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THE ROLE OF DIGITAL TRANSFORMATION IN MODERATING THE INFLUENCE OF GREEN INNOVATION CAPABILITY ON SUPPLY CHAIN RESILIENCE AND COMPETITIVE ADVANTAGE

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Abstract: Digital transformation and breakthrough innovations that contain concern for the environment can answer the target of reducing logistics costs and regulatory provisions which ultimately become a source of excellence for companies and maintain company's supply chain resilience. The aim is to explore digital transformation role and the ability to innovate in generating supply chain resilience and competitive advantage for companies. This research was conducted on 168 stevedoring service companies in 5 major Indonesian ports that are members of the Association of stevedoring companies in Indonesia. Data was collected through the distribution of questionnaires via Google Forms, and subsequently analyzed using descriptive and inferential statistics. The study found that companies with strong green innovation capabilities had higher supply chain resilience and competitive advantage. Digital transformation for companies weakens the ability to innovate green in gaining supply chain resilience as long as the breakthrough innovation made is not related to technology adaptation. Different results show that digital transformation strengthens the ability to innovate green and generate competitive advantages for companies. The findings of this study provide further evidence to support the theory of competitive advantage based on the resource-based view (RBV).

Keywords: stevedoring, digital transformation, green innovation, supply chain resilience, competitive advantage

Abstrak: *Transformasi digital dan terobosan inovasi yang mengandung kepedulian terhadap lingkungan dapat menjawab sasaran penurunan biaya logistik dan ketentuan regulasi yang pada akhirnya menjadi sumber keunggulan bagi perusahaan serta menjaga ketahanan rantai pasok perusahaan. Penelitian ini bertujuan mengeksplorasi peranan transformasi digital dan kemampuan berinovasi dalam menghasilkan ketahanan rantai pasok dan juga keunggulan bersaing bagi perusahaan. Penelitian ini dilakukan pada 168 perusahaan jasa bongkar muat di 5 pelabuhan utama Indonesia yang tergabung dalam asosiasi perusahaan bongkar muat di Indonesia. Pengumpulan data dilakukan dengan cara mengedarkan kuesioner menggunakan google form dan selanjutnya dilakukan pengolahan data dan analisa baik analisa statisik deskriptif dan analisis statistik inferensial. Hasil penelitian menunjukkan bahwa kemampuan berinovasi hijau perusahaan bongkat muat memberikan sumbangan dalam peningkatan ketahanan rantai pasok perusahaan. Demikian juga kemampuan berinovasi hijau memberikan kontribusi dalam peningkatan keunggulan bersaing perusahaan. Dengan adanya transformasi digital bagi perusahaan justru memperlemah kemampuan berinovasi hijau dalam mendapatkan ketahanan rantai pasok sepanjang terobosan inovasi yang dilakukan tidak berkaitan dengan adaptasi teknologi. Hasil yang berbeda menunjukkan bahwa adanya transformasi digital justru memperkuat kemampuan berinovasi hijau dalam menghasilkan keunggulan bersaing bagi perusahaan. Hasil penelitian ini memperkaya temuan empiris dalam pembuktian teori keunggulan bersaing berbasis resource base view (RBV).*

Kata kunci: *bongkar muat, transformasi digital, inovasi hijau, rantai pasok, keunggulan bersaing*

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INTRODUCTION

Stevedoring business activities at the port in recent years have transformed the use of resources at the port. Businesses operating at ports, including stevedoring service providers, must integrate digital technology into their processes to efficiently deliver customer products and services. Major port managers in Indonesia have implemented the use of digital technology in business and administrative processes, which requires business partners to adjust their respective business processes in partnership with port managers. In addition, every business actor in the port work environment needs and demands compliance with international maritime standard regulations emphasizing environmental care. This aligns with the provisions of international maritime agreements related to carbon emissions in the fuels used.

This makes every business actor in the port environment also allocate their business operational strategies to efforts to make breakthrough innovations that favour environmental concerns. Every business operating at the port needs to transform their business processes and adapt to customer needs proactively. This is essential to own the supply chain resilience and at the same time, gain a competitive advantage for the company.

The stevedoring business at the port, which is known to rely more on human resources in its business process at the port, cannot ignore the demand for services that favour environmental concerns. For stevedoring service business actors to maintain business existence in the form of supply chain resilience, breakthrough steps for green innovation cannot be avoided.

The ability to innovate green is a must in the transformation program of stevedoring companies' business activities. Previous empiricists confirm that green-minded innovations contribute to increasing company competitiveness (Tu and Wu, 2021). Other empiricists also show that companies that have a more innovative environment will be more resilient to disruption due to innovation. The benefits obtained by the company, either directly or indirectly, will help the company strengthen its ability to respond positively to the worst due to the uncertainty of the business environment and competition situation (Sabahi and Parasat, 2019).

Stevedoring service companies, known to rely more dominantly on human resources, are faced with optimizing their resources to make breakthrough innovations that answer stakeholder demands. The extent to which breakthrough innovations in the colour of environmental concern will contribute to supply chain resilience for loading and loading companies still requires further testing. Likewise, the extent to which breakthrough innovations in favor of environmental concerns will also contribute to increasing competitive advantage.

The development of mandatory digitalization implementation around ports is also a challenge for stevedoring service companies to deliver their products and services at a more efficient cost, maintain business resilience, and also customer satisfaction. Previous empirical studies have shown that digital transformation carried out by port operators shows significant results in terms of increased productivity, efficient costs and increased customer satisfaction (Vrakas et al. 2020). Other empiricists show that digital transformation accompanied by innovation contributes to increasing the durability and competitiveness of container shipping companies (Balci, 2021).

The extent to which digital transformation is accommodated by stevedoring companies that will support companies in making breakthrough green innovations to increase supply chain resilience and at the same time to increase competitive advantage also requires study considering that previous empirical evidence is not yet available.

This study is based on the theory of resource base view (RBV) which focuses on aspects of dynamic capabilities owned by companies. The assumption that the resources owned by the company can be the main capital in generating competitive advantage as long as it is handled effectively and how to drive the dynamic capabilities owned by the company (Barney, 2021). Breakthrough innovation and also adapting external resources by transforming are the hallmarks of empowering the company's dynamic capabilities. This study aimed to investigate the claims that innovative and environmentally conscious service products can improve a company's supply chain resilience. Additionally, the research sought to address the assertion that demolition companies' adoption of digital transformation can enhance resilience and confer competitive advantages.

METHODS

This research is classified as explanatory research with a quantitative method approach. The research will focus on stevedoring business that are members of the Association of Indonesian Stevedoring Companies (APBMI). Stevedoring business is a service company that handles the unloading and loading of goods from and onto ships as well as delivering and receiving goods from and to the owner of the goods at seaport. The research was conducted from March to April 2023. The population is several stevedoring companies that are members of APBMI in 5 (five) major ports in Indonesia, namely Tanjung Priok, Jakarta, Semarang, Surabaya, Belawan and Makassar, which is as many as 285 stevedoring companies. To determine the number of samples, the Slovin formula (Solimun et al. 2018) was used so that the minimum number of samples was 166. The number of samples used in this study was 168 companies. The sampling technique is carried out by a proportional random sampling technique. The data collection mechanism is carried out by distributing questionnaires to selected respondents using random results from Google Docs. The study data was measured using a 5-point Likert scale with the following range: strongly disagree, disagree, neutral, agree, and strongly agree. Moreover, descriptive statistical analysis was used to analyze the data, and inferential statistical analysis was carried out using the multivariate analysis method.

The study has four variables, including one exogenous variable (green innovation), two endogenous variables (supply chain resilience and competitive advantage), and one moderation variable (digital transformation). Refer to Table 1 for variable definitions.

Green innovation was initially perceived in the form of breakthrough innovations related to sustainable development. Consumer awareness of sustainability has increased in its development, so business people use it as a business model based on green innovation. (Guinot et al. 2022).

Supply chain resilience which is defined as the company's adaptive ability to the supply chain which is useful for reducing unanticipated disruptions, maintaining control, recovering and responding to overcome disruptions and restoring supply chains to be strong again (Ivanov, 2021). Previous empirical showed that the ability to innovate increases supply chain resilience (Sabahi and Parasat, 2019; Alhakimi et al. 2022).

Table 1. Defenition of operation variable

Variable	Indicator	Source
Green Innovation Capability (GIC)	environmentally friendly business processes (GIC1)	Zameer et al. (2022)
	equipment maintenance processes based on minimal pollution (GIC2)	
	low-carbon emission service products (GIC3)	
	service-based products prioritizing environmental health (GIC4)	
Supply Chain Resilience (SCR)	overcoming to recover quickly (SCR1)	Liu et al. (2018)
	bounce back to better conditions (SCR2)	
	anticipating financial resilience from worse conditions (SCR3)	
	Maintaining service levels from weakening partnership (SCR4)	
Competitive Advantage (CA)	human resources are more reliable (CA1)	Sigalas and Papadakis (2018)
	pioneers fulfill customer desires (CA2)	
	leading the way in new services (CA3)	
	excelling in service in markets (CA4)	
	more efficient quality (CA5)	
	more competitive prices (CA6)	
Digital Transformation (DT)	digitizing all business processes (DT1)	Shehadeh et al. (2023)
	encouraging new business processes built on technology (DT2)	
	integrating digital tech with partners (DT3)	
	Interaction with customers utilizing digital tech (DT4)	

The ability to innovate green besides aiming to show a sense of responsibility for the environment can also be a capability capital for companies that is useful in generating competitive advantages for companies. Several empirical results showed that green innovation contributes to competitive advantages for companies (Tu and Wu, 2021; Gurleck and Tuna, 2018; Sellitto et al. 2020; Roespinoedji, 2019).

The companies that have supply chain resilience are reflected in the company's internal support in managing supply chains as well as the agility of collaboration and engineering or restructuring business processes that have an impact on increasing the company's competitive advantage (Abeysekara et al. 2019).

Digital transformation carried out by companies is not limited to digitalization which emphasizes information processing but is aimed in making breakthrough innovations that will strengthen supply chain resilience. (Sabahi and Parasat, 2019; Zhang et al. 2021)

Based on a series of empirical reviews conducted earlier, the study aims to establish a relationship between various variables. The theoretical basis used is the resource-based view (RBV) theory. This theory emphasizes that a company's efforts in empowering its resources through breakthrough innovations and technological adaptation (digital transformation) can increase supply chain resilience and become a source of competitive advantage. The research model has been reconstructed and presented in Figure 1, and hypotheses can be built accordingly:

H1. Green Innovation Capability is positively associated with Supply Chain Resilience
H2. Green Innovation Capability is positively associated with Competitive Advantage
H3. Supply Chain Resilience is positively associated with Competitive Advantage
H4. The Role of Digital Transformation in moderating the Influence of Green Innovation Capability on Supply Chain Resilience
H5. The Role of Digital Transformation in moderating the Influence of Green Innovation Capability on Competitive Advantage

RESULTS

To ensure the questionnaire is valid and reliable, it's tested before distributing it to the target respondents. A sample of 30 respondents was chosen randomly for the questionnaire testing, which showed a correlation coefficient value above 0.3 for all questionnaire items, indicating validity. Similarly, all questionnaire items had a Cronbach Alpha value above 0.6, indicating reliability. The results of testing the questionnaire instrument as illustrated in Table 2 show that all questionnaire items have a correlation coefficient value above 0.3 so that it is concluded to be valid for use. Likewise, testing the reliability of the questionnaire instrument showed that all questionnaire items had a Cronbach Alpha value above 0.6 so it could be concluded to be reliable for use (Solimun et al. 2017).

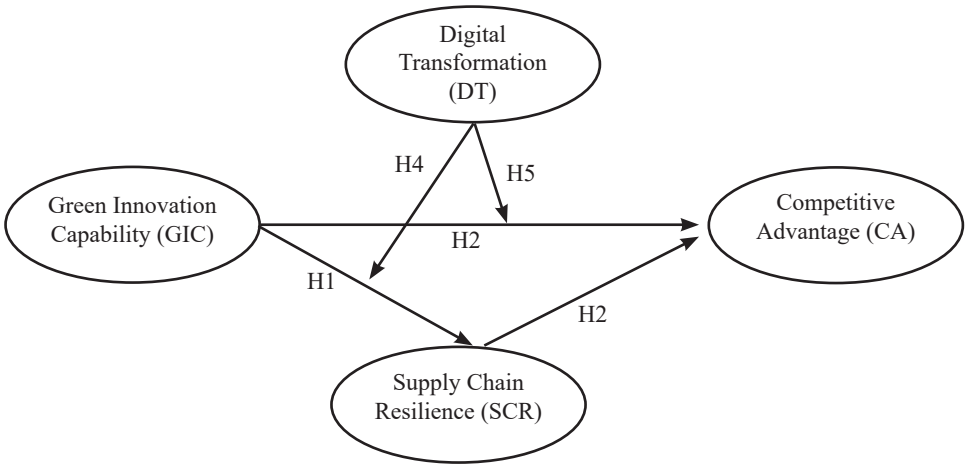

Figure 1. The proposed model

Table 2. Validity and reliability tests

Variable	Item	Loading Factor	Cronbach Alpha	Description
Green Innovation Capability (GIC)	Innovating environmentally friendly business processes (GIC1)	0.824	0.852	Valid & Reliable
	Innovating equipment maintenance processes based on minimal pollution (GIC2)	0.830		Valid & Reliable
	Innovating low-carbon emission service products (GIC3)	0.840		Valid & Reliable
	Innovating service-based products prioritizing environmental health (GIC4)	0.836		Valid & Reliable
Supply Chain Resilience (SCR)	Overcome to recover quickly (SCR1)	0.812	0.855	Valid & Reliable
	Bounce back to a better condition (SCR2)	0.876		Valid & Reliable
	Anticipate financial resilience from worsening environmental conditions (SCR3)	0.841		Valid & Reliable
	Can maintain the level of stevedoring services from weakening port authority partnerships (SCR4).	0.811		Valid & Reliable
Competitive Advantage (CA)	Human resources are more reliable (CA1)	0.718	0.879	Valid & Reliable
	Pioneers fulfill customer desires (CA2)	0.855		Valid & Reliable
	Leading the way in new services (CA3)	0.841		Valid & Reliable
	Excelling in service in markets (CA4)	0.836		Valid & Reliable
	More efficient quality (CA5)	0.775		Valid & Reliable
	More competitive prices (CA6)	0.713		Valid & Reliable
Digital Transformation (DT)	Digitize all business processes (DT1)	0.806	0.832	Valid & Reliable
	Encourage new business processes (DT2)	0.761		Valid & Reliable
	Integrate digitalization with partners (DT3)	0.850		Valid & Reliable
	Interaction processes to customers utilizing digital technology (DT4)	0.845		Valid & Reliable

According to Table 3, the data processing results indicate that 24% or 41 companies are less than 5 years old, 27% are aged between 5-10 years, 31% are between 11-15 years old, and 18% are over 15 years old. When we consider the size of the companies in terms of the number of employees, there are 34% or 58 companies with less than 25 employees, 28% or 47 companies with 25-50 employees, 17% with 51-75 employees, and 21% or 34 companies with more than 75 employees. Moreover, when we analyze the respondents' position level in the company, there are 107 people or 63% with the position level of general manager and 61 people or 37% with the position level of director.

According to the results of the latest test, which describes the variables in Table 4, the mean values of each variable are as follows: green innovation ability -3.9, supply chain resilience -4.2, competitive advantage -3.8, and digital transformation -4.1. Each variable is represented by an indicator that has the highest loading factor. For instance, the ability to innovate variable is represented by the indicator with the highest loading factor value of 0.840, which is innovating low-carbon emission service products. Similarly, the indicator with the highest loading factor value of 0.876 represents the supply chain resilience variable, which is bouncing back to a better condition. The indicator with the highest loading factor value of 0.855 represents the competitive advantage variable, which is meeting customer needs ahead of time. Lastly, the indicator with the highest loading factor value of 0.850 represents the digital transformation variable, which is integrating digital technology with partners.

This result indicates that the respondents perceive that stevedoring companies carry out digital transformation by integrating digital technology with corporate partners such as port operators. Similarly, respondents perceive that stevedoring companies emphasize producing service products with low carbon emissions when making breakthroughs in green innovation.

Table 3. Respondent Profil

Parameters		Number of Company	Percentage (%)
Company Age (year)	< 5	41	24%
	5–10	46	27%
	11–15	52	31%
	>15	29	18%
Firm Size (number of employee)	< 25	58	34%
	25–50	47	28%
	51–75	29	17%
	>75	34	21%
Respondent Status/Position	General Manager	107	63%
	Director	61	37%

Table 4. Mean and loading factor

Variable	Mean	Indicator	Mean	Loading factor	Description
Green Innovation Capability (GIC)	3.9	GIC1	4.1	0.824	Valid
		GIC2	4.1	0.830	Valid
		GIC3	3.7	0.840	Valid
		GIC4	3.8	0.836	Valid
Supply Chain Resilience (SCR)	4.2	SCR1	4.3	0.812	Valid
		SCR2	4.1	0.876	Valid
		SCR3	4.2	0.841	Valid
		SCR4	4.3	0.811	Valid
Competitive Advantage(CA)	3.8	CA1	3.9	0.718	Valid
		CA2	3.8	0.855	Valid
		CA3	3.6	0.841	Valid
		CA4	3.6	0.836	Valid
		CA5	3.9	0.775	Valid
		CA6	3.7	0.713	Valid
Digital Transformation (DT)	4.1	DT1	4.2	0.806	Valid
		DT2	3.9	0.761	Valid
		DT3	4.0	0.850	Valid
		DT4	4.2	0.845	Valid

The survey respondents perceive that the ability to recover from setbacks is the most important factor for supply chain resilience. On the other hand, when it comes to gaining a competitive advantage, the respondents believe that meeting the customers' needs at a higher level than competitors is crucial.

The outer model review of the research model was tested for validity, as presented in Table 4 of the test results. The findings indicate that all indicators meet the requirements for convergent validity as the total loading factor value is above 0.6, which demonstrates a strong correlation between indicators representing the four variables (Solimun et al. 2017). This means that all indicators representing the four variables and scores obtained by different indicators or obtained by different variables measuring the same concept show a high correlation

Another validity test, the discriminant validity provision, was conducted to determine that different construct gauges should not correlate with each other. The test results in Table 5 exhibit that the loading factor value of each indicator is higher than the cross-loading, signifying that all indicators meet the requirements for discriminant validity.

Table 5. Discriminant validity test

Variable	AVE	Indicator	GIC	SCR	CA	DT
Green Innovation Capability (GIC)	0.698	GIC1	0.824	0.045	0.084	-0.224
		GIC2	0.830	0.076	-0.203	0.080
		GIC3	0.840	0.021	-0.084	0.082
		GIC4	0.836	-0.149	0.221	0.053
Supply Chain Resilience (SCR)	0.666	SCR1	- 0.165	0.812	-0.018	0.090
		SCR2	0.105	0.876	0.008	-0.059
		SCR3	0.185	0.841	0.031	-0.116
		SCR4	-0.123	0.811	-0.021	0.083
Competitive Advantage (CA)	0.627	CA1	-0.025	0.238	0.718	0.088
		CA2	-0.059	0.305	0.855	-0.109
		CA3	0.184	-0.136	0.841	0.018
		CA4	-0.064	0.234	0.836	-0.011
		CA5	0.092	-0.208	0.775	-0.068
		CA6	0.011	-.010	0.713	0.107
Digital Transformation (DT)	0.693	DT1	0.041	0.212	-0.029	0.806
		DT2	0.087	0.228	-0.150	0.761
		DT3	-0.122	-0.221	0.110	0.850
		DT4	-0.004	-0.214	0.067	0.845

The discriminant validity of the four variables is tested by looking at the Average Variance Extracted (AVE) value, which is the average root value of the loading indicator value related to the construct. Table 5 shows that the AVE value of each variable is above 0.5, which means that all variables meet the requirements of discriminant validity. These results show that each variable predicts its indicator better than other variables. The next test is the reliability test of indicators and variables. Indicators and variables are considered reliable when the Cronbach Alpha coefficient value of each variable is above 0.70 and the Composite reliability coefficient value of each variable is above 0.60 (Solimun et al. 2017). As shown in Table 6, the four variables have a Cronbach Alpha coefficient value above 0.70 and a Composite reliability coefficient value above 0.60, which means that all variables meet the requirements for reliability. These results show that all research variables, including indicators that reflect variables, are reliable and consistent with measurement consistency.

The next test is to test the feasibility of the research model, which the Goodness of Fit measures. The Goodness of Fit is an index and measure of the goodness of relationships between latent variables related to assumptions. The model feasibility test is structurally measured using R-squared and Q-squared, which is equivalent to the total coefficient of determination in path analysis. The R-squared value indicates what proportion of endogenous variables can be explained by exogenous variables, and the Q-squared value is used to assess the relevance of a set of exogenous latent variables to their endogenous variables (Solimun et al. 2017).

Based on the test results presented in Table 6, the R-squared value of the supply chain resilience variable is 0.335, which falls under the moderate category. Similarly, the R-squared value of the competitive advantage variable is 0.513, also falling under the moderate category. These results indicate that the ability to innovate green explains 33.5% of the supply chain resilience of stevedoring companies, while 66.5% can be attributed to other factors outside of this study. The variable of competitive advantage is explained by both the ability to innovate green and the supply chain resilience variable, accounting for 51.3%, while the remaining 48.7% can be attributed to factors beyond this study. Finally, the Q-squared value test results indicate that the supply chain resilience variable and the competitive advantage variable fall under the large category.

The next test is the overall model goodness test, which measures the goodness of the relationship between latent variables through an index. Based on the results of testing the model's overall goodness, as shown in Table 7, all the parameters exhibit good and ideal fit criteria. Therefore, it can be concluded that the model's fit criteria are in good condition and ideal for each indicator. This indicates that the research model is a good fit.

The next inner model testing is to test the relationship between variables to prove the hypothesis built. Based on the results of tests conducted using WarPLS7, as shown in Table 8, it was found that one hypothesis was not accepted or insignificant. The hypothesis that digital transformation plays a role in moderating the influence of green innovation capabilities on supply chain resilience was not accepted.

Testing the effect of green innovation ability on supply chain resilience showed a significant influence of 57.9% of stevedoring companies in producing breakthrough innovations for stevedoring service products that emphasize low carbon emissions contributing to improving the company's supply chain resilience. The breakthrough innovation aims to fulfill compliance with regulations referring to international maritime standards. This breakthrough step also increases the resilience of the company's supply chain.

Supply chain resilience is aimed more at the condition of companies that must bounce back to better conditions when facing challenges and difficulties. These results are in line with previous empirical studies (Sabahi and Parasat, 2019; Alhakimi et al. 2022) that show how the ability to innovate green can increase the resilience of companies' supply chains. The results of this study also contribute to the theory of resource-based competitive advantage, where companies use various methods to empower dynamic capabilities in the form of breakthrough innovations. This enables them to maintain survival in competition.

Tablel 6. Reliability and the goodness of fit structural model

Variable	Cronbach Alpha	Composite Reliability	R-Squared	Q-squared
Green Innovation Capability (GIC)	0.852	0.900		
Supply Chain Resilience (SCR)	0.855	0.902	0.335	0.343
Competitive Advantage (CA)	0.879	0.909	0.513	0.490
Digital Transformation (DT)	0.832	0.888		

Table 7. Model fit dan quality indices

Parameters	Fit Criteria	Result	Remarks
Average Path Coeficient (APC)	Model Fit and Quality indices	APC = 0.241 p < 0.001	Good
Average R-squared (ARS)	p < 0.05	ARS =0.424 p < 0.001	Good
Average Adjusted R-squared (AARS)	P < 0.05	AARS = 0.419 p< 0.001	Good
Average block VIF (AVIF)	Accepted if <=5 ideally <=3.3	AVIF = 1.455	Ideal
Average full collinearity VIF (AFVIF)	Accepted if <=5 ideally <=3.3	AFVIF = 1.899	Ideal
Tenenhaus GoF (GoF)	Small >= 0.1 medium >=0.25 large >=0.36	GOF = 0.576	Ideal
Sympson's paradox ratio (SPR)	Accepted if >=0.7 ideally =1	SPR = 0.833	Good
R-squared contribution ratio (RSCR)	Accepted if >=0.9 ideally =1	RSCR = 0.997	Good
Statistical suppression ratio (SSR)	Accepted if >=0.7	SSR = 1.000	Ideal
Nonlinear bivariate causality direction ratio (NLBCDR)	Accepted if >=0.7	NLBCDR =1.000	Ideal

Table 8. Hypotheses Result

Hipothesis	Relationship between Variables	Path Coefficient	P- value	Result
H1	Green Innovation Capability (GIC) and Supply Chain Resilience (SCR)	0.579	P<0.001**	Significant
H2	Green Innovation Capability (GIC) and Competitive Advantage (CA)	0.563	P<0.001**	Significant
H3	Supply Chain Resilience (SCR) and Competitive Advantage (CA)	0.217	P<0.001**	Significant
H4	Digital Transformation (DT) in moderation of Effect Green Innovation Capability (GIC) on Supply Chain Resilience (SCR)	(0.010)	0.425	Weaken (not significant)
H5	Digital Transformatuon (DT) in moderating of effect Green Innovation Capability on Competitive Advantage (CA)	0.060	0.017**	Strengthen (significant)

The study conducted tests on two factors that may contribute to a company's competitive advantage: green innovation ability and supply chain resilience. The results showed that green innovation ability significantly affected competitive advantage with a result of 56.3%. The ability of stevedoring companies to offer innovative and environmentally friendly products can give them a unique competitive advantage, but the process requires a large capital investment to change existing business processes. The study found that companies that successfully make breakthroughs in green innovation have the opportunity to offer new products that have not been offered by their competitors, thus increasing their competitive advantage. These results are in line with previous empirical where the results of several empirical studies show a significant influence (Sudirjo, 2023; Tu and Wu, 2021; Gurleck and Tuna, 2018; Sellitto et al. 2020; Roespinoedji, 2019). The results of testing the role of the ability to innovate green which is a source of competitive advantage become an empirical enhancer in proving the theory of resource-based competitive advantage where capital in the form of resources is transformed into a unique form of service that becomes a source of competitive advantage for companies.

On the other hand, the study found that supply chain resilience, which refers to a company's ability to bounce back from difficult situations, only had a weak effect on competitive advantage with a result of 21.7%. The study found that a company's supply chain resilience does not necessarily translate into a competitive advantage unless the company has three important conditions: agility, adaptability, and harmony within the company. These three conditions are essential in ensuring that a company's resources are managed effectively to produce service products with unique characteristics. These results are still in line with previous empirical where a company's competitive advantage will be obtained from supply chain resilience as long as the company has 3 (three) important conditions in obtaining supply chain resilience such as company agility, high adaptability and harmony within the company (Rezaei et al. 2022). This result also adds empirical evidence that companies that have supply chain resilience are not necessarily a source of competitive advantage if the company's resources are not managed to produce service products with unique characteristics. This uniqueness will be obtained by the existence of 3 (three). The basic requirements are that the company has agility in responding to challenges, good and fast adaptation and harmony within the company.

Furthermore, after testing related to the role of digital transformation carried out by companies in moderating the influence of green innovation capabilities, the test results showed that the influence of green innovation capabilities carried out was not strengthened by digital transformation in achieving company supply chain resilience. The value of the path coefficient is interpreted as weakening the influence of the ability to innovate green on supply chain resilience. This can happen if the company is making a breakthrough in green innovation that is not related to technology. Referring to the results of this test, if stevedoring companies want to improve supply chain resilience, the emphasis on the dimension of green innovation based on digital transformation is not on the dimension of achieving low carbon emissions but on the dimension of environmentally friendly business process innovation and product innovation that prioritizes environmental.

Other test results with digital transformation's role in innovating green contribute to increasing competitive advantage. The value of a positive path coefficient means that digital transformation strengthens the influence of the ability to innovate on competitiveness. The test results provide evidence in support of the theory of competitive advantage, specifically the resource-based view. The digital transformation actions that a company undertakes can enhance its ability to achieve green innovation breakthroughs, thereby giving it a competitiveness over its rivals.

Manager Implications

The ability to innovate green in the form of an emphasis on achieving low carbon emissions in stevedoring companies shows the impact of achieving supply chain resilience on a medium scale. This is based on the fact that breakthrough innovations are carried out solely to fulfill compliance with international maritime regulations and provisions. On the other hand, when stevedoring companies carry out digital transformation, supply chain resilience is not increased. These results imply that if stevedoring companies carry out digital transformation aimed at increasing supply chain resilience, their green innovation capability is not just about fulfilling regulatory compliance but rather an emphasis on perfecting business processes that favor the environment and customer needs. If green innovation breakthroughs are not correlated with technology, the digital transformation carried out will not contribute to increasing supply chain resilience. On the other hand, the ability to innovate green, which emphasizes achieving low carbon emissions through digital transformation, actually increases competitiveness. These results provide implications for stevedoring companies that digital transformation is still relevant in supporting breakthrough innovations made by companies to become market pioneers in customer fulfilment. The digital transformation that supports green innovation capabilities aims solely to produce the newest services compared to competitors.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Stevedoring companies can enhance their supply chain resilience and gain a competitive advantage by leveraging green innovation and digital transformation breakthroughs. Studies indicate that a company's ability to innovate in green practices significantly impacts supply chain resilience. However, this resilience is being weakened due to the emphasis on achieving low carbon emissions in digital transformation. Additionally, the research shows that the ability to innovate green can significantly influence a company's competitive advantage, and digital transformation further strengthens this relationship. Digital transformation, the influence of the ability to innovate, is stronger in increasing competitive advantage.

The results of this study contribute to the implication that when stevedoring companies improve supply chain resilience sourced from green innovation based on digital transformation, the dimension of green innovation is emphasized more on those related to technology such as innovation in environmentally friendly business processes and product innovation that prioritize environmental health rather than on achieving low carbon emissions.

Recommendations

This research did not explore measuring the supply chain resilience of stevedoring companies, so We cannot determine the magnitude of the strengthening or weakening effect due to the moderation of digital transformation in the relationship between green innovation capability and supply chain resilience and competitive advantage. This is a challenge for future research in exploring supply chain resilience measurement that relies on the ability to innovate green based on digital transformation

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