

**Enterprise risk management and supply chain effectiveness: Evidence in the Indonesian electricity project**

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**ABSTRACT**

The research aimed to know the influence of long-term relationships, information sharing, Cooperation, and integration process in partial on the supply chain effectiveness of the EPC Steam Power Plant project in the Province of North Sulawesi. It was also to know whether enterprise risk management moderates the influence, long-term relationship, information sharing, Cooperation, and integration process toward supply chain effectiveness. The employees who became the sample in the supply chain activities of the steam power plant project in North Sulawesi were 250 people, 149 of whom were proportionally from the project owner. The research uses the data analysis technique using Structural Equation Modelling-Partial Least Square. The result of the study indicated that long-term relationships, information sharing, Cooperation, and integration process partially have a positive and significant influence on supply chain effectiveness. In addition, enterprise risk management proved to moderate the impact of information sharing. Still, it needed to moderate the effect of a long-term relationship, Cooperation, and integration process on the supply chain effectiveness of the EPC Steam Power Plant Sulut-3 project.

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**1. Introduction**

Today, the construction project has experienced much development from all aspects, such as technology, material, and construction work contract model. EPC contract (Engineering, Procurement, Construction) is a construction contract that has developed much nowadays. This research is carried out in the Steam Power Plant (PLTU) Sulut-3 project in Minahasa, an area of North Sulawesi. PLTU Sulut-3 is a generating unit of independent power producer (IPP) with a capacity of 2x50 MW. This coal-based PLTU is projected to supply the need for electricity for the electricity system in the provinces of North Sulawesi and Gorontalo. Today the capacity of electricity production of North Sulawesi is 598.1 MW; the peak load is 409.5 MW, and the reserve capacity is 188.6 MW. The power plant construction in the PLTU Sulut-3 project uses an EPC contract.

Supply chain management is vital for controlling the process in specified and systematic ways to improve quality, save time and increase profit (Wahyuni et al., 2022). However, construction supply chains can be complex, especially in big projects. Complexity is one of the main characteristics related to various parties, namely suppliers and contractors, required for construction projects. It can be more complex when many people are involved. As a result, some problems in the field are found, such as: (1) Too many commodities and quantity of goods are supplied, (2) The timeline for the project completion specified is very tight, (3) The supply chain process of EPC PLTU Sulut-3 project comes from cross-country sources, (4) There are three main parties involved in the supply chain of EPC PLTU Sulut-3 project, namely project owner, contractor

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and suppliers with their different interests.

According to Al-Werikat (2017), it needs changes to integrate the supply chain with all parties' involvement, the project's human resource knowledge, and the understanding of contract documents. Supply Chain Effectiveness (SCE) shows a good way for a company organization in the supply chain process to achieve its financial and operational goals (Barata et al., 2022; Gunasekaran et al., 2004; Ketikidis et al., 2013). Mulchandani et al. (2022) show that an internal factor like trade digitalization plays a vital role in SCE adoption. Mangla et al. (2018) propose some necessary policy steps and recommendations to help managers and government agencies adopt and manage the concept of the supply chain to circle effectively. This variable is essential to be used in the supply chain analysis because if the supply chain effectiveness is achieved, it can balance the finance and operation. In addition, SCE can relate strategic mitigation with supply chain effectiveness. SCE also shows an effective external and internal relationship.

Supply chain management in a construction project provides chances to control more on a project, increase profit, and reduce the time and cost of waste treatment. Procurement uncertainty can influence the whole construction process and the project schedule (Yeo & Ning, 2006). The supply chain in construction has the following characteristics: (1) The assembly point of the material is in the construction location, where the objects of the project exist and then the incoming materials are assembled; (2) Construction project includes only one production; and it is made to be repeated configuration from the project organization separated from the design; (3) Supply chain typically "makes-to-order," where each project creates new products or prototypes (Vrijhoef & Koskela, 2000; Johansson et al., 2016)

Information Sharing is a continuous flow of formal and informal communication between working partners in the supply chain (Miguel & Brito, 2011). Information Sharing is the key to increasing competitive advantage and excellent supply chain performance (Baah et al., 2022; Ricardianto et al., 2022; Omar et al., 2010). The Study by Kim and Narasimhan (2002) and Huang and Wang (2017) states that the utilization of information systems with empirical data from manufacturing companies shows that the focus of information system utilization should shift from infrastructure support to value creation management and logistic operation. In addition, information sharing will increase collaboration among stakeholders, which can help with on-time delivery and reduce operational costs.

Collaboration in the supply chain develops through repeat transactions and gradually develops to become a long-term partnership based on loyalty and trust (Ryciuk & Nazarko, 2020; Ting et al., 2007). Collaboration is one of the critical variables in the supply chain, along with trust, communication, and adaptation (Indrasari et al., 2022; Ryciuk & Nazarko, 2020; Su et al., 2008; Tian, 2018). Collaboration among partners in the supply chain will increase the supply chain's flexibility and innovation, which can also prevent the occurrence of the bullwhip effect (Cao & Zhang, 2011). Concerning the integration process, Fianko et al. (2022) validates the presumption of the relation between customer integration and customer value and theoretically shows the process and capability of product innovation uniquely. The study by Cui et al. (2022) shows that supply chain integration plays a mediation role in the effect of digital technology on company resilience, and the mediation effect is very significant to customer integration.

The risks of business obstruction and economic slowdown related to Enterprise Risk Management (ERM) become significant in a company (Tan & Lee, 2000). ERM has been regarded as one of the most significant variables related to enterprise management in the modern era (Shatnawi et al., 2022). Companies should practice enterprise risk management appropriately, where risk management is integrated into the company strategy (Damayanti & Augustine, 2019; Ricardianto et al., 2023; Nurhayati et al., 2022). The results of a study by Zou et al. (2019), and Shad et al. (2022), also show that the strong impact of ERM assessment is highly related to cost management, inventory management, asset management, and cash flow management. Vickery et al. (2003) suggest that long-term relationships can result in the improvement of company performance. Paulraj et al. (2008) explain the significant relationship and information sharing between long-term relationships and suppliers. Sheu et al. (2006) inform that long-term orientation affects the architecture of the supply chain, including the capability of information technology and information sharing.

## **2. Theoretical Basis**

### *2.1 Supply Chain Effectiveness*

The definition of supply chain management effectiveness is the good way a company organization in the supply chain process achieves financial and operational goals (Anatan, 2006). The financial and operational goals are achieved when the operational process of the supply chain can balance the cost and effectiveness (Virgiawan et al., 2021). Some researchers like Ali et al. (2019), Fugate et al. (2009), and Jacyna-Gółda et al. (2018) measure the supply chain effectiveness by a six-item scale that has been developed and used. The operational effectiveness of the supply chain can be measured based on the ability to manage transportation, warehousing, inventory, and total acquisition costs. Humphreys et al. (2004) state that the operational mechanism of the supply chain is very important for improving the company's performance and significantly increasing the supply chain's effectiveness.

## 2.2 Information Sharing

Information sharing is a continuous flow of formal and informal communication among working partners and contributes to better planning and control in a chain (Miguel & Brito, (2011). Information sharing is a mutual exchange of business market information with stakeholders (Wu, 2008). Information sharing can help companies improve the efficiency and effectiveness of the supply chain and is the most critical factor in achieving effective supply chain coordination and becoming the controller along the supply chain (Endri et al., 2022; Anatan, 2014). Wei et al. (2013), Wu et al. (2022), and Saleem et al. (2021) state that employees need the mechanism of systematic information sharing, which widens their insights about the company and competitors' products and services.

## 2.3 Cooperation

According to Chen and Paulraj (2004) and Mentzer et al. (2001a,b), in a satisfactorily long-term collaborative relationship, it is necessary to develop Cooperation to resolve conflicts. The Cooperation, as stated by Chakraborty et al. (2014), has four variable dimensions: incentive alignment, information access, collaborative communication orientation, and goal congruence. The research by Asghari et al. (2022) guides managers to promote coordination and achieve a fair profit allocation. The supply chain must understand Cooperation and coordination to develop a supply chain integration to avoid decision-makers misperceptions (Feizabadi & Alibakhshi, 2022).

## 2.4 Long-Term Relationship

A long-term relationship is the company's ability to build a long-term relationship that will not cause damage to the ecosystem and at the same time will bring in a long-term profit (Niño-Amézquita et al., 2017; Yang & Černevičiūtė, 2017). Ogden (2006) adds that one of the critical aspects of supplier relations in the most recent trend is building a long-term relationships with suppliers. Another critical aspect today, according to Kotabe et al. (2003) and Chen and Paulraj (2004), is that the improved relationship with suppliers up to a strategic level has been considered an integral part of a company's operation.

## 2.5 Integration Process

Integration in the supply chain shows a complex process of Cooperation between the company and suppliers and buyers which, if well managed, will be able to improve the efficiency of the company's operation and can further increase the company's profit and give satisfaction to all parties (Cousineau et al., 2004). According to Freije et al. (2022), customer integration impacts the product innovation ability of the companies served, and internal integration is a supporting factor for external integration. Cui et al. (2022) add that customer integration, supplier integration, and internal integration reduce the requirements for information processing and increase the information processing ability through cross-functional department information management and beyond the organization's limits. In the integration process, the business scale changes, and it needs to find the balanced suitability between the relative and absolute indicators when making an evaluation indicator system (Imamguluyev et al., 2021).

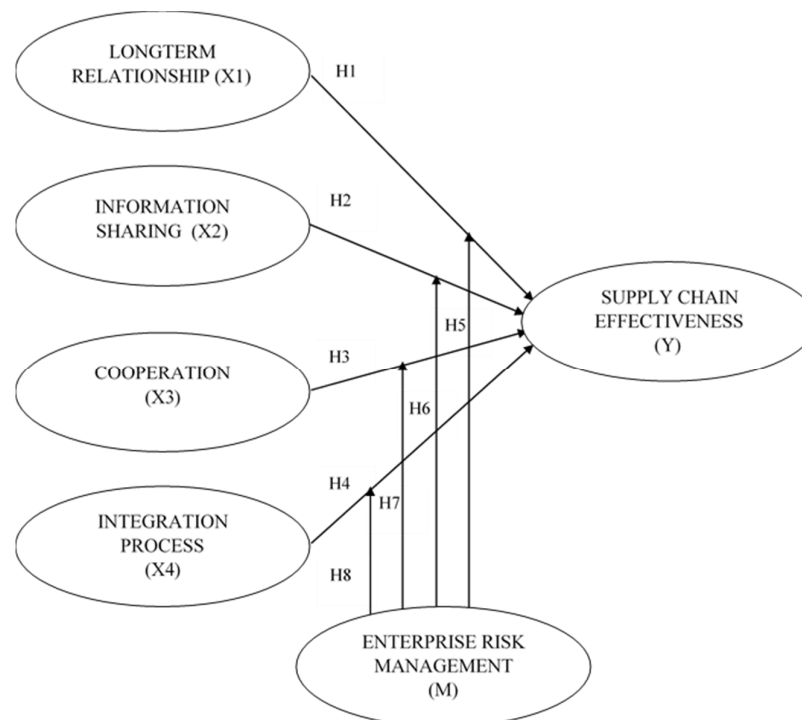
## 2.5 Enterprise Risk Management

Risk management can be stated as the procedure of design and implementation to manage business risks (Mondy, 2012). Bromiley et al. (2015) say that Enterprise Risk Management (ERM) is an integrated management of all an organization's risks; it needs conformity between risk management and corporate governance and strategy. ERM aims to integrate all the risks a company faces, including the alignment between risk management and corporate governance and strategy (McShane, 2018). ERM is the number of business activities that can influence and actively implement risk management to achieve business goals (Klučka & Grünbichler, 2020). ERM implementations include risk identification, involvement, risk criteria, risk appetite, tolerance, reporting, and benefit (Fraser et al., 2022). ERM is also a strategic risk and risk management orientation based on corporate policy (Shatnawi et al., 2022). Other researchers, Samuel and Prasetyo (2020) and Yin et al. (2020), find a positive relationship between the company value and the use of ERM.

This research aims to know and analyze the moderating variables, namely enterprise risk management that influences supply chain effectiveness, information sharing, Cooperation, and integration process that influences the supply chain effectiveness of Engineering, Procurement, Construction (EPC) projects for Steam Power Plant in PLTU Sulut-3 in Minahasa, the province of North Sulawesi.

## 2.7 Framework of Thinking

Fig. 1 presents the structure of the proposed method.



**Fig. 1.** Research Framework

### 2.8 Hypotheses

**H<sub>1</sub>:** Long term relationship positively influences supply chain effectiveness.

**H<sub>2</sub>:** Information sharing positively influences supply chain effectiveness.

**H<sub>3</sub>:** Cooperation positively influences supply chain effectiveness.

**H<sub>4</sub>:** Integration process positively influences supply chain effectiveness.

**H<sub>5</sub>:** Enterprise risk management moderates the influence of long-term relationships on supply chain effectiveness.

**H<sub>6</sub>:** Enterprise risk management moderates the influence of information sharing on supply chain effectiveness.

**H<sub>7</sub>:** Enterprise risk management moderates the influence of Cooperation on supply chain effectiveness.

**H<sub>8</sub>:** Enterprise risk management moderates the influence of the integration process on supply chain effectiveness.

## 3. Research Method

Research activities were done in the steam power plant project in North Minahasa, North Sulawesi. The population in this research are those related to the EPC PLTU Sulut-3 project comprising President Director up to staff level from the project owner, contractor, and EPC PLTU Sulut-3 project suppliers total of 456 in number. The sampling technique used is purposive sampling. The samples were taken from the employees directly involved in the supply chain activities in the PLTU Sulut-3 project as many as 250 people. This research used SmartPLS 3 software because the analysis of this research used the structural equation method with partial least squares (SEM PLS). The SEM PLS analysis was presented in three parts consisting of the outer model test, namely indicator reliability, discriminant validity, convergent validity, and internal consistency; an inner model test using multicollinearity test, coefficient of determination (R<sup>2</sup>); and Predictive Relevance (Q<sup>2</sup>), path coefficient, and F Square or Effect Size, and hypothetical tests, the analysis of the influence of independent variables (exogen) on the dependent variable (endogen) can be seen from the path coefficient (Mean, STDEV, and T-Value). This research used the SEM-PLS approach.

## 4. Results

### 4.1 Validity Test (Convergent Validity)

Validity test or convergent validity uses the value of outer loading. The processing result using SmartPLS with the value of the outer Model or correlation between the construct and variable shows that all the values of the loading factor are more than 0.5, so the construct for all variables has been valid from the Model. The following are the results of the initial structural Model of the outer Model (Figure 3).

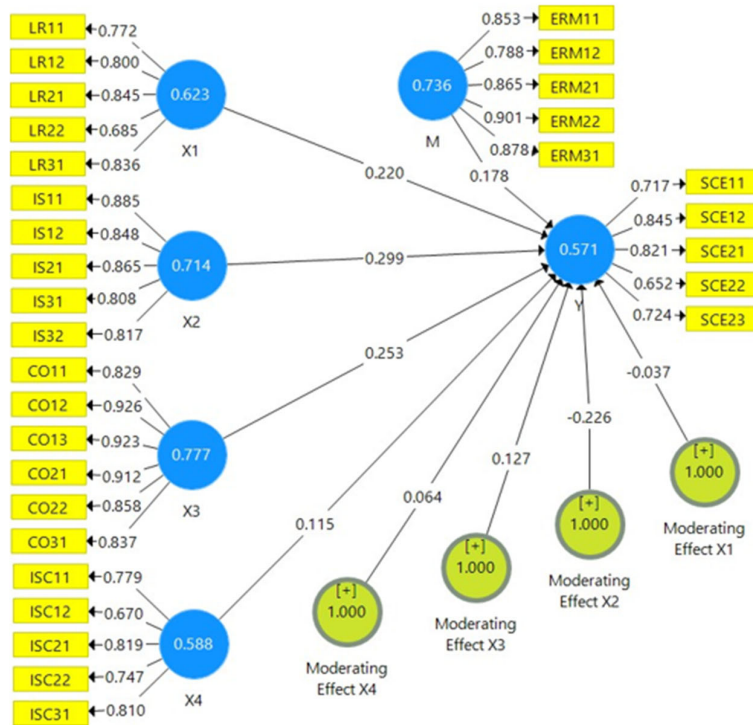


Fig. 3. Structural Model of Outer Model

4.2 Discriminant Validity Test

The next step is the discriminant validity test using the value of Average Variance Extracted (AVE) (Table 2).

Table 2  
Discriminant Validity Test

Variable	Average Variance Extracted
Enterprise Risk Management (M)	0.736
Longterm Relationship (X1)	0.623
Information Sharing (X2)	0.714
Cooperation (X3)	0.777
Integration Process (X4)	0.588
Supply Chain Effectiveness (Y)	0.571

Table 3  
Fornell-Larcker Criterion among Variables

	ERM	LR	IS	CO	ISC	SCE
ERM	<b>0.858</b>					
LR	0.221	<b>0.789</b>				
IS	0.543	0.236	<b>0.845</b>			
CO	0.609	0.305	0.764	<b>0.882</b>		
ISC	0.008	0.482	0.199	0.229	<b>0.767</b>	
SCE	0.533	0.468	0.707	0.693	0.317	<b>0.755</b>

The AVE value resulting from the discriminant test is > 0.5; the AVE value is valid for all variables. Then it is continued to measure Fornell-Larcker Criterion and Cross loading (Table 3).

4.3 Reliability Test

The next step is the reliability test using the values of Cronbach's Alpha and composite reliability (Table 4).

Table 4  
Reliability Test

Variable	Cronbach's Alpha	Composite Reliability	Rule of Thumb	Model Evaluation
Enterprise Risk Management (ERM)	0.911	0.933		Reliable
Longterm Relationship (LR)	0.847	0.892		Reliable
Information Sharing (IS)	0.901	0.926		Reliable
Cooperation (CO)	0.942	0.954		Reliable
Integration Process (ISC)	0.828	0.877		Reliable
Supply Chain Effectiveness (SCE)	0.810	0.868	> 0.70	Reliable

The values of Cronbach's Alpha and composite reliability obtained from the estimation of SmartPLS are > 0.70, and all the variables are stated as reliable (Table 4).

4.4 Structural Model (Inner Model)

The research model with an inner model test using R-square for dependent constructs, the t-test, and the significance of the parameter coefficient of the structural path can be depicted by the structural Model of the inner Model (Figure 5).

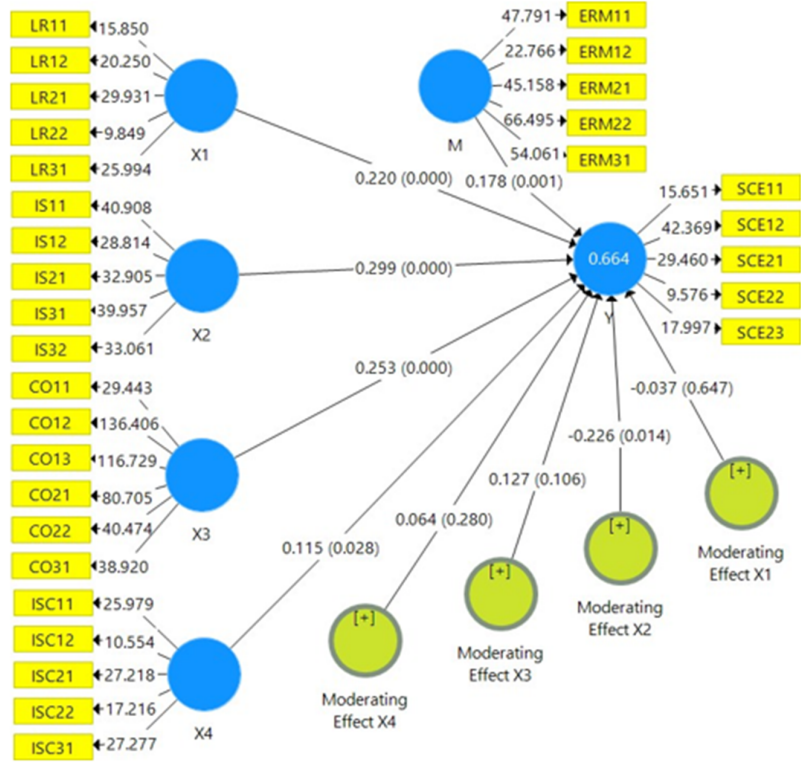


Fig. 5. Structural Model of Inner Model

The results of R-square and Q Square estimation using SmartPLS for Supply Chain Effectiveness can be seen in Table 5.

**Table 5**  
R Square and Q Square Values

Variable	R Square	Q Square
Supply Chain Effectiveness	0.664	0.358

The R Square value of the Supply Chain Effectiveness (SCE) variable resulted in 0.664 or 66.4%, meaning that the variables of Longterm Relationship (LR), Information Sharing (IS), Cooperation (CO), Integration Process, and Enterprise Risk Management (ERM) can substantially explain the variable of SCE at the level of 66.4%. In contrast, the rest are influenced by other factors not included as the variables of this research. Subsequently, the Q Square value of the SCE variable is 0.358, meaning that it is more than 0.1, showing that the Model has a predictive relevance. Based on calculating the quality index using Goodness of Fit (GoF), the value of GoF is obtained as big as 0.543, meaning that the Model used in this research has a good predictive model.

4.5 Hypothetical Testing

The significance of the estimated parameter provides beneficial information on the relationship among the research variables. The foundation used to test the hypotheses is the value of the output path coefficient.

**Table 6**  
Analysis of Direct Influence

	Original Sample	T Statistics	P Values
Longterm Relationship (LR) positively and significantly influences Supply Chain Effectiveness (SCE)	0.220	3.667	0.000
Information Sharing (IS) positively and significantly influences Supply Chain Effectiveness (SCE)	0.299	4.581	0.000
Cooperation (CO) positively and significantly influences Supply Chain Effectiveness (SCE)	0.253	3.513	0.000
Integration Process (ISC) positively and significantly influences Supply Chain Effectiveness (SCE)	0.115	2.202	0.028

**H<sub>1</sub>: Longterm Relationship (LR) Positively and Significantly Influences Supply Chain Effectiveness (SCE).**

The result of direct influence analysis, as in Table 6, is that the influence of the Longterm Relationship variable on the Supply Chain Effectiveness variable shows an estimated value as significant as 0.220 (positive), meaning that LR variable gives a positive influence as significant as 0.220 to SCE. Subsequently, the value of  $t_{\text{the t-statistic}}$  is as significant as  $3.667 > 1.97$ , and  $p\text{-values}$  as big as  $0.000 < 0.05$  so that it can be concluded that LR positively and significantly influences SCE. Thus, hypothesis 1 is accepted.

**H<sub>2</sub>: Information Sharing (IS) Positively and Significantly Influences Supply Chain Effectiveness (SCE).**

The result of direct influence analysis, as in Table 6, is that the influence of the Information Sharing variable on the Supply Chain Effectiveness variable shows an estimated value as significant as 0.299 (positive), meaning that IS variable gives a positive influence as significant as 0.299 to SCE. Subsequently, the value of  $t_{\text{the t-statistic}}$  is as significant as  $4.581 > 1.97$ , and  $p\text{-values}$  as big as  $0.000 < 0.05$  so that it can be concluded that IS positively and significantly influences SCE. Thus, hypothesis 2 is accepted.

**H<sub>3</sub>: Cooperation (CO) Positively and Significantly Influences Supply Chain Effectiveness (SCE).**

The result of direct influence analysis, as in Table 6, is that the influence of the Cooperation variable on the Supply Chain Effectiveness variable shows an estimated value as significant as 0.253 (positive), meaning that CO variable gives a positive influence as significant 0.253 to SCE. Subsequently, the value of  $t_{\text{the t-statistic}}$  is as big as  $3.513 > 1.97$ , and  $p\text{-values}$  as significant as  $0.000 < 0.05$  so that it can be concluded that CO positively and significantly influences SCE. Thus, hypothesis 3 is accepted.

**H<sub>4</sub>: Integration Process (IP) Positively and Significantly Influences Supply Chain Effectiveness (SCE).**

The result of direct influence analysis, as in Table 6, is that the influence of the Integration Process variable on Supply Chain Effectiveness shows an estimated value as significant as 0.115 (positive), meaning that IP variable gives a positive influence as significant as 0.115 to SCE. Subsequently, the value of  $t_{\text{the t-statistic}}$  is as significant as  $2.202 > 1.97$ , and the  $p\text{-values}$  are as significant as  $0.028 < 0.05$ , so it can be concluded that IP positively and significantly influences SCE. Thus, hypothesis 4 is accepted.

**Table 7**  
Analysis of Moderation Influence

	Original Sample	T Statistics	P Values
Enterprise Risk Management (ERM) moderates the influence of Long Term Relationship (LRM) on Supply Chain Effectiveness (SCE)	-0.037	0.458	0.647
Enterprise Risk Management (ERM) moderates the influence of Information Sharing (IS) on Supply Chain Effectiveness (SCE)	-0.226	2.468	0.014
Enterprise Risk Management (ERM) moderates the influence of Cooperation (CO) on Supply Chain Effectiveness (SCE)	0.127	1.619	0.106
Enterprise Risk Management (ERM) moderates the influence of the Integration Process (IP) on Supply Chain Effectiveness (SCE)	0.064	1.081	0.280

Based on the hypothetical testing of indirect influence, it can be explained as follows.

**H<sub>5</sub>: Enterprise Risk Management (ERM) Moderates the Influence of long-term Relationships (LR) on Supply Chain Effectiveness (SCE).**

The result of the moderation influence analysis, as in Table 7, is that the moderation of Enterprise Risk Management in the influence of Long Term Relationships on Supply Chain Effectiveness shows the estimated value as significant as -0.037 (negative), meaning that ERM negatively moderates the influence of LR on SCE as big as -0.037. Subsequently, the value of  $t_{\text{the t-statistic}}$  is as big as  $0.458 > 1.97$ , and the  $p\text{-values}$  are as significant as  $0.647 > 0.05$ , so it can be concluded that ERM does not moderate the influence of LR on SCE. Thus, hypothesis 5 is refused.

**H<sub>6</sub>: Enterprise Risk Management (ERM) Moderates the Influence of Information Sharing (IS) on Supply Chain Effectiveness (SCE).**

The result of hypothetical test 6 is that the moderation of Enterprise Risk Management (ERM) in the influence of Information Sharing (IS) on Supply Chain Effectiveness (SCE) shows the estimated value as significant as -0.226 (negative), meaning that ERM negatively moderates the influence of IS on SCE as big as -0.226. Subsequently, the value

of the  $t$ -statistic is as significant as  $2.468 > 1.97$ , and the  $p$ -values are as significant as  $0.014 < 0.05$ , so it can be concluded that ERM moderates the influence of IS on SCE. Thus, hypothesis 6 is accepted.

**H7:** *Enterprise Risk Management (ERM) effect moderated Cooperation (CO) Terhadap Supply Chain Effectiveness (SCM).*

The result of hypothetical test 7 is that the moderation of Enterprise Risk Management (ERM) in the influence of Cooperation (CO) on Supply Chain Effectiveness (SCE) shows the estimated value as significant as 0.127 (positive), meaning that ERM positively moderates the influence of CO on SCE as big as 0.127. Subsequently, the value of the  $t$ -statistic is as big as  $1.619 < 1.97$ , and  $p$ -values as significant as  $0.106 > 0.05$ , so it can be concluded that ERM does not moderate the influence of CO on SCE. Thus, hypothesis 7 is refused.

**H8:** *Enterprise Risk Management (ERM) Moderates the influence of the Integration Process (IP) on Supply Chain Effectiveness (SCE).*

The result of hypothetical test 8 is that the moderation of Enterprise Risk Management (ERM) in the influence of Integration Process (IP) on Supply Chain Effectiveness (SCE) shows an estimated value as significant as 0.064 (positive), meaning that ERM positively moderates the influence of IP on SCE as big as 0.064. Subsequently, the value of the  $t$ -statistic is as big as  $1.081 < 1.97$ , and  $p$ -values as significant as  $0.280 > 0.05$ , so it can be concluded that ERM does not moderate the influence of IP on SCE. Thus, hypothesis 8 is refused.

## 5. Discussion

### 5.1 Long-Term Relationship and Supply Chain Effectiveness

This research shows that long-term relationship positively and significantly influences Supply Chain Effectiveness (SCE). It means hypothesis 1 is proven. Long-term relationships can be created by having a sustainable relationship among all the parties involved in SCE. A long-term relationship is essential for an EPC project because the coverage of EPC is more comprehensive than conventional procurement. The result of this research is in line with the study by Chakraborty et al. (2014) that relationship transparency is essential for the value of SCE, and inter-partner relationship is built by the spirit of trust and openness. Thus, the result of this research is in line with the result of the other research that long-term relationship positively and significantly influences SCE.

### 5.2 Information Sharing and Supply Chain Effectiveness

Information sharing positively and significantly influences Supply Chain Effectiveness (SCE). It means that hypothesis 2 is proven. This research's result aligns with the theory of Information Sharing. Information Sharing is a continuous flow of formal and informal communication among working partners in the supply chain. Information sharing can contribute to better planning and control in a supply chain. This research is in line with the research by Zhou and Benton (2007), which explains that Information Sharing helps supply chain management partners cope with the fear of the impact of inappropriate information. Furthermore, this research is in line with the study by Anatan (2014), Arshinder and Deshmukh (2008), Chen (2003), and Sahin and Robinson (2005) that SCE is the most critical factor for achieving effective coordination in a supply chain and become the controller along the supply chain. Thus, the result of this research is in line with other research that Information Sharing positively and significantly influences SCE.

### 5.3 Cooperation and Supply Chain Effectiveness

Cooperation positively and significantly influences Supply Chain Effectiveness (SCE). It means that hypothesis 3 is proven. The result of this research is in line with the theory of Cooperation. Good and mutually beneficial Cooperation in the EPC project is essential, considering that each procurement step has a relationship mostly with external parties requiring good communication and negotiation. This research is in line with the studies by Feizabadi and Alibakhshi (2022), Wallis et al. (2021), and Asghari et al. (2022) that it needs to accomplish the integration of the existing supply chain by highlighting the complementary effect of coordination and Cooperation. Thus, the result of this research is in line with other research that Cooperation positively and significantly influences SCE.

### 5.4 Integration Process and Supply Chain Effectiveness

The integration process positively and significantly influences Supply Chain Effectiveness (SCE). It means that hypothesis 4 is proven. This research is in line with the result of a study by Dainty et al. (2001), that it needs some changes for the integration of the supply chain and the involvement of all parties, knowledge of human resources in the project, fair remuneration system and knowing the benefits of integration, and the understanding of contract documents. Thus, the result of this research is in line with the other research that Integration Process positively and significantly influences SCE.



### *5.5. Enterprise Risk Management Does Not Moderate Long Term Relationship and Supply Chain Effectiveness*

Enterprise Risk Management (ERM) does not moderate the influence of long-term relationships on Supply Chain Effectiveness (SCE). It means that hypothesis 5 is not proven. The result of this research is different from the theory of ERM since it moderates the influence of long-term relationship variables on SCE. In the previous research, enterprise risk management has not been used as a variable that moderates long-term relationships and SCE. This research finds that long-term relationship through the moderation of enterprise risk management does not influence the SCE in the project of EPC PLTU Sulut-3.

### *5.6 Enterprise Risk Management Moderates Information Sharing and Supply Chain*

Enterprise Risk Management (ERM) moderates the influence of information sharing on Supply Chain Effectiveness (SCE). It means that hypothesis 6 is proven. No previous research has used enterprise risk management as a moderating variable for the influence of information sharing on SCE. In the PLTU Sulut-3 project, three main parties are involved, namely, the project owner, contractor, and suppliers, who in the information exchanging process linkage need ERM due to the consideration that the risk is related to each party's interest for the sake of SCE creation. No previous research has used ERM as a moderating variable for the influence of information sharing on SCE. This research finds that information sharing through the moderation of ERM influences the SCE in the EPC PLTU Sulut-3 project.

### *5.7 Enterprise Risk Management Does Not Moderate Cooperation and Supply Chain Effectiveness*

Enterprise Risk Management (ERM) does not moderate the influence of Cooperation on Supply Chain Effectiveness (SCE). It means that hypothesis 7 is not proven. The result of this research is different from the research by Xie et al. (2010), showing that partnership can remove many communication obstacles and positively impact social collaboration in the process design. This may have a negative impact on team communication if the appropriate procedures have yet to be applied. However, no previous research has used ERM as a moderating variable for the influence of Cooperation on SCE. The result of this research finds that, through the moderation by ERM, Cooperation influences the SCE in the project of EPC PLTU Sulut-3.

### *5.8 Enterprise Risk Management Does Not Integration Process and Supply Chain Effectiveness*

Enterprise Risk Management (ERM) does not moderate the influence of the integration process on Supply Chain Effectiveness (SCE). It means that hypothesis 8 is not proven. No previous research has used ERM as a moderating variable for the influence of the integration process on SCE. ERM does not moderate the influence of the integration process on SCE in the project of EPC PLTU Sulut-3. This may be because the integration process can directly influence SCE without requiring the parties to implement ERM. However, the integration process is a must in the supply chain process to be effective in a project. No previous research has used ERM as a moderating variable for the influence of the integration process on SCE. This research finds that, through the moderation by ERM, the integration process influences the SCE in the project of EPC PLTU Sulut-3.

## **6. Conclusions**

Based on the results of this research by considering the formulation of problems and hypotheses, it can be concluded that the eight research hypotheses are divided into two; hypotheses 1 to 4 have direct correlations, whereas the other four hypotheses, hypotheses 5 to 8, have indirect correlations through a moderating variable. The four hypotheses stating direct correlation are proven because each independent variable of those four hypotheses partially gives positive and significant influence. The results of the other four hypotheses of indirect correlations through a moderating variable (hypotheses 5 to 8) show that only one hypothesis is proven, and three other hypotheses are unproven. This research uses the moderating variable of ERM toward SCE as a renewal of previous research, with the result of research finding that ERM moderates the influence of information sharing on SCE. Implementing ERM by managing the risks in the information-sharing process can generate the effectiveness of the supply chain in the EPC PLTU Sulut-3 made by the project owner, contractor, and suppliers.

One problem in the EPC involving many parties is the need for more criteria or qualitative and quantitative measurements concerning the supply chain effectiveness. That is why it is necessary to establish the criteria or qualitative and quantitative measurements before carrying out the EPC project. Suppose the measurement of supply chain effectiveness needs to be established together in the beginning to be an objective reference for all parties involved in the EPC project. In that case, it potentially raises some conflicts when the project runs. On the other hand, the novelty and results of this research are expected to enrich the existing literature and develop further research.

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