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Quality Risks Performance through Monitoring and Control: The Role of Subcontractor Construction Management at the Gas Unitization Project

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ABSTRACT

Due to rising levels of complexity and intense competition, effective risk management is a must for any project manager hoping to see their work through to completion. Since risks are evaluated according to their possible impact on project goals, there is a direct correlation between good risk management and successful projects. To minimise deviations from objectives, monitoring and control are carried out regularly. This research aims to directly analyse the influence of direct technical, financial, resource, managerial, and communication risks from subcontractors on the quality of building construction performance and through monitoring and control intervening. This study used a quantitative approach through questionnaires and documentation. The participants in this study were 39 individuals who were directly involved with PT—Rekayasa Industri subcontractors on the Jambaran Tiung Biru project. The subcontractors were responsible for completing a specific work package. According to the Partial Least Square analysis, technical and resource risks negatively and significantly impact building performance quality. Financial and managerial risks substantially and indirectly influence the quality of building construction performance through monitoring and control.

Keywords: control, construction, monitoring, performance quality, risk management

INTRODUCTION

Every project is always associated with risk-taking. Companies and institutions must be prepared for possible risks (Szymanski, 2017). A risk is an uncertain event or situation with positive or negative consequences affecting one or more project objectives (PMI, 2017). Risk management can be defined as the process of making decisions on accumulated risks, reducing the possibility that losses will occur, and minimising the scale of losses that will arise. The main goal of the risk management process is to minimise the effects of risks affecting project objectives and thereby improve critical decision-making. This includes preventing potential problems and early detection of actual issues when they occur. Because competition is getting tougher and projects are becoming more complex, risk management is critical to project management success. Since risks are evaluated according to how they might affect project objectives, there is a direct correlation between successful risk management and project success. Because competition is getting tougher and projects are becoming more complex, risk management is critical to project management success. Since risks are evaluated according to how they might affect project objectives, a direct correlation exists between successful risk management and project success (Issa, 2013).

The shortcomings inherent in any subcontractor, whether in terms of financial, resource, technical, managerial, or subcontractor communication, must be accepted by the main contractor to minimise deviations from the initial objectives due to the use of subcontractors. To minimise deviations from objectives, monitoring and control are carried out regularly.

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LITERATURE REVIEW

Risk Management

Adinyira et al. (2020) stated that risk management is divided into five indicators: financial condition risk, human resource risk, technical risk, managerial risk, and communication risk. Jayasudha et al. (2016) define technical risk as the incapacity to construct a product that satisfies specifications. Technical risks in construction can be traced back to project planning and scheduling, as well as the bidding and estimating stages. Edwards, P.J., and Bowen (1998) classified the main technical risks as design flaws, strategy failure, equipment and system failure, and estimation errors. Financial conditions are essential in maintaining a project's health during the project cycle. For neat and clear bookkeeping reports, there must be a healthy cash flow, clear money inflow and outflow, and reports on how the funds are being used. Processes for cost control and project status monitoring are also necessary to update project costs and handle adjustments to the cost baseline. The main benefit of this process is that the cost baseline is maintained throughout the project (PMI, 2017).

Iqbal et al. (2015) state that financial risk is one factor that influences construction projects. Cost management must be carried out very carefully, starting with a rational price estimate by taking into account all aspects of construction, including project materials, material delivery methods, scope of work, work methods, quality control and recording systems, direct and indirect workforce requirements, heavy equipment requirements, office operational costs, local taxes and regulations, safety requirements (OHSE), margin assumptions, and project cycle (Wijayaningtyas et al., 2024). From these initial actions, prudence in their implementation is paramount in maintaining a healthy cash flow so that subcontractors can maintain continuity of financing for material arrivals, direct and indirect workforce payments, office operational costs, and accurate schedule progress, and the subcontractor's internal financial estimates are achieved according to subjective project.

If the work breakdown structure (WBS) decomposition is not yet detailed, with hidden risks and unsolved estimates, efforts will still be made to conduct further analysis and decomposition. So, risk management depends on the competence of the subcontractor's resources to analyse, plan schedules, and monitor work. Also, when competent resources can carry out project work, the work will likely be carried out adequately and according to schedule (Kendrick, 2015).

One of the main known risks associated with subcontractors is low managerial competence. Subcontractors must utilise the proper resources and comprehend the project's scope. They also need to take full accountability for the project's seamless progress under the guidance of client management (Mullins, 2005). Where there is an increase in the value or progress of the work being done, managerial contractors must ascertain the contractor's level of expertise in completing the project in stages and sequentially. Stated differently, every work step must be meticulously completed to the last detail (Keshk et al., 2017).

The contractor's and its subcontractors' ability to communicate effectively significantly impacts a construction project's timely completion. Inappropriate information sharing and dissemination methods among project participants can significantly impede work progress (Al-Hammad, 2000). Referring to PMI (2017), project communication management includes the processes necessary to ensure that the project's and its stakeholders' information needs are met through the development of artefacts and the implementation of activities designed to achieve effective information exchange.

Monitoring and Control

According to PMI (2017), monitoring and control include all of the procedures required to keep tabs on, evaluate, and oversee the performance of a project, spot any areas that call for

plan modifications, and start those modifications. Monitoring gathers information about the performance of a project, creates performance metrics, reports the results, and shares the results. Schedule control, which is the process of tracking project status to update the project schedule and handle modifications to the main schedule, is a part of this monitoring and control. The primary advantage of this procedure is that it keeps the project's schedule baseline intact. The purpose of the Weekly Report Progress is to provide an update on the progress of construction products, which will be submitted weekly, as well as any deviations between the subcontractors' actual physical work and their planned work. In order to evaluate performance and guarantee that project output is accurate, complete, and meets customer expectations, quality control is the process of keeping track of and documenting the outcomes of putting quality management practices into practice. Verifying that the project deliverables and work fulfil the requirements set forth by important stakeholders for final acceptance is a crucial benefit of this process. In order to manage modifications to the cost baseline and update project costs, Budget Control keeps track of project status. Maintaining a cost baseline throughout the project is the primary advantage of this process.

Construction Performance Quality

Isikyildiz and Akcay (2020) revealed that the primary goal of a project is to complete the planned work at the desired time, cost, and quality. Project construction consists of hundreds of activities within a specific organisation and model. These activities are connected sequentially. Each activity may have many alternatives for cost, time, and quality. The larger the project, the more difficult it is to choose between these alternatives. Many amounts of time, cost, and quality choices may come out.

PMI (2017) and Kendrick (2015) stated that, in general, a quality construction project is how to organise and manage the project so that the following aspects are met, namely: the actual schedule does not lag behind the planning schedule, and every level of the construction planning sequence is fulfilled, continuous and no clash between one level of construction and another. Accurate construction project financing is significant because it is the key to determining whether the project meets the margin targets determined at the start of the project. The quality of the physical construction work provided by the contractor to the client or owner is the key to whether the work is acceptable or not. If the work quality does not meet the requirements of the previous client, the client has the right to reject the contractor's work results.

METHODS

The research is explanatory research with a quantitative approach. The populations in this study were personnel who interacted directly with subcontractors from PT. Rekayasa Industri was involved in the work package carried out by subcontractors at the Jambaran Tiung Biru project. The sampling technique was saturated; all population members were used as samples, namely 39 people. The data collection technique was a questionnaire and documentation.

The hypotheses in this study are:

1. Technical, financial, resource, managerial, and communication risks are estimated to affect the quality of construction performance significantly.
2. Technical risk, financial risk, resource risk, managerial risk, and communication risk are estimated to have significant effects on the quality of construction performance through monitoring and control as intervening.

The data analysis used was descriptive, and the inferential analysis used was variance-based SEM, known as Partial Least Square (PLS) with Smart PLS 4. Variable indicators for technical risk (X1), financial risk (X2), resource risk (X3), managerial risk (X4),

communication risk (X5), monitoring and control (Z), and quality of construction performance (Y) were reflexive indicators, measured using Likert scale.

RESULTS AND DISCUSSION

The structural model was tested or evaluated using the following methods: the significance of the structural path parameter coefficient, which was obtained through a bootstrapping procedure, the t-test, the Stone-Geisser Q-Square test for predictive relevance, and R-Square for the dependent construct. The monitoring and control (Z) R-square is 0.582, meaning that technical risk (X1), financial risk (X2), resource risk (X3), managerial risk (X4), and communication risk can account for 58.2 per cent of the variance in monitoring and control (X5). The remaining 41.8 per cent can be explained by factors not included in the study. The R-square for the quality of construction performance (Y) is 0.902. This indicates that technical risk (X1), financial risk (X2), resource risk (X3), managerial risk (X4), communication risk (X5), and monitoring and control can account for 90.2% of the variance in the quality of construction performance (Z). The remaining 9.8 per cent can be explained by factors not included in the study. The predictive relevance q-square test gauges how well the fit model and its parameters work. This research model has a q-square score of 0.959, indicating that it is good because the score is closer to one. Figure 1 displays the results of the PLS analysis as a relationship between the variables and their coefficient path.

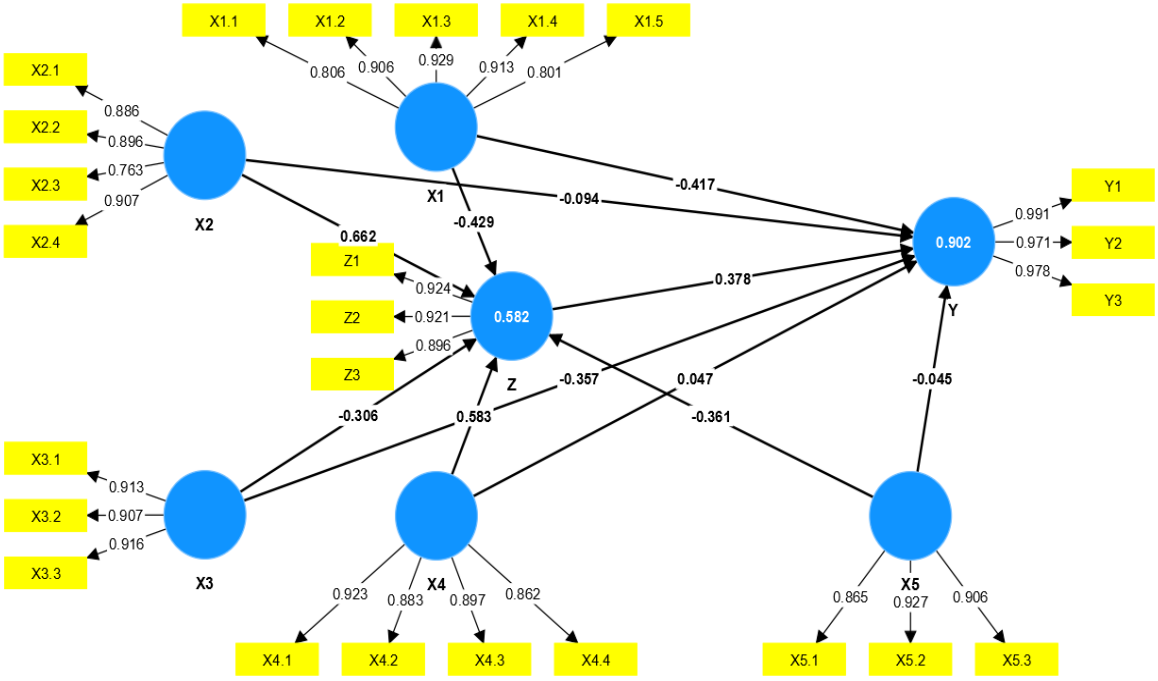

Figure 1. Relationship between variables and indicators
Source: Smart PLS's output, 2023

The analysis results of the influence of technical, financial, resource, managerial, and communication risks on the quality of construction performance directly or through monitoring and control as intervening are presented in Table 1.

Table 1. Analysis Results

Exogenous Variable	Endogenous Variable	Direct Effect	Indirect Effect	Total Effect
Technical risk (X1)	Quality of building construction performance (Y)	-0.417 (0.000**)	-0.162 (0.112^{ns})	-0.579 (0.000**)
Financial risk (X2)	Quality of building construction performance (Y)	-0.094 (0.351^{ns})	0.250 (0.003**)	0.157 (0.098^{ns})
Resource risk daya (X3)	Quality of building construction performance (Y)	-0.357 (0.000**)	-0.116 (0.108^{ns})	-0.473 (0.000**)
Managerial risk (X4)	Quality of building construction performance (Y)	0.047 (0.552^{ns})	0.220 (0.011*)	0.267 (0.007**)
Communication risk (X5)	Quality of building construction performance (Y)	-0.045 (0.726^{ns})	-0.136 (0.244^{ns})	-0.181 (0.192^{ns})

Note: ns = not significant; * = significant 5%; ** = significant 1%
Source: Author's computation, 2023

The technical risk significantly affects the quality of building construction performance, with a path coefficient value of -0.417. This shows that the increasing technical risk significantly affects the decrease in the quality of construction performance. In Jimbaran Tiung Biru projects, subcontractors often have incorrect implementation strategies, incorrect specifications, incorrect work methods and tools, incorrect price estimates, and many design changes, resulting in a decrease in the quality of construction performance. This is in line with what PMI (2017) explained that project implementation strategies, quality control of specifications, determination of work methods and heavy equipment selection, reasonable price estimates, and not many design changes will have a direct influence on the quality of construction performance in terms of quality, schedule, and cost.

The indirect influence of technical risk on the quality of building construction performance through monitoring and control is insignificant, with a path coefficient of -0.162. This shows that monitoring and control do not mediate the influence of technical risk on the quality of building construction performance. In the Jambaran Tiung Biru project, many subcontractors were generally found to have wrong strategy formulation risk, inconsistent with predetermined specifications, mistakes in work method preparation, and estimation errors, which were challenging to direct through regular monitoring and control. This makes the periodic monitoring and control activities unable to mediate the influence of technical risk on the quality of construction performance. Following the opinion of Jayasudha et al. (2016), the inability of subcontractors to build products that meet requirements is a technical risk. The opinion of Tumelap et al. (2014) said that contractor performance is the result of the quality and quantity of work that the contractor has achieved as part of the scope of work assigned to him. Meanwhile, subcontractors cannot be mediated to improve the final results of construction, namely the quality of construction performance in terms of time, quality, and budget.

Financial risk does not significantly affect the quality of building construction performance, with a path coefficient value of -0.094. This shows that increasing financial risk does not significantly affect the quality of construction performance. Even though the financial condition of the subcontractors was found to be unhealthy, the subcontractors are still required

to provide good quality construction performance. This is by PMI (2017), which said cost control and project status monitoring processes to update project costs and manage changes to the cost baseline. The main benefit of this process is that a cost baseline is maintained throughout the project.

Financial risk significantly indirectly influences the quality of building construction performance through monitoring and control with a path coefficient of 0.250. This shows that monitoring and control can mediate the influence of financial risk on the quality of building construction performance. This followed PMI (2017), which said cost control and project status monitoring processes to update project costs and manage changes to the cost baseline. The main benefit of this process is that a cost baseline is maintained throughout the project. Periodic control of the subcontractor's financial condition regarding the accuracy of the main contractor's payments to subcontractors following the dynamic economic conditions at that time is an effort to recover cash flow which had stalled and missed initial estimates, which would harm the continuity of progress, this is in line with the opinion of Fernando, et al. (2017) who noted in their article that some of the financial risks associated with construction include unavailability of funds from clients, fluctuations due to exchange rates, and subcontractor financial defaults. Suppose this risk is not monitored and becomes higher. In that case, it will also impact the main contractor because the results provided by local subcontractors regarding quality control and progress control will also be problematic. By the opinion of Li et al. (2015) said in their article that the inability to control this kind of risk can result in several problems, including the contractor's refusal to repair defects, asking for additional payments, filing for bankruptcy intentionally, overtime, etc.

Resource risk significantly affects the quality of building construction performance, with a path coefficient value of -0.357. This shows that the increasing resource risk significantly affects the decrease in the quality of construction performance. The high risk of resources consisting of a lack of staff, lack of materials, and lack of planning will result in increased work duration, work quality not being as specified, and budget increases due to the extension of time. The risks from subcontractors in the Jambaran Tiung Biru project cause increased work duration, inappropriate quality control, and an increased budget. This follows Zavadskas et al. (2009), who said the risk of unavailability of resources can also influence the overall progress of a construction project. The construction industry has considerable materials, equipment, and human resources risks.

The indirect influence of resource risk on the quality of building construction performance through monitoring and control is insignificant, with a path coefficient of -0.116. This shows that monitoring and control do not mediate the influence of resource risk on the quality of building construction performance. In the Jambaran Tiung Biru project, it was often found that subcontractors did not have adequate resources, such as staff appropriate to the workload, materials, and planning readiness. So, periodic monitoring and control cannot mediate the influence of resource risks on the quality of construction performance. Referring to the literature, Fisk and Reynolds (2010) stated that the availability and productivity of the resources needed to build a project are risks worthy of being borne by the contractor. It turns out that the main contractor cannot demand the quantity and quality through the mediation of periodic controls.

Managerial risk does not significantly affect the quality of building construction performance, with a path coefficient value of 0.047. This shows that increasing managerial risk does not significantly affect the quality increase of construction performance. Inappropriate planning, incompetence of subcontractors, lack of quality and control of work, and incompatibility of communication skills do not affect subcontractors in maintaining the duration of work, maintaining the quality of work, and the budget following what was agreed upon. This refers to PMI (2017), which said that developing a schedule is analysing the

sequence of activities, duration, resource requirements, and schedule constraints to create a schedule model for project implementation, monitoring, and control. The process produces a schedule model with planned dates for completing project activities. Also, referring to the opinion of Fisk and Reynolds (2010) in their literature, they say that the subcontractor's commitment to implementing the points listed in the weekly meeting is one way to assess the subcontractor's performance in their efforts to maintain the planning progress schedule.

Managerial risk significantly indirectly influences the quality of building construction performance through monitoring and control with a path coefficient of 0.220. This shows that monitoring and control can mediate the influence of managerial risk on the quality of building construction performance. Simple subcontractor managerial in the Jambaran Tiung Biru project by carrying out regular control of the planning line, subcontractor incompetence, lack of quality and work control, and communication can be reduced by carrying out regular periodic control and weekly meetings to monitor the consistency of work schedule implementation, subcontractor commitment to implementing suggestions technically based on the due date stated in the minutes of the meeting. This follows the opinion of Edwards, P.J, and Bowen (1998) in their literature, which states expertise in managing a construction project from the beginning to the end of the project cycle in controlling project activities, controlling the team, managing and predicting cash flow, maintaining internal and external communication, managing risks, controlling logistical accuracy so that project objectives are achieved in terms of quality, time and cost. In line with the opinion of Fisk and Reynolds (2010), the subcontractor's commitment to implementing the points listed in the weekly meeting is one of the subcontractors' performance assessments in their efforts to maintain the planning progress schedule; likewise, the opinion of Ardhiansyah et al. (2023) said that a project is defined as a unique series of activities that are interrelated to achieve specific results and are carried out within a certain period. Activities are carried out in a specific sequence that has been logically predetermined and completed within a specified time to meet performance standards, so to control and monitor these activities, a periodic reporting and monitoring system is needed to evaluate each sequence of activities.

Communication risk does not significantly affect the quality of building construction performance, with a path coefficient value of -0.045. This shows that increased communication risk does not significantly affect quality decrease of construction performance. Despite the lack of communication, commitment, and proper organisation and coordination, subcontractors must still carry out the work according to the specified time duration while maintaining quality, and there are no addendums. This refers to PMI (2017), which said that project communication management includes the processes necessary to ensure that the information needs of the project and its stakeholders are met through the development of artefacts and the implementation of activities designed to achieve effective information exchange.

The indirect effect of communication risk on the quality of building construction performance through monitoring and control is insignificant, with a path coefficient of -0.136. This shows that monitoring and control do not mediate the effect of risk communication on the quality of building construction performance. In the Jambaran Tiung Biru project, it was found that subcontractors had communication that was less helpful in improving the quality of construction performance, such as lack of commitment, lack of communication intensity during the project, and lack of proper organisation and coordination. The monitoring and control activities cannot mediate the influence of risk communication on the quality of construction performance. We refer to PMI (2017), which said that Project Communication Management includes the processes necessary to ensure that the information needs of the project and its stakeholders are met through the development of artefacts and the implementation of activities designed to achieve effective information exchange, it turns out that they cannot be made effective through periodic control efforts.

CONCLUSION

Based on the analysis result, it can be concluded that technical risk significantly affects the quality of building construction performance. Incorrect implementation strategies, incorrect specifications, incorrect work methods and tools, incorrect price estimates, and many design changes resulted in a decrease in the quality of construction performance in terms of quality, schedule, and cost. Periodic monitoring and control activities cannot mediate the influence of technical risk on the quality of construction performance. Financial risk does not significantly affect the quality of building construction performance. The subcontractor's unhealthy financial condition causes the subcontractor to be unable to carry out its commitment to bringing in materials on time, meeting staff according to workload, and being consistent with work methods and tools. Periodic monitoring and control of the subcontractors can reduce financial risks, thereby increasing the influence of construction performance quality. Resource risk has a significant effect on the quality of building construction performance. Periodic monitoring and control that has been carried out cannot mediate the influence of resource risks on the quality of construction performance. The high risk of resources consisting of a lack of staff, lack of materials, and lack of planning will result in increased work duration, work quality not being as specified, and budget increases due to the extension of time. Managerial risk does not significantly affect the quality of building construction performance. However, monitoring and control can mediate the influence of managerial risk on the quality of building construction performance. The quality of building construction performance can be improved by carrying out regular monitoring and control. Communication risk does not significantly affect the quality of building construction performance. Subcontractors had less helpful communication in improving the quality of construction performance, such as lack of commitment, lack of communication intensity during the project, and lack of proper organisation and coordination. The monitoring and control activities cannot mediate the influence of risk communication on the quality of construction performance.

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