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Article

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The effect of digital adoption and service quality on business sustainability through strategic alliances at port terminals in Indonesia

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ABSTRACT

Effective port management is vital for a nation's economic growth. Amid global advancements, ports must ensure business sustainability across social, environmental, and economic domains due to regulations and market demands. Stakeholders often rely on two strategies: digital technology adoption and service quality enhancement. As ports involve diverse stakeholders, collaborative strategies in alliances gain importance. Therefore, this study investigates digital adoption, service quality, and strategic alliances' impact on Indonesian ports' business sustainability. Using quantitative methods, 72 respondents' questionnaire data from Indonesian port terminals was analyzed with structural equation modeling. Results show digital adoption and service quality positively influence strategic alliance formation, which then enhances business sustainability. Interestingly, the direct impacts of digital adoption and service quality on business sustainability are absent, which emphasizes the need for strategic alliances. Thus, Indonesian port terminals should forge alliances as resource-sharing vehicles, promoting business sustainability. This research advances Resource-Based View theory and offers practical insights for navigating Indonesia's port industry challenges while also giving valuable insight about port characteristics in archipelagic countries.

1. Introduction

The importance of maritime transport in global logistics chains cannot be overstated, as it serves as an enabler of economic development across nations and regions (Clark et al., 2004). Ports that serve as transfer points between maritime and land transport play a vital role in facilitating the movement of goods. Despite global trends changing across all sectors, ports continue to be a crucial component of the supply chain, with over 80% of global trade flows being serviced through maritime transport (UNCTAD, 2022).

This importance is even more prominent for archipelago countries, such as Indonesia, where maritime transport and ports are critical for connecting about a thousand islands and facilitating billions of tonnes of trade (Zen & Yudhistira, 2021). Ports in Indonesia also have a crucial role in maintaining logistic efficiency and quality as a determinant of developing trade between regions (Amin et al., 2021). As of 2020, Indonesia has an extensive number of ports and terminals, with 3514 scattered throughout the country. Some public ports are intended for public purposes and are managed by the Indonesia Port Company (PT Pelindo) and the Indonesian Ministry of Transportation (MoT). In

addition to public ports, there are dedicated terminals that are used for the special interests of business entities.

After 2020's pandemic, the supply chain of goods, including port activities in Indonesia, has been seriously disrupted. In addition, the pandemic has brought back important paradigms in various aspects, including those related to the environment, social, and economic issues (Sarkis, 2021). International shipping companies, which are the main users of Indonesian port services, are also affected by the pandemic. Maersk Line, one of the shipping companies with the largest number of vessels and volume of cargo transported in the world, has emphasized its commitment to sustainable business through its reported strategy in the company's Sustainability Report (Maersk Line, 2023). This commitment is also carried out by the world's largest 3rd party logistics (3PL) companies, such as DHL (DHL, 2023). New regulatory and societal requirements for business sustainability are putting greater pressure on ports to comply (Lim et al., 2019). This is due to the increasing importance of this factor in the decision-making process of shipping and logistics companies when selecting a port, and ports have been compelled to take proactive measures in this regard (Parola et al., 2017). As part of the supply chain, the movement of economic goods in Indonesia is 90%

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transferred by sea (BPS, 2022). This indicates that ports have a vital role in economic growth. However, in the Logistic Performance Index Report published by The World Bank (2023), Indonesia’s ranking has decreased significantly (down from 46 to 61). This means Indonesia still faces challenges in reducing logistics costs in various sectors, including ports.

Environmental management has become an important concern for port operators in the world. For this reason, in 2017 the International Association of Ports and Harbors (IAPH) initiated the World Port Sustainability Program to develop and coordinate future sustainability efforts of ports around the world and accelerate international cooperation with partners in the supply chain (World Port Sustainability Program, 2020), however, ports in Indonesia have not participated in the program (World Port Sustainability Program, 2020).

From the above explanation, it is very important that business sustainability in the port sector in Indonesia be studied further, especially regarding its influence on the economy, supply chain, and environment.

Considering the resource-based view (RBV) theory, business sustainability or competitive advantage can be achieved by exploiting existing resources within a company. In this digital era, one strategic resource commonly relied upon is the adoption of digital technology (Gavalas et al., 2022). Digital adoption, in this context, refers to the organizational ability to adopt and utilize appropriate technologies based on their business processes and needs (Rosário, 2022). This approach has been identified as a critical factor in enhancing sustainability, reducing costs, and improving efficiency in port terminal operations (Heilig et al., 2017). Utilizing technologies such as the Internet of Things (IoT), blockchain, and artificial intelligence (AI) can improve port operations by enabling real-time monitoring and analysis of cargo movements, increasing supply chain visibility, and facilitating stakeholder communication (Muñuzuri et al., 2020).

Moreover, the escalating competition within the port industry presents distinct challenges to achieving business sustainability. In this context, service quality has emerged as a pivotal element in elevating competitiveness and ensuring the business sustainability of maritime industries. Service quality is described as the customer’s perception of the overall excellence of the service provided by the organization (Cronin & Taylor, 1992; Parasuraman et al., 1985). By doing so, ports can improve their reputation and business sustainability in the global market.

However, some ports may struggle to recoup investments in digital adoption and the improvement of their service quality due to limited resources (Paulauskas et al., 2021). Therefore, an alternative strategy to achieve the business sustainability target is to establish collaborations and strategic alliances to achieve mutual competitive advantage (Carayannis, 2000; Mamédio et al., 2019; Philsoophian et al., 2021). Additionally, the communication network established through partnerships with port communities and port authorities can facilitate adaptation to changes, allow for the sharing of information, resources, and strategic plans, and improve sustainability performance in environmental and social domains (Ashrafi et al., 2020; Tijan et al., 2021; Wang et al., 2020).

Currently, existing research literature primarily focuses on examining these strategies separately (Carayannis, 2000; Mamédio et al., 2019; Philsoophian et al., 2021; Ashrafi et al., 2020; Tijan et al., 2021; Wang et al., 2020), with limited studies investigating their combined effects within the specific context of port business management in Indonesia. As a result, there is a research gap concerning the interplay between these factors and their impact on business sustainability. To address this gap, this study aims to provide a comprehensive analysis of the relationship between digital adoption, service quality, strategic alliances, and sustainability performance in port terminals.

The primary objective of this research is to investigate the influence of digital adoption, service quality, and strategic alliances on port terminals’ business sustainability in the case study of Indonesia. Different from previous research on ports that were dominated by mainland countries’ cases (Caylan & Emiroglu, 2014; Ha, 2003; Meyer et al., 2021;

Nguyen et al., 2021; Phan et al., 2021; Wang et al., 2020), this research gives new insight by using data on port business entities in an archipelagic country, such as Indonesia. A quantitative approach will be employed, utilizing a survey questionnaire to collect data from commercial port terminals across Indonesia. The findings and discussions of this study are expected to provide valuable insights and practical implications for commercial port terminals and their stakeholders, assisting in the development of effective management strategies to achieve business sustainability. Furthermore, these findings will contribute to the existing literature on business sustainability and strategic alliance in the maritime industry, particularly within the context of commercial port terminals in an archipelagic country.

2. Literature review

2.1. Port and terminal in Indonesia

Indonesia has an extensive number of ports and terminals, with 3514 scattered throughout the country. At least 1144 of them are public ports, which may have several terminals and are mostly operated by the Indonesian Port Company (PT Pelindo) and Ministry of Transportation (MoT). Besides the public ports, there are 2370 dedicated terminals.

Referring to Indonesian Government Regulation No. 31 of 2021 regarding the Implementation of Port Shipping, a port is a place consisting of land and/or water with certain boundaries used for government and business activities as a place for ships to dock, passengers to embark and disembark, and/or loading and unloading of goods. It includes terminals and berthing places equipped with safety and security facilities for shipping and supporting activities, as well as for the transfer of goods between transportation modes.

Meanwhile, a port terminal is a facility consisting of berthing areas and a place for ships to dock or moor, as well as areas for cargo storage, waiting and boarding areas for passengers, and/or loading and unloading of goods (Indonesian Government, 2021). Therefore, based on the above explanation, a terminal is a part of a port, and a port can have several terminals, as shown in the example in Fig. 1.

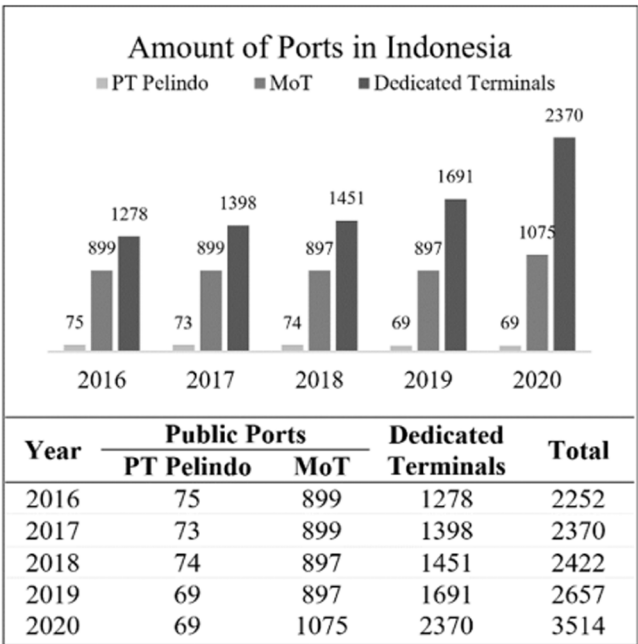


Fig. 1. Amount of Ports in Indonesia.

2.2. Business sustainability

Business sustainability (BS) is described as a management approach that enables companies to grow profitably while delivering economic, social, and environmental value (Kantabutra & Ketrapakorn, 2020). Its term was first introduced in 1987 as an effort to meet current needs without ignoring the ability of future generations to meet their own needs (WCED, 1987). This idea developed over time into the eight MDGs (Millennium Development Goals) for 2015 and the seventeen UN SDGs (United Nations Sustainable Development Goals) for 2030. In academic circles, the main concept of business sustainability has now emerged as an important topic that is widely used by interdisciplinary fields to address contemporary issues such as environmental, economic, cultural, and social problems (Hassan et al., 2014), finance (Gillan et al., 2021), corporate competition (Koilo, 2019), and strategic management (Suriyankietkaew & Petison, 2020).

The ability of the company to adapt to changes and uncertainties in the global environment will be improved over time as a result of the systematic and concurrent integration of all three areas (Evans et al., 2017; Suriyankietkaew & Petison, 2020). This concept needs to be maximized by all stakeholders to achieve sustainability in their businesses. This includes companies in the port industry ecosystem, which is experiencing changing trends (Denktas-Sakar et al., 2012; Jaafar et al., 2021).

The current business development trend in the port industry is evolving along with the increasing world trade conducted by sea, which has led to an increase in emissions that have negative impacts on health and the environment (Christodoulou & Woxenius, 2019). The impact of technological innovation and operational concepts has also affected the transportation industry, particularly the maritime sector (Ashrafi et al., 2019). Therefore, all stakeholders in the maritime sector are trying to develop strategic management plans to remain aligned with the development plans undertaken by other players around the world in providing sustainable services and development (Lam & Yap, 2019).

As concluded by Rodrigo González et al. (2020), the development of a port must be based on digital technology adoption to move towards a sustainable model and port efficiency. Ports must invest more in these areas to achieve a greater degree of adaptation to the Smart Port concept, to advance in the ranking, and to avoid possible sanctions and restrictions from international regulations. Based on these factors, a strategic role is played by following global developments and providing development programs and plans at all levels.

Finally, this study operationalizes business sustainability using the dimensions of social, environmental, and economic sustainability indicators, such as health and safety, employee rights, corporate social responsibility, the rate of harmful gas emissions, water usage, energy consumption, waste generation, the effect on supply chain costs, and economic growth (Lim et al., 2019; Varsei et al., 2014).

2.3. Digital adoption

Digital adoption (DA) is defined as the organizational ability to adopt and utilize appropriate technologies based on their business processes and needs (Rosário, 2022). The development of information technology and digitalization has greatly influenced business processes in various sectors, including the maritime and port sectors in Indonesia (Iman et al., 2022).

Digital adoption in the port industry ecosystem includes the application of digital technology to improve the flow of goods, documents, information, and finance, which plays a crucial role in increasing productivity and providing better efficiency and competitiveness for all key players in the port industry (Adabere et al., 2021; Haralambides, 2019). Moreover, digital adoption also enhances the quality of services provided by companies to their customers, which can strengthen their reputation in the global market (Agatić & Kolanović, 2020). By utilizing digital technology, companies can also improve integration and

collaboration with business partners in the supply chain, bringing benefits to all parties involved (Kraus et al., 2021). The applications and implications of digital transformation technologies in various aspects are also one of the underlying research themes in smart port (Pham, 2023).

However, the adaptation of this sector to the digital ecosystem has been slow compared to other industries (Gavalas et al., 2022; Tijan et al., 2021). The process of digital adoption and transformation in the port industry requires time, resources, and a change in organizational culture and mindset (Cappgemini, 2017; Carlan et al., 2017; Iman et al., 2022). There are also challenges in resource management, stakeholder conflicts, and regulation readiness (Sys & Vanelslender, 2020). Moreover, research suggests that not every business can go through a digital transformation fast enough to make more revenue and stay ahead of the competition (Gavalas et al., 2022).

Nevertheless, the adoption of digital technology has the potential to enhance the business sustainability of port terminals in Indonesia. A case in point of how digital adoption has led to better business sustainability is the vehicle booking system (VBS) introduced by the Port of Auckland in 2007. By requiring logistic companies' trucks to reserve slots ahead of time, the web-based VBS was created to simplify the supply chain. As a result, there has been a decrease in truck lines, which has in turn led to a reduction in fuel expenses and air pollutants (Gonzalez Aregall et al., 2018). Therefore, companies in the port industry ecosystem need to embrace the digital transformation and integrate digital technology into their business processes to achieve business sustainability (González-Cancelas et al., 2020; Iman et al., 2022).

Regarding the current condition of digital technology adoption for port enhancement in Indonesia, the Ministry of Transportation of Indonesia has issued regulations for stakeholders involved in vessel services at ports to utilize the INAPORTNET platform. This regulation was established in 2015 through Minister of Transportation Regulation No. 157 of 2015. INAPORTNET serves as a coordination system for vessel service activities among government agencies (Harbor Master and/or Port Authority), port operators, and shipping companies. By 2022, only 109 ports had already adopted this platform, representing approximately 4.4% of the total number of ports (3,514 ports), with an additional 42 ports targeted for implementation in the following year (Ministry of Transportation, 2023).

Finally, this study operationalizes digital adoption using the dimensions of technology, operational system, and customer system indicators, such as operating system for enterprise and terminal operation, auto-gate, auto identification, digital payment, and an integrated single window (Bastug et al., 2020; Gavalas et al., 2022).

2.4. Service quality

Service quality (SQ) is generally defined as consumers' perception and evaluation of the service performance offered by a company (Cronin & Taylor, 1992; Parasuraman et al., 1985). It is a generic term for all industries; however, several studies have developed service quality frameworks in the maritime industry, such as the SERVQUAL model, which was applied to measure port service quality (Ugboma et al., 2007).

Other researchers have suggested dimensions to measure service quality in ports, such as efficiency, timeliness, and safety (López & Poole, 1998), or other proposed factors, including the availability of accessible information, location, turnaround time, facilities, management, cost, and customer comfort (Ha, 2003). However, one of the most commonly used methods to measure port service quality in recent days is known as the Resources, Outcomes, Process, Management, Image, and Social Responsibility (ROPMIS) model to measure service quality in the maritime industry (Phan et al., 2021; Thai, 2008).

Making improvements in the service quality of port terminals may not necessarily lower costs for the port terminals themselves. However, these enhancements improve the cost-effectiveness of the port terminal

for other stakeholders in the industry, indirectly contributing to strategic alliances and business sustainability for all parties (Kontovas & Psaraftis, 2011). For instance, researchers have discovered that quicker ship's turnaround times at ports lead to reduced operating expenses and decreased CO2 emissions for ships that dock (Moon & Woo, 2014). Additionally, spending less time in ports enables ships to travel at slower speeds, which can subsequently reduce fuel consumption, air emissions, and expenses (Chang & Wang, 2012). Some studies by Le et al. (2020) and Phan et al. (2021) also showed that great port and logistics service quality exerts a positive influence on social aspects, where customers will have more satisfaction. So, by enhancing their service quality, port terminals can thus have a positive impact on business sustainability as well.

Most studies use port service quality variables from the perspective of port customers, such as shipping lines, freight forwarders, and logistics service providers with port characteristics in mainland countries (Phan et al., 2021; Thai, 2008). In this study, port service quality is examined from the perspective of port/terminal operators with port characteristics in archipelagic countries. Therefore, this study operationalizes service quality using the ROPMIS model, including resources, outcomes, process, management, image, and social responsibility that have been used in previous research by Phan et al. (2021) and Thai (2008).

2.5. Strategic alliance

Strategic alliances (SA) represent an important mechanism of knowledge transfer and interfirm coordination that can play a crucial role in a firm's learning, productivity, profitability, and shaping the development of system integration capabilities (Geleilate et al., 2021). In periods of rapid change, many companies are now teaming up with other companies that have different skills and resources to tackle three big problems that decision-makers often face: (1) It is hard to know what people will want in the future; (2) It's hard to keep up with what other companies are doing; and (3) It's hard to find ways to do things cheaper than your competitors. To deal with these problems, many companies are now teaming up with other companies that have different skills and resources, which is now called a "strategic alliance" (Child, 1987).

In the port industry ecosystem, strategic alliances refer to independent companies working together to execute their supply chain activities related to one or multiple port terminals (Chandra & Van Hillegersberg, 2017). This collaboration enables the port-related industry to overcome challenges and increase performance and business opportunity in an ever-increasingly competitive and globalized environment (Denktas-Sakar & Karatas-Cetin, 2012; Senarak, 2020). Such alliances also involve concession contracts for infrastructure, where parties establish a profit and loss sharing model based on each other's contributions and regulate the alliance's terms to avoid undesirable deadlocks and facilitate ongoing communication (Juan et al., 2008).

Strategic alliances are established primarily to enhance joint competitive advantage by improving service quality and promoting overall growth (Varadarajan, 1995). However, collaborating port terminals can also pool their resources and efforts to increase the efficacy of research and development, leading to improved business sustainability in environmental and social domains (Ashrafi et al., 2020). For example, a study in collaboration with terminal operations in Busan Port could significantly reduce vessels waiting more than 12 h while balancing utilization across the port and shortening the average vessel turnaround time. Furthermore, this consolidation could reduce costs and attract more container volume, resulting in balanced and increased overall utilization at all the port terminals (Kim et al., 2022). The PNW Seaport Alliance also provides an excellent example of this. They have implemented various initiatives, including the Northwest Ports Clean Air Strategy, aimed at reducing diesel and gas emissions, and other environmental program plans. As a result, the alliance has significantly improved its business sustainability (Ashrafi et al., 2020).

This study operationalizes port strategic alliances using the quality of collaboration between firms in the port industry ecosystem, such as holding or subsidiary companies, government authorities, port companies, shipping line companies, stevedoring companies, maritime service companies, logistic companies, and industry or cargo owners (Vitsounis & Pallis, 2012).

2.6. Research theoretical model and hypotheses

As an archipelagic country, developing port business sustainability is very important because it affects the regional economy, social and environment where the port operates. (Kusuma & Tseng, 2019, pp. 9163407). In line with globalisation and technological developments, port operators are also required to work more efficiently with greater transparency in the supply chain system. Basole & Nowak (2018) argue that the most beneficial real-time supply chain data is now most likely generated and delivered by some form of tracking technology. This can be seen in several components of the Logistic Performance Index assessment in the form of tracking and tracing and service quality (World Bank, 2023). Because the port business process involves many actors, the involvement and cooperation of each port stakeholder (strategic alliance) is very important so that business sustainability can be achieved. In the implementation of the strategic alliance, the use of technology has become possible because IT technology (digital adoption) has been widely used. It is expected that with digital adoption in coordinating between actors, efficiency and transparency at the port can be better.

Digital technology nowadays is experiencing robust development in business and marketing. Therefore, contemporary companies need to review their traditional business models for interfirm collaboration and relationship coordination to meet the rapidly changing expectations, requirements, and characteristics of existing or potential strategic partners (Bouncken & Fredrich, 2016). Information technology could also enable integrated systems in terminal containers with a hinterland network, which in turn may benefit operators, ship owners, and industry or cosigners (Clott & Hartman, 2016; Sirajuddin & Sunaryo, 2019).

Based on the description above, Hypothesis 1 (H1) is written as follows:

2.6.1. H1: Digital adoption influences strategic alliance

There have been many studies around the topic of digital adoption relation to business sustainability especially in Small Medium Enterprises (SME). (Kurniasari et al., 2023) implement that SMEs digital adoption is positively affecting its performance, which eventually affects their business sustainability. Digital adoption will lead to more efficient business processes, simplified documentation, and speedy financial decision-making. While (Vrontis et al., 2022) also shows that show that adopting digital technologies has a significant impact on the creation of economic sustainability and social value for SMEs. In port business, this is also the case. As concluded by (González et al., 2020), the development of a port must be based on digital technology adoption in order to move towards a sustainable model and port efficiency.

Based on the description above, Hypothesis 2 (H2) is written as follows:

2.6.2. H2: Digital adoption influences business sustainability

Due to the nature of the service sector, where competition is increasingly concentrated, the main objective of firms is the creation of their strategy for competitive advantage in regard to knowing the level of quality of the services offered and the firm's image from the customers' point of view (Ozbekler & Ozturkoglu, 2020). In the sector of shipping services, competition intensified with worldwide competition, and many traditional shipping companies were forced to exit the market. In such a condition, global alliances emerged rapidly for shipping companies to cater to the new requirements of customers (Huang & Yoshida, 2013). According to Sirajuddin and Sunaryo (2019), the

implementation of strategic alliance is expected to increase the service capacity of ports, such as serving vessels that have huge capacities, providing adequate stacking fields, etc. It is very important to note that to gain a higher quality of service, firms should collaborate to give themselves a competitive advantage; hence, it is very likely that service quality has a relationship with strategic alliances.

Based on the description above, Hypothesis 3 (H3) is written as follows:

2.6.3. H3: Service quality influences strategic alliance

The quality of service has a direct influence on creating a sustainable local economy, meaning that improving service quality to understand customer needs can enhance sustainable economic growth and competitive advantage through marketing mix strategies (Syapsan, 2019). As a result of research conducted by Ozbekler & Ozturkoglu (2020), firms have emphasized the importance of reaching the competition by expanding their quality perceptions within the scope of corporate sustainability in parallel with increasing customer demands and expectations, while Enquist et al. (2007) proposed a model where four dimensions of value-based service quality are incorporated with five dimensions of sustainability.

Based on the description above, Hypothesis 4 (H4) is written as follows:

2.6.4. H4: Service quality influences business sustainability

In the past decades, alliances have become a central part of most companies' competitive and growth strategies (Cui & Jiao, 2011). It is also expected that strategic alliances have a correlation with business sustainability. According to Lin (2012), alliances tend to be associated with more proactive environmental strategies. Valbuena-Hernandez & Ortiz-de-Mandojana (2022) also found that greater diversity referring to social sectors involved and longer duration partnerships improve sustainability measures, but only in responsive firms. This implies that strategic alliances have an influence on the sustainability of business.

Based on the description above, Hypothesis 5 (H5) is written as follows:

2.6.5. H5: Strategic alliance influence business sustainability

Implementation of a digital adoption strategy alone in the context of port business performance and sustainability may not be enough. A study by Sirajuddin and Sunaryo (2019) indicates that integrated information technology systems have no significant impact on port performance. Therefore, other variables should be taken for consideration as mediating variables. He et al. (2020) suggest that strategic alliances in the era driven by digital transformation deserve more development guidance. The influence of technological flexibility capability on sustainable competitive advantage is partially mediated by strategic alliances with stakeholders (Cui & Jiao, 2011). Hence, in this study, strategic alliance is considered a mediation variable between digital adoption and business sustainability.

Based on the description above, Hypothesis 6 (H6) is written as follows:

2.6.6. H6: Digital adoption influences business sustainability through strategic alliance

The logistics sector is one of the most important domains in the service sector for understanding the increasing scale of business activities along with globalization. Research by Ozbekler & Ozturkoglu (2020) shows that firms have emphasized the importance of reaching the competition by expanding their quality perceptions within the scope of corporate sustainability in parallel with increasing customer demands and expectations. Several studies also show that strategic alliances and service quality correlate with each other and have an effect on the sustainability and performance of port (Lim, 2016; Sirajuddin & Sunaryo, 2019). Hence, this study examines the effect of strategic alliance mediation on service quality and its influence on business

sustainability (Fig. 2).

Based on the description above, Hypothesis 7 (H7) is written as follows:

H7: Service quality influences business sustainability through strategic alliance.

Based on all hypothesis mentioned above, the model construct in this study is as shown below (Fig. 3).

3. Methodology

This study employs a quantitative research method with an associative and explanatory approach. The quantitative method was chosen to develop mathematical and theoretical models as well as hypotheses related to the research. Furthermore, the associative approach is a type of research that aims to explore relationships between two or more variables. Meanwhile, the explanatory approach is employed to compare the results of mathematical modelling with existing literature reviews in an effort to strengthen or refute the stated hypotheses.

3.1. Population, sample, and data collection

The population in this study was comprised of all commercial port terminals located in Indonesia. The samples taken are port business entities (non-dedicated ports or non-dedicated terminals) managed by state-owned company. Out of 102 commercial ports in Indonesia, we obtained 72 samples representing units of a state-owned company (PT. Pelindo), the largest port operator in Indonesia. These 72 samples represent at least 1 port for each major island in Indonesia, namely Java, Sumatra, Kalimantan, Sulawesi, and Papua, as well as the islands of Bali and Nusa Tenggara. The sample consisted of representatives for each port business entity who possessed a comprehensive understanding of port business conditions, such as directors, general managers, managers, or senior staff.

Data collection was conducted using Google Forms, an online survey service that facilitated the distribution of a questionnaire. The survey remained open for one week and consisted of 42 operationalization questions that described the characteristics of each variable. These questions were derived from indicators used in previous research. Specifically, the DA variable was adapted from Bastug et al.'s (2020) research; the SQ variable was adapted from research by Phan et al. (2021) and Thai (2008); the SA variable was adapted from Vitsounis & Pallis's (2012) research; and the BS variable was adapted from research by Lim et al. (2019) and Varsei et al.'s (2014).

For this research, a minimum sample size of 40 was employed to examine the relationships among the four variables. This number is based on the rule of thumb for multivariate research proposed by

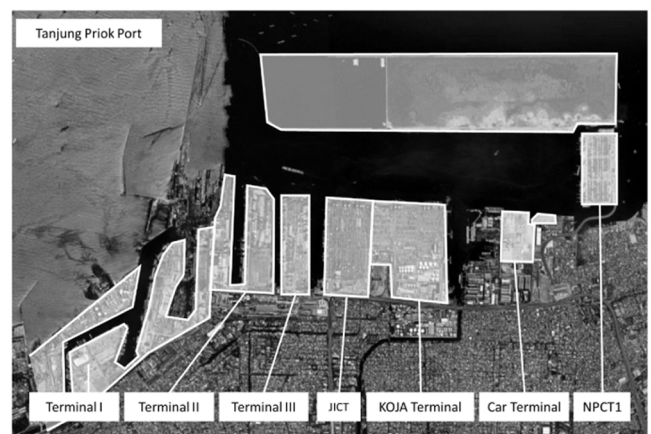


Fig. 2. Multiple Terminals in Tanjung Priok Port. Source: Indonesian Ministry of Transportation.

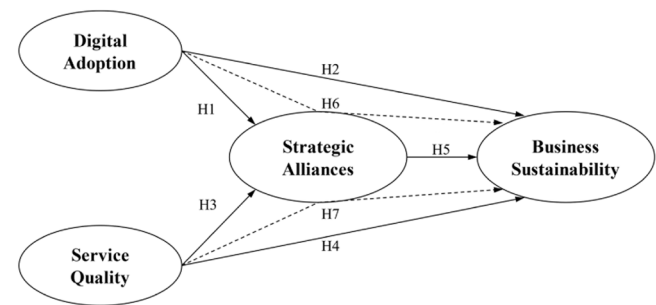


Fig. 3. Conceptual Model Framework.

Sekaran (2016). To measure the data, a commonly used 5-point Likert scale was utilized. Respondents were presented with five answer options, ranging from 1 to 5. A rating of 1 indicated "very bad," 5 indicated "very good," and 3 indicated "neutrality" (Croasmun, 2011; Likert, 1932) [Fig. 4].

3.2. Data analysis

After receiving the completed questionnaires, they were carefully reviewed and inputted into the system model. The research model was evaluated using the partial least squares (PLS) path modelling tool via Smart Partial Least Square (Smart PLS) version 4. PLS refers to a variance-based structural equation modelling (SEM) technique that is useful for evaluating complex models consisting of high-level constructs, direct associations, and mediation (Hair Jr. et al., 2021). The PLS-SEM analysis consists of a two-step approach, including validity and reliability tests for the developed questionnaire and structural model analysis to test the relationship between variables (Taliento et al., 2019).

Validity is crucial to ensuring that a questionnaire accurately measures what it intends to measure. In this research, two methods of validity, namely convergent and discriminant validity, were employed. Convergent validity is assessed through the loading factor/outer loading (OL) (≥ 0.5) and average variance extracted (AVE) (≥ 0.5) to demonstrate the extent to which the variables represent the measured construct (Bagozzi, Y, 1988; Hair Jr. et al., 2021). Discriminant validity is necessary to ascertain that a construct is distinct from other measured constructs. The Heterotrait-Monotrait Ratio (HTMT) test is utilized, with values < 0.90 indicating adequate discriminant validity (Henseler, 2015).

Reliability tests use Cronbach's Alpha (CA) (≥ 0.6) and Composite Reliability (CR) (≥ 0.7) to assess the consistency and reliability of the questionnaire. By conducting validity and reliability tests, researchers can ensure that the questionnaire used in this study is valid and reliable, thereby strengthening the research findings and increasing their dependability (Fornell & Larcker, 1981).

In this structural model, the values of r-square and f-square will be presented. The r-square value will measure the variance in the dependent variable explained by the independent variables, with recommendations by Falk and Miller (1992) for R^2 values at or above 0.10 to

establish adequate explained variance, while Chin et al. (1998) proposed assessment thresholds of 0.67 (substantial), 0.33 (moderate), and 0.19 (weak) for dependent variables. In this case, removing an independent variable can affect the dependent variable, and the f-square or f^2 will determine this effect size (≥ 0.02 is small; ≥ 0.15 is medium; ≥ 0.35 is large) (Cohen, 1988).

Furthermore, the research employed a path analysis model to examine the associative relationships between variables. Path analysis helped determine the strength of these variable influences. The path coefficients of the independent variables were assessed to gauge their impact on the dependent variable. T-values and P-values were used for hypothesis testing and evaluating the significance of direct path coefficients. If the T-value exceeded the critical value (1.96) at a 5% significance level, the null hypothesis was rejected and the alternative hypothesis was accepted, indicating significant path estimates. Moreover, if the P-value was below 0.05, the relationships were considered significant (Kock, 2016).

Finally, the research findings were further validated through explanatory analysis, comparing mathematical models with existing literature to support or refute the stated hypotheses before coming to recommendations.

4. Results

4.1. Respondents

The research survey successfully gathered responses from 77 respondents. However, for the analysis, only 72 responses were considered, representing a sample of 40 port terminals in Indonesia in Table 1.

4.2. Validity and reliability test

Once the data is collected, the research questionnaire needs to be tested to ensure measurement validity. The questionnaire is examined through two methods: validity testing and reliability testing. In this study, validity is tested using the convergent validity method by considering the values of the loading factor/outer loading (OL) and average variance extracted (AVE). Additionally, discriminant validity is assessed using the HTMT method. On the other hand, reliability is tested based on Cronbach's alpha and composite reliability. The results of the validity tests are shown in Table 2 and Table 3, while the results of reliability tests are shown in Table 4.

Based on the tables above, the results of validity and reliability testing for the questionnaire used as the research questionnaire are as follows:

- Each loading factor or outer loading value is ≥ 0.5 , indicates that the measurement indicators used have significant variation and a strong correlation with the measured construct.
- Each AVE value is ≥ 0.5 , indicates that the manifest variables effectively represent the measured constructs and show good correlation between measurements of the same construct.
- Each HTMT value is < 0.9 , shows good discriminant validity for the constructs, confirming their distinctiveness from other constructs.
- Each Cronbach's alpha value is > 0.6 , indicates that the measurement tool is reliable.

Table 1
Amount of Respondents.

Description	#	(%)
Total Considered Respondents	72	
Position		
Director/General Manager	27	38
Manager	34	47
Senior Staff	11	15

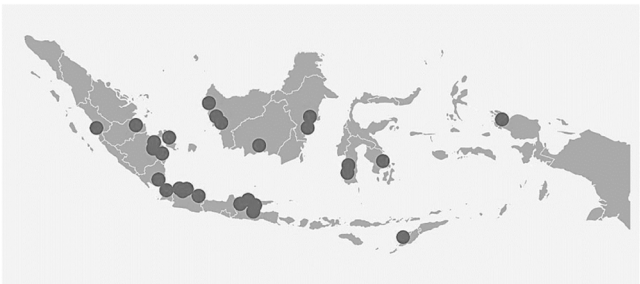


Fig. 4. Sample Distribution.

Table 2
Results of Convergent Validity Tests.

Variables and Indicators	OL	AVE
DA - Digital Adoption		0.523
DA1 – Terminal Operating and Management System	0.771	
DA2 – Auto-Gate System	0.807	
DA3 – Auto-Identification System	0.811	
DA4 – Digital Payment System	0.595	
DA5 – Electronic Data Integration	0.600	
SQ - Service Quality		0.697
SQ1 – Employee Attitude and Behavior	0.835	
SQ2 – Efficiency in Operation and Management	0.895	
SQ3 – Application of IT and EDI in Operation and Management	0.902	
SQ4 – Image and Branding	0.806	
SQ5 – Social and Environmental Strategy	0.773	
SQ6 – Availability and Quality of Equipment and Facility	0.79	
SA - Strategic Alliance		0.634
SA1 – SA with Holding and Subsidiaries Company	0.711	
SA2 – SA with Government Authorities and Institutions	0.813	
SA3 – SA with Other Port Terminals	0.839	
SA4 – SA with Stevedoring Company	0.827	
SA5 – SA with Shipping Line Company	0.798	
SA6 – SA with Marine Service Company	0.724	
SA7 – SA with Logistic Company	0.828	
SA8 – SA with Industry or Cargo Owner	0.820	
BS - Business Sustainability		0.586
BS1 – Health and Safety	0.814	
BS2 – Employee Rights	0.751	
BS3 – Corporate Social Responsibility	0.792	
BS4 – Gas Emission Management	0.845	
BS5 – Water Management	0.742	
BS6 – Energy Management	0.797	
BS7 – Waste Management	0.732	
BS8 – Strategy for Reducing Logistic Cost	0.663	
BS9 – Strategy for Regional Economy Growth	0.741	

OL: Outer Loading; AVE: Average Variance Extracted.

Table 3
Results of Discriminant Validity Tests – HTMT.

	DA	SA	BS	SQ
DA - Digital Adoption				
SA - Strategic Alliance	0.647			
BS - Business Sustainability	0.526	0.854		
SQ - Service Quality	0.203	0.331	0.319	

DA: Digital Adoption, SA: Strategic Alliance, BS: Business Sustainability, SQ: Service Quality.

Table 4
Results of Reliability Tests.

	CA	RA	CR
DA - Digital Adoption	0.77	0.795	0.843
SA - Strategic Alliance	0.914	0.951	0.932
BS - Business Sustainability	0.917	0.92	0.933
SQ - Service Quality	0.911	0.914	0.927

CA: Cronbach's Alpha; RA: rho_A; CR: Composite Reliability.

- Each composite reliability value is > 0.7 , signifies that the construct variables meet the reliability criteria, making them trustworthy in measuring the phenomena under investigation.

Therefore, it can be concluded that the questionnaire used in this research exhibits good levels of validity and reliability. As a result, it can be considered an accurate measurement tool for each variable.

4.3. Path coefficient analysis

The next step of analysis involved testing the normality of the data by applying bootstrapping with a large sample size of 5000, which was

derived from the original sample of 72. The purpose was to check for errors and calculate P-values to prove the significance of the measurement model. The significance level used in this study was 5%. Therefore, P-Values and T-values must show a significant influence with a $P < 0.05$ and $T > 1.96$ to prove the hypothesis (Kock, 2016). Path coefficient analysis is shown in Table 5.

- DA and SA have $T = 7.52$, and $P = 0.00$, which shows that DA has an influence on SA, and hence Hypothesis 1 is accepted (Fig. 5).
- DA and BS have $T = 0.0705$ and $P = 0.481$, which shows that DA has no influence on BS, and hence Hypothesis 2 is rejected.
- SQ and SA have $T = 2.463$, and $P = 0.014$, which shows that SQ has an influence on SA, and hence Hypothesis 3 is accepted.
- SQ and BS have $T = 0.889$ and $P = 0.374$, which shows that SQ has no influence on BS, and hence Hypothesis 4 is rejected.
- SA and BS have $T = 9.004$, and $P = 0.000$, which shows that SA has an influence on BS, and hence Hypothesis 5 is accepted.
- DA and BS through SA have $T = 2.327$, and $P = 0.020$, which shows that DA has an indirect influence on BS through a mediation of SA, and hence Hypothesis 6 is accepted.
- SQ and BS through SA have $T = 4.831$, and $P = 0.000$, which shows that SQ has an indirect influence on BS through a mediation of SA, and hence Hypothesis 7 is accepted.

The findings demonstrate that the development of strategic alliances is positively impacted by the deployment of digital technologies and the enhancement of service quality. The outcome also highlights how much easier it will be to achieve company sustainability when these are combined with strategic collaborations. But a crucial insight emerges: Neither digital adoption nor service quality directly affect the business sustainability (Table 6).

5. Discussion

The results of the study demonstrate the connection between digital adoption, service quality, strategic alliances, and business sustainability. Drawing on these findings and analysis in the context of port industries in developing nations such as Indonesia, the study proposes several implications that could be integrated into the strategic planning and management of port terminal operators and their related stakeholders. The following discussion will explore the implications of these findings in more detail, with the aim of facilitating policy and strategy discussions that can drive real-world change (Table 7).

5.1. Digital adoption in Indonesian port terminals: alliances and sustainability

This study's results indicate that digital adoption has a significant positive impact on strategic alliance, which aligns with the relationship that has been theorized by Gavalas et al.'s (2022) theory that digital adoption can bring new business opportunities for collaboration with strategic partners or alliances, leading to benefits for all parties involved and increased competitiveness for port terminals in the global market.

Table 5
Results of Hypotheses Tests using Path Coefficient Analysis.

Hypotheses	OS	SM	STD	T	P	Conclusion
H1 DA SA	0.534	0.542	0.071	7.502	0.000	Accepted
H2 DA BS	0.056	0.065	0.079	0.705	0.481	Rejected
H3 SQ SA	0.235	0.246	0.096	2.463	0.014	Accepted
H4 SQ BS	0.069	0.071	0.077	0.889	0.374	Rejected
H5 SA BS	0.732	0.726	0.081	9.004	0.000	Accepted
H6 DA SA BS	0.172	0.180	0.074	2.327	0.020	Accepted
H7 SQ SA BS	0.391	0.396	0.081	4.831	0.000	Accepted

OS: Original Sample; SM: Sample Mean; SD: Standard Deviation; T: T-Values; P: P-Values.

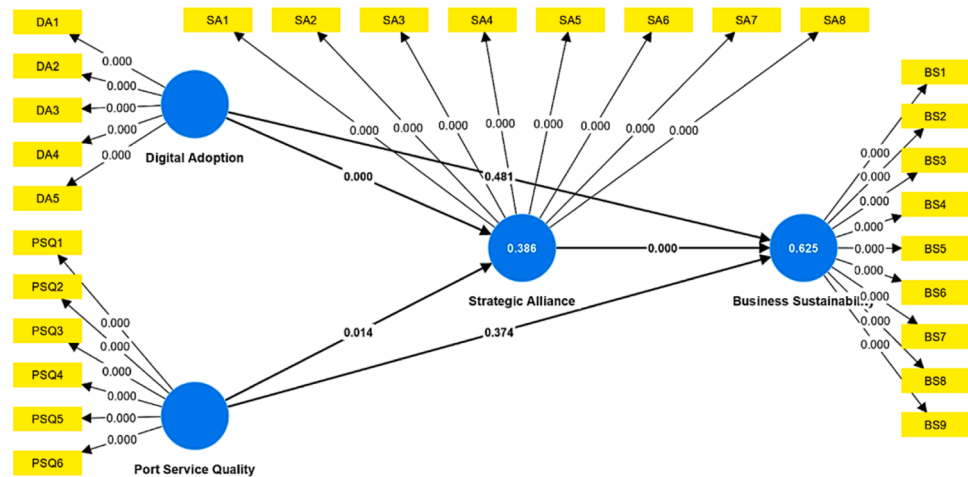


Fig. 5. Results of Path Coefficient Analysis (P Value)Based on the table and figure above, the hypothesis test can be concluded from the results of the path analysis as follows.

Table 6
Results of the R².

Dependent Variable	R ²	Category
Strategic Alliances	0.625	Moderate
Business Sustainability	0.386	Moderate

Table 7
Results of the F².

Constructs	F ²	Effect Size
DA SA	0.006	No effect
DA BS	0.449	Large
SQ SA	0.011	No effect
SQ BS	0.087	Small
SA BS	0.877	Large

Furthermore, implementing an integrated system in the port industry would lead to more efficient flows, simplify the supply chain, reduce pollutants, and promote sustainable practices, as exemplified by Gonzalez Aregall et al. (2018) in Auckland’s port.

However, despite these efforts, our research shows that digital adoption in Indonesia’s commercial ports doesn’t have a crucial role in affecting its business sustainability, which contradicts much of the existing research in the field. Although a study by Sirajuddin and Sunaryo (2019) found that Integrated Technology Systems in Indonesia’s ports don’t have a significant effect on port operational performance either.

This raises the question of what might be missing in the process of digital adoption in Indonesia’s ports. It is possible that the current maturity level of digital adoption in port terminal operations is a contributing factor. Indonesian port terminals may adopt technologies and digital transformations on an organizational basis to improve efficiency and reduce costs, but if many processes and operations are still manual and require safety improvements, it means that numerous systems are still ineffective (Sinay, 2021). Indeed, the absence of research on the digital maturity of Indonesia’s port terminals makes it difficult to draw definitive conclusions. But if this is the case, it suggests that Indonesian port terminals need to implement a digital strategic alliance or digital service collaboration model that goes beyond the existing service which aligns with the study’s result that strategic alliance has a mediator role of these influences. By improving infrastructure efficiency and digital collaboration at a cluster or regional level, these terminals can achieve efficiencies and business sustainability that were previously

unattainable (Toh et al., 2010).

5.2. Service quality in Indonesian port terminals: alliances & sustainability

The results of analysis indicate that service quality has a significant influence on strategic alliance. While the effect of SQ on SA has been previously described by Kontovas & Psaraftis (2011), this relationship has not been empirically tested in Indonesia’s context, especially after the increase in strategic alliances. This study also uncovers a novel dimension by revealing that the connection between service quality and business sustainability gains its true potential when channelled through the conduit of strategic alliances.

Continuous improvement in Indonesia’s commercial port terminals’ service quality is essential to enhance the port terminal’s reputation and attractiveness for other companies to cooperate or form strategic alliances. A port terminal that provides fast, safe, and reliable services can attract large logistics companies to collaborate, resulting in increased shipping volume and revenue for the port terminal. Additionally, this can lead to cost savings for businesses and increased competitiveness in the region’s supply chain management.

Moreover, from a RBV perspective, excellent port terminal service quality can be a critical resource to facilitate the formation of strategic alliances that may lead to the combination of resources and the transfer of technology and knowledge, elevating the port terminal’s overall quality and tendency to have better business sustainability. Such alliances can create opportunities for local communities to learn new skills and promote economic growth in the region. By focusing on improving service quality and forming strategic alliances, it is possible to develop future-oriented strategies that are more feasible to achieve.

On the other hand, the study results show that SQ does not have a direct connection or impact on business sustainability, which contrasts with the findings of previous research by C. C. Chang & Wang (2012) and Moon & Woo (2014). It may be assumed that Indonesia’s port terminal companies are most likely to see business sustainability solutions as involving renewable energy usage, waste reduction, compliance with strict environmental regulations, or implementing green practices in their operations. Hence, the impact of improving service quality on sustainability may be relatively small compared to these other initiatives. Even though Roh et al. (2023) research on Korean ports concluded that the key factors in ensuring a port’s sustainable development is optimized operation planning, internal environment, and social management or programs were the least significant practices by Korean port managers.

6. Conclusions

The present study aimed to explore the influences of digital adoption and service quality on business sustainability through strategic alliances in Indonesia's commercial port terminals. To achieve this objective, a structural equation modelling (SEM) model was constructed to examine the direct correlations between these variables. The research findings provide valuable insights, particularly from the perspective of the resource-based view (RBV).

First, the study revealed significant positive connections between some variables. Digital adoption was found to be positively correlated with strategic alliances, suggesting that embracing digital technologies can create collaborative business opportunities that benefit all parties involved. Additionally, service quality demonstrated a direct positive relationship with strategic alliances, implying that reliable services can attract partnerships with strategic players, leading to increased shipping volume and revenue for the ports. Moreover, the presence of strategic alliances was positively correlated with business sustainability, indicating their potential role in enhancing sustainable practices within the port industry.

Second, the study's hypotheses regarding the significant impacts of digital adoption and service quality on business sustainability did not find strong support. However, both factors could have indirect impacts when channelled through strategic alliances. The results suggest that the level of digital adoption in Indonesian port terminals at an individual level may not be effective enough to make significant differences in business sustainability. Therefore, digital collaboration across sectors becomes imperative. Furthermore, good terminal port service quality can be a crucial tool for facilitating the creation of strategic alliances that may result in the pooling of resources and the transfer of knowledge and information, raising the overall quality of the port terminal and its propensity to be more sustainable.

These findings provide support and enrich the RBV theory in the port terminal industry by highlighting that digital adoption can be regarded as a strategic resource. Embracing digital technologies allows port companies to optimize their operations and achieve business sustainability. Similarly, service quality, when seen as a critical resource, showcases the firm's capability to deliver high-grade services, potentially enticing strategic alliances. Once again, strategic alliances can be perceived as vehicles for resource exchange and integration, thereby contributing to the firm's resource base and ultimately amplifying its business sustainability.

7. Limitation & future research

Despite the valuable insights gained from this study, it is essential to recognize its limitations. The sample of this study is limited to commercial ports in Indonesia for the purpose of focusing on port business entities. Furthermore, the commercial ports taken as samples are limited only to the branches of PT. Pelindo, the largest port operator in Indonesia (a state-owned enterprise).

Even though these samples already represent all the main islands in Indonesia, the sample size could be increased to represent the extensive number of ports and terminals more accurately in Indonesia. This enlargement could also encompass private commercial ports, non-commercial ports, and dedicated terminals, offering a more comprehensive perspective of the industry.

8. Research implication

Strategic alliances seem to be a high priority for regulators, operators, and related stakeholders in improving business sustainability by involving them in planning, action, and monitoring and taking into account the surrounding environmental and social conditions. With these steps, it is expected that port operators can still continue to make profits while contributing to the economy, social, and environment.

It should be noted by each party that solely implementing digital technology would not have a positive impact on business sustainability. In this regard, the regulator needs to encourage business port stakeholders to collaborate as a strategic alliance as well as to adopt digital technology. One of the policies that could be applied by the Indonesian government is the establishment of the Port Community System (PCS). Port Community Systems (PCS) are inter-organizational software platforms that connect port community actors, enabling commercial services and information exchange between the port to its customers and a variety of stakeholders (Moros-Daza et al., 2020).

References

- Adabere, S., Owusu Kwateng, K., Dzidzah, E., & Kamewor, F. T. (2021). Information technologies and seaport operational efficiency. *Marine Economics and Management*, 4(2). <https://doi.org/10.1108/maem-03-2021-0001>
- Agatić, A., & Kolanović, I. (2020). Improving the seaport service quality by implementing digital technologies (University of Rijeka, Faculty of Maritime Studies Rijeka) *Pomorstvo*, 34(1), 93–101. <https://doi.org/10.31217/p.34.1.11>
- min, C., Mulyati, H., Anggraini, E., & Kusumastanto, T. (2021). Impact of maritime logistics on archipelagic economic development in eastern Indonesia. In *Asian Journal of Shipping and Logistics*, 37 pp. 157–164. <https://doi.org/10.1016/j.ajsl.2021.01.004>
- Ashrafi, M., Acciaro, M., Walker, T. R., Magnan, G. M., & Adams, M. (2019). Corporate sustainability in Canadian and US maritime ports. *Journal of Cleaner Production*, 220, 386–397. <https://doi.org/10.1016/j.jclepro.2019.02.098>
- Ashrafi, M., Walker, T. R., Magnan, G. M., Adams, M., & Acciaro, M. (2020). A review of corporate sustainability drivers in maritime ports: a multi-stakeholder perspective. *Maritime Policy and Management*, 47(8), 1027–1044. <https://doi.org/10.1080/03088839.2020.1736354>
- Bagozzi, R. P., & Y. Y. (1988). On the Evaluation of Structural Equation Models. *Journal of the Academy of Marketing Science*.
- Basole, R. C., & Nowak, M. (2018). Assimilation of tracking technology in the supply chain. *Transportation Research Part E: Logistics and Transportation Review*, 114. <https://doi.org/10.1016/j.tre.2016.08.003>
- Bastug, S., Arabelen, G., Vural, C. A., & Deveci, D. A. (2020). A value chain analysis of a seaport from the perspective of Industry 4.0 (Inderscience Publishers) In *International Journal of Shipping and Transport Logistics*, 12(4), 367–397. <https://doi.org/10.1504/IJSTL.2020.108405>
- Bouncken, R. B., & Fredrich, V. (2016). Business model innovation in alliances: Successful configurations. *Journal of Business Research*, 69(9). <https://doi.org/10.1016/j.jbusres.2016.01.004>
- Capgemini D.T. Institute. (2017). *The Discipline of Innovation*.
- Carayannis, E. G. (2000). Investigation and validation of technological learning versus market performance (In) *Technovation*, 20 (In) (www.elsevier.com/locate/technovation).
- Carlan, V., Sys, C., Vanelslander, T., & Roumboutsos, A. (2017). Digital innovation in the port sector: Barriers and facilitators. *Competition and Regulation in Network Industries*, 18(1–2). <https://doi.org/10.1177/1783591717734793>
- Caylan, D. O., & Emiroglu, Ç. (2014). The Importance Of Strategic Leadership for Port Management: A Delphi Research On Top Managers Of Turkish Private Ports. *Journal of Global Strategic Management*, 2(8), 5. <https://doi.org/10.20460/jgsm.2014815637>
- Chandra, D. R., & Van Hillegersberg, J. (2017). Governance lifecycles of inter-organizational collaboration: A case study of the Port of Rotterdam. *Procedia Computer Science*, 121. <https://doi.org/10.1016/j.procs.2017.11.086>
- Chang, C. C., & Wang, C. M. (2012). Evaluating the effects of green port policy: Case study of Kaohsiung harbor in Taiwan. *Transportation Research Part D: Transport and Environment*, 17(3). <https://doi.org/10.1016/j.trd.2011.11.006>
- Child, J. (1987). Child - 1987 - Information Technology, Organization, and the Response to Strategic Challenge. *California Management Review*, 33.
- Chin, W. W., Chin, W. W., & Chin, W. W. (1998). In G. A. Marcoulides (Ed.), *The partial least squares approach to structural equation modelling*, 295 p. 2). Modern Methods for Business Research.
- Christodoulou, A., & Woxenius, J. (2019). Sustainable short sea shipping. In *Sustainability (Switzerland)* (11, 10). MDPI. (<https://doi.org/10.3390/su11102847>).
- Clark, X., Dollar, D., & Micco, A. (2004). Port efficiency, maritime transport costs, and bilateral trade. *Journal of Development Economics*, 75(2 SPEC. ISS.), 417–450. <https://doi.org/10.1016/j.jdeveco.2004.06.005>
- Clott, C., & Hartman, B. C. (2016). Supply chain integration, landside operations and port accessibility in metropolitan Chicago. *Journal of Transport Geography*, 51. <https://doi.org/10.1016/j.jtrangeo.2015.12.005>
- Cohen, J. (1988). *Statistical power analysis for the behavioural sciences*. Hillsdale, NJ: Lawrence Erlbaum Associates.,
- Croasmun, J. T. (2011). Using Likert-Type Scales in the Social Sciences. In *Journal of Adult Education*, 40(1).
- Cronin, J. J., & Taylor, S. A. (1992). Measuring Service Quality: A Reexamination and Extension (In) *Source: Journal of Marketing*, 56(3).
- Cui, Y., & Jiao, H. (2011). Dynamic capabilities, strategic stakeholder alliances and sustainable competitive advantage: Evidence from China. *Corporate Governance*, 11 (4). <https://doi.org/10.1108/14720701111159235>

- Denktas-Sakar, G., & Karatas-Cetin, C. (2012). Port sustainability and stakeholder management in supply chains: A framework on resource dependence theory. *Asian Journal of Shipping and Logistics*, 28(3). <https://doi.org/10.1016/j.ajsl.2013.01.002>
- DHL (2023). DHL Sustainability Report of 2022.
- Evans, S., Vladimirova, D., Holgado, M., Van Fossen, K., Yang, M., Silva, E. A., & Barlow, C. Y. (2017). Business Model Innovation for Sustainability: Towards a Unified Perspective for Creation of Sustainable Business Models. *Business Strategy and the Environment*, 26(5), 597–608. <https://doi.org/10.1002/bse.1939>
- Enquist, B., Edvardsson, B., & Petros Sebhatu, S. (2007). Values-based service quality for sustainable business. *Managing Service Quality*, 17(4). <https://doi.org/10.1108/09604520710760535>
- Falk, R.F., & Miller, N.B. (1992). A Primer for Soft Modeling. *The University of Akron Press, April*.
- Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, 18(1). <https://doi.org/10.1177/002224378101800104>
- Gavalas, D., Syriopoulos, T., & Roupis, E. (2022). Digital adoption and efficiency in the maritime industry. *Journal of Shipping and Trade*, 7(1). <https://doi.org/10.1186/s41072-022-00111-y>
- Geleilate, J. M. G., Parente, R. C., & Talay, M. B. (2021). Can systems integration lead to improved performance? The role of strategic alliances. *Industrial Marketing Management*, 95. <https://doi.org/10.1016/j.indmarman.2021.03.002>
- Gillan, S. L., Koch, A., & Starks, L. T. (2021). Firms and social responsibility: A review of ESG and CSR research in corporate finance. *Journal of Corporate Finance*, 66. <https://doi.org/10.1016/j.jcorpfin.2021.101889>
- González, A. R., González-Cancelas, N., Serrano, B. M., & Orive, A. C. (2020). Preparation of a Smart Port Indicator and Calculation of a Ranking for the Spanish Port System. *Logistics*, 4(2). <https://doi.org/10.3390/logistics4020009>
- Gonzalez Aregall, M., Bergqvist, R., & Monios, J. (2018). A global review of the hinterland dimension of green port strategies. *Transportation Research Part D: Transport and Environment*, 59, 23–34. <https://doi.org/10.1016/j.trd.2017.12.013>
- González-Cancelas, N., Molina Serrano, B., Soler-Flores, F., & Camarero-Orive, A. (2020). Using the SWOT Methodology to Know the Scope of the Digitalization of the Spanish Ports. *Logistics*, 4(3). <https://doi.org/10.3390/logistics4030020>
- Ha, M. S. (2003). A comparison of service quality at major container ports: Implications for Korean ports. *Journal of Transport Geography*, 11(2). [https://doi.org/10.1016/S0966-6923\(02\)00069-8](https://doi.org/10.1016/S0966-6923(02)00069-8)
- Hair Jr., Joseph F. Hult, G. Tomas M. Ringle, Christian M. Sarstedt, Marko Danks, Nicholas P. Ray, Soumy (2021). *Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R*. doi: 10.1007/978-3-030-80519-7 (<https://library.oapen.org/handle/20.500.12657/51463>).
- Haralambides, H. E. (2019). Gigantism in container shipping, ports and global logistics: a time-lapse into the future. *In Maritime Economics and Logistics*, 21(1). <https://doi.org/10.1057/s41278-018-00116-0>
- Hassan, S. U., Haddawy, P., & Zhu, J. (2014). A bibliometric study of the world's research activity in sustainable development and its sub-areas using scientific literature. *Scientometrics*, 99(2), 549–579. <https://doi.org/10.1007/s11192-013-1193-3>
- He, Q., Meadows, M., Angwin, D., Gomes, E., & Child, J. (2020). Strategic Alliance Research in the Era of Digital Transformation: Perspectives on Future Research. *British Journal of Management*, 31(3). <https://doi.org/10.1111/1467-8551.12406>
- Heilig, L., Lalla-Ruiz, E., & Voß, S. (2017). Digital transformation in maritime ports: analysis and a game theoretic framework. *NETNOMICS: Economic Research and Electronic Networking*, 18(2–3), 227–254. <https://doi.org/10.1007/s11066-017-9122-x>
- Henseler, J. (2015). *Discriminant Validity: Check Out How To Use The New HTMT Criterion ! A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*.
- Huang, S. T., & Yoshida, S. (2013). Analysis of key factors for formation of strategic alliances in liner shipping company: service quality perspective on Asia/Europe route after global economic crisis. *International Journal of Economics and Management Engineering*, 7, 78.
- Iman, N., Amanda, M. T., & Angela, J. (2022). Digital transformation for maritime logistics capabilities improvement: cases in Indonesia. *Marine Economics and Management*, 5(2), 188–212. <https://doi.org/10.1108/maem-01-2022-0002>
- Indonesian Government (2021). Indonesian Government Regulation no 31 year 2021.
- Jaafar, H. S., Aziz, M. L. A., Ahmad, M. R., & Faisol, N. (2021). Creating innovation in achieving sustainability: Halal-friendly sustainable port. *Sustainability (Switzerland)*, 13(23). <https://doi.org/10.3390/su132313339>
- Juan, C., Olmos, F., & Ashkeboussi, R. (2008). Private-public partnerships as strategic alliances: Concession contracts for port infrastructures. *Transportation Research Record*, 2062. <https://doi.org/10.3141/9062-01>
- Kantabutra, S., & Ketprapakorn, N. (2020). Toward a theory of corporate sustainability: A theoretical integration and exploration (Elsevier Ltd.) *In Journal of Cleaner Production*, 270. <https://doi.org/10.1016/j.jclepro.2020.122292>
- Kim, G. S., Lee, E. S., & Kim, B. K. (2022). Strategic port management by consolidating container terminals. *Asian Journal of Shipping and Logistics*, 38(1), 19–24. <https://doi.org/10.1016/j.ajsl.2021.11.003>
- Kock, N. (2016). Hypothesis testing with confidence intervals and P values in PLS-SEM. *In International Journal of e-Collaboration*, 12(3). <https://doi.org/10.4018/IJEC.2016070101>
- Koilo, V. (2019). Sustainability issues in maritime transport and main challenges of the shipping industry. *Environmental Economics*, 10(1), 48–65. [https://doi.org/10.21511/ee.10\(1\).2019.04](https://doi.org/10.21511/ee.10(1).2019.04)
- Kontovas, C., & Psaraftis, A. H. N. (2011). Reduction of emissions along the maritime inter modal container chain: Operational models and policies. *Maritime Policy and Management*, 38(4). <https://doi.org/10.1080/03088839.2011.588262>
- Kraus, S., Jones, P., Kailer, N., Weinmann, A., Chaparro-Banegas, N., & Roig-Tierno, N. (2021). Digital Transformation: An Overview of the Current State of the Art of Research. *SAGE Open*, 11(3). <https://doi.org/10.1177/21582440211047576>
- Kurniasari, F., Lestari, E. D., & Tannady, H. (2023). Pursuing Long-Term Business Performance: Investigating the Effects of Financial and Technological Factors on Digital Adoption to Leverage SME Performance and Business Sustainability—Evidence from Indonesian SMEs in the Traditional Market. *Sustainability (Switzerland)*, 15(16). <https://doi.org/10.3390/su151612668>
- Kusuma, L. T. W. N., & Tseng, F. S. (2019). Analysis of the impact of the “sea toll” program for seaports: Resilience and competitiveness. *Applied Sciences (Switzerland)*, 9(16). <https://doi.org/10.3390/a>
- Lam, J. S. L., & Yap, W. Y. (2019). A stakeholder perspective of port city sustainable development. *Sustainability (Switzerland)*, 11(2). <https://doi.org/10.3390/su11020447>
- Le, D. N., Nguyen, H. T., & Hoang Truong, P. (2020). Port logistics service quality and customer satisfaction: Empirical evidence from Vietnam. *Asian Journal of Shipping and Logistics*, 36(2), 89–103. <https://doi.org/10.1016/j.ajsl.2019.10.003>
- Likert, R. (1932). *A technique for the measurement of attitudes*.
- Lim, S., Pettit, S., Abouarghoub, W., & Beresford, A. (2019). Port sustainability and performance: A systematic literature review. *Transportation Research Part D: Transport and Environment*, 72, 47–64. <https://doi.org/10.1016/j.trd.2019.04.009>
- Lin, H. (2012). Strategic Alliances for Environmental Improvements. *Business and Society*, 51(2). <https://doi.org/10.1177/0007650312437918>
- López, R. C., & Poole, N. (1998). Quality assurance in the maritime port logistics chain: The case of Valencia, Spain. *In Supply Chain Management*, 3(1). <https://doi.org/10.1108/13598549810200915>
- Maersk Line. (2023). *Maersk Sustainability Report of 2022*.
- Mamedio, D., Rocha, C., Szczepanik, D., & Kato, H. (2019). Strategic alliances and dynamic capabilities: a systematic review (Emerald Group Holdings Ltd.) *In Journal of Strategy and Management* (Vol. 12, (Issue 1), 83–102. <https://doi.org/10.1108/JMSA-08-2018-0089>
- Meyer, C., Gerlitz, L., Philipp, R., & Paulauskas, V. (2021). A digital or sustainable small and medium-sized port? Sustainable port blueprint in the baltic sea region based on port benchmarking. *Transport and Telecommunication*, 22(3), 332–342. <https://doi.org/10.2478/tjt-2021-0026>
- Moon, D. S. H., & Woo, J. K. (2014). The impact of port operations on efficient ship operation from both economic and environmental perspectives. *Maritime Policy and Management*, 41(5). <https://doi.org/10.1080/03088839.2014.931607>
- Moros-Daza, A., Amaya-Mier, R., & Paternina-Arboleda, C. (2020). Port Community Systems: A structured literature review. *Transportation Research Part A: Policy and Practice*, 133, 27–46. <https://doi.org/10.1016/j.tra.2019.12.021>
- Muñuzuri, J., Onieva, L., Cortés, P., & Guadix, J. (2020). Using IoT data and applications to improve port-based intermodal supply chains. *Computers and Industrial Engineering*, 139. <https://doi.org/10.1016/j.cie.2019.01.042>
- Ozbekler, T. M., & Ozturkoglu, Y. (2020). Analysing the importance of sustainability-oriented service quality in competition environment. *Business Strategy and the Environment*, 29(3). <https://doi.org/10.1002/bse.2449>
- Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1985). . A Conceptual Model of Service Quality and Its Implications for Future Research. *In Source: Journal of Marketing*, 49(4) (Autumn).
- Parola, F., Risitano, M., Ferretti, M., & Panetti, E. (2017). The drivers of port competitiveness: a critical review. *Transport Reviews*, 37(1), 116–138. <https://doi.org/10.1080/01441647.2016.1231232>
- Paulauskas, V., Filina-dawidowicz, L., & Paulauskas, D. (2021). Ports digitalization level evaluation. *Sensors*, 21(18). <https://doi.org/10.3390/s21186134>
- Pham, T. Y. (2023). A smart port development: Systematic literature and bibliometric analysis. *Asian Journal of Shipping and Logistics*. <https://doi.org/10.1016/j.ajsl.2023.06.005>
- Phan, T. M., Thai, V. V., & Vu, T. P. (2021). Port service quality (PSQ) and customer satisfaction: an exploratory study of container ports in Vietnam. *Maritime Business Review*, 6(1), 72–94. <https://doi.org/10.1108/MABR-01-2020-0003>
- Philosophian, M., Akhavan, P., & Abbasi, M. (2021). Strategic alliance for resilience in supply chain: A bibliometric analysis. *Sustainability (Switzerland)*, 13(22). <https://doi.org/10.3390/su132212715>
- Rodrigo González, A., González-Cancelas, N., Molina Serrano, B., & Orive, A. C. (2020). Preparation of a Smart Port Indicator and Calculation of a Ranking for the Spanish Port System. *Logistics*, 4(2). <https://doi.org/10.3390/logistics4020009>
- Roh, S., Thai, V. V., Jang, H., & Yeo, G. T. (2023). The best practices of port sustainable development: a case study in Korea. *Maritime Policy and Management*, 50(2), 254–280. <https://doi.org/10.1080/03088839.2021.1979266>
- Rosário, A.T. (2022). *The Organizational Impact of Digital Adoption*. <https://doi.org/10.4018/978-1-7998-9008-9.ch002>
- Sarkis, J. (2021). Supply chain sustainability: learning from the COVID-19 pandemic. *International Journal of Operations and Production Management*, 41(1), 63–73. <https://doi.org/10.1108/IJOPM-08-2020-0568>
- Sekaran, U. (2016). *Research Methods For Business A Skill Building Approach*. (www.wileypluslearningspace.com).
- Senarak, C. (2020). Shipping-collaboration model for the new generation of container port in innovation district: A case of Eastern Economic Corridor. *Asian Journal of Shipping and Logistics*, 36(2). <https://doi.org/10.1016/j.ajsl.2019.11.002>
- Sinay (2021). *5 Steps to Become a Smart Port*.
- Sirajuddin, Z., & Sunaryo, T. Y. (2019). Effect of strategic alliance based on port characteristic and integrated global supply chain for enhancing industrial port performance. *Cogent Business and Management*, 6(1), 1–14. <https://doi.org/10.1080/23311975.2019.1567893>

- Suriyankietkaew, S., & Petison, P. (2020). A retrospective and foresight: Bibliometric review of international research on strategic management for sustainability, 1991–2019 (MDPI). In *Sustainability (Switzerland)*, 12(1), 1–27. <https://doi.org/10.3390/SU12010091>.
- Syapsan. (2019). The effect of service quality, innovation towards competitive advantages and sustainable economic growth: Marketing mix strategy as mediating variable. *Benchmarking*, 26(4). <https://doi.org/10.1108/BIJ-10-2017-0280>
- Sys, C., & Vanelslander, T. (2020). Future maritime supply networks: Key issues in and solutions. In *Maritime Supply Chains*. <https://doi.org/10.1016/B978-0-12-818421-9.00013-6>
- Taliento, M., Favino, C., & Netti, A. (2019). Impact of environmental, social, and governance information on economic performance: Evidence of a corporate “sustainability advantage” from Europe. *Sustainability (Switzerland)*, 11(6). <https://doi.org/10.3390/su11061738>
- Thai, V. V. (2008). Service quality in maritime transport: Conceptual model and empirical evidence. *Asia Pacific Journal of Marketing and Logistics*, 20(4), 493–518. <https://doi.org/10.1108/13555850810909777>
- Tijan, E., Jović, M., Aksentijević, S., & Pucihar, A. (2021). Digital transformation in the maritime transport sector. *Technological Forecasting and Social Change*, 170. <https://doi.org/10.1016/j.techfore.2021.120879>
- Toh, K. K. T., Welsh, K., & Hassall, K. (2010). A Collaboration Service Model for a Global Port Cluster. In *International Journal of Engineering Business Management*, 2(1).
- Ugboma, C., Ogwude, I. C., Ugboma, O., & Nnadi, K. (2007). Service quality and satisfaction measurements in Nigerian ports: An exploration. *Maritime Policy and Management*, 34(4). <https://doi.org/10.1080/03088830701539073>
- UNCTAD. (2022). *Review of Maritime Transportation*.
- Valbuena-Hernandez, J. P., & Ortiz-de-Mandojana, N. (2022). Encouraging corporate sustainability through effective strategic partnerships. *Corporate Social Responsibility and Environmental Management*, 29(1). <https://doi.org/10.1002/csr.2188>
- Varadarajan, P. R., & Cunningham, M. H. (1995). Strategic Alliances a Synthesis of Conceptual Foundations. *Journal of the Academy of Marketing Science*, 23(4), 282–296.
- Varsei, M., Soosay, C., Fahimnia, B., & Sarkis, J. (2014). Framing sustainability performance of supply chains with multidimensional indicators. *Supply Chain Management*, 19(3), 242–257. <https://doi.org/10.1108/SCM-12-2013-0436>
- Vitsounis, T.K., & Pallis, A.A. (2012). *Port value chains and the role of interdependencies*. (<https://www.researchgate.net/publication/281610713>).
- Vrontis, D., Chaudhuri, R., & Chatterjee, S. (2022). Adoption of Digital Technologies by SMEs for Sustainability and Value Creation: Moderating Role of Entrepreneurial Orientation. *Sustainability (Switzerland)*, 14(13). <https://doi.org/10.3390/su14137949>
- Wang, L., Zhou, Z., Yang, Y., & Wu, J. (2020). Green efficiency evaluation and improvement of Chinese ports: A cross-efficiency model. *Transportation Research Part D: Transport and Environment*, 88. <https://doi.org/10.1016/j.trd.2020.102590>
- World Bank. (2023). *Logistic Performance Index 2023*.
- World Port Sustainability Program. (2020). *World Port Sustainability Report 2020*.
- Zen, F., & Yudhistira, M.H. (2021). *Maritime Highway and Eastern Indonesia Development*.