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The influences of sustainability practices and IT capability on project operational performance through supply chain resilience in Indonesia's coal mining contractors

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A B S T R A C T

Coal mining is a very important sector in Indonesia, but there has been a decline in the realization of coal production in recent years, so this can reduce state revenues. One of the big challenges in the mining sector is the uncertainty of the mining business, such as information technology and sustainability concerns, that affect the mining industry's supply chain procedure. The purpose of this examination is to identify and determine the performance of supply chain resilience in the face of business uncertainty by determining the function of IT capabilities and sustainability practices in coal mining contractors. This research was conducted using a quantitative research method approach that was carried out using a structured survey instrument. The methodology employed in this study is built on purposive sampling, which is a non-probability selection method. The researchers used the Structural Equation Model (SEM) to examine data that were gathered from a sample of 128 project managers of coal mining contractors in Indonesia. The findings of this study demonstrated that project operational performance was significantly and favorably impacted by supply chain resilience. Additionally, a major and advantageous mediating IT skill in the operational execution of projects is supply chain resilience. Furthermore, it was shown that the use of IT capacity and the implementation of sustainability practices had a noteworthy and favorable influence on enhancing the performance of mining contractor projects. This research also provides information that environmental dynamism does not significantly moderate supply chain resilience on mining project performance. The novelty of this research is the contribution of supply chain resilience as an important resource for organizations that are integrated with IT capabilities to encourage increased project operational performance, especially for coal mining contractors. Additionally, research is still rarely carried out in between sustainability practices and supply chain resilience in the mining sector. It is concluded that coal mining contractor projects need to build supply chain resilience at the site amidst the uncertainty of the coal mining business.

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1. Introduction

The coal mining industry is one of the most important industries for Indonesia, but this industry is greatly influenced by various external factors (Atho & Hasibuan, 2022). Despite this, the government always strives to increase the production target for mineral mining in Indonesia from year to year (Central Statistics Agency, 2021). The amount of non-tax revenue received by the state from the mining sector is IDR 34.6 trillion, of which 85% of the total non-tax revenue for Minerals and Coal comes from coal (Rp. 29.41 trillion), so coal is an important sector for the State (Central Statistics Agency, 2021). However, according to the statistics from the Central Statistics Agency, coal production realization decreased in 2020 and 2021 and only fell short of the objective in 2021. This could have a negative impact on the state revenue (Central Statistics Agency, 2021). Over the past few years, the coal mining industry has faced major challenges. For several years, the movement of the reference coal price has been very fluctuating, and this is caused by external business environmental conditions that have an impact on the coal mining industry (Atho & Hasibuan, 2022). The very rapid fluctuations in coal

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prices show that the coal mining industry is not only vulnerable to economic phenomena but also to various environmental, social, and geopolitical situations (Atho & Hasibuan, 2022). High-pressure conditions in the global supply chain greatly affect the performance of the heavy equipment supply chain as well as components and spare parts in Indonesia (Simatupang & Sridharan, 2016). When coal prices fall, it causes customers to revise production targets so that existing equipment must be in standby (idle) condition. On the other hand, when the reference coal price is in a rebound condition, the equipment must be able to operate again. This happens because there is a shortage of heavy equipment, components and spare parts due to the manufacturers' unpreparedness to produce heavy equipment because of over-demand (APBI, 2022; Atho & Hasibuan, 2022; IMI, 2021; Rice & Caniato, 2003; Simatupang & Sridharan, 2016).

The environmental dynamism conditions above have a significant impact on the coal mining industry, especially on heavy equipment asset management. The aspect that is greatly impacted is the supply chain of spare parts and components for heavy equipment maintenance that needs to have availability and reliability in production according to target (Simatupang & Sridharan, 2016). According to Ramezankhani et al. (2018)'s research, supply chain disruptions seriously affect any supply chain because they obstruct the flow of money, materials, and information and prevent the chain from operating regularly, which only lowers the chain's efficiency and competitiveness (Ramezankhani et al., 2018). According to (Rice & Caniato, 2003), the term "supply chain resilience" describes a system's capacity to bounce back from any kind of setbacks. Long-term network performance may be enhanced by incorporating resilience into supply chain networks to make them more resilient to disturbances and to facilitate a quicker return to regular operating circumstances (Sheffi & Rice, 2005). Thus, it can be seen that supply resilience is needed to respond to uncertain environmental conditions (uncertainty), so it is very important to support business continuity (Sheffi & Rice, 2005).

One of the environmental dynamisms that have an impact on the mining sector is sustainability issues like net zero emissions and renewable energy (IAP, 2022). So, to answer the challenges of coal mining, the company's commitment is needed to implement environmental, social and governance programs (Ahmadi & Pintado, 2022; CNBC, 2022). The report submitted by the Ministry of Finance in 2021 shows that Indonesia is in the 36th position in the world in implementing ESG (Indonesian Ministry of Finance, 2021). This is supported by the IBCSD survey, which found that 40% of Indonesian companies still do not realize the importance of implementing ESG (IAP, 2022). The implementation of ESG in the coal sector is still unclear and has not been implemented optimally, both by coal companies and regulations by the government (IRESS, 2022). Even though during the pandemic, mining businesses with good ESG ratings was able to increase shareholder returns by 10% (PWC, 2021), this statement is also supported by several studies (Ahmadi & Pintado, 2022; Jin & Kim, 2022; Rahi et al., 2022). However, amidst the pressure of sustainability issues in the mining sector, very little research has identified the role of sustainability practices on supply chain resilience in particular, so further research is needed.

According to the findings of a survey that the Indonesian Mining Institute carried out in 2021, it is stated that one of the abilities to optimize the use of resources and capabilities is by utilizing technology, especially in managing heavy equipment (IMI, 2021). Wamba's research from 2020 demonstrates how IT Capability affects supply chain resilience and how the development of information technology (IT) may enhance supply chain operations. Supply chains can be seen as adaptive decision systems that react to dynamic business changes by processing data quickly (Dubey, 2020). Organizations may employ information technology (IT) to mitigate risk and enhance transparency and adaptability throughout the supply chain. (Ivanov & Dolgui, 2021). Organizations can enhance their ability to withstand and recover from external disruptions by incorporating IT capabilities and organizational information (Yang et al., 2022).

From this background, further research will be carried out on how the role of IT capability and sustainability practices has an impact on increasing supply chain resilience in coal mining contractors in Indonesia so that it has an impact on improving project performance.

2. Literature Review

2.1 Resources-Based View (RBV)

One of the most important management theories is the resource-based view theory, or RBV. According to this theory, business continuity will be realized if the resources and capabilities possessed by the company are highly precious, exceptionally uncommon, impossible to replicate flawlessly, and irreplaceable (Barney, 1991). Companies can compete with their rivals if they can create resources that cannot be replaced by competitors (Grant, 1991). Company capabilities are used in creating the long-term sustainability of a business. This can be realized if there is integration between the resources and processes owned by the company (Grant, 1991; S. Wamba, 2017).

2.2 Supply Chain Resilience

The key to success in carrying out asset maintenance is ensuring that spare parts and components are always ready when maintenance activities are carried out. Resilience, as determined by Rice and Caniato's research, according to the functionalities of a system, is to recover and regain functionality after experiencing setbacks (Rice & Caniato, 2003).

According to Christopher and Peck (2004), resilience in supply chains is the ability to withstand shocks, turn things around, and adjust accordingly (Christopher, Martin and Peck, 2004). It can also imply that a chain has the ability to "transition to a different, more favorable condition after being interrupted" in order to continue operating. By adding resilience, SC networks (SCN) can withstand disruptions more quickly and return to normal operation more quickly. This will increase resilience over the long run and enhance network performance (Sheffi & Rice, 2005).

2.3 IT Capability

IT Capability is defined as the capacity to control IT-related costs, supply systems when needed, and leverage IT to advance organizational objectives (S. Chen & Tsou, 2012). Tarigan et al. (2018) state that information technology is associated with hardware, networking, software, and people who work in the field (Siagiana & Tarigan, 2018). According to Abbaszadeh et al. (2019), one way to think about IT capability is as an internal resource that helps a business build its values (Zhou et al., 2022). The cability of a company to acquire, use, integrate, and set up technology and information resources to support and enhance the company's methods and procedures is referred to as IT capability (Zhou et al., 2022). According to Jie Zhou (2022), Companies can obtain a competitive edge by utilizing IT capacity, which is an uncommon, valuable, irreproducible, and irreplaceable resource (Siagian, 2021; Zhou et al., 2022). Chen and Tsou (2012) conducted a study and classified IT capabilities into four constructs: IT infrastructure, IT business experience, IT relationship resources, and IT people resources (Chen & Tsou, 2012). The ability to deliver dependable, consistent, and modern information technology capabilities to support ongoing business activities is reflected in an organization's IT capability (Liu, 2015; Siagian, 2021).

2.4 Sustainability Practices

Three primary components comprise the framework that outlines sustainability practices generally: environmental, social, and economic (Michel-Villarreal, 2023). According to (Gomes Silva et al., 2022; Ostrosm, 2009; Talapatra et al., 2019), and others, sustainability involves more than just understanding the environment. It also requires attention to social justice and economic progress. The triple bottom line (TBL), which is synonymous with sustainability, is a concept that carries a positive connotation when its three components are integrated (Boyer et al., 2016; Gomes Silva et al., 2022). According to Gomes Silva (2022), the triple bottom line is predicated on three pillars of sustainability: economic, environmental, and social (Gomes Silva et al., 2022). Reducing economic uncertainty and raising profitability are two benefits of concentrating on economic sustainability measures (Jarzebowski, 2020; Michel-Villarreal, 2023). According to Malak-Rawlikowska (2019) and Rosario Michel (2023), the foundation of social sustainability practices stems from the proximity of all parties involved in the process, which leads to a trusting or cooperative relationship between producers and consumers (Malak-Rawlikowska et al., 2019; Michel-Villarreal, 2023). Additionally, according to Galli and Brunori (2013) and Rosario Michel (2023), the social sustainability method can enhance worker performance by giving each person fair rewards and recognition based on their contributions (Galli & Brunori, 2013; Michel-Villarreal, 2023). Sustainability measures help to lower carbon emissions from an environmental standpoint (Forssell & Lankoski, 2015).

2.5 Environmental Dynamism

The environmental turbulence theory was originally introduced by Emery and Trist (1965), where it was explained that the business environment is influenced by several factors such as competition, customers, suppliers, shareholders, market share, regulators, economics, technology, and the social environment (Emery & Trist, 1965). From the literature study, several definitions from previous researchers were added related to another definition also stated by Duncan (1972), namely environmental dynamism, which is characterized by the regularity, intensity, and overall state of unpredictability of the environment (Duncan, 1972). This was also explained by Atuahene-Gima and Li (2004) that environmental dynamism includes uncertainty and unpredictability due to large and rapid changes in technological development and market preferences (Atuahene-Gima & Li, 2004). Environmental dynamics refers to the ways in which technology, consumer preferences, trade practices, climatic conditions, and other environmental issues are dynamic (Mandal, 2017; Srinivasan et al., 2011).

2.6 Project Operational Performance

Project performance may be defined as the output or results that the organization achieves and evaluates in relation to the anticipated outcomes. There are many measuring tools used to determine project performance such as financial performance, operational performance, project performance, customer satisfaction, and employee satisfaction (Kim & Chiang, 2017). Samee explains that company performance presents the company's status in its business operations – whether the company meets, for example, its standards, goals, mission, and vision (Samee & Pongpeng, 2015). According to Dubey et al., there are several dimensions to measure company performance, including social performance, environmental performance, and economic performance (Dubey et al., 2016). Meanwhile, according to Samee, there are several dimensions, including time, cost, quality, environment & community, stakeholder satisfaction, finance, customers, internal processes, learning & growth (Samee & Pongpeng, 2015).

3. Hypothesis Development

3.1 The correlation between supply chain resilience and project operational performance in the coal mining contractors

A multitude of studies provide support for the notion that Supply Chain Resilience significantly influences the operational performance of projects (Gligor et al., 2015; Mandal, 2017). Supply chain resilience helps companies achieve competitive advantage through quickly recovering necessary processes and maintaining performance at optimal levels (Mandal, 2017). The objective of supply chain resilience is to promptly resume supply chain functions in the event of disruptions, earning it the designation of a critical dynamic capacity (Gligor et al., 2015). An empirical research conducted by Santanu Mandal (2017) provides additional support for the claims put forth by the academicians. The study reveals that supply chain resilience positively influences both operational and relational performance (Mandal, 2017). The findings of this research are corroborated by several other studies that also affirm the existence of favorable effects of supply chain performance in relation to supply chain resilience (Gligor et al., 2015). Apart from the research above, several studies empirically test asset management variables with performance and present study findings demonstrating evidence in favor of this concept (Abeysekara et al., 2019; Chowdhury et al., 2019; Mandal, 2017).

Hypothesis 1. The affect of supply chain resilience on project operational performance is both positive and statistically significant.

3.2 The correlation between IT capability and project operational performance in the coal mining contractors

With the presence of technology that has changed how companies carry out their operations, Venkatraman believes that the role of technology in companies was initially only an important tool for building flexible business networks between organizations (Venkatraman, 1994). There are several opinions regarding technology adoption in previous research, including information technology (IT) is recognized as an important factor that enables a company's core competencies by increasing operational efficiency, minimizing costs, and automation (Ashrafi & Mueller, 2015; Y. Chen & Pock, 2017). A previous study has revealed that IT capability has a substantial influence on firm performance, as evidenced by several literature sources. According to Griffith & Chen's study, the research model and associated hypotheses provided more information on the important connection between IT capabilities and firm success, expanding on the existing understanding (Griffith et al., 2006). The findings of a study carried out by Attencia in 2022 concluded that IT capability is very important for entrepreneurship and technology orientation (TO) to produce higher Firm Performance (FP) (Attencia & Mattos, 2022). Multiple empirical researches have examined the impact of IT Capability on project operational success, providing evidence that these two factors are significantly and positively related (H. J. Kim, 2017; Kmieciak et al., 2018; Siagian, 2021).

Hypothesis 2. The impact of IT capability on project operational performance is both positive and statistically significant.

3.3 The correlation between IT capability and supply chain resilience in the coal mining contractors

Prior research has demonstrated that IT capability has a substantial influence on the resilience of supply chains (Ivanov & Dolgui, 2021; Kache & Seuring, 2017; S. F. Wamba et al., 2020). Research conducted by Wamba (2020) shows that IT capability directly influences the robustness of the supply chain where the emergence of information technology (IT) can improve supply chain operations (S. F. Wamba et al., 2020). Organizations may employ information technology (IT) to mitigate risk and enhance transparency and adaptability throughout the supply chain (Ivanov & Dolgui, 2021). Emerging IT capabilities for development purposes influence supply chain resilience for survival purposes (Yang et al., 2022). In addition to the aforementioned study, several studies have conducted empirical tests on the variables of IT capability and supply chain resilience. The results demonstrate a significant correlation between these factors (Zhou et al., 2022).
Hypothesis 3. The impact IT capability of on supply chain resilience is both positive and statistically significant.

3.4 The correlation between IT capability and project operational performance mediating with supply chain resilience in the coal mining contractors

An organization can obtain external information from supply chain partners about how to use IT development to improve collaboration between organizations to manage various risks from good IT connections externally (Mehrjerdi & Shafiee, 2021). Emerging IT capabilities provide companies with the capacity to distribute resources dynamically and strengthen their resilience to unforeseen circumstances that can lead to SC disruptions (Dubey et al., 2019). Zhou Jie (2022) conducted research that empirically examines the correlation between the resilience of the supply chain, the capabilities of information technology, and the performance of operations (Zhou et al., 2022). The findings of the study demonstrate that supply chain resilience plays a significant mediating role between IT capability and operational performance (Zhou et al., 2022).

Hypothesis 4. The impact IT capability of on project operational performance-mediated supply chain resilience is both positive and statistically significant.

3.5 The correlation between sustainability practices and project operational performance in the coal mining contractors

Sustainability practices are a very important aspect of business strategy in almost all business sectors (Abbas et al., 2022). Prior research has shown a correlation between the implementation of sustainable practices and organizational success (Chong et al., 2018; Martí-Ballester, 2015). Research conducted by Chang states that companies that focus on sustainability practices can increase company profits (Chang & Kuo, 2008; Chong et al., 2018). According to Wagner (2010), organizations can gain benefits by focusing on sustainability in the business model they run (Chong et al., 2018; Wagner, 2010). Maletic et al. (2015) revealed that firms had enhanced financial performance through increased engagement in sustainability initiatives (Maletič, 2015). In addition to the aforementioned study, several studies have conducted empirical tests on the variables of sustainability practices and project operational performance. The results of this research demonstrate a significant correlation between these factors (Ahmadi & Pintado, 2022; Chong et al., 2018; Jin & Kim, 2022; Rahi et al., 2022).

Hypothesis 5 The impact sustainability practices of on project operational performance is both positive and statistically significant.

3.6 The correlation between sustainability practices and supply chain resilience in the coal mining contractors

The primary concern in the supply chain process is sustainability, which encompasses the fulfillment of sustainability parameters, including the standards for Supply Chain Resilience (Abbas et al., 2022). Multiple studies have indicated that the implementation of sustainable practices can enhance various aspects of resilience in supply chains when faced with different sorts of disruptions (Cui et al., 2022). Furthermore, the implementation of sustainable practices has a crucial role in determining whether a firm can survive or recover from supply chain disruptions (Cui et al., 2022). A separate study examined the impact of sustainability measures on the ability of supply networks to withstand different sorts of interruptions. The study also highlights the necessity for further empirical investigation to ascertain the extent to which organizations' sustainability strategies or their interactions with suppliers or consumers may enhance resilience (Alejandro, 2022). Research conducted by Fahimnia explains that the transition from sustainability practices to supply chain resilience provides cost efficiency due to adjustments in strategy, sourcing, production, and distribution (Jabbarzadeh et al., 2018; Michel-Villarreal, 2023).

Additional studies have demonstrated that the association between these two variables is quite robust, encompassing social, environmental, and economic aspects (Zhu & Wu, 2022). According to a study conducted by Usman Abbas (2022), sustainability practices support circular economic growth by strengthening supply chains (Abbas et al., 2022). The study determined that cradle-to-cradle practices, environmental sustainability, economic sustainability, and social sustainability are crucial factors in maintaining the resilience of supply chains in consumer products firms, particularly in the progress of a circular economy (Abbas, 2022). Based on the aforementioned study, other studies have conducted empirical tests on the variables of sustainable practices and supply chain resilience. The research findings indicate that these two factors have a notable and favorable impact (Abbas, 2022; Alejandro, 2022; Zhu & Wu, 2022).

Hypothesis 6. The impact sustainability practices of on supply chain resilience is both positive and statistically significant.

3.7 The correlation between sustainability practices and project operational performance mediated by supply chain resilience in the coal mining contractors

Prior research has indicated that the utilization of sustainability practices has a stronger impact on project operational performance when supplier resilience is taken into account. This has been observed in several studies where supply chain resilience has been used as a mediating variable to assess performance (Liu & Lee, 2018; Yang et al., 2022; Zhu & Wu, 2022). This study demonstrates that the supply chain has a crucial and beneficial role in enhancing performance. Supply chain sustainability contributes to higher levels of supply chain performance (Zhu & Wu, 2022). Additionally, several studies show that internal resilience, customer resilience, and supply chain resilience all have an indirect positive impact on improving operational performance (Gu & Huo, 2017; Zhu & Wu, 2022).

Hypothesis 7. The impact sustainability practices of on project operational performance-mediated supply chain resilience is both positive and statistically significant.

3.8 The correlation between supply chain resilience and project operational performance moderated by environmental dynamism in coal mining contractors

Based on the previous study, it is evident that environmental dynamism enhances the correlation between supply chain resilience and corporate success. As a dynamic capability, Supply Chain Resilience, according to the literature, allows corporations to successfully overcome environmental problems while maintaining their performance (Jüttner & Maklan, 2011; Liu & Lee, 2018; Mandal, 2017; Yang et al., 2022; Zhu & Wu, 2022). Based on the aforementioned study, other studies have conducted empirical tests on environmental dynamism characteristics that affect the connection between the resilience of the

supply chain and the operational effectiveness of the project. The research findings indicate that these two variables have a substantial impact (Mandal, 2017).

Hypothesis 8. Environmental dynamism moderation influences the relationship between supply chain resilience and project operational performance

From previous research, a research model was built which is shown in Fig. 1. This picture depicts the correlation between the robustness of a supply chain, as the primary variable, and its impact on the operational success of coal mining contractor projects. Following previous literature studies, there are IT capability and sustainability practices variables that will be seen as their influence on building increased supply chain resilience and their impact on improving project operational performance.

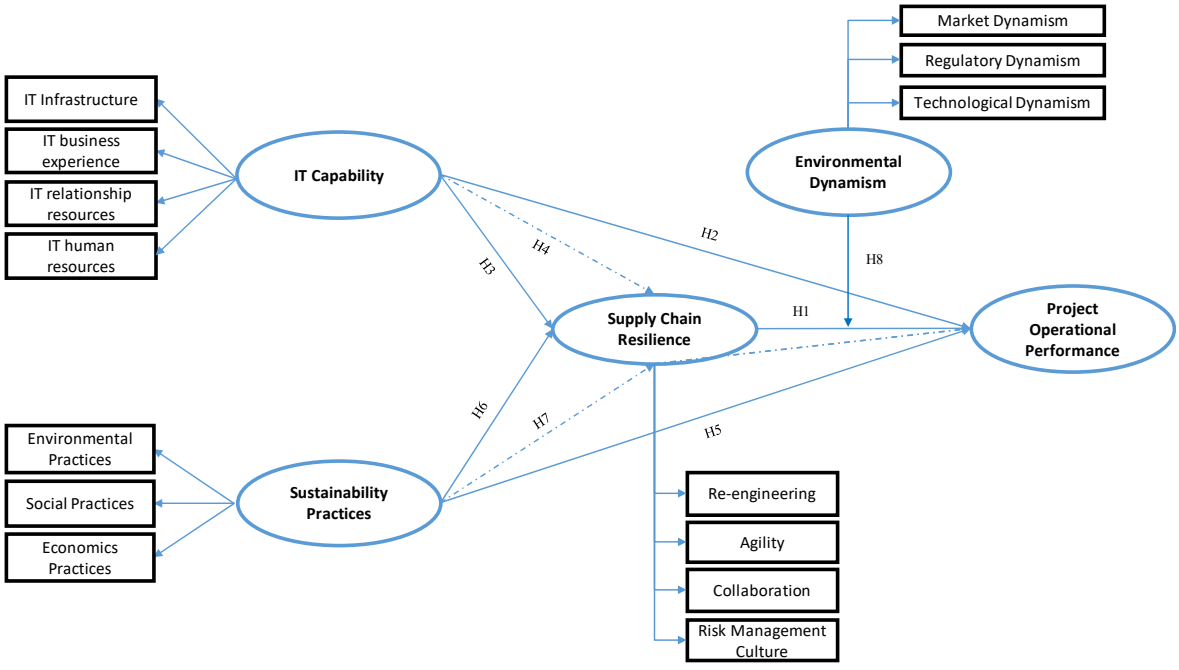

Fig. 1. Research Model

4. Research Methodology

The examination used a quantitative study design to identify the correlation between IT Capability and Sustainability Practices, mediated by supply chain resilience, and moderated by environmental dynamism, on project operational performance.

4.1 Sample Data Collection

The utilization of a questionnaire constitutes the method of data acquisition used in this research. Information has been compiled from participants through the administration of research instruments, specifically questionnaires. The purpose of the questionnaire is to gather information from a specific group of individuals, namely project managers in Indonesian coal mining contractors. 128 participants comprised the sample number for this investigation. The questionnaire was completed between December 2023 and January 2024. According to the recommendations of Hair et al., (2017), a minimum sample was calculated, that included 4 variables related to the construct, a significance threshold of 5%, and an R2 value of 0.10. As a result, a minimum sample of 113 respondents was achieved (Hair et al., 2017). The research employed a sampler approach that relied on a non-probability sampling procedure, specifically adopting a purposive sampling technique.

4.2 Scale Development

Questionnaire statements were developed from research instruments that had been used in previous research in which supply chain resilience consists of 9 questionnaire statements developed by Abeysekara et al., (2019), sustainability practices consists of 6 questionnaire statements developed by Begnini et al., (2022), IT capability consists of 8 questionnaire statements developed by S. Chen & Tsou, (2012), environmental dynamism consists of 6 questionnaire statements developed by Harun et al., (2023) and project operational performance consists of 6 questionnaire statements (Abeysekara et al., 2019; Begnini et

al., 2022; S. Chen & Tsou, 2012; Harun et al., 2023; Qamruzzaman & Karim, 2020). The survey was collected applying the Likert scale method with 5 response items to be filled in (number 5 = very appropriate to number 1 = very inappropriate).

4.3 Model Measurement

In order to resolve the connection among the latent variables in terms of cause and effect in the structural equation, the survey were evaluated through the utilization of structural equation modeling in combination with partial least squares. The data was analyzed using Smartpls 4.0.9.5. The data obtained from the questionnaire was analyzed and evaluated by implementing techniques of multivariate structural equation modeling (SEM), based on the calculation method outlined in the results. The instrument undergoes a two-phase examination. The criteria for evaluation include an outer loading of more than 0.7, minimum values for discriminant validity, Cronbach's alpha above 0.6, composite reliability (Pc) above 0.7, and average variance extracted (AVE) above 0.5 (Hair et al., 2017).

5. Results and Discussion

5.1 Sample Description

The participants of the survey were project managers who were employed by contractors in the coal mining industry in Indonesia. In this investigation, demographic information collected from 128 respondents was included in the findings.

Table 1
Respondents Background

Demographic	Attribute	Percentage	Demographic	Attribute	Percentage
Age (years old)	<35	2,34%	OB Production	< 25 Mio BCM	20,31%
	35 – 40	22,66%		25 - 50 Mio BCM	25,78%
	40 – 45	34,38%		50 - 75 Mio BCM	9,38%
	45 – 50	17,19%		75 - 100 Mio BCM	21,88%
	>50	23,44%		> 100 Mio BCM	22,66%
Education	High School	22,66%	Equipment Quantity	< 100 unit	17,97%
	Diploma	12,50%		100 - 200 Unit	30,47%
	Bachelor	58,59%		200 - 350 Unit	24,22%
	Magister	3,91%		350 - 450 Unit	6,25%
	Doctoral	2,34%		> 450 Unit	21,09%
Work Experience (year)	5 – 10	3,13%	Man Power Quantity	< 400 Employee	9,38%
	10 – 15	18,75%		400 - 700 Employee	21,09%
	15 – 20	40,63%		701 - 1000 Employee	13,28%
	>20	37,50%		1001–1300 Employee	10,16%
Coal Production	< 2 Mio Ton	16,41%		> 1300 Employee	46,09%
	2 - 5 Mio Ton	26,56%			
	5 - 7 Mio Ton	17,97%			
	7 - 10 Mio Ton	9,38%			
	> 10 Mio Ton	29,69%			

In Table 1 of the profile respondents above, the distribution of respondent profiles was based on the respondent's age profile, educational background, work experience, total coal & OB production per year, equipment quantity, and manpower quantity.

5.2 Reliability and Validity

1. Outer loadings

It is a quantification of the association between hidden variables and the observable variables that represent them. This term is equivalent to the measurement model that specifies the attributes of the underlying concept and its observable measures. The outer loading number must exceed 0.7 in order to be deemed legitimate. The experimentation was conducted using the smartpls 4.0.9.5 program (Hair et al., 2017).

The findings of the smartpls assessment, illustrated in Figure 2, demonstrate that the loading factors for all indicators exceed 0.7, thereby satisfying the criteria for a strong convergent validity. From the preceding investigation model, each individual indicator is evidently represented, namely IT (IT capability), SCR (supply chain resilience), SP (sustainability practices), ED (environmental dynamism), and OPC (project operational performance).

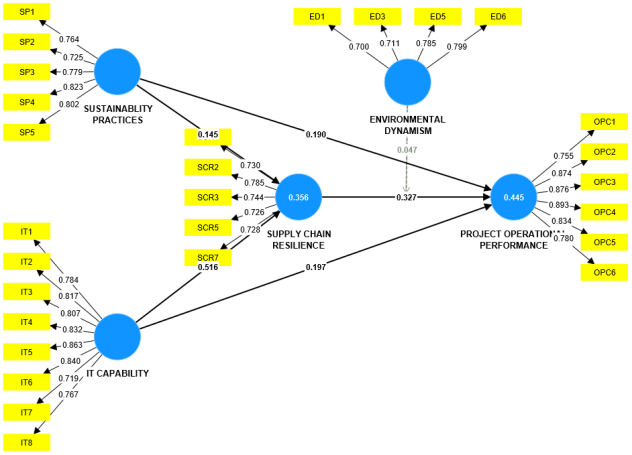

Fig. 2. Outer Loading

2. Path Coefficient

The route coefficient test is another assessment in the outer model of smartpls that measures the dependability of all indicators in the model. Multiple indications may be assessed, one of which is Cronbach's alpha, which should have a value greater than 0.7. Furthermore, it is imperative that the composite reliability value is above 0.7, and the average variance extracted (AVE) value surpasses 0.5 (Hair et al., 2017).

Table 2
Construct Reliability and Validity

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
ED	0,741	0,750	0,837	0,563
IT	0,922	0,928	0,936	0,648
OPC	0,914	0,923	0,933	0,701
SCR	0,797	0,800	0,860	0,552
SP	0,838	0,845	0,885	0,608

Table 2 presents the outcomes of the concept validity and reliability assessments. According to the outcome of the evaluation, the Cronbach's alpha value exceeds 0.7, suggesting that the latent variable possesses a considerable degree of reliability. Evaluation of the data acquired from the exploration instrument for adequate internal consistency was performed as part of the reliability testing process. The average variance extracted (AVE) test yielded several scores greater than 0.5, which is used to determine the fulfillment of discriminant validity criteria (Hair et al., 2017).

3. Discriminant Validity

By determining whether the average variance extracted (AVE) exceeds the squared relationship with different constructs, the Fornell-Larcker criteria is a method for evaluating assessments. The Fornell-Larcker testing approach necessitates that the average variance extracted (AVE) of each variable surpasses the maximum squared effect with other variables (Hair et al., 2017).

Table 3
Discriminant Validity (Fornell-Larcker criteria)

	ED	IT	OPC	SCR	SP
ED	0,750				
IT	0,351	0,805			
OPC	0,407	0,532	0,837		
SCR	0,331	0,583	0,565	0,743	
SP	0,224	0,461	0,444	0,383	0,779

The discriminant validity results, namely the Forner-Larcker criteria, are shown in Table 5. This research demonstrates that the AVE value for each variable surpasses the values of the other variables. From the AVE values for each variable supply chain resilience, IT capability, sustainability practices, environmental dynamism, and project operational performance. The table clearly demonstrates that the AVE score for the measured variables surpasses the impact between variables. The criteria for establishing discriminant validity in this study model have been satisfied.

4. R-Square

R-squared is a metric that quantifies the impact of the exogenous variable, which is independent, on the endogenous variable, which is dependent. The R-squared value, ranging from 0 to 1, indicates the level of interaction among independent factors that impact the dependent variable (Hair et al., 2010).

Table 4
R Square

	R-square	R-square adjusted
OPC	0,445	0,423
SCR	0,356	0,346

Evaluation findings show that R square score of 0.445 shows that all independent factors together have a 44.5% impact on project operational success. Unconfirmed factors in the investigation exert an impact on the remaining 55.5%.

5.3 Hypothesis Testing

1. T Statistic

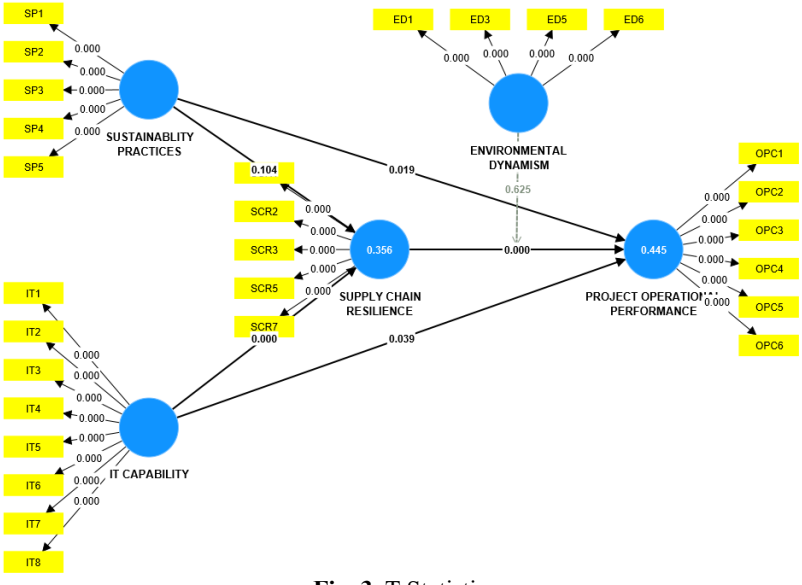

Fig. 3. T Statistic

In the study conducted using smartPLS, Fig. 3 illustrates the route coefficient analysis, which represents the direct consequence of exogenous factors on endogenous variables. For this study, it is crucial to determine several criteria such as the p-value, t statistic, and path coefficient that establish the connection between endogenous variables and exogenous variables. A p-value less than 0.05 indicates that the exogenous variable has a statistically significant impact on the endogenous variable.

2. Path Coefficient

Table 5
Original Sample Table

HYPOTHESIS	ORIGINAL SAMPLE (O)	T STATISTICS (|O/STDEV|)	P VALUES	RESULT
ED → OPC	0,181	2,052	0,040	Significant
IT → OPC	0,197	2,068	0,039	Significant
IT → SCR	0,516	7,194	0,000	Significant
SCR → OPC	0,327	4,025	0,000	Significant
SP → OPC	0,190	2,349	0,019	Significant
SP → SCR	0,145	1,627	0,104	Not Significant
ED X SCR → OPC	0,047	0,489	0,625	Not Significant

The information above presents the definition of the p-value, that is the probability of the number of observed opportunities based on the test statistic. If the p-value is below 0.05, it argues that the outcome of the research shows a significant effect,

then it is regarded as successful in discovering a significant link. Conversely, if the p-value is more than 0.05, it proposes that the researcher has not been successful in identifying a significant association.

The evaluation outcome indicates that the p-value for supply chain resilience is 0.000, the p-value for IT capacity is 0.000, and the p-value for sustainability practices is 0.019. It can be ascertained that latent variables exhibit a robust correlation. The route coefficient represents the direct impact between variables. A positive path coefficient signifies a favorable correlation. Information from Table 7 indicates that sustainable measures do not exert a substantial impact on the supply chain. The data also revealed that environmental dynamism did not have moderating consequences on the relationship between supply chain resilience and coal mining contractor project performance.

Table 6
Indirect Effect (Innovation Culture as Mediating Variable)

HYPOTHESIS	ORIGINAL SAMPLE (O)	T STATISTICS (|O/STDEV|)	P VALUES	RESULT
SP → SCR → OPC	0,047	1,603	0,109	Not Significant
IT → SCR → OPC	0,169	3,297	0,001	Significant

From the table analysis above, supply chain resilience significantly mediates between IT capability and project operational performance, with a t value of 3.297, and supply chain resilience does not significantly mediate between sustainability practices and project operational performance, with a statistical t value of 1.603.

3. Model Fit

An evaluation of a model may be conducted by investigating the result of the standardized root mean square residual (SRMR). When the outcome falls within 0.05 to 0.08, it may be concluded that the research is suitable. The model fit results are displayed in Table 10.

Table 7
Model Fit

	Saturated model	Estimated model
SRMR	0.079	0.080
d_ULS	2,520	2,590
d_G	1,132	1,138
Chi-square	739,612	739,581
NFI	0,699	0,699

The SRMR number above, which is 0.080, indicates that the research model is a good match. This research demonstrates that coal mining contractor organizations may enhance project operational performance by effectively implementing strategies such as IT capabilities and sustainability practices in an unpredictable business environment. Alignment of IT capability mediated by supply chain resilience will build acceleration in increasing the project's operational performance. Where the maximum role of supply chain resilience will certainly influence better project performance (Canhoto et al., 2021).

6. Discussion

The correlation between supply chain resilience and project operational performance

The study of hypothesis 1 reveals that supply chain resilience has a substantial and beneficial consequence on project operational performance in mining contractor firm projects in Indonesia. The path coefficient findings indicate a score of 0.327 and p-value of 0.000 (p-value < 0.05). The association between supply chain resilience and operational performance of the project is that an increase in the value of supply chain resilience leads to a corresponding increase in operational performance. The hypothesis aligns with the research of Mandal et al. (2017), who determines that supply chain resilience enables organizations to gain a competitive edge by swiftly recovering essential operations and sustaining optimal performance. According to a study done by D. Gligor et al. (2015), supply chain resilience seeks to promptly restore supply chain activities in the event of an interruption (Gligor et al., 2015; Mandal, 2017).

The correlation between IT Capability and project operational performance

The study of hypothesis 2 reveals that IT capability has a statistically significant and beneficial consequence on project operational performance in mining contractor firm projects in Indonesia. The path coefficient is 0.197, and the p-value is 0.039. It can be interpreted that the greater the value of IT capability is, the greater the operational performance of the project is. This outcome is in line with the discoveries of H. J. Kim, 2017; Kmieciak et al., 2018; Siagian, 2021, where they discovered that operational performance was significantly and favorably impacted by IT capability (Kim, 2017; Kmieciak et al., 2018; Siagian, 2021).

The correlation between IT capability and supply chain resilience

The study of hypothesis 3 reveals that IT capacity has a substantial and beneficial impact on supply chain resilience in mining contractor firm projects in Indonesia. The path coefficient findings indicate a value of 0.516 and p-value of 0.000 (p-value < 0.05). It can be definite that the greater the value of supply chain resilience is, the greater the operational performance of the project is. This is similar to studies conducted by several previous researchers (Ivanov & Dolgui, 2021; Kache & Seuring, 2017; S. F. Wamba et al., 2020). Research conducted by Wamba (2020) presents that IT Capability has consequences on Supply Chain Resilience where the emergence of Information Technology (IT) can improve supply chain operations from three main aspects. In addition to the aforementioned study, several studies have conducted empirical tests on the variables of IT Capability and Supply Chain Resilience (S. F. Wamba et al., 2020). These studies have yielded research findings that demonstrate a substantial and favorable impact of these two factors (Stephens et al., 2022; Yang et al., 2022).

The correlation between IT capability and project operational performance mediated by supply chain resilience

The analysis of hypothesis 4 reveals that IT capability has an impact on project operational performance through supply chain resilience in mining contractor company projects in Indonesia. The path coefficient result is 0.169 and p-value of 0.001, showing statistical significance (p-value < 0.05). Zhaojun Yang (2022) states that there is an indirect effect or mediation effect of supply chain resilience between emerging IT capability and company performance in the manufacturing industry (Yang et al., 2022). Additionally, research conducted by Minhyo Kang (2022) examined the effect of supply chain resilience mediation in the manufacturing industry in South Korea during the ongoing Covid pandemic (Kang & Stephen, 2022)

The correlation between sustainability practices and project operational performance

The study of hypothesis 5 reveals that sustainability practices have a substantial and beneficial impact on project operational performance in mining contractor firm projects in Indonesia. The path coefficient findings indicate a value of 0.190 and p-value of 0.019 (p-value < 0.05). It can be interpreted that the greater the value of sustainability practices is, the greater the operational performance of the project is. Several previous studies have investigated the association between sustainability practices and performance (Chong et al., 2018; Martí-Ballester, 2015). Research conducted by Chang states that companies that focus on sustainability practices can increase company profits (Chang & Kuo, 2008; Chong et al., 2018). According to Wagner (2010), organizations can benefit from incorporating sustainability into their business models (Chong et al., 2018; Wagner, 2010).

The correlation between sustainability practices and supply chain resilience

In the analysis of testing hypothesis 6: Sustainability practices have significant and positive consequences on supply chain resilience in mining contractor company projects in Indonesia. The path coefficient data indicate a value of 0.145 with a p-value of 0.104, which is more than the significance level of 0.05. This condition shows that there is no influence of sustainability practices on supply chain resilience. Nevertheless, one of the researchers in this study also advocated for testing the variables that were excluded. This aligns with previous research conducted by Alejandro (2022), that emphasizes the necessity for further empirical investigation to ascertain the extent to which companies' sustainability practices or their interactions with suppliers or customers can enhance resilience (Alejandro, 2022). There may be signs in sustainable measures that may not directly impact the ability of projects to withstand disruptions in the supply chain, and it is legitimate to have this suspicion. One of the indicators that is thought to have no direct relationship is related to the project's commitment to reducing carbon emission levels, so it is necessary to use a certain mediation that is not supply chain resilience to achieve a significant increase in the performance of coal mining contractor projects.

The correlation between sustainability practices and project operational performance mediated by supply chain resilience

In the analysis of testing hypothesis 7: Sustainability practices have a notable and favorable impact on the operational performance of mining contractor firm projects in Indonesia, by enhancing supply chain resilience. The path coefficient findings indicate a value of 0.047 and p-value of 0.109 (p value > 0.05). This condition indicates that the operational performance of a project is not mediated by supply chain resilience. Prior empirical investigations have demonstrated the absence of a statistically significant correlation between supply chain resilience and sustainability practices. According to a study by Rosario Michel Villarreal (2023), a particular facet of sustainability practices does not exert a substantial impact on the resilience of supply chains (Michel-Villarreal, 2023).

The correlation between supply chain resilience and project operational performance moderated by environmental dynamism

Hypothesis 8 in the data analysis suggests that environmental dynamism plays a role in moderating the connection between supply chain resilience and project operational performance in mining contractor company projects in Indonesia. This hypothesis has a path coefficient of 0.047 and a p-value of 0.625, indicating that the association is not statistically significant (p-value > 0.05). This condition implies that environmental dynamism does not have an impact on moderating the link between

supply chain resilience and project operational performance. According to a prior study by Amit Arora in 2023, it has been shown that supply chain resilience does not have a substantial role in moderating the link between market instability and project operational success. This state is attributed to many variables, including coal mining contractors who are accustomed to market fluctuations and competition, therefore mitigating the impact of environmental dynamism. In addition, coal mining contractors have a robust clientele and a network of suppliers that enables them to mitigate the effects of environmental volatility. The collaboration among suppliers, customers, and other stakeholders has bolstered coal mining contractors, enabling them to thrive and expand in an environment characterized by volatility.

7. Conclusion

The study's conclusions have added to our understanding of how to build more substantial levels of project operational performance in coal mining contractors in Indonesia. This study enhances the significance of the resource-based view (RBV) in enhancing project performance under unpredictable business circumstances. From the test results, it was found that supply chain resilience performs a critical function in improving the operational performance of mining contractor projects in Indonesia. An effective approach adopted to ensure that coal mining contractor projects in Indonesia are equipped with an advanced inventory management system. This is very important to anticipate every existing condition so that the goods in inventory are in optimal condition. This is in accordance with the research results that show that utilizing IT capabilities will increase supply chain resilience and will have an impact on improving the operational performance of coal mining contractor projects amidst uncertainty in the mining business. In this research, there is an interesting finding that sustainability practices do not have a significant influence on supply chain resilience, so this can provide additional insight regarding the implementation of sustainability practices in other sectors. Although environmental dynamism does not moderate significantly among variables.

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