Tekmapro : Journal of Industrial Engineering and Management
Vol. 20, No.01, Year 2025, p. 209-225
e-ISSN 2656-6109. URL: http://tekmapro.upnjatim.ac.id/index.php/tekmapro

THE EFFECT OF CARGO MANAGEMENT, FACILITY MANAGEMENT, AND INFORMATION MANAGEMENT MODERATED BY SECURITY CULTURE ON SUPPLY CHAIN SECURITY OPERATIONAL PERFORMANCE ON THE DELIVERY OF DORE BULLION BY GOLD MINING COMPANIES IN INDONESIA

Marchel P Rumlaklak[1)], *Iveline Anne Marie[2)] Jakaria[3])

[1]Universitas Trisakti : rumlaklak_marchel@yahoo.com
[2]Universitas Trisakti : iveline.annemarie@trisakti.ac.id
[3]Universitas Trisakti : jakaria.fe@trisakti.acl.id
*) Correspondence author :

ABSTRACT

Gold mining companies in Indonesia must refine gold from dori bullion in Jakarta, which faces various risks, including theft. This study examined the effect of cargo management, facility management, and information management on supply change security operational performance moderated by security culture in gold mining companies in Indonesia. The type of research used is causality research, which is a hypothesis to test the effect of a variable on another variable. The variables used consist of 3 independent variables: cargo management, facility management, and information management; 1 moderating variable, security culture; and 1 dependent variable, supply change security operational performance. The sample withdrawal method uses purposive sampling, namely respondents who work in gold mining companies related to the supply chain for sending Dori bullion. The sample used was 160 respondents, and the analysis tool was SEM-PLS. The findings show that cargo management, facility management, and information management are proven to have a positive effect on supply change security operational performance, while security culture is not proven to moderate the influence of cargo management, facility management, and information management on supply change security operational performance.

Keyword : cargo management, facility management, information management, security culture, supply change security operational performance

A. INTRODUCTION

Indonesia has great potential as one of the countries with the largest gold mining reserves in the world. Over time, more and more local mining companies began to process mining ore. This step is encouraged by Law No. 4 of 2009 concerning Mineral and Coal Mining [1]. As of 2022, Indonesia is ranked 12th globally, with a gold production of 70 tons annually. China ranks first as the world's largest gold producer, with a total production of 330 tons in 2022, followed by Australia and Russia, with a total production of 320 tons. More information is shown in figure 1

Gold, which has the symbol Au or Aurum in Latin, is a mineral in the category of transition metals. It is a metal that can conduct heat and electricity well, so it is often used as a mixed material to manufacture electronic components to ensure the smooth flow of electricity. In addition, we often find gold in jewelry stores in finished form, such as necklaces, rings, bracelets, earrings, and precious metal bars. Gold also plays an important role as collateral for the Central Bank in printing new money to prevent inflation. In the health sector, gold is used to manufacture teeth and is useful in various other industries (Bujani, 2020). The Precious Metals Processing and Refining Business Unit (UBPP) is the only Precious Metals refining company in Indonesia registered in the Good Delivery List of LBMA (London Bullion Market Association) and is a business of PT Antam. All activities of the dori bullion production process produced by gold mining companies in Indonesia will carry out Dori bullion refining in Jakarta. (https://www.logammulia.com/id/services/refining)

Source:https://databoks.katadata.co.id/pertambangan/statistik/c0d25208a9d8008/negara-penghasil-emas-terbesar-di-dunia-indonesia-masuk-daftar

Figure 1 The World's Largest Gold Producing Countries

Security in delivering dore bullion to Jakarta has a considerable risk, primarily related to the criminal crime of dore bullion theft. Companies using third-party services can spend more to reduce the risk of theft, but they have drawbacks, namely, the delivery service will bear the risk of theft. Without guaranteed security, industries or companies are vulnerable to losses, which can even cause companies to go out of business [2].

The gold mining industry is generally high-risk, with many security incidents from upstream to downstream. The gold mining industry in Indonesia is filled by relatively few companies, including PT Freeport Indonesia, PT ANTAM, Agincourt, Nusa Halmahera, Bumi Suksesindo, Amman Mineral, Indo Muro Kencana, Bumi Resources Minerals, Merdeka, and Group Archi. In the production process, most gold mining companies produce the final product, dore bullion, which is gold bars still mixed with other minerals and metals. Therefore, there is a need for further purification at purification facilities belonging to other business entities located in different locations. Every company is required to refine metals domestically before making a sale. This provision is also the basis for the construction of metal refining factories in various regions in Indonesia [1].

The refining company carries out advanced refining to produce pure gold through a series of processes. The primary process applied is the electrorefining method, where gold is melted first to produce a cathode, followed by an electrolysis process to obtain a high gold content. The bullion smelting process also produces by-products like slag or slag, which still contain precious metals [3].

The need for unique and separate permits for dore bullion refining facilities, as well as a relatively high level of risk - cause Indonesia's average gold mining company to only produce gold until the final product stage of dore bullion. Further processes are outsourced to existing and officially licensed refining facilities through shipment. The delivery process/shipment of bullion uses third-party logistics services. According to "Article 4 letter a of Law No. 8 of 1999 concerning Consumer Protection, consumers who use goods and/or services have the right to comfort, security, and safety". In addition, based on "Article 4 letter h of the same law, consumers are also entitled to compensation if the goods and/or services received are not by the agreement or do not function as they should" [3]

The location of refinery facilities in different locations adds to the field risk variables that must be carefully calculated, as well as the implementation of appropriate risk mitigation. With the dynamics of gold prices in the global market that continue to increase, the safety aspect in the operational activities of gold mining companies is crucial, mainly when ore materials have been processed into dore bullion. Third-party freight forwarding services (expeditions) ensure that the goods sent are protected by shipping insurance so that claims can be filed for damage or loss of goods. However, consumers still face risks, namely, waiting for an investigation process from the insurance and refund authorities. On the other hand, companies also face risks such as time losses due to the need to file claims with the expedition party; process refunds to consumers, loss of revenue, and deterioration of the company's reputation [15].

Empirical studies have been carried out to analyze the antecedents of supply chain security operational performance. In their research, [15] produced findings that cargo management, facility management, human resource management, and information management are proven to have a positive effect on supply change security operational performance in the logistics industry in Malaysia. The findings also show that security culture only moderates the positive influence of facility management on supply chain security operational performance. [4] in his research in Jorda on companies that use supply chain management, found that cargo management and information management were proven to have a positive effect on supply chain operational performance, while facility management was not proven to affect supply chain operational performance.

From the background explanation above, this study was conducted to analyze the influence of supply chain security practices consisting of cargo management, facility management, and information management on supply chain security operational performance moderated by security culture.

B. LITERATURE

Supply Chain Security Operational Performance (SCSOP)

Supply Chain Security Operational Performance refers to the operational performance of a supply chain security system, which aims to ensure smooth operations while maintaining the security and resilience of the supply chain from potential external risks, disruptions, or threats. This SCSOP includes the application of best practices in risk management, security technologies such as blockchain, and mitigation protocols to improve operational efficiency as well as reduce vulnerability to cyberattacks or physical disturbances. Research shows that improvements in cybersecurity can directly contribute to improved supply chain operational performance, especially in terms of timeliness, reliability, and efficiency. In addition, the implementation of new technologies such as smart inventory systems and blockchain has shown a positive impact on overall supply chain performance. Improving operational performance in the context of supply chain security also involves using big data and artificial intelligence (AI) to detect threats early and manage responses to risks more efficiently. Further research shows that integrating security into supply chain strategies also improves overall organizational performance. [5], [6], [7], [8] and [9]

Supply Chain Security Practices (SCSP)

[10] defines SCSP as an effort to maintain the confidentiality and security of data in the supply chain, which involves protecting sensitive information from misuse by unauthorized parties. Stated that SCSP in the context of Supply Chain 4.0 includes the application of cybersecurity and data protection technologies to address complex supply chain digitalization challenges. Emphasized that the SCSP aims to reduce security risks in the global supply chain, including protecting procurement,

manufacturing, and distribution processes from operational disruptions arising from cyber threats. Defines SCSP as an approach to address the ethics, privacy, and security challenges that arise in utilizing Big Data analytics in the supply chain, particularly in maintaining data transparency and reliability. defines SCSP as a practice that integrates big data analytics and data security to improve the performance and sustainability of supply chain operations, with a focus on cyber risk mitigation. SCSP, including cargo management, facility management, and information management, will be managed optimally to improve supply chain security performance. [11], [12], [13] and [14]

The Relationship between Cargo Management and Supply Chain Security Performance

Cargo Management is the effective and efficient operational management of cargo or goods during the transportation process, including tracking, planning, and optimizing logistics from transportation to receipt. This process is important to ensure that goods can be transported safely, on time, and by customer standards or regulations. Cargo Management involves using technologies such as blockchain systems, real-time management, and data-driven approaches to improve efficiency and reduce the risk of loss. In addition, developments in cargo management are also related to sustainability, including the reduction of carbon emissions in cargo transportation and energy optimization in the shipping proce. [15], [16], [17] and [18]

Cargo management plays an important role in maintaining supply chain security operational performance. Effective cargo management includes strict monitoring of the movement of goods, safety monitoring, and compliance with existing regulations, which can directly improve the operational efficiency and safety of the supply chain. Empirically, companies that implement good cargo management practices tend to have stronger security systems, reducing the risk of loss, damage, or theft of goods during the shipping process. This also impacts overall operational performance, such as more precise delivery times, reduced operational costs, and increased consumer confidence. Therefore, efficient cargo management contributes significantly to the supply chain's safety and better operational performance. The results of the empirical study conducted by produced the findings of a positive influence of [11]. Cargo Management on Supply Chain Security Operational Performance and this result is supported by the findings of the research [19], [20] and [4] From the above explanation, the hypothesis proposed in this study is:

H1: *Cargo Management* has a positive effect on *Supply Chain Security Operational Performance*

The Relationship between Facility Management Management and Supply Chain Security Performance

Facility Management refers to managing and maintaining physical facilities within an organization, including buildings, infrastructure, and work environments, to ensure efficient operations and meet user needs. Facility management includes a variety of tasks such as building maintenance, energy management, safety, hygiene, and maintenance of technologies used in day-to-day operations. In addition, new technologies such as BIM (Building Information Modeling) and IoT (Internet of Things) are increasingly being adopted in facility management to support digital transformation, improve efficiency, and reduce operational risks. Sustainability principles are also becoming increasingly important in facility management, focusing on reducing carbon emissions and efficient energy management. Good facility management can increase user productivity and help organizations achieve their strategic goals. [21], [22], [23] and [24]

Facility management has a vital role in supporting supply chain security operational performance. Facility management that includes infrastructure maintenance, logistics area monitoring, and the implementation of adequate security systems can improve supply chain resilience and security. Empirically, well-managed facilities from warehouses to distribution centers can reduce the risk of operational disruptions such as theft, damage to goods, or information leakage. This contributes to improved operational efficiency, distribution speed, and security reliability, ultimately improving the overall performance of the supply chain. Therefore, optimal facility management is essential to maintain integrity and security in supply chain operations. The results of the empirical study produced findings that there is a positive influence of [13] Facility Management on Supply Chain Security Operational Performance. The results of this finding are also supported by empirical studies carried out by the findings of the research research [19], [20] and [4] From the above explanation, the hypothesis proposed in this study is:

H2: *Facility Management* has a positive effect on *Supply Chain Security Operational Performance*

The Relationship between Information Management Management and Supply Chain Security Performance

Information Management collects, stores, processes, and distributes information efficiently to support decision-making, coordination, and business operations. In the digital age, information management is becoming increasingly important because organizations must manage large volumes of data and ensure information security, accuracy, and availability for all interested parties. Technologies such as blockchain and artificial intelligence have also been integrated into information systems to improve information efficiency, security, and reliability. Information management also involves developing strategies to ensure that information is relevant, accessible, and used promptly. During the COVID-19 pandemic, the role of information systems increased rapidly as many organizations adopted technology to enable remote work and maintain operational continuity. A well-managed information system can help organizations respond to changes in the business environment more quickly and efficiently [25] and [26]

Information management has a significant influence on supply chain security operational performance. Good information management includes collecting, storing, distributing, and protecting data relevant to the entire supply chain process. Empirically, companies that implement effective information management can increase visibility and transparency throughout the supply chain, make it easier to identify potential risks and improve their ability to respond to security threats. The use of sophisticated information systems also allows for real-time monitoring of the movement of goods and operational flows, thereby reducing the risk of security breaches, theft, and fraud. Therefore, good information management improves operational security and strengthens the supply chain's overall integrity. Results of an empirical study conducted by [19], [20] and [4] findings on the positive influence of Information Management on Supply Chain Security Operational Performance. Based on this explanation, the hypothesis proposed in this study is:

H3: *Information Management* has a positive effect on *Supply Chain Security Operational Performance*

The Relationship between Security and Supply Chain Security Performance

Security Culture refers to the values, attitudes, and collective behaviors adopted by individuals in an organization or society to ensure the safety and security of information, infrastructure, and essential assets. This culture is formed through policies, training, and practices that aim to increase awareness and responsibility for security at every level of the organization. Security culture focuses on security technology and how individuals play an active role in preventing security threats. Research shows that organizations with a strong security culture can better manage risk and respond to security incidents more effectively. The implementation of a good cybersecurity culture can significantly reduce the risk of cyberattacks [27], [28] and [29]

Cargo management is an essential factor that affects supply chain security and operational performance. Proper management of facilities, such as warehouses, distribution centers, and other supporting infrastructure, ensures that all operations run safely and efficiently. Measures such as maintaining security systems, monitoring access, and implementing safety procedures contribute directly to the security of the supply chain. However, the influence of facility management on supply chain security is influenced by the security culture in the organization. A strong safety culture where all company members are committed to safety compliance and have a high awareness of risks will reinforce the positive impact of cargo management. The results of the empirical study produced findings that clicking or tapping here to enter text has a positive influence.[NO_Cargo Management on Supply Chain Operational Performance moderated by Security Culture. Based on this explanation, the hypothesis proposed in this study is:

H4: *Cargo Management* has a positive effect on *Supply Chain Security Operational Performance* moderated by *Security Culture*

Proper management of facilities, such as warehouses, distribution centers, and other supporting infrastructure, ensures that all operations run safely and efficiently. Measures such as maintaining security systems, monitoring access, and implementing safety procedures contribute directly to the security of the supply chain. However, the influence of facility management on supply chain security is influenced by the security culture in the organization. If an organization's security culture is strong, implementing good facility management will result in much better supply chain security performance. Conversely, in organizations with a weak security culture, the positive impact of facility management tends to diminish. The results of the empirical study produced findings that there is a positive influence of [13]. Facility Management on Supply Chain Operational Performance moderated by Security Culture. Based on this explanation, the hypothesis proposed in this study is:

H5: *Facility Management* has a positive effect on *Supply Chain Security Operational Performance* by moderating by *Security Culture*

Information management is an essential factor that affects supply chain security operational performance. Proper management of facilities, such as warehouses, distribution centers, and other supporting infrastructure, ensures that all operations run safely and efficiently. Measures such as maintaining security systems, monitoring access, and implementing safety procedures contribute directly to the security of the supply chain. However, the influence of facility management on supply chain security is influenced by the security culture in the organization. A strong security culture in which all company members are committed to safety compliance and a high awareness of risks will reinforce the positive impact of facility management on security operational performance. When a culture of security is implemented comprehensively, the entire facility system will function more optimally in protecting goods and reducing potential risks, such as theft, sabotage, or damage. Thus, security culture acts as a moderator that strengthens the relationship between facility management and supply chain security operational performance. If an organization's security culture is strong, implementing good facility management will result in much better supply chain security performance. Conversely, in organizations with a weak security culture, the positive impact of facility management tends to diminish. The results of the empirical study produced findings that there is a positive influence of [13]. Information Management on Supply Chain Operational Performance moderated by Security Culture. Based on this explanation, the hypothesis proposed in this study is:

H6: *Information Management* has a positive effect on *Supply Chain Security Operational Performance* moderated by *Security Culture*

Based on the literature review and empirical studies as explained above, the conceptual framework of the proposed research can be seen in figure 2

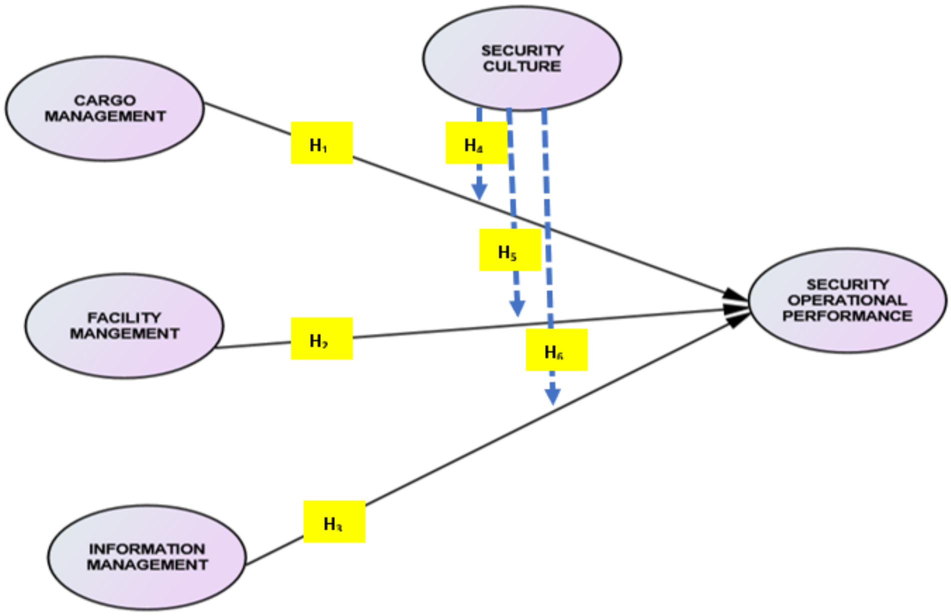

Figure 2. Research Conceptual Framework

C. RESEARCH METHOD

The type of research used is causality research, which aims to examine the influence of cargo management, facility management, and information management on supply chain security operational performance. This approach was adopted from the article [13].

The variables in this study consist of independent variables (Cargo management, Facility management, Information management) to dependent variables (Supply Chain Security Operational Performance) The independent variables of Supply Chain Security Practices [13] are divided into three dimensions: the cargo management dimension is measured using six indicators, the facility dimension is measured using 11 indicators, and the information management dimension is measured using three indicators. The variable control security culture [13] was measured using five indicators. The measurement of the dependent variables of Supply Chain Security Operational Performance [13] is divided into four dimensions namely the cargo safety dimension is measured through 3 indicators, the Supply ChainVisibility dimension is measured through 5 indicators, the Supply chain efficiency dimension is measured through 3 indicators, and the Supply chain resilience dimension is measured with five indicators. The scale used is the Likert scale, which ranges from 1 to 5 (strongly disagree to agree strongly).

The analytical tool used in this research is the PLS SEM Model as shown in the following figure 3.

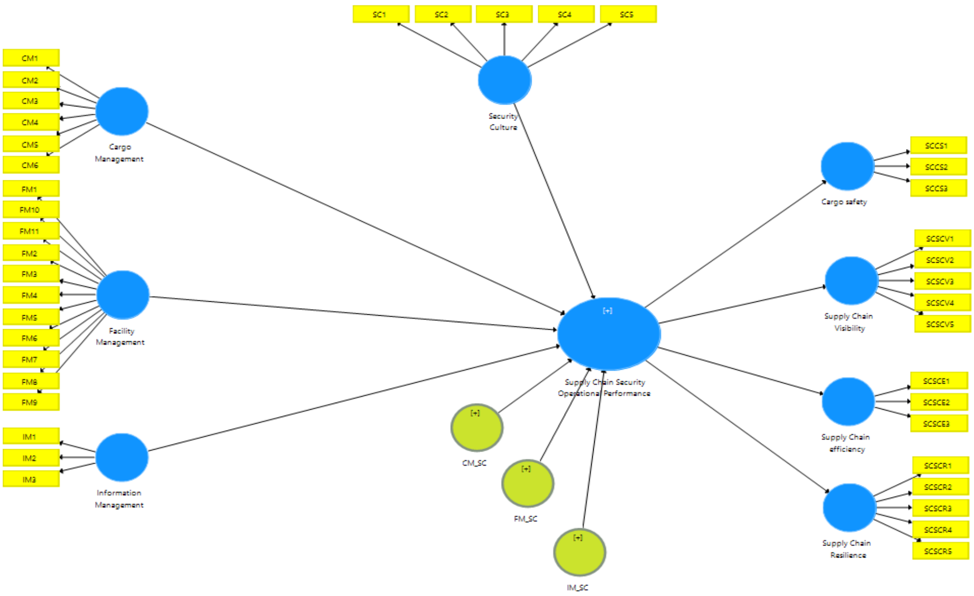

Figure 3. SEM-PLS Research Model

The stages of SEM-PLS model analysis are carried out as follows

1. Validity and Reliability Testing Validity refers to the extent to which the indicators used actually measure the intended variables, or in other words, whether the indicators are valid in measuring the variables (Hair et al., 2019). In this study, the validity test was carried out using outer loading, where an indicator is said to be valid if it has an outer loading> 0.7. Discriminant validity is used to test whether the indicators that form a variable are interrelated in forming the relevant variable. The test was carried out using Average Variance Extracted (AVE) with the criteria that if the AVE value ≥ 0.5 indicates that the indicators that form a variable are interrelated Reliability testing is carried out to test whether the indicator knows whether the research instrument item if treated several times will provide relatively consistent measurement results. Reliability testing is carried out using the Composite Reliability criterion where the criteria for determining whether or not a variable is reliable are considered reliable if it has a Composite Reliability value ≥ 0.7.
2. Goodness of fit model
   Goodness of fit model testing consists of multicollinearity testing and determination coefficient testing. Multicollinearity testing is used to test that the independent variables in the research mode should not be related to each other. If the VIF value of each independent variable is <10, then there is no multicollinearity in the independent variables concerned.
   The determination coefficient test is carried out using R square adjusted which shows how much variation in the independent variables is able to explain the variation in the dependent variable. The determination coefficient value is in the interval between 0 and 1. The closer to 1, the better the model is goodness of fit and vice versa, the closer to 0, the worse the model is goodness of fit.
3. Hypothesis Testing Theory
   Hypothesis testing theory is used to test the effect of each independent variable on its dependent variable. Hypothesis is done in stages
   Ho: b1 = 0 Independent variable does not affect dependent variable
   Ho: b1≠0 Independent variable affects dependent variable
   Decision making:
   If p-value of t <0.05 then Ho is rejected
   If p-value of t> 0.05 then Ho is accepted

D. RESULT AND DISCUSSION

D.1. Result

The results of the instrument test and descriptive statistics for the research variables can be seen in Table 1. The information from the table shows that the validity test for the Cargo management dimension consisting of six indicators resulted in the conclusion that all indicators were proven valid because they produced an outer loading > of 0.5 and reliability resulted in a composite reliability value of 0.958 > 0.7 which means that six indicators of reliable measurement were proven to be consistent. The validity test for the Security culture dimension consisting of five indicators resulted in the conclusion that all indicators were proven valid because they produced an outer loading > of 0.5 and reliability produced a composite reliability value of 0.973 > 0.7 which means that five indicators of reliable measurement were proven to be consistent. The validity test for the Supply Chain Visibility dimension consisting of five indicators resulted in the conclusion that all indicators were proven valid because they produced an outer loading of > 0.5 and reliability produced a composite reliability value of 0.957 > 0.7, which means that three indicators of measurement were proven to be reliable (consistent).

Table 1 Testing of Validity and Reliability and Descriptive Statistics of Research Variables

Items	Outer Loading	AVE	Composite Reliability	Mean
Cargo Management				**4.336**
CM1	0.901	0.79	0.958	4.318
CM2	0.912			4.375
CM3	0.932			4.337
CM4	0.877			4.362
CM5	0.897			4.387
CM6	0.818			4.237
Facility Management				**4.379**
FM1	0.889	0.74	0.969	4.35
FM2	0.87			4.325
FM3	0.881			4.406
FM4	0.809			4.313
FM5	0.92			4.4
FM6	0.828			4.375
FM7	0.896			4.419
FM8	0.868			4.419
FM9	0.872			4.4
FM10	0.864			4.4
FM11	0.772			4.363
Information management				**4.304**

Items	Outer Loading	AVE	Composite Reliability	Mean
IM1	0.944	0.79	0.918	4.369
IM2	0.926			4.394
IM3	0.786			4.15
Security culture				**4.359**
SC1	0.923	0.88	0.973	4.331
SC2	0.933			4.325
SC3	0.953			4.338
SC4	0.949			4.375
SC5	0.926			4.425
Cargo Safety				**4.427**
SCCS1	0.972	0.95	0.984	4.45
SCCS2	0.981			4.425
SCCS3	0.976			4.406
Supply chainVisibility				**4.315**
SCSCV1	0.829	0.82	0.957	4.2
SCSCV2	0.949			4.363
SCSCV3	0.935			4.363
SCSCV4	0.944			4.375
SCSCV5	0.854			4.275
Supply chainEfficiency				**4.294**
SCSCE1	0.913	0.85	0.946	4.269
SCSCE2	0.956			4.338
SCSCE3	0.901			4.275
Supply chainResilience				**4.311**
SCSCR1	0.949	0.87	0.971	4.325
SCSCR2	0.943			4.344
SCSCR3	0.933			4.3
SCSCR4	0.94			4.269
SCSCR5	0.898			4.319

Source : data processed with AMOS 23 and SPSS 25

The fit model test for the SEM-PLS model is shown by the determination coefficient value, where the processing results are shown in Table 2. The table can be explained as follows: For the Supply Chain Security Operational Performance model, an adjusted R square value of 0.922 was obtained, which means that the variation or behavior of the independent variables, namely Cargo management, Facility management, Information management, and Security culture, can explain the variation of the dependent variable, namely Supply Chain Security Operational Performance 92.2%, while the rest, which is 7.8%, is the variation of the independent variable other that affect Supply Chain Security Operational

Performance but are not included in the model. These results show that the Supply Chain Security Operational Performance model has a good fit model.

Table 2

Coefficient of Determination

Type	R Square	R Square Adjusted
Supply chainOperation Performance	0.926	0.922

Source : processed data

The results of processing for testing theoretical hypotheses can be seen in Table 3. Information from the table shows that Cargo management has a positive effect on Supply Chain Security Operational Performance (H1), and Facility management positively impacts Supply Chain Security Operational Performance (H2). This hypothesis is supported because it produces a value of the resulting estimation coefficient with a positive sign and a p-value of T statistic ≤ 0.05. Cargo management has a positive effect on Supply Chain Security Operational Performance Moderated by Security culture (H4), Facility management has a positive impact on Supply Chain Security Operational Performance Moderated by Security culture (H5), and Information management has a positive effect on Supply Chain Security Operational Performance is moderated by Security culture (H6) but produces a p-value of t statistical t > 0.05, so it is concluded that the three hypotheses are not proven.

Table 3 Testing of Theoretical Hypotheses

Hypothesis		Coefficient	Statistics	P-value	Decision
H1	*Cargo management* has a positive effect on *Supply Chain Security Operational Performance*	0.155	1.688	0.046	Hypothesis Supported
H2	*Facility management* has a positive effect on *Supply Chain Security Operational Performance*	0.198	1.805	0.036	Hypothesis Supported
H3	*Information management* has a positive effect on *Supply Chain Security Operational Performance*	0.261	2.877	0.002	Hypothesis Supported
H4	*Cargo management* has a positive effect on *Supply Chain Security Operational Performance* Moderated by *Security culture*	-0.084	1.099	0.136	Hypothesis is not Supported
H5	*Facility management* has a positive effect on *Supply Chain Security Operational Performance* Moderated by *Security culture*	0.075	0.748	0.227	Hypothesis is not Supported
H6	*Information management* has a positive effect on *Supply Chain Security Operational*	0.002	0.025	0.490	Hypothesis is not Supported

Hypothesis		Coefficient	Statistics	P-value	Decision
	Performance Moderated by *Security culture*				

Source : data processed with AMOS 23

D.2. Discussion

The first hypothesis in this study shows that Cargo management positively impacts Supply Chain Security Operational Performance. Efficient and effective cargo management in distributing and managing goods contributes significantly to improving the security and operational performance of the supply chain. This research is in line with the findings of [30], which stated that good supply chain management can optimize cargo management and improve operational safety. In addition, research by [31] also shows that effective integration in supply chain management can strengthen overall safety performance, as good cargo management will reduce risk and improve operational efficiency.

The second hypothesis in this study shows that Facility management positively impacts Supply Chain Security Operational Performance. Research by [32] found that optimal facility management can reduce operational disruptions, improve the efficiency of the flow of goods, and optimize the use of available space. This study is also consistent with the findings by [13] which show that efficient facility management can accelerate the distribution of goods and minimize operational risks, thereby improving supply chain performance.

The findings of hypothesis 3 prove that Information management positively impacts Supply Chain Security Operational Performance. This is in line with research by [33], which shows that effective information management can minimize operational risks and improve accuracy and safety in the delivery of goods. These findings are also consistent with the study by [4], which found that comprehensively which shows that although the role of facility management in the management of integrated information management helps simplify the monitoring and control process, improving operational performance and security in the supply chain.

Hypothesis 4 shows that Security culture has not been able to moderate the positive influence of Cargo management on Supply Chain Security Operational Performance. This is in line with research conducted by [34] which found that although the management of logistics and security of goods is essential, organizational culture factors that support the implementation of security procedures are still a significant challenge in improving the operational performance of the supply chain. In addition, these findings are also consistent with a study by [35] which emphasizes that a less strong security culture can reduce the effectiveness of existing security policies. Interviews with decision-makers in companies related to supply chain security operational performance revealed that organizations with weak security cultures tend not to maximize the benefits of existing logistics management systems. This is because employees are not fully engaged in efforts to maintain the security and smooth operation of the supply chain. Even though many companies have implemented modern and technology-based Cargo management policies, a security culture that is not well integrated at all levels of the organization causes a suboptimal influence on supply chain security operational performance. Many organizations focus on improving security technologies and procedures, but pay insufficient attention to the importance of building and strengthening a culture that supports the implementation of these policies.

The findings of hypothesis 5 show that Security culture has not been able to moderate the positive influence of Facility management on Supply Chain Security Operational Performance. These findings are in line with research conducted by [36] (logistics assets and facilities is vital, without a deep security culture, the positive influence of facility management practices on supply chain security performance cannot be optimally achieved. A study by [37] also highlights that an organizational culture that is not adequately internalized can hinder the implementation of an adequate facility management system in the context of supply chain security. The findings show that even though Facility management procedures are well implemented, without a strong security culture throughout the organization, these policies and procedures cannot have a maximum impact on supply chain performance. The facts on the ground show that many companies have modernized their Facility management systems but on the other hand the lack of attention to security culture in the organization hinders the achievement of optimal performance in terms of supply chain security. They noted that success in managing facilities and assets depends largely on how the policies and procedures are accepted and implemented by all members of the organization. Good Facility management policies can help in identifying and mitigating risks in the supply chain, but without the support of a strong security culture, such efforts will not be able to optimize operational performance to the fullest.

The findings of hypothesis 6 show that Security culture has not been able to moderate the positive influence of Information management on Supply Chain Security Operational Performance. These findings align with research conducted by [38], which showed that while sophisticated information management systems can help identify and respond to threats quickly, without a strong culture that prioritizes data security, implementing such systems will not work effectively. In addition, a study by [39] also states that although information management has great potential to support security, the lack of awareness and commitment to a security culture reduces the positive impact that can be produced. Field interviews with decision makers show that while sophisticated information management systems can help identify and respond to threats quickly, without a strong culture that prioritizes data security, the implementation of such systems will not be effective. While information management technology can speed up data processing and response to security threats, the effectiveness of such systems depends largely on how the organizational culture supports their implementation and use. Without a strong commitment to security culture, the success of information management in improving supply chain operational performance will not be optimal. In practice, many organizations have implemented sophisticated information management solutions to manage risks in the supply chain, but on the other hand, the culture that supports security in the use of these technologies is still low. The findings show that reliable information systems can provide great benefits in terms of threat management, but without a high awareness of the importance of data and information security throughout the organization, the effectiveness of these systems is limited.

E. CONCLUSION

From the findings of the above research, it is found that 3 out of 6 hypotheses proposed in the study are supported, namely: Cargo management have a positive effect on Supply Chain Security Operational Performance (H1) which means An effective cargo management system, including planning, supervision, and coordination between related parties, has been proven to be able to improve operational efficiency and security in the supply chain, Facility management have a positive effect on Supply Chain Security Operational Performance (H2) which means that effective facility management, such as infrastructure maintenance, access monitoring, and the application of security technology, plays an important role in ensuring smooth operations and increasing protection against risks in the supply chain, Information management have a positive effect on Supply Chain Security Operational Performance (H3) which means Structured information management, including accurate and timely data collection, processing, and distribution, contributes to improved operational efficiency and security in the supply chain. A total of 3 hypotheses are not supported. Namely, Cargo management does not have a positive effect on Supply Chain Security Operational Performance Moderated By Security culture (H4), Facility management does not have a positive effect on Supply Chain Security Operational

Performance Moderated By Security culture (H5), and Information management does not have a positive effect on Supply Chain Security Operational Performance Moderated By Security culture (H6)

This research has several limitations. First, the research object was limited to employee respondents who had tasks related to dore bullion delivery to focus the analysis on logistics and security management in the supply chain. This aims to obtain specific data on operational performance that is influenced by managerial policies and procedures. Additionally, the study considered factors such as the level of training, awareness of safety procedures, and respondents' work experience. Second, the variables used are limited to Cargo management, Facility management, Information management, Security culture, and Supply chain Operational Performance, without including other variables such as risk management or external factors. These restrictions are in place to maintain the focus of the research, but other variables that are not studied can provide additional insights into operational performance and supply chain security. Therefore, further research is recommended to expand the study of variables to obtain a more comprehensive picture

Bibliography

[1] T. Wahyuningsih and W. Pamungkas, “Proses Acid Wash Untuk Menurunkan Kadar Pengotor Pada Cake Hasil Merril Crowe,” *J. Metall. Eng. Process. Technol.*, vol. 2, no. 2, p. 28, 2022, doi: 10.31315/jmept.v2i2.6524.

[2] I. Suhadi, “The security of the Pongkor mountain gold mining area in Bogor regency by the West Java Brimobda in order to prevent the practice of mining without a permit (PETI).,” 2020.

[3] R. Adianto, I. Putra, and F. Ardia, “Study on Gold Acquisition in Slag from Gold Bullion Refining Using the Hydrochloric Acid Leaching Method at PT Sucofindo Bekasi.,” 2022.

[4] H. Hajar, “The Role of Pesantren in Guarding the Halal Supply chainin Indonesia. Jihbiz: Journal of Islamic Economics,” *Financ. Banking*, vol. 7, no. 1, pp. 46–55, 2023.

[5] J. Aslam, A. Saleem, N. T. Khan, and Y. B. Kim, “Factors influencing blockchain adoption in supply chain management practices: A study based on the oil industry,” *J. Innov. Knowl.*, vol. 6, no. 2, pp. 124–134, 2021, doi: https://doi.org/10.1016/j.jik.2021.01.002.

[6] K.-F. Cheung, M. Bell, and J. Bhattacharjya, “Cybersecurity in logistics and supply chain management: An overview and future research directions,” *Transp. Res. Part E Logist. Transp. Rev.*, vol. 146, p. 102217, Feb. 2021, doi: 10.1016/j.tre.2020.102217.

[7] E. P. Mondol, “The Impact of Block Chain and Smart Inventory System on Supply Chain Performance at Retail Industry,” *Int. J. Comput. Inf. Manuf.*, vol. 1, no. 1, pp. 56–76, 2021, doi: 10.54489/ijcim.v1i1.30.

[8] L. Zhao and A. Huchzermeier, “Supply Chain Risk Management,” *EURO Adv. Tutorials Oper. Res.*, pp. 39–55, 2018, doi: 10.1007/978-3-319-76663-8_3.

[9] S. Bag, L. C. Wood, L. Xu, P. Dhamija, and Y. Kayikci, “Big data analytics as an operational excellence approach to enhance sustainable supply chain performance,” *Resour. Conserv. Recycl.*, vol. 153, p. 104559, 2020, doi: https://doi.org/10.1016/j.resconrec.2019.104559.

[10] V. Hassija, V. Chamola, V. Gupta, S. Jain, and N. Guizani, “A Survey on Supply Chain

Security: Application Areas, Security Threats, and Solution Architectures," *IEEE Internet Things J.*, vol. PP, Oct. 2020, doi: 10.1109/JIOT.2020.3025775.

[11] T. Sobb, B. Turnbull, and N. Moustafa, "Supply chain 4.0: A survey of cyber security challenges, solutions and future directions," *Electron.*, vol. 9, no. 11, pp. 1–31, 2020, doi: 10.3390/electronics9111864.

[12] S. Pandey, R. K. Singh, A. Gunasekaran, and A. Kaushik, "Cyber security risks in globalized supply chains: conceptual framework," *J. Glob. Oper. Strateg. Sourc.*, vol. 13, no. 1, pp. 103–128, Jan. 2020, doi: 10.1108/JGOSS-05-2019-0042.

[13] S. H. Zailani, K. S. Subaramaniam, M. Iranmanesh, and M. R. Shaharudin, "The impact of supply chain security practices on security operational performance among logistics service providers in an emerging economy: Security culture as moderator," *Int. J. Phys. Distrib. Logist. Manag.*, vol. 45, no. 7, pp. 652–673, 2015, doi: 10.1108/IJPDLM-12-2013-0286.

[14] Y. Fernando, R. Chidambaram, and I. Wahyuni-Td, "The impact of Big Data analytics and data security practices on service supply chain performance," *Benchmarking An Int. J.*, vol. 25, p. 0, Nov. 2018, doi: 10.1108/BIJ-07-2017-0194.

[15] S. Emek, İ. Tosun, M. E. Yılmaz, Z. Say, and Y. B. Peker, "A Modeling Approach for Cargo Transportation Considering Energy Saving TT - Kargo Taşımacılığında Enerji Tasarrufuna Dayalı Bir Modelleme Yaklaşımı," *Fırat Üniversitesi Mühendislik Bilim. Derg.*, vol. 36, no. 2, pp. 965–978, 2024, doi: 10.35234/fumbd.1468659.

[16] S. Narayanan, "Electric cargo cycles - A comprehensive review," *Transp. Policy*, vol. 116, Dec. 2021, doi: 10.1016/j.tranpol.2021.12.011.

[17] A. Cruz *et al.*, "Comparing the biomechanical and perceived exertion imposed on workers when using manual mechanical and powered cargo management systems during ladder loading and unloading tasks," *Int. J. Ind. Ergon.*, vol. 86, p. 103199, Nov. 2021, doi: 10.1016/j.ergon.2021.103199.

[18] A. Kasaei and A. Albadvi, "Cargo chain: Cargo Management in Port Logistics with Blockchain Technology," 2023, [Online]. Available: https://doi.org/10.21203/rs.3.rs-2990402/v1

[19] C. Dusitin, "The Effect of Facility Management in Supply Chain Security Operational Performance and Firm in Malaysia," *SSRN Electron. J.*, 2018, doi: 10.2139/ssrn.3090093.

[20] S. Abualoush, "The nexus of knowledge management processes and innovation performance: the moderates of big data analytical," *Kybernetes*, vol. ahead-of-print, no. ahead-of-print, Jan. 2023, doi: 10.1108/K-01-2023-0056.

[21] K. C. Dahanayake and N. Sumanarathna, "IoT-BIM-based digital transformation in facilities management," *a Concept. Model*, vol. 20, no. 3, pp. 437–451, May 2022, doi: 10.1108/JFM-10-2020-0076.

[22] M. F. Andrada, A. K. R. B. Alfaro, and J. A. Cruz, "Facility management system improvement of the Philippine National Railways," *Proc. Int. Conf. Ind. Eng. Oper. Manag.*, vol. 0, no. March, pp. 1709–1718, 2020.

[23] D. Troje, "Path dependencies and sustainable facilities management: a study of housing companies in Sweden," *Build. Res. Inf.*, vol. 51, no. 8, pp. 965–978, 2023, doi:

10.1080/09613218.2023.2216795.

[24] C. Shaw, F. de Andrade Pereira, C. McNally, K. Farghaly, T. Hartmann, and J. O'Donnell, "Information management in the facilities domain: investigating practitioner priorities," *Facilities*, vol. 41, no. 5/6, pp. 285–305, Jan. 2023, doi: 10.1108/F-02-2022-0033.

[25] I. O. Pappas and A. G. Woodside, "Fuzzy-set Qualitative Comparative Analysis (fsQCA): Guidelines for research practice in Information Systems and marketing," *Int. J. Inf. Manage.*, vol. 58, p. 102310, 2021, doi: https://doi.org/10.1016/j.ijinfomgt.2021.102310.

[26] C. Collins, D. Dennehy, K. Conboy, and P. Mikalef, "Artificial intelligence in information systems research: A systematic literature review and research agenda," *Int. J. Inf. Manage.*, vol. 60, p. 102383, 2021, doi: https://doi.org/10.1016/j.ijinfomgt.2021.102383.

[27] K. Khando, S. Gao, M. S. Islam, and A. Salman, "Enhancing Employees Information Security Awareness in Private and Public Organisations: A Systematic Literature Review," *Comput. Secur.*, vol. 106, p. 102267, Apr. 2021, doi: 10.1016/j.cose.2021.102267.

[28] F. Hoffman, "Assessing U.S. And Slovenian organizational security culture with Hofstede's national culture framework," *Issues Inf. Syst.*, vol. 22, no. 3, pp. 114–128, 2021, doi: 10.48009/3_iis_2021_127-141.

[29] K. Gould and C. Bieder, *The Coupling of Safety and Security*. 2020. doi: 10.1007/978-3-030-47229-0.

[30] A. Deveshwar and R. Rathee, "Challenges For Supply Chain Management In Today's Global Competitive Environment," Jul. 2010.

[31] R. Masa'deh, M. Jaber, A. A. A. Sharabati, A. Y. Nasereddin, and A. Marei, "The Blockchain Effect on Courier Supply Chains Digitalization and Its Contribution to Industry 4.0 within the Circular Economy," *Sustain.*, vol. 16, no. 16, pp. 1–21, 2024, doi: 10.3390/su16167218.

[32] F. N. Abdeen and Y. G. Sandanayake, "Facilities Management Supply Chain: Functions, Flows and Relationships," *Procedia Manuf.*, vol. 17, pp. 1104–1111, 2018, doi: https://doi.org/10.1016/j.promfg.2018.10.074.

[33] A. Husna, M. F. M. Yusof, A. Jafar, and A. Q. Qadri, "Determinants and Complexities of Halal Logistics in Malaysia: A Systematic Literature Review," *Muslim Bus. Econ. Rev.*, vol. 3, no. 1, pp. 32–51, 2024, doi: 10.56529/mber.v3i1.269.

[34] B. S. Patel and M. Sambasivan, "A systematic review of the literature on supply chain agility," *Manag. Res. Rev.*, vol. 45, no. 2, pp. 236–260, Jan. 2022, doi: 10.1108/MRR-09-2020-0574.

[35] A. C. Silva, C. M. Marques, and J. P. de Sousa, "A Simulation Approach for the Design of More Sustainable and Resilient Supply Chains in the Pharmaceutical Industry," *Sustain.*, vol. 15, no. 9, 2023, doi: 10.3390/su15097254.

[36] A. Carvalho, R. Calejo, and J. Santos, "BIM Model as Support for Maintenance Activities," 2023, pp. 53–62. doi: 10.1007/978-3-031-48461-2_5.

[37] D. Kumar, G. Soni, R. Joshi, V. Jain, and A. Sohal, "Modelling supply chain viability

during COVID-19 disruption: A case of an Indian automobile manufacturing supply chain," *Oper. Manag. Res.*, vol. 15, no. 3–4, pp. 1224–1240, 2022, doi: 10.1007/s12063-022-00277-5.

[38] R. Rathi, M. Singh, J. Antony, J. A. Garza-Reyes, R. Goyat, and A. Shokri, "Integration of blockchain and Lean Six Sigma approach for operational excellence:a proposed model," *Int. J. Lean Six Sigma*, vol. 15, no. 5, pp. 1043–1064, Jan. 2024, doi: 10.1108/IJLSS-07-2022-0148.

[39] B. Goh, N. Li, and T. Ranasinghe, "Big Data Analytics and Management Forecasting Behavior," *Account. Horizons*, vol. 38, pp. 1–18, Aug. 2023, doi: 10.2308/HORIZONS-2020-145.