and Sys, 2020). Thus, it is essential to investigate the factors that contribute to the adoption of technological innovations, including e-booking systems, by maritime industry stakeholders.

The maritime industry differs from other industries, such as retail. It involves a variety of stakeholders, including the supplier (known as the shipper), the buyer (known as the consignee) and logistics service providers (known as the shipping line/carrier, first-tier forwarder, second-tier forwarder and trucking service provider), as well as national authorities and international organizations such as the International Maritime Organization (Yang, 2019; Zeng et al., 2020). Therefore, there are, in relative terms, more constraints on operational activities between organizations in the maritime supply chain than other industries. However, previous studies on technological innovation concerning both general supply chain management and the maritime supply chain have mainly been conducted from the perspective of individual firms or firms with dyadic relationships (Harris et al., 2015; Mondragon et al., 2017). Few studies have been conducted at a chain level, with consideration of both up- and downstream supply chain partners. This study, thus, contributes to the literature by investigating the adoption of innovations at the supply chain level.

Moreover, the maritime industry is an oligopoly with a small number of organizations controlling the bulk of the market. For instance, the five largest shipping lines collectively hold around 53% of the overall market share, while the ten largest hold around 82% between them (Alphaliner, 2020). Given to the unique characteristics of this industry, it is essential to take this context into account when investigating the adoption of information systems in the maritime supply chain. Container booking is one of the core activities in the maritime shipping chain and involves many of the chain's key stakeholders; thus, we considered it an appropriate focus for our investigation of adoption behaviour in the maritime supply chain (Zeng et al., 2020).

Against this background, this research involved a qualitative study of the adoption of e-booking systems in the maritime supply chain, aiming to (a) understand the overall booking process used by the maritime industry and (b) identify the factors influencing the adoption of e-booking systems by different stakeholders on multiple tiers in the chain. Our study found that both inter- and intra-organizational factors are influential, including support from top management, compatibility and pressure from regulators, trading partners and leading firms. The results also showed that organizations both within the same tier and across multiple tiers express diverse preferences when considering whether to adopt an e-booking system. For instance, forwarders are under greater pressure from both shipping lines and customers regarding their decisions to use interorganizational information systems.

In terms of our contribution to the literature on innovation diffusion, we firstly contribute by offering a chain-level analysis that considered the main participants in the container shipping chain (i.e., the shipping line, two tiers of forwarders and various kinds of shippers). This research also sheds light on the adoption of information systems in the specific context of the maritime supply chain and, we hope, will contribute to increasing digitalisation in the industry. Finally, we validate the effects of essential inter- and intraorganizational factors on the adoption of information systems, which extends the existing body of knowledge in the area.

The rest of the paper is organized as follows. Section 2 describes the theoretical and empirical background of this study. Section 3 outlines the methodology of this research, including company selection, data collection and analysis. Section 4 presents the results of the study, including descriptions of the container booking process, the tools utilized and the inter- and intraorganizational factors affecting adoption. This is followed by a discussion of these results in Section 5 and the conclusion in Section 6.

2. Literature review: maritime transportation and technological innovation adoption

2.1 Maritime industry and container booking

Container transportation is established as the main channel for global distribution (Yang, 2019). However, recently, the growth rate of the maritime transport industry has declined slightly due to various factors, including trade tensions between China and the US, protectionism and economic transition in China (UNCTAD, 2019; Chan et al., 2019). Developments like the Belt and Road Initiative and new bilateral and regional trade agreements may help to offset the pressure on maritime trade (UNCTAD, 2019). Meanwhile, trends like Industrial 4.0, big data and electronic commerce (e-commerce) may also contribute to the growth of the container shipping industry (UNCTAD, 2016). New technologies enable the maritime industry to achieve greater efficiency and increased performance. However, digitalization in the field of logistics appears to be trailing behind other industries such as retail, travel and media (Sanchez-Gonzalez et al., 2019; WTO, 2019). Although still in their infancy, emerging technologies and collaborative platforms enabled by such technologies have begun to be adopted by the maritime industry. Start-ups like Flexport and FreightHub are transforming the traditional process of container booking (WTO, 2019). However, these tech start-ups are still in the early stages of development and some have already failed. For instance, Onetouch by Alibaba Group considered e-booking as one of its main business types, it turned out to be unsuccessful. One plausible reason might be the unique context and characteristics of maritime supply chain and container e-booking process. Therefore, it is of great significance to

explore the adoption of e-booking system in this context.

Efficiency remains one of the most pressing issues in the container booking process (Zeng et al., 2020). Maritime shipping involves many complex stakeholders and requires the exchange of a large number of documents, which can reduce efficiency (Lieber, 2017; White, 2018). As Van Baalen et al. (2009) pointed out, 40 different organizations might be involved and hundreds of documents exchanged when dealing with the shipment of a single container. In this study, we adapted the definition of the container booking process proposed by Zeng et al. (2020); they suggested that the process *'involves a series of activities from the initial request of booking a container, the release of container from shipping line and the loading of the container, to the arrival of the container in the port, and its release by the customs offices'*. Among the five types of stakeholders in the maritime supply chain (i.e., the shipping line, first-tier forwarder, second-tier forwarder, trading firm and manufacturer), only the shipping line and the organizations with which they communicate are likely to have a unified booking system. Enterprises in the chain employ a diverse range of internal information systems for bookings and such systems are not interconnected (Zeng et al., 2019). In terms of interorganizational communication and information sharing, the majority of organizations still use traditional communication tools such as e-mails, telephone and instant messengers such as Wechat and QQ (Zeng et al., 2019). Our investigation of the adoption of e-booking systems and other technological innovations may, thus, contribute to increased digitalization in the maritime supply chain.

2.2 Technological innovation adoption studies

Many studies have investigated the diffusion of technological innovations in supply chain management (Gillani et al., 2020; Harris et al., 2015; Mondragon et al., 2017; Yang, 2019; Yeh and Chen, 2018). Several intention-based theories (e.g., Diffusion of Innovation [DOI], institutional theory, the Technology Acceptance Model [TAM] and the Technology-Organisation-Environment [TOE] framework) have been used to investigate the factors influencing the adoption of a variety of information systems, including blockchain technology (Kouhizadeh et al., 2021; Orji et al., 2020), digital manufacturing (Yeh and Chen, 2018), cloud computing (Oliveira et al. 2014; Raut et al., 2018), e-business (Ilin et al., 2017), Radio Frequency Identification (RFID; Quetti et al., 2012; Tsai et al., 2010) and ICT (Mondragon et al., 2017). Studies have been conducted in diverse contexts, including both developed and developing countries (Lin, 2014; Orji et al., 2020; Wei et al., 2015) and have examined both manufacturing (Yeh and Chen, 2018) and logistics firms (Wei et al., 2015). Although these studies have provided a theoretical basis for understanding the adoption behaviours of organizations in supply chain management, the general factors they identify (e.g., organisational strategy, complexity) may not apply in specific contexts (Johns, 2006). For instance, Ilin et al. (2017) found that governments can encourage firms' adoption of e-business, whereas the study conducted by Kurnia et al (2015) found governmental support to be unimportant. Moreover, few studies have examined the adoption of information systems in the maritime supply chain (Woo et al., 2011). Thus, our empirical investigation of the adoption of information systems in the context of the maritime supply chain develops the theoretical understanding of the factors that influence adoption and extends the overall body of knowledge concerning the adoption of information systems.

One relevant perspective relates to inter- and intraorganizational factors at the firm level. First, intraorganizational factors, including firm size, top management support and organizational

structure, affect the adoption of technological innovations (Ilin et al., 2017; Lin, 2014; Orji et al., 2020). The DOI theory (Rogers, 1995) suggests that adoption is affected by the characteristics of the technological innovation itself, as well as organisational factors. This view has been validated by other studies (Ilin et al., 2017; Lin, 2014; Orji et al., 2020; Sun et al., 2020, Yeh and Chen, 2018). For instance, Ilin et al. (2017) identified support from senior management as a significant factor encouraging the adoption of e-business by organisations on the Western Balkan Peninsula.

Secondly, adoption is also affected by interorganizational factors. According to the Resource Dependence Theory (RDT), organizations do not survive in isolation; rather, they rely on other organizations (Pfeffer and Salancik, 1978). Moreover, the TOE framework (Depietro et al., 1990) postulates that organizations' intention to adopt a technological innovation is also influenced by their external environment. The TOE framework is generic and does not contain specific sub-constructs. This enables researchers to extend the framework by combining it with other theories (e.g., the TAM and institutional theory) and incorporating specific factors such as competitive pressure (Lin, 2014; Orji et al., 2020), support and pressure from trading partners (Nilashi et al., 2016) and government policy and regulation (Yeh and Chen, 2018). With some exceptions (Harris et al., 2015; Mondragon et al., 2018; Orji et al., 2020; Yang, 2019; Zeng et al., 2020), the adoption of innovation in the maritime supply chain has been sparsely investigated (Acciaro and Sys, 2020) and this study fills that gap by investigating the adoption of container e-booking systems in this context.

Innovation diffusion theories can be divided into individual- and firm-level theories, according to their unit of analysis (Oliveira and Martins, 2011). The theory of reasoned action (TRA), the theory of planned behaviour (TPB), the TAM and the unified theory of acceptance and use of technology (UTAUT) have been used in prior studies to investigate the adoption intention and actual use of information technology and information systems at the individual level, whereas DOI and TOE are two key theories used to examine and investigate behaviours at the firm level (Oliveira and Martins, 2011; Oliveira et al., 2014). These two theoretical streams have each been adapted in many studies (Autry et al., 2010; Bienstock et al., 2008; de Mattos and Laurindo, 2017; Lin, 2014; Quetti et al., 2012; Tsai et al., 2010; Wang et al., 2010). Researchers have also extended the streams by employing individual-level theories in firm-level diffusion studies or applying several theories in one study (Autry et al., 2010; Pu et al., 2020). For example, the TAM is a powerful model for understanding and predicting individual users' behaviour concerning information technology (Chau and Hu, 2001). However, some researchers have used the TAM to examine the adoption of innovation at a firm level. For instance, Autry et al. (2010) extended the TAM to investigate firm-level acceptance and adoption of supply chain technology. The authors argued that organizational decisions are, ultimately, made by individuals (i.e., senior executives). Further, the behaviours of an organization are determined by the behaviours of individuals within that organization. Therefore, individual-level theories and models can be applied in organizational settings (Staw, 1991).

This study considered the adoption of e-booking systems by organizations in the maritime shipping chain. However, we did not limit ourselves to any of the existing theories. Rather, this study was conducted inductively, with the existing theories and literature serving as the theoretical basis for the research.

Many prior studies have identified factors influencing adoption based on existing theories (Gillani

et al., 2020; Ilin et al., 2017; Kurnia et al., 2015). For instance, Kurnia et al. (2015) employed TOE as their overall framework and complemented it with DOI, RDT, institutional theory and Hofstede's national culture theory (Hofstede, 1983). The authors examined the factors influencing the adoption of e-commerce technologies in the Indonesian grocery industry.

Further, there are two streams of research concerning the diffusion of technological innovations: single-stage (including adoption) and multi-stage. Many prior studies have examined a single-stage diffusion of technological innovation (Orji et al., 2020; Wang et al., 2016; Yang, 2019; Zeng et al., 2020). However, the adoption of innovations is a longitudinal process (Rogers, 1995) and an adoption intention and adoption decision do not ensure the actual adoption (Wei et al., 2015). New uncertainties might appear concerning the use of innovations, such as the unwillingness of supply chain partners to invest and use an electronic data interchange (EDI) after its adoption by the initial organisation (Hart and Saunders, 1997) or resistance from end-users in an organisation (Chau and Hu, 2001). Therefore, recent studies have focused on the factors influencing post-adoption implementation. For instance, Wei et al. (2015) examined the factors affecting the post-adoption implementation of RFID in the Chinese manufacturing industry. In this study, we focused on the adoption stage, following several previous studies (Yang, 2019; Zeng et al., 2020), because the maritime industry is still in the early stages of adopting e-booking systems and there is not yet sufficient data from other stages of diffusion. Moreover, focussing our investigation on the adoption stage enabled us to provide insights to support decision-making by practitioners concerning the adoption of e-booking systems.

2.3 Studies on technological innovation adoption in the maritime supply chain

Research on technological innovation diffusion in the maritime supply chain is limited and fragmented (Harris et al., 2015; Orji et al., 2020; Mondragon et al., 2017; Yang, 2019; Zeng et al., 2020). Our review of the extant literature found that a few technological innovations have been investigated in recent years, including ICT (Harris et al., 2015; Mondragon et al., 2017), RFID (Ramanathan et al., 2014) and cloud computing (Durowoju et al., 2011; Subramanian et al., 2014). For instance, Harris et al. (2015) examined the barriers to ICT adoption in multimodal transport and the ways in which technological innovations (e.g., cloud computing and the Internet of Things) can help to overcome these barriers. The researchers reviewed 33 EU Framework Programme projects and classified the identified barriers into three groups: user-related barriers, technology-related barriers and policy-related barriers. Mondragon et al (2017) identified the core factors affecting the adoption of ICT in the context of multi-modal seaport terminals. The authors conducted a multi-case study of seven seaport terminals across two continents and found that both government legislation and the dominant organizations running the seaports influence the existence of ICT adoption policies, which may lead to the actual adoption of such technologies.

Previous studies have focused on different elements of adoption, with some paying more attention to the technological innovation itself and others investigating from a more comprehensive point of view, by considering factors other than innovation itself. For instance, Yang (2019) investigated adoption intentions concerning blockchain applications in the maritime supply chain. Based on the TAM, the author identified three technological factors influencing the intention to adopt blockchain applications: (a) customs clearance and management, (b) digitalisation and ease of paperwork, (c) standardisation and platform development. All these factors could be considered as related to the

functions of blockchain applications. Meanwhile, Orji et al. (2020) proposed a TOE-based framework of factors affecting the successful adoption of blockchain technologies in the freight logistics industry. Using the Analytic Network Process, the authors identified that the three most vital factors influencing adoption are the availability of specific blockchain tools, adequate infrastructure and government policy and support.

The increasing number of studies concerning technological innovation diffusion in maritime transportation illustrates that this is an emergent stream of research (Orji et al., 2020). Further, some maritime industry practitioners (e.g., Maersk, Flexport and YQNLINK) have also realized the essential role played by technological innovations and digitalization and started to take action; we expect that moving forward, an increasing number of innovations will be adopted. Hence, it is critical to investigate the adoption behaviour of organizations towards such innovations, including e-booking systems.

The unique characteristics of the maritime supply chain provide an opportunity to revisit the application of existing innovation diffusion theories and other relevant theories (e.g., RDT and institutional theory). Investigating the adoption of e-booking systems and other interorganizational information-sharing and communication systems in the context of the maritime supply chain enables the development of innovation diffusion theories specific to this context (Mondragon et al., 2017). As Woo et al. (2011) suggested, maritime transportation is still an emerging discipline, so there is limited literature exploring the diffusion of technological innovations in this context. According to a literature review conducted by Woo et al. (2011), among 840 papers between the 1980s and 2000s, only one applied theory related to innovation diffusion, which was TAM (Norzaidi et al., 2009). Further, only 3.3% of papers (i.e., 28 out of 840) employed an interview approach. Generalized theories have a limited application to the maritime supply chain, leading to a need for more diverse methodologies in this context (Mondragon et al., 2017). The qualitative research method employed in this study contributes to methodological diversity in the maritime transportation field, which advances the literature on innovation diffusion in this context.

This study inductively explored the inter- and intraorganizational factors influencing the adoption of container e-booking systems. Our review of the extant literature and theories played a crucial role in this research from two perspectives: (a) it provided theoretical guidance for our data collection and data analysis (Zeng et al., 2020) and (b) it validated the conclusions drawn from our data (Barratt et al., 2011).

3. Method

As discussed above, in this study, we investigated the adoption of container e-booking systems in the maritime supply chain, a topic which has not been comprehensively explored in previous studies. We conducted a qualitative multi-case study because research on organizational adoption of e-booking and other interorganizational information systems is limited and adoption in this context is complicated due to the involvement of multiple organizations from different tiers of the maritime supply chain (Liber, 2017; White, 2018; Yang, 2019; Zeng et al., 2020).

Of the several research methods available in qualitative research, a case study was employed in this study. Case studies enable the exploration of real-world practices, a topic that is currently understudied in the area of innovation adoption in supply chain management (Choi et al., 2016).

Case studies enable researchers to collect insightful data and explore the reasons why organizations make certain decisions (Yin, 2018). Case studies are a type of experiment that enables researchers to develop theories inductively (Eisenhardt and Graebner, 2007). In the business field, case study research uses empirical evidence from real people in real organizations to build on existing theory and knowledge (Myers, 2020).

We chose to perform a multi-case study as it enabled us to achieve more significant results and make a stronger contribution to the field (Kurnia et al., 2015). Another justification for the use of a multi-case study is that, as mentioned, the maritime supply chain is more complex than other industries as it involves many stakeholders from different tiers (Yang, 2019; Zeng et al., 2020); using a multi-case study allowed us to gather more comprehensive insights into organizations' behaviour. A semi-structured interview was used to collect data; as suggested by Myers (2020), we considered that the best way of discovering the truth was to talk to people. The interview protocol can be found in Appendix A.

3.1 Company selection and setting

This study examined eight organizations from multiple tiers of the maritime supply chain. One important criterion for our research was that we approached organizations from different tiers that had direct or indirect relationships (i.e., shipping lines, first-tier forwarders, second-tier forwarders and shippers), enabling us to achieve a more holistic understanding of the industry and the adoption of e-booking systems (Yang, 2019; Zeng et al., 2020). This differed from prior studies examining technological innovations in the maritime supply chain, which focused on individual parties, including shippers (Hsu et al., 2009; Lu et al., 2007), freight forwarders (Orji et al., 2020), and ports (Mondragon et al., 2017). Our decision to conduct this study at the system level was driven by the initial findings of our early interviews. At the outset of this research, we planned to interview only forwarders and shippers, but we discovered through our interviews that the decision to adopt an e-booking system is sometimes controlled by shipping lines. Thus, we tried to include such organizations in our sample.

The selection of organizations for a research project is always challenging (Mondragon et al., 2017). In this study, the firms were selected according to (a) their position in the maritime supply chain (i.e., shipping line, first- or second-tier forwarder or shipper) and (b) their accessibility, which was mainly based on our contacts and the recommendations of other interviewees. To arrive at a representative sample of enterprises in the container booking chain, we began by approaching organizations which are world leading shipping lines and forwarding firms. The lists are shown in Table 1 and Table 2. Among the eight case organizations, one shipping line, three forwarders from two tiers selected are from the initial lists. The involvement of these firms was believed to provide comprehensive insights on the adoption of e-booking system in this context. Besides, the participation of two shippers contributes to the completeness of the findings of this study, as they represent a large number of organizations in the same position in the maritime supply chain who are shippers. As aforementioned, conducting data from the perspective of container booking chain was motivated by initial interviews and was expected to offer deeper understanding of the adoption of container e-booking system among organizations in maritime supply chain. In total, we interviewed one shipping line, two first-tier forwarders, three second-tier forwarders and two shippers (see Figure 1). Five organizations were reached by authors' personal

network, and the left three were accessed by using snowball sampling technique (Saunders et al., 2012). The interviewees were informants of the chosen organizations who were familiar with organizational decision-making, e.g., general manager, documentation manager, and founder of the organization. All the cases selected were operating in Ningbo or Shanghai City, both of which are world-leading ports (UNCTAD, 2019).

World's largest shipping lines (2020)

Rank	Company	Market share
1	MSK	17.70%
2	MSC	16.20%
3	COSCO Group	12.40%
4	CMA CGM Group	11.40%
5	Hapag-Lloyd	7.40%
6	ONE	6.70%
7	Evergreen	5.40%
8	Yang Ming	2.70%
9	PIL	1.70%
10	Hyundai	1.60%

Table 1. World's largest shipping lines (2020) (Alphaliner, 2020)

World's leading ocean freight forwarders (2019)

Rank	Company	Container Volume (TEU equivalents)
1	Kuehne + Nagel	4,861,000
2	Sinotrans	3,740,000
3	DHL	3,207,000
4	DB Schenker	2,260,000
5	DSV Panalpina	1,907,130
6	Kerry Logistics	1,325,000
7	Expeditors International	1,125,140
8	C.H. Robinson	1,000,000
9	Hellmann	955,800
10	Bolloré Logistics	873,000
11	Fr. Meyer' Sohn	850,000
12	Yusen Logistics / NYK Logistics	815,000
13	Geodis	798,140
14	Ceva Logistics	786,600
15	Agility Logistics	740,000
16	Kintetsu World Express	700,040
17	Logwin Logistics	690,000
18	Nippon Express	686,210
19	AllCargo Logistics	684,000
20	Orient Overseas Container Line	650,000

Table 2. World's leading ocean freight forwarders (statista, 2020)

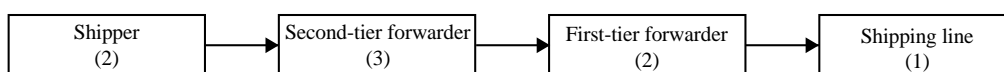


Figure 1. Number of interviewees and their position in the maritime supply chain

3.2 Data collection and analysis

3.2.1 Data collection

Before conducting the interviews, we first reviewed the existing literature on the adoption of technological innovations in supply chain management. This review enabled us to identify the general factors influencing the adoption of information systems and served as the theoretical foundation for our data analysis. Following this, we developed our understanding of the maritime industry by reviewing industry reports, organizational annual reports and the websites of leading enterprises in the industry, such as Maersk, CMA CGM, Sinotrans, Kuehne + Nagel and Casa Logistics.

The data were collected via semi-structured face-to-face interviews. An interview guide was designed for the authors to use during interviews to explain the interview process and ensure its reliability. The interview questions were divided into three categories: (a) background questions about the interviewee and their firm, (b) booking processes and the tools used and (c) views regarding the adoption of e-booking and similar systems. Traditional systems (e.g., EDI, RFID, INTTRA and CargoSmart) and technologies (e.g., e-mail, telephone, mobile and fax) were referred to during the interviews to aid the participants in their understanding of the nature of the research, whereas emerging information systems (e.g., OneTouch by Alibaba, YQNLINK and open platform by Maersk) were used as examples of e-booking systems. Through the interviews, we sought to develop a general understanding of the current booking process, the information systems and technologies involved and the attitudes of enterprises toward new information systems. Followed Neuman (2006), we conducted three pilot interviews to ensure the appropriateness of the interview questions, which then served as the foundation for five follow-up interviews (Kurnia et al., 2015). Table 3 summarises key information concerning the interviews.

	Organizational Role	Nationality	Ownership Structure	Tier Level	Location	Interview Duration
Company A	Documentation Manager	French	Non state-owned	Shipping line	Ningbo	90 mins
Company B	General Manager	Chinese	State-owned	First-tier forwarder	Ningbo	60 mins
Company C	General Manager	Chinese	Non state-owned	First-tier forwarder	Shanghai	50 mins
Company D	Finance Director	French	State-owned	Second-tier forwarder	Shanghai	50 mins
Company E	Operation Manager	Italian	Non state-owned	Second-tier forwarder	Shanghai	40 mins
Company F	Founder & Owner	Chinese	Non state-owned	Second-tier forwarder	Ningbo	60 mins
Company G	Founder & Owner	Chinese	Non state-owned	Shipper	Ningbo	80 mins
Company H	Operation Director	Australian	Non state-owned	Shipper	Ningbo	50 mins

Table 3. Interview information

3.2.2. Data analysis

We first started the process of data analysis with a deductive approach by reviewing literature of information system adoption and that in supply chain management, in order to develop an

understanding of the adoption of information system in supply chain. Our literature analysis resulted in different inter- and intraorganizational adoption factors, a classification utilized by Ahmadi et al. (2018) in examining the effects of factors on Hospital Information System adoption. Examples of inter- and intraorganizational factors were shown in Figure 2.

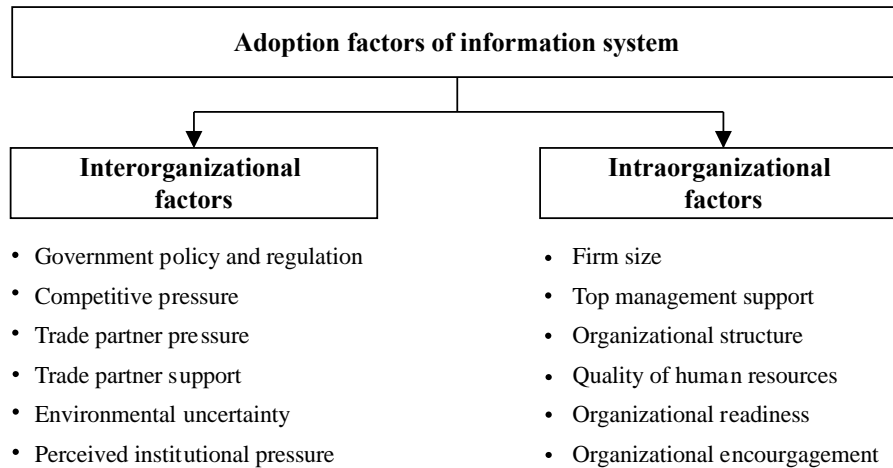


Figure 2. Taxonomy for categorizing adoption factors of information system in supply chain

Then, we followed inductive reasoning (Yin, 2018) by coding the interviews conducted. Coding is the most common method of data analysis. A code is a tag or label that summarises a word, phrase, sentence, or paragraph (Miles and Huberman, 1994). The process of coding can, thus, be considered a labelling activity. In this study, we mainly adopted a bottom-up approach to code, mainly following the process proposed by Auerbach and Silverstein (2003) (see Figure 3). The process consisted of five steps: (1) interviews and the preparation of transcripts, (2) the coding of the relevant text, (3) the categorization of repeating ideas into groups, (4) further categorization into higher-order themes and (5) the identification of theoretical constructs. The second and third steps are referred to as open coding (Myers, 2020), the fourth step as axial coding (Saunders et al., 2012) and the last step as theoretical coding (Urquhart et al., 2010).

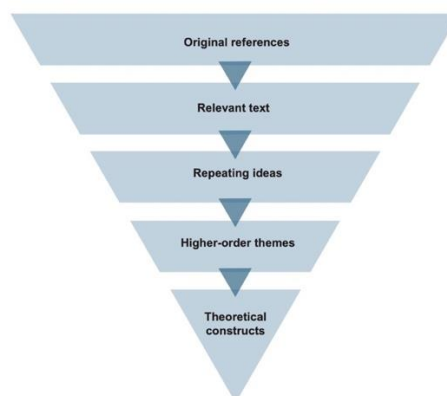


Figure 3. Coding process (Auerbach and Silverstein, 2003)

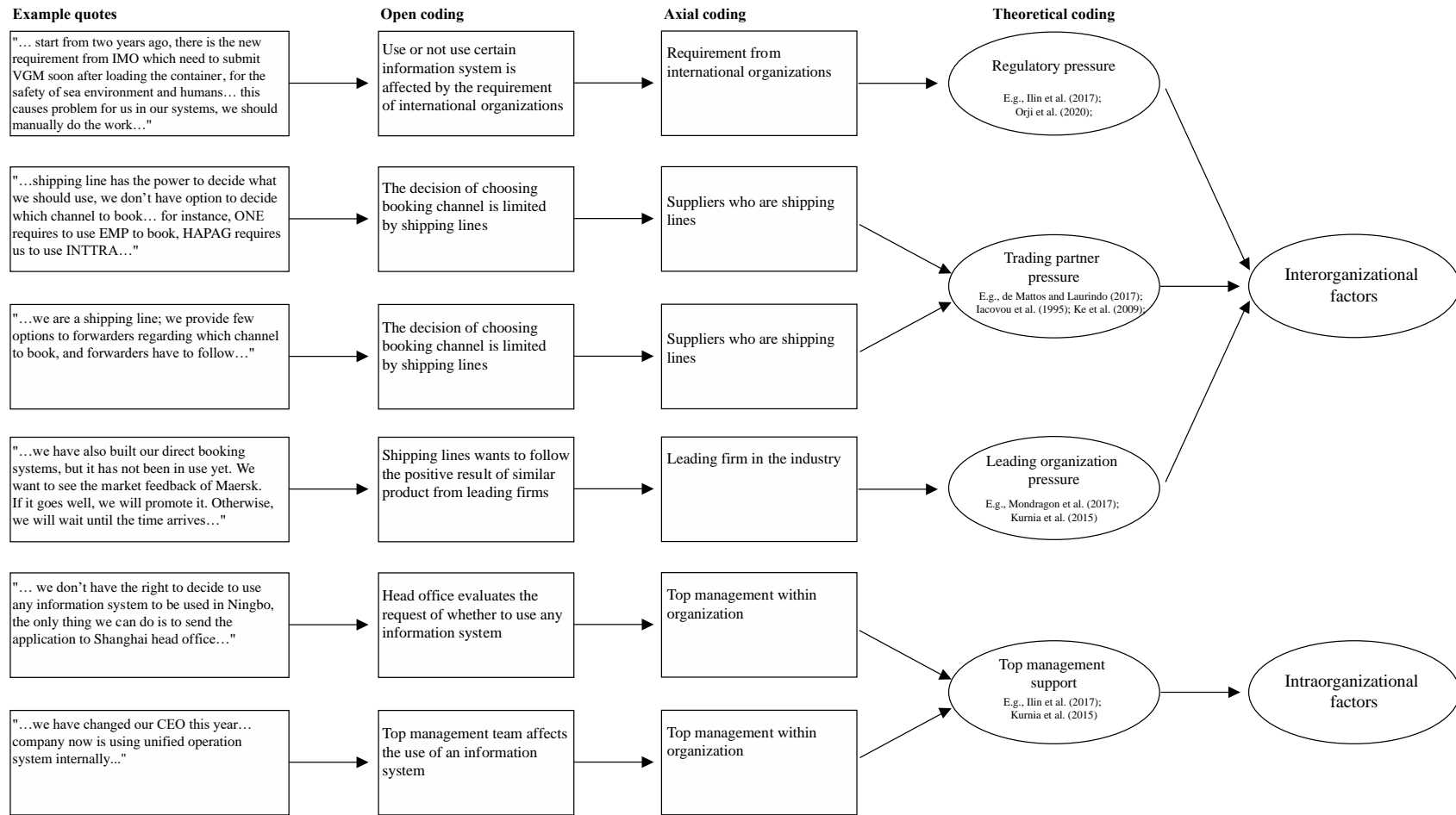


Figure 4. Coding scheme for identification of adoption factors of e-booking system

Following Orlikowski (1993), we drew on theory and literature during both data collection and analysis. Texts which were relevant with the adoption of container e-booking system in transcripts were identified, and similar texts were then classified into groups, which were then further categorized into higher-order codes. This process was followed by a deductive phase of coding, in which we returned into the classification and factors identified from theory and literature in the review process (examples refer to Figure 2). For instance, we categorized *the influence from suppliers who are shipping lines to trading partner pressure* (de Mattos and Laurindo, 2017), which was then coded into interorganizational factors. Figure 4 illustrates the coding procedure of this study. In this process, factors which attract limited attention were also recognized, i.e., compatibility and leading firm pressure. The identification of these factors extended the initial list of adoption factors of information system in supply chain. During the data analysis process, we frequently iterated between the aforementioned steps and investigated the relationships between the empirical data to ensure the validity of the abstract themes we had identified (Wuttke et al., 2013). The results of our data analysis are reported in the following section in two parts: a description of the current container booking process and tools, and the inter- and intraorganizational factors influencing the adoption of e-booking systems.

4. Results

4.1 Description of container booking process and tools employed

As discussed in the previous sections, the process of container booking involves multiple parties. Shipping lines are the companies that provide space (or entire containers) to the shippers; the shipping lines may own their ship or may rent the space from others. Shippers are the firms that request the use of space in a container on a ship. However, shipping lines and shippers do not always communicate directly. Sometimes, first- and second-tier forwarders handle the communication process and arrange the bookings and relevant paperwork for shipping lines and shippers. First-tier forwarders work more closely with shipping lines, whereas second-tier forwarders have closer relationships with shippers.

The booking process begins with a request from the customer (either the shipper or a consignee). The customer sends the booking request to a second-tier forwarder using one of a range of different communication tools. The second-tier forwarder then sends the booking information to a first-tier forwarder, who forwards the request to the shipping line. The shipping line processes the booking and the booking information is shared back and forth between all the organizations. There are some exceptions—for example, shippers sometimes work directly with first-tier forwarders—but these are relatively rare. It is also possible for shippers to communicate directly with the shipping line. However, this option only exists for shippers requiring large numbers of containers (e.g., large retailers such as ZARA and IKEA).

Various intra- and interorganizational systems and technologies are used for booking-related communication and information sharing. Preferences may differ between shipping lines, forwarders and shippers, and even enterprises within the same tier may use different technologies and systems. For instance, some forwarders who were interviewed use EDI for shipping line bookings, whereas others use INTTRA and CargoSmart. Some shippers do not use an interorganizational system for communicating with the forwarder, preferring to use e-mails and instant-messaging tools. Overall, we found that shipping lines and final customers (shippers) are the most influential agents when

parties are deciding which communication channel to use. Both EDI and systems like INTTRA, CargoSmart, and GT Nexus are widely used for communication and information sharing between shipping lines and first-tier forwarders, whereas e-mails, telephones and instant messaging tools are more often used between shippers and second-tier forwarders. E-mails and telephones are mainly used for the communication between first-tier forwarders and second-tier forwarders interviewed. Shippers, in general, are more flexible in terms of the channels they use when making a booking. There is, as yet, no single, widely adopted e-booking system for the sharing of information between all stakeholders in the booking chain. A unified e-booking system that allowed all the main stakeholders to share booking-related information would potentially reduce the errors caused by manual work and the use of various information systems and technologies. Figure 5 illustrates the current container booking process and the concept of a unified e-booking system.

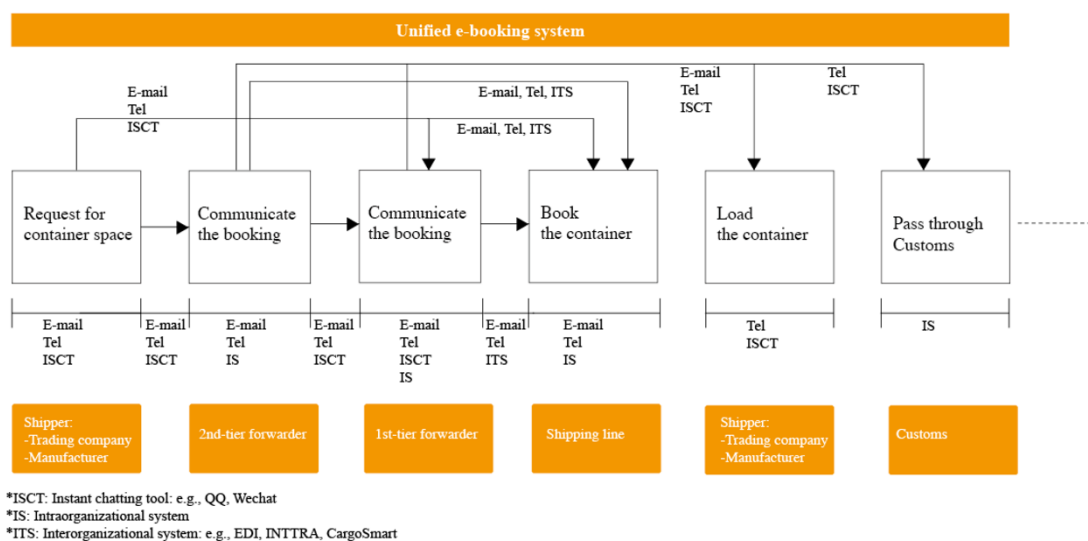


Figure 5. Container booking process and tools used during the process

4.2 Factors influencing the adoption of container e-booking systems

In this section, we describe the inter- and intraorganizational factors affecting the adoption of e-booking and other relevant systems in the maritime industry. Table 6 summarizes the factors mentioned by the interviewees, each of which is discussed in more depth below.

Tier Company	Shipping line		First-tier forwarder		Second-tier forwarder			Shipper	
	A	B	C	D	E	F	G	H	
Interorganizational factors									
Regulatory pressure	•				•				
Trading partner pressure	•	•	•	•	•	•	•	•	•
Leading organization pressure	•	•							
Intraorganizational factors									
Top management support	•	•	•	•	•	•	•	•	•
Compatibility	•					•			

Table 6. Overview of inter- and intraorganizational factors mentioned by interviewees

4.2.1 Interorganizational factors

The interviewees highlighted three kinds of pressure that affect the adoption of e-booking and other relevant information systems: regulatory pressure, trading partner pressure and leading organization pressure.

- **Regulatory pressure.** We found that regulatory pressure influences organizations' adoption decisions. The interviewees indicated that regulatory pressure forces them, to varying degrees, to adopt or reject certain kinds of information system. For example, in some regions of China, shipping lines are not allowed to send container-related information directly to the customs authorities; instead, the information must be transferred using specific information systems. This indirectly forces shipping lines to adopt these particular information systems. Preferences regarding information systems differ from region to region in China: *'In Shen Zhen, there are less constraints towards this, the information could be transferred either by certain kind of information systems or from shipping lines directly'* (Interviewee A). Further, in China, stakeholders in the maritime shipping chain are required to employ *Single Window* (China International Trade Single Window), a unified electronic trading platform, for all export-related activities, including logistics services, qualification certification and data applications. This forces stakeholders to adopt such system. In general, shipping lines and large-scale forwarding firms are under greater regulatory pressure than other parties.
- **Trading partner pressure.** Two distinct forms of trading partner pressure were identified by interviewees: pressure from suppliers and customers. Shipping lines, which are the initial suppliers in the maritime shipping servicing chain, are one of the most powerful players in the shipping chain because they are generally responsible for providing containers and space. Our investigation indicated that shipping lines have coercive power over customers (mainly forwarders) regarding the adoption of information systems for bookings, and shippers in different regions may have different preferences. Interviewee A noted, *'We are a shipping line; we provide few options to forwarders regarding which channel to book and forwarders have to follow'*. This was echoed by Interviewee B, *'We do have options; however, we must book from the channels provided by the shipping line, which might be EDI, INTTRA, CargoSmart, GT Nexus, e-commerce platforms and so forth'*.

Although forwarders can also be considered to be suppliers for shippers, they exert less pressure regarding the adoption decision. As noted by Interviewee B, *'We provide various options to our customers (shippers) for booking, like EDI, e-mails, telephone and QQ (instant chatting tool). We also have one customer who still uses fax. It is up to the customer'*.

Moreover, pressure from customers affects the decisions of suppliers, including both shipping lines and forwarders. Although shipping lines occupy a unique position in the shipping chain, their decisions regarding information systems are also influenced by their customers. Customers here refers primarily to the firms (shippers, consignees and forwarders) that work directly with the shipping lines, which are mainly either large international companies like ZARA and IKEA or first- or second-tier forwarders: *'We will follow what big customers want: if they want to use EDI, we will open the EDI access for them. If they prefer e-mail, or other approaches, we are also fine for it'* (Interviewee A). Further, small and medium-size shippers also affect the adoption behaviour of forwarders: *'I do not have EDI access now; if my*

customer is big enough, I can open the access for them' (Interviewee F). However, our investigation revealed that many customers (i.e., shippers and consignees) are, in fact, not particularly concerned about which channel is used to book a container. Interviewee G supported this view: *'Booking is only a small part of our work; the cost is also relatively low. I don't even mind processing it manually'*.

- **Leading organization pressure.** The results confirmed the influence of large and leading organizations. Information systems and technologies are playing an increasingly important role in the daily operations of shipping organizations, with some firms adopt innovations earlier than others. Other organizations are affected by these adoption choices, especially by leading organizations. For example, Maersk began to offer direct online booking to shippers in 2018, and the results of this decision are being evaluated by other shipping lines. Interviewee A reported, *'We have also built our direct booking systems, but it has not been in use yet. We want to see the market feedback of Maersk. If it goes well, we will promote it. Otherwise, we will wait until the time arrives'*. The adoption decisions made by forwarders are also influenced by their leading competitors: *'One of the reasons I choose HY2000 was because other forwarders also use it. Even companies who are much larger in size than us'* (Interviewee F).

4.2.2 Intraorganizational factors

- **Top management support.** We found that support from top management influences the adoption decisions made by all organizations in the shipping chain. Top management here refers to the management team or company owner. For small and medium-sized enterprises, company owners normally decide on adoption: *'I am the one to decide whether to use an information system for booking and which system to use'* (Interviewee F). Meanwhile, in large organizations, the management team collectively decides to adopt a particular booking information system. Interviewee A supported this view: *'If we need to use a new information system, we (a subbranch) need to report to the China area head office for approval'*.
- **Compatibility.** Our findings confirmed the impact of the compatibility of technology within each organization. Any proposed e-booking system must be compatible with the information systems already in use in the organization. Interviewee A mentioned that *'when we evaluate the information system, we need to consider the information system in our company. The functions of many of the information systems in the market overlap with each other. If so, our management team will not approve the application of using a new information system'*. Even effective and comprehensive information systems will not be adopted by organizations if they are incompatible with other systems. As Interviewee F mentioned, *'The technology (interorganizational information system) itself is mature. It can provide many more functions than we need in our daily operations. We do not need all of them; we can consider adopting it as long as it provides the functions that match the requirements of our company'*.

5. Discussion

As outlined in the earlier sections, our qualitative multi-case study of the maritime industry sought input from players throughout the shipping chain to better understand the container booking process and the inter- and intraorganizational factors influencing the adoption of e-booking systems. The results demonstrated the usefulness of DOI, institutional theory and RDT in understanding the

adoption of e-booking systems and other interorganisational information systems and technologies in the maritime supply chain. We found that organizations cannot freely and independently decide whether to adopt e-booking systems and other interorganizational communication and information sharing systems; the adoption process is largely determined by the external environment in which the organization operates, as well as its internal characteristics. Specifically, we identified several important factors influencing adoption: pressure (including pressure from regulators, suppliers, customers and leading enterprises), top management support and compatibility. These findings are consistent with many earlier studies (de Mattos and Laurindo, 2017; Ilin et al., 2017; Mondragon et al., 2017; Tu, 2018). This study empirically validates the effects of factors identified by prior innovation diffusion studies in the specific context of the maritime supply chain.

This study took into account the fact that maritime transportation is under relatively greater regulatory constraints than other industries because it operates across multiple countries with diverse regulations. We found that decisions regarding the adoption of e-booking systems by shipping lines and forwarders are affected by regulatory pressure, the impact of which may be both positive and negative. Regulations, e.g., governmental initiatives, may also accelerate the adoption of certain information systems, increasing the digitalization of the maritime supply chain. This is consistent with Ilin et al. (2017) and Mondragon et al. (2017). We found that pressure from suppliers and customers also affects organizations' decision-making processes. This is consistent with the findings of previous studies concerning the adoption of e-supply chain management systems (Ke et al., 2009) and the Internet of Things (Tu, 2018). This study found that forwarders are pressured by both suppliers (shipping lines) and customers (shippers or consignees). However, only large shippers, as well as consignees and forwarders, affect the adoption decisions of shipping lines. In general, small and medium-size shippers do not express preferences regarding the channel they use to book a container. Lastly, the adoption decisions made by shipping lines and forwarders are influenced by the behaviour of the leading organizations in each tier.

We identified that two intraorganizational factors influencing the use of e-booking systems are senior top management support and compatibility. Top management support was found to have a significant impact on all the participating companies. This is consistent with the results of previous studies of innovation diffusion in supply chain management, including investigations concerning cloud computing (Oliveira et al., 2014), e-business (Ilin et al., 2017) and e-supply chains (Lin, 2014). Moreover, the definition of senior management varies between organizations; it may include the company owner for many small and medium-sized enterprises or a team of senior managers in larger firms. The study also identified the impact of technological compatibility. With the advancement of technologies and widespread adoption of information systems, some organizations use different systems with overlapping functions. The results indicated that when making adoption decisions, organizations consider whether a new information system is equipped with similar functionality to a system they already use. If so, organizations tend not to adopt the new system as they consider it an unnecessary expenditure. Moreover, though modern information systems are multifunctional, organizations in the maritime shipping chain prefer to use only those functions necessary to meet their needs, rather than the full functionality.

6. Conclusion

This study investigated the process of container booking in the maritime industry and the inter- and

intraorganizational factors that affect the adoption of e-booking and other interorganizational information systems. To achieve this, we conducted a multi-case study of the systems used by organisations on various tiers of the shipping chain. We found that the container booking process is complex and involves a variety of organizations. The communication and information-sharing methods used between organizations for booking purposes are fragmented. A unified e-booking system has not yet been widely adopted by the industry. Interviews with informants from organizations revealed both inter- and intraorganizational factors influencing the adoption of e-booking systems in the industry: pressure from regulators, customers, suppliers and leading organizations, top management support and compatibility.

6.1 Contributions and implications

- Theoretical contributions

The theoretical contributions of this research to the literature on the diffusion of technological innovation in the maritime supply chain are manifold. First, we contribute to the literature by investigating the adoption of e-booking systems by organizations in the context of the maritime supply chain. Our multidiscipline research contributes to the development and application of theory in the maritime supply chain (Woo et al., 2011). Although other studies have investigated the diffusion of technological innovations in the maritime supply chain, we applied an inductive approach based on existing theories and literature concerning the diffusion of information systems. This study, thus, addresses the lack of theoretical consideration of the maritime transportation industry (Woo et al., 2011). Secondly, the inductive qualitative research approach employed in this study adds methodological diversity to the extant literature on the diffusion of technological innovations.

Thirdly, in contrast to prior research examining the adoption of relatively mature technological innovations, including RFID (Ramanathan et al., 2014), cloud computing (Subramanian et al., 2014) and ICT (Harris et al., 2015; Mondragon et al., 2017), we investigated the adoption of an emerging type of interorganizational information system, namely e-booking systems, in the maritime supply chain, thus contributing to the diversity of research in this context. Fourthly, whereas existing studies have largely focused on individual- (Oliveira et al., 2014) or firm-level decision-making (Ilin et al., 2017; Kurnia et al., 2015; Orji et al., 2020), the characteristics of the maritime supply chain enabled us to investigate the adoption behaviour of organizations at the chain level.

Finally, although factors influencing the adoption of e-booking systems in the maritime industry have been identified in the existing literature, this study confirms the effectiveness of these factors in the context of the maritime supply chain. The results could support future studies in this area. Overall, this research supplements the limited prior research concerning the diffusion of interorganizational information systems and technologies in the maritime industry, building on studies conducted by Chao and Lin (2009), Harris et al. (2015), Hsu et al. (2009), Lu et al. (2006), Mondragon et al. (2017), Yang (2019), Orji et al. (2020) and Zeng et al. (2020).

- Managerial implications

Our research also has several implications for practitioners within the maritime supply chain. Our research was motivated by the emerging trend towards digitalization in the maritime supply chain and the existence of diverse information systems for communication used and high volume of

manual work in the container booking process. Interorganizational information systems (e.g., container e-booking systems) are an innovative approach to assist organizations in the chain to improve efficiency and keep up with the trend towards digitalization. Our findings suggest that managers in leading enterprises in this field, such as Maersk and CMA CGM, should consider the unique characteristics of the maritime industry (e.g., multiple complex stakeholders using a diverse range of information systems and technologies) to receive a high adoption rate for e-booking and interorganizational information systems that they initiate. Industrial alliances and leading industry organizations should also collaborate to encourage or pressure other, less influential, supply chain partners to adopt their preferred information systems or technologies to increase digitalization across the industry. In contrast to a traditional information system used within an individual organization (e.g., ERP) or between organisations in a dyadic relationship (e.g., RFID), a unified container e-booking system could be used across the whole maritime supply chain. Therefore, managers need to consider both upstream and downstream stakeholders and other organizations that might be involved (e.g., governmental offices). Government officials and policymakers should consider the essential role they play in the adoption of e-booking and other interorganizational information systems in the maritime supply chain. Exerting pressure on organizations in the chain may lead to a higher rate of adoption of technological innovations, which might contribute to a higher degree of digitalization. Finally, practitioners, government officials and policymakers all need to think beyond adoption. As mentioned earlier, the diffusion of information systems and technologies is a complex and lengthy process; adoption does not necessarily lead to successful implementation and continuous effort and commitment are needed.

6.2 Limitations and future research opportunities

As with all empirical research, our study was not without limitations. Firstly, we found that organizations' adoption decisions are dominated by the decisions and behaviour of shipping lines, suggesting an imbalance of power. We did not investigate this issue in depth due to the scope of this study. Future research could deductively investigate if and how this imbalance of power affects the adoption of information systems in the maritime supply chain. Secondly, organizations selected represent different characteristics, e.g., ownership structure and firm size, which might affect the adoption of information system as suggested by prior literature (Orji et al., 2020). They were, however, not included in this study. Future studies could have deeper investigation on such characteristics of organizations. Thirdly, although the organizations we selected operate worldwide, all of their headquarters are located in China. Future work could be conducted in other regions and countries to generalize the results of this study. Further, as the digitalization of this industry is still in its infancy, this study was explorative. However, the digitalization process is dynamic and future studies could compare the decision-making processes of both adopters and non-adopters to identify motivators and barriers to the adoption of information systems. Moreover, the results of this study could be validated using other research approaches, such as mixed and quantitative methods. Finally, because the maritime industry differs from many other industries, this study focused on organizational factors. Future research could consider a broader range of factors, including technical issues such as perceived ease of use, as well as the perceived usefulness of the information system and technology.

There are tremendous challenges, e.g., conflict of interest between organizations and countries, to the adoption of e-booking and other interorganizational information systems in the maritime

transportation industry. We hope our study will lead to further work and, ultimately, contribute to the digital transformation of the industry.

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Appendix A

Interview protocol

I. Introduction

- a. Research motivation and objectives
- b. Confidentiality and research consent

II. General background information

- a. Background of the company interviewees serve, e.g., business type, number of employees, and so forth
- b. Interviewee's role and responsibility within the organization, years of experiences and areas of expertise etc.
- c. Could you please share about the information systems used in your company?

III. Detailed interview questions

The following interview questions will act as the principal topics of discussion, follow-up questions might be used depending on the direction of the interviews.

- a. Container booking process
 - i. How do you book container now? Could you please explain in detail?
 - ii. What issues do you think exist of the current container booking process?
- b. Tools used for inter-organizational communication for container booking
 - i. What tools do you use for the communication for booking?
 - ii. Do you use any information system for intra-organizational communication for booking? why or why not?
 - iii. Do you use any information system for inter-organizational communication for booking? why or why not?
 - iv. What communication issues do you think exist of the current communication approach?
- c. Container e-booking system and factors affecting the adoption decision
 - i. Do you know that there is container e-booking system available?
 - ii. Are you using any kind of e-booking system? Why or why not?
 - iii. What factors might affect the adoption decision of your organizations?
 - iv. Who/which department makes the adoption decision in your company?
 - v. Do you think that your company can make the decision directly? or the decision is affected by factors outside of your company? what are they?
 - vi. What is your opinion about container e-booking system?

Appendix B

Table B1. Table of abbreviations

Abbreviation	Full name
DOI	Diffusion of Innovation
E-booking	Electronic booking
E-commerce	Electronic commerce
EDI	Electronic data interchange
ERP	Enterprise resource planning
ICT	Information and communication technologies
IS	Intraorganizational system
ISCT	Instant chatting tools
ITS	Interorganizational system
RDT	Resource Dependence Theory
RFID	Radio frequency identification
TAM	Technology Acceptance Model
TOE	Technology-Organisation-Environment
TPB	Theory of Planned Behavior
TRA	Theory of Reasoned Action
UTAUT	The Unified Theory of Acceptance and Use of Technology