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# The Effects of Implementing Sustainability and Digitalization Management on Small Shipping Companies' Competitive Advantage

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Competitive Advantage, Dynamic Capabilities, Service Capabilities, Sustainability, Digitalization, Small Shipping Companies

**Abstract**
Sustainability and digitalization have been important issues for the world shipping industry in recent years. Shipping companies need to address these issues to be able to thrive for the long run, including the small shipping companies in Indonesia. However, there has not been any empirical study on the effects of implementing sustainability and digitalization management on the competitive advantage of small shipping companies. This study aims to analyze the effects of sustainability and digitalization management, termed Sustainable Shipping Management (SSM) and Shipping Digitalization Management (SDM) respectively, on Indonesian small shipping companies' competitive advantage (SCA). Since Dynamic Capabilities (DC) and Service Capabilities (SC) are considered to be essential capabilities in creating sustainable competitive advantage based on Resource-Based View (RBV) theory, this study focuses on the roles of DC and SC in mediating the SSM and SDM effects on SCA. It utilized survey method on top management of Indonesian small shipping companies. It used sample from the population, selected using non-probability sampling technique and purposive sampling method. There were 185 respondents from 170 companies qualified to participate in this study. The result shows that SSM and SDM positively affects SCA, either directly or indirectly via the mediations of DC and/or SC. SSM and SDM are both found to contain the elements of DC and SC, therefore their implementations are important for the companies to create and maintain competitive advantage. It provides insights for the owners or the management of Indonesian small shipping companies on how to allocate their limited resources in SSM and SDM to build and strengthen their competitive advantages. It also calls for policies and incentives developed and created by the government and related agencies to assist the small shipping companies to implement sustainable management and conduct digital transformation.



## 1. Introduction

International Maritime Organization (IMO) has identified two issues that are going to reshape the world shipping industry: sustainability (IMO, 2021c) and digitalization (IMO, 2020). With stricter regulation on sustainability (IMO, 2021b) and rapid growth of digital technology it is very imperative for shipping companies to address these issues appropriately, including shipping companies in Indonesia. Sustainable Shipping Management (SSM) and Shipping Digitalization Management (SDM) are the effects of these efforts.

The implementation of sustainable business activities and digitalization, however, are very challenging for Indonesian shipping companies as most of them are categorized as small shipping companies (INSA, 2018). Within this category the companies usually possess limited resources that become barriers to perform sustainable business activities and digitalization (Baycik & Gowda, 2023), (Caballero-Morales, 2021), (Zayed & Yaseen, 2021). Moreover, given today's increased demand from stakeholders for companies to comply with sustainability requirements (IMO, 2021b; Arsenault, 2020; Rousseau and Deschacht, 2020) and intense effect of Industrial Revolution 4.0 towards shipping industry (Aiello et al., 2020), shipping companies need to address these issues simultaneously.

The companies' inability to address these issues will negatively affect their competitive advantages (Cohen, 2023; Hsiao, 2024) and, thus, their business survival. In logistic industry, competitive advantage can be created from dynamic capabilities (Chen, Fung, & Yuen, 2019) and/or service capabilities (Lai, 2004). Hence, drawing from Resource-Based View (RBV) theory (Barney, 1991), it can be argued that implementing SSM and SDM is important for Indonesian small shipping companies to create and maintain their competitive advantages through their dynamic capabilities and/or service capabilities.

Currently there have been quite a number of studies analyzing the relationship between sustainability and the competitive advantage of companies in various industries and countries (Kwarteng, Dadzie, & Famiyeh, 2016); (Walsh & Dodds, 2017); (Cantele & Zardini, 2018); (Gutiérrez-Martínez & Duhamel, 2019). Several studies had analyzed the relationship between sustainability and competitive advantage of companies in the liner shipping industry (Shin & Thai, 2016); (Jozef, Kumar, Iranmanesh, & Foroughi, 2019). However, a study that also analyzes this relationship within small shipping companies management in developing countries such as Indonesia has not yet been found.

The relationship between digitalization and competitive advantage has been widely studied. One of these studies was conducted by (Knudsen, Lien, Timmermans, Belik, & Pandey, 2021) that concluded the more digitalization, in this case the impact of managing Big Data and its networks, complements a business model, the greater the possibility of forming a large and sustainable competitive advantage. The topic of digitalization in small and medium sized enterprises (SME) has also been widely researched. One of these studies is by (Eller, Alford, Kallmünzer, & Peters, 2020) that formulated the background, consequences and challenges of digital implementation in SMEs. This research encourages further research in different geographic regions and on the impact of different digital adoption and transformation scenarios on SME performance.

The relationship between DC and firm performance has been a topic of many studies (Lin & Wu, 2014); (Makkonen, Pohjola, Olkkonen, & Koponen, 2014); (Kuo, Lin, & Lu, 2017); (Wilden, Gudergan, Nielsen, & Lings, 2013); (Chen et al., 2019). Several studies have been conducted within the scope of analyzing the relationship between sustainable management and DC, such as the application and role of DC for corporate sustainability programs (Beske, 2012), analysis of factors that support the development of DC into sustainable management (Castiaux, 2012), (Cezarino, Alves, Caldana, & Liboni, 2019), and the impact of DC on corporate sustainability performance (Eikelenboom & de Jong, 2019); (Shang, Chen, & Li, 2020). However, there were only several studies that analyzed the relationship between sustainable management and DC (de Moura & Saroli, 2021) and no research has been found that analyzes whether implementing sustainable management enable a company to create DC which leads to the development of competitive advantage.

The relationship between SC and company performance has also been analyzed by quite a number of researches (Lai, 2004); (Ching Chiao Yang, Marlow, & Lu, 2009); (Ho & Chang, 2015); (Chung Shan Yang & Lirn, 2017); (Valtakoski & Witell, 2018). However, no research has been found that specifically analyzes the relationship among sustainability, SC and the competitive advantage of small companies.

To the best of author's knowledge, there is a lack of prior study that investigates the effects of implementing SSM and SDM on small shipping companies' competitive advantage (SCA) in developing countries. There is also a lack of prior studies confirming the effects of SSM and SDM on SCA either directly of indirectly mediated by DC and SC. To bridge this gap the current study aims to analyze the effects of implementing SSM and SDM on SCA. Subsequently the mediating roles of DC and SC on the effects of SSM and SDM on SCA are also examined. A proposed conceptual model is developed based on RBV to link SSM, SDM, DC, SC and SCA, while also find the mediating effects of DC and SC in the relationships among SSM, SDM and SCA.

Following this section are the literature review, conceptual framework and hypotheses development. After that the methodology of this study is discussed, then results, discussions, conclusions, implications, limitations and recommendations are presented

## 2. Materials and Methods

Measurement

This study collected data from owners or top management of Indonesian small shipping companies (respondents) by using a survey questionnaire consists of 33 questions with 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The questions in the questionnaire were structured from the following sources:

1) Sustainable Shipping Management was measured by seven questions following (Yuen, Li, Xu, Wang, & Wong, 2019);
2) Shipping Digitalization Management was measured by nine questions following (Vogelsang, Liere-Netheler, Packmohr, & Hoppe, 2018), (Bavassano, Ferrari, & Tei, 2020) and (Tran, Yuen, Li, Balci, & Ma, 2020);
3) Dynamic Capabilities consisted of nine questions adapted from (Kuo et al., 2017);
4) Service Capabilities consisted of six questions also adapted from (Kuo et al., 2017);
5) Small Shipping Enterprise Competitive Advantage was measured in two attributes following (Correia, Dias, & Teixeira, 2020).

This study used statistical tools including the confirmatory factor analysis (CFA) to verify whether the measures of a variable are consistent with the theories, the structural equation modelling (SEM) to quantify the effects across variables, and the multiple regression analysis to analyze the structural relationship of the model. Specifically it used LISREL to conduct the SEM. The usage of these statistical tools was intended to test the aforementioned twelve hypotheses.

Sampling Technique

The current study was based on empirical research involving primary data. The preliminary data has been collected first-hand through the survey. Secondary data had been utilized only for identifying the population of this study, in this case the latest edition of the Directory of Indonesian National Ship-owners Association (INSA, 2018).

The population used in this study was Indonesian small shipping companies registered with INSA. This study was able to collect 170 samples from 185 respondents in the period of January until August 2023. The number of samples collected exceeds the minimum sample size required to conduct structural equation analysis, that is twenty times the number of independent variables (sample-to-variable ratio of 20:1) (Hair, WC, BJ, & RE, n.d.).

The following criterias were used to select sample companies in the purposive sampling method in order to obtain reliable data regarding the Indonesian small shipping companies' competitive advantage and its relation with sustainability and digitalization:

a. the shipping company is located in an Indonesian provincial capital or in a city with the minimum population of 1.000.000 people;
b. the shipping company holds Indonesian sea transportation business license (SIUPAL – surat ijin usaha pelayaran angkutan laut); and
c. the shipping company operates only the following vessel types: cargo vessel, landing crafts, tug boats and barges or combination of these vessels.

The respondents of this study consist of the owners or top management of the Indonesian small shipping companies. Several companies that had participated in this study had more than one respondent because they are family businesses in the middle of regeneration or they have senior managers that had been with companies for more than 10 years and had been entrusted in making some strategic decisions for the companies

## 3. Results and Discussions

### Descriptive Statistics

**Table 1**
Demographic profile of the samples and respondents

| | Frequency | Percentage |
|---|---|---|
| *Sample locations* | | |
| Greater Jakarta | 58 | 34.12 |
| Java excluding Greater Jakarta | 65 | 38.23 |
| Kalimantan | 34 | 20.00 |

| | | |
|---|---|---|
| Sumatera | 7 | 4.12 |
| Sulawesi | 5 | 2.94 |
| Others | 1 | 0.59 |
| *Sample age* | | |
| 1 – 25 years | 145 | 85.30 |
| 26-50 years | 23 | 13.53 |
| > 50 years | 2 | 1.17 |
| *Sample Fleet Type* | | |
| Landing Crafts (LCT) | 36 | 21.18 |
| Tug and Barge | 68 | 40.00 |
| Cargo Vessels | 66 | 38.82 |
| *Respondents Age* | | |
| < 35 years | 24 | 12.97 |
| 35 – 55 years | 135 | 72.98 |
| 56 – 70 years | 23 | 12.43 |
| > 70 years | 3 | 1.62 |

**Table 2**
Descriptive statistic result for variable

| | Mean | Std. Dev. | Description |
|---|---|---|---|
| Sustainable Shipping Management | 4.01 | 0.49 | Agree |
| Shipping Digitalization Management | 3.76 | 0.65 | Slightly agree |
| Dynamic Capabilities | 3.96 | 0.51 | Agree |
| Service Capabilities | 4.05 | 0.39 | Agree |
| Small Shipping Enterprise Competitive Adv. | 3.83 | 0.68 | Slightly agree |

Table 2 presented descriptive statistics of each construct. The results showed that respondents had opinions of Sustainable Shipping Management (SSM), Dynamic Capabilities (DC) and Service Capabilities (SC) in the level of agreement, while the opinions of Shipping Digitalization Management (SDM) and Small Shipping Enterprise Competitive Advantage (SCA) were in slightly agree level.

The variable SSM had higher mean value than SDM because respondents believed that their companies had already met stakeholders' demand and requirements. These shipping companies had already complied with regulation and business ethics such as paying required taxes, compensating their employees according to industry standard, and providing complete and accurate information related to their services to customers. Regarding the compliance with environmental standard, the respondents believed that operating the latest version of marine engines, installing required ship waste processing systems and using current industry's approved marine products constituted the real evidence of sustainable technology application in their business activities.

The variable SDM had the lowest mean value because respondents stated that the organizational aspects can be found in their shipping companies while the environmental aspects can vaguely be recognized. Respondents agreed that their shipping companies received full support and commitments from the owners or top management to manage the digital transformation. However, within the environmental aspects, they were not sure if complying with customers' requirements could be categorized as having cooperation with stakeholders (customers, suppliers, regulators) to manage digital transformation. Moreover, these shipping companies stated that they had never been given any clear

direction from the regulator, in this case the government of Indonesia, about the digital transformation in shipping industry.

**Confirmatory Factor Analysis (CFA)**

Confirmatory factor analysis (CFA) was used to determine whether the measures of each construct are consistent with the theories. Based on the CFA of each variable shown on Table 3, all indicators used to construct the variables are valid with the loading factor value greater than 0.5 (Hair et al., n.d.) This implies that all indicators are good measurements of each construct.

**Table 3**
Confirmatory Factor Analysis

| Variables | Average Variance Extracted (AVE) | Construct Reliability (CR) |
|---|---|---|
| | *Degree of Acceptance > 0.5* | *Degree of Acceptance > 0.7* |
| SSM | 0.652 | 0.929 |
| SDM | 0.715 | 0.957 |
| DC | 0.735 | 0.961 |
| SC | 0.677 | 0.926 |
| SCA | 0.921 | 0.959 |

**Structural Equation Modeling (SEM)**

The structural equation model (SEM) was utilized to investigate the mediating roles of Dynamic Capabilities and Service Capabilities in the effects of Sustainable Shipping Management and Shipping Digitalization Management on Small Shipping Enterprise Competitive Advantage. The final result was in Figure 2, and the model's goodness of fit and the degree of acceptance were presented in Table 4.

**Figure 2**
The result of Structural Equation Modeling (SEM)

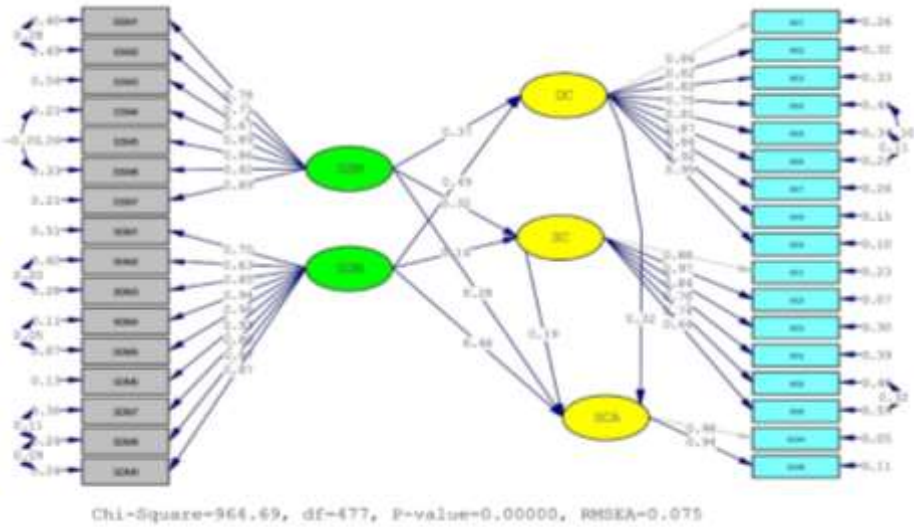

**Table 4**
The goodness of fit of Structural Equation Modeling

| Statistics to measure consistency | Degree of acceptance | Result |
|---|---|---|
| *Absolute Fit Test* | | |
| RMSEA | ≤ 0.08 | 0.075 |
| SRMR | ≤ 0.05 | 0.033 |
| *Incremental Fit Measures* | | |
| NFI | > 0.90 | 0.95 |
| TLI | > 0.90 | 0.97 |
| CFI | > 0.90 | 0.97 |
| IFI | > 0.90 | 0.97 |
| *Parsimonious Fit Measures* | | |
| PGFI | ≥ 0.50 | 0.65 |
| PNFI | ≥ 0.50 | 0.86 |

Table 5 presented interesting findings. All the direct correlations among variables have p-value < 0.05, which means that all correlations are statistically significant and all hypoth eses are supported. However, none of them have strong correlation based on Pearson Correlation Coefficient (Hair et al., n.d.). Only Shipping Digitalization Management – Small Shipping Enterprise Competitive Advantage and Shipping Digitalization Management – Dynamic Capabilities correlations are considered to have moderate correlations while the rest have low correlations.

The results of the indirect correlations among variables were presented in Table 6. Sobel Test was used to determine the mediating effect in each hypothesis. Based on these tests all mediating variables are determined to have partial mediation roles. This means even without the mediating roles of Dynamic Capabilities and Service Capabilities the variables Sustainable Shipping Management and Shipping Digitalization Management still affect Small Shipping Enterprise Competitive Advantage significantly.

**Table 5**
Direct correlations among variables

| Hypothesis | Variables | Coefficients | Standard Error | P-value | Results |
|---|---|---|---|---|---|
| 1 | SSM -----> SCA | 0.28 | 0.044 | 0.0000 | Supported |
| 2 | SDM -----> SCA | 0.46 | 0.050 | 0.0000 | Supported |
| 3 | SSM -----> DC | 0.37 | 0.064 | 0.0000 | Supported |
| 4 | SDM -----> DC | 0.49 | 0.067 | 0.0000 | Supported |
| 5 | SSM -----> SC | 0.32 | 0.075 | 0.0000 | Supported |
| 6 | SDM -----> SC | 0.16 | 0.073 | 0.0298 | Supported |
| 7 | DC -----> SCA | 0.32 | 0.051 | 0.0000 | Supported |
| 8 | SC -----> SCA | 0.19 | 0.039 | 0.0000 | Supported |

**Table 6**
Indirect correlations among variables

| Hypothesis | Variables | Indirect Effect | P-value | Results |
|---|---|---|---|---|
| 9 | SSM -> DC -> SCA | 0.37 x 0.32 = 0.12 | 0,0000 | Partial Mediation |

| | | | | |
|---|---|---|---|---|
| 10 | SDM -> DC -> SCA | 0.49 x 0.32 = 0.16 | 0,0000 | Partial Mediation |
| 11 | SSM -> SC -> SCA | 0.32 x 0.19 = 0.06 | 0,0013 | Partial Mediation |
| 12 | SDM -> SC -> SCA | 0.16 x 0.19 = 0.03 | 0,0496 | Partial Mediation |

## Discussion

### The effects of Sustainable and Digitalization Management on Small Shipping Enterprise Competitive Advantage

This study finds that SSM and SDM have positive effects on SCA. As shipping industry is considered to be a high-risk industry (Hasanspahić, Frančić, Vujičić, & Maglić, 2020) the implementation of SSM and SDM assists Indonesian small shipping companies to minimize operating risks and to meet customers' demand and requirements. The ability to minimize risks and meet customers' demand and requirements will result in the development of competitive advantage.

The presence of SSM elements in Indonesian small shipping companies' managements was strongly related to the profiles of this study's sample companies. The majority of these companies had landing crafts, tug boats and barge vessels that had been designed and utilized to provide shipping services to mining, oil and gas industries. In order to serve companies in these industries shipping companies must comply with the industry's requirements that have high safety, environmental and good governance standards.

Digitalization also helped Indonesian small shipping companies to meet those mining, oil and gas industry's requirements, especially in the safety aspects. Digital map and GPS (Global Positioning System) technology, for example, were very useful for shipping companies to plan the safest passageways with the most efficient fuel consumption. This allowed shipping companies to reduce operating costs and offer safe shipping services at competitive rates, which would make the companies to be competitive in the market.

### The effects of Sustainable and Digitalization Management on Dynamic Capabilities

SSM and SDM are found to have positive effects on DC. This study finds that small Indonesian shipping companies had good relationships with their stakeholders (society, employees, customers, shareholders and regulators). This good relationship could help the company to have better sensing and seizing capabilities. The owners and top management of shipping companies participated in this study believed that communication with its customers can help the companies to collect data and information about potential changes in customers' demand. This in turn would assist the companies to anticipate and make necessary adjustments to meet with the changing customers' demand.

The use of digital technology in the operations of small Indonesian shipping companies helps strengthening of their sensing capabilities. Collected operational data, such as trends in cargo locations and the most economical shipping routes, can be processed and presented more easily, thereby helping management to design and implement appropriate company strategies. As Indonesian small shipping companies that participated in this study were mostly under 25 years old they had been in operation along with the rapid development of information technology and, therefore, had become accustomed to exploiting information technology for their interests.

### The effects of Sustainable and Digitalization Management on Service Capabilities

This research finds that SSM and SDM have positive effects on SC. The shipping companies participated in this study and implemented SSM stated that they had good access to a qualified workforce and had good communication with their customers. The availability of these qualified employees made the companies to be more confident in being able to provide safe and timely shipping services at competitive prices. In addition to that, good communication with customers ensured that the company can fulfill its obligations and responsibilities as a cargo carrier to meet customers' demand.

SDM also supported these companies to have service capabilities. One concrete example of this was the use of a fuel management system (FMS) on vessels owned by several shipping companies participated in this study. The installation and usage of FMS equipment was usually required for vessels chartered for a certain period (time charter) by mining, oil and gas companies. FMS provided information on engine performance, fuel consumption and ship location directly to charterers so they could get objective and real-time data.

### The effects of Dynamic Capabilities and Service Capabilities on Small Shipping Enterprise Competitive Advantage

Both DC and SC are found to have positive effects on SCA. This study confirms that DC has positive effects on SCA. The respondents of this study stated that small Indonesian shipping companies have the ability to search and discover business opportunities in shipping industry that is highly competitive. The companies' strategic locations in big cities in Indonesia of which some of their ports become transit hubs were the main drive of the formation of dynamic capabilities. Being in these strategic locations bolstered shipping companies' capabilities to scan the market and seize business opportunities while also reconfigure their assets and resources to meet customers' demand.

The respondents of this study also indicated that small Indonesian shipping companies had the ability to provide quality services at competitive prices. In a highly segmented shipping industry where each segment has its own niche market (for example, ferries for passenger transportation, crew boats for offshore services, and wooden cargo ships for interinsular shipping) having competitive rates and on-time delivery were more important than applying differentiation strategy. Therefore having service capabilities was very important for Indonesian small shipping companies to create and maintain competitive advantage.

**The mediating roles of Dynamic Capabilities and Service Capabilities**

Both DC and SC have partial mediating roles in the effects of SSM and SDM on SCA. The main reason for these partial mediating roles is because both SSM and SDM have elements of DC and SC in them. Therefore, without mediating roles of DC and SC both SSM and SDM still have positive effects on SCA.

Sensing capabilities in DC, for example, can be found clearly in the customers aspect of SSM. The ability to search for and discover customer needs is closely related to the company's ability to provide complete and accurate information about its products and services to customers. Several respondents of this study stated that through the dissemination of product and service information, a shipping company will obtain information from its customers not only about what the customers' expect and demand, but also what its competitors' offers and their capabilities.

This result is in line with a study conducted by (Hong, Zhang, & Ding, 2018). The study found that the companies that implemented sustainability management usually have stronger dynamic capability than companies that did not implement it. The companies that implemented sustainability management were better equipped to deal with the market changes.

Regarding the implementation of SDM in shipping companies participated in this study, the availability and optimal use of information technology was found to facilitate companies to find (sensing) and fulfill (seizing) customer needs more effectively. This finding is in line with the result of a study conducted by (Davies, Bustinza, Parry, & Jovanovic, 2023) which found that digitalization has a positive impact on company performance in various forms of service aspects. The role of digitalization is more effective for companies that focus on services that support customers (SSC or services supporting customers) such as the information technology used by shipping companies.

In addition to that, SDM allows data and information from the market to be collected and processed more quickly and comprehensively so as to support the company's ability to detect new business opportunities or possible new threats in the market. Efforts to seize new business opportunities or prevent new threats in the market are carried out through SC by offering basic and value-added services to customers and potential service users.

## 4. Conclusion

There have been abundant research studies analyzing shipping industry in Asia Pacific in general and in developing countries like Indonesia in particular. Although some studies have been conducted analyzing Indonesian small shipping companies, they had not been conducted as extensive as this study in terms of the number of owners or top management involved and the geographical areas covered. Most of the previous studies focused on either sustainability or digitalization in shipping industry, and their respondents were mostly employees, customers or service users in one specific area that did not have access to the strategic decision making process of the top management of small shipping companies.

The novelty of present study is significant as no prior study explored the mediating roles of dynamic capabilities and service capabilities in the effects of sustainability and digitalization management on small shipping companies' competitive advantage. With the stricter regulations on sustainability and rapid development and application of digital technology in the world shipping industry today both SSM and SDM become strategically important to be implemented. As DC and SC were found by many studies to be important factors in creating sustainable competitive advantage and their elements were found in both SSM and SDM, this study finds that the implementation of SSM and SDM are critical for Indonesian small shipping companies to thrive and be competitive in the long run.

This study has demonstrated that both DC and SC partially mediate the effects of SSM and SDM on SCA. Implementation of SSM and SDM was found to automatically create and develop DC and SC. Therefore by implementing SSM and SDM the Indonesian shipping companies are concurrently creating and developing their capabilities of creating and maintaining competitive advantage in the forms of DC and SC. The significant outcome from this finding is that it confirms the importance of managing sustainability and digitalization for small shipping companies and therefore it acts as a trigger for greater focus on these two issues within the companies.

This study successfully contributes to the strategic decision making process of small shipping companies that have limited resources in creating and maintaining their competitive advantage. The study shows that SDM have stronger correlation with DC and SCA. Therefore it is suggested that, under the condition of having limited resources, Indonesian small shipping companies prioritize the implementation of SDM over SSM to be in better position to create and maintain competitive advantage. This finding is interesting because SDM was found to be the least developed among the companies participated in this study yet its implementation was found to be strategically more important for Indonesian shipping companies to achieve sustainable competitive advantage.

The data collected by this study suggests that the owners and top management of Indonesian small shipping companies had strong commitments in implementing SDM. However there was still a lack of stakeholders' support in digital transformation, especially from the regulators to provide necessary direction and assistance. This study indicates that more involvements from stakeholders will positively affect the technological aspects of SDM and thus supports the Indonesian small shipping companies profoundly to maintain competitive advantage in the rapidly changing shipping industry.

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