Advances in Economics, Business and Management Research, volume 135
3rd Asia Pacific International Conference of Management and Business Science (AICMBS 2019)

Risk Analysis of Tower a Development in Surabaya "X" Project

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ABSTRACT
The construction of Tower A in Surabaya's "X" Project is one of the largest projects owned by PT X with a construction period of four years. The long period of development will certainly lead to various types of risks that can affect the development of the Surabaya "X" Project. This study aims to identify, assess, rank, and provide mitigation actions against risk factors that can affect the Surabaya "X" Project. This study uses a risk map method to conduct a risk assessment and analytical hierarchy process (AHP) to compare the weighting of each risk factor. Respondents in this study amounted to five informants from different team, consisting of the architect team, civil structure team, project operational controls (POP) team, mechanical, electricity, and plumbing (MEP) team, and site engineering manager team. The identification results obtained 41 risk factors, consisting of 11 risk factors in the architecture section, 11 risk factors in the civil structure, 6 risk factors in the POP section, and 13 risk factors in the MEP section. The results of the assessment and ranking obtained 26 risk factors that require risk mitigation actions, these risk factors consist of 11 factors part of the architecture, with priority being the delay in the completion of the design by the consultant. 6 factors are part of the civil structure, with priority being the mismatch of building structure design. 5 factors are part of the POP, with priority is the unavailability of cash flow. Lastly, the 4 factors of MEP part, with priority is the quality of material that is not according to the specifications. This research is expected to provide a reference material for owners of the "X" Surabaya Project in determining actions against each risk factor that can affect the project.
Keywords: *risk factor, risk mapping, AHP, risk mitigation*

1. INTRODUCTION

In current political regime, infrastructure development becomes the priority national policies to answer the challenges of globalization. These challenges include increasing population, urbanization rates, and development disparities between different areas in Indonesia. Based on data from the Central Statistics Agency [1], Indonesian population is projected to experience a significant increase each year. This will certainly cause new problems such as providing the residence. According to Jeffrey and Xin Hua [2], shelter or home is a major human need and has a significant role in the economy. Until 2018, housing construction projects in Indonesia are currently being the focus of the government.

According to Adeleke et. al. [3], the risk associated to a certain project is an uncertain event, that is when the event occurs, it will at least have a positive or negative impact on the project objectives which include scope, cost, time, and quality. The aim of project risk management is to increase the likelihood and impact of positive events, and reduce the likelihood and impact of negative events on the project [4, 5].

PT X, is one of the construction company. In accordance with PT X's vision of becoming a leading and sustainable national and global development company, the company continues to contribute to developing the country through meeting the needs of residential housing. PT X has completed various projects, such as hotel and apartment construction projects. Various risk categories that can have an impact on a project, force PT X Tbk to make changes to the company's structure by adding a risk management division. In 2017, PT X has implemented a Good Corporate Governance (GCG) system in its business processes and infrastructure development. The application of GCG in companies has included important aspects that play a role to support the strengthening of control and management of the company, one of the important aspects is the risk management. Currently PT X is working on the 5 large residential projects. The residential projects include the "X" Project (Surabaya), Project A (Bekasi), Project B

(Semarang), Project C (Malang), and Project D (Depok). The construction of these large projects is unique in every project being carried out, so that from each of these uniqueness various uncertainties and risks associated to the project will increase. However, risk management applied to PT X is still partial in nature, and cannot be sensed for all projects being carried out by the company.

One of the biggest residential projects being developed by PT X is the "X" Project located in Surabaya. This project was built on an area of 1.6 hectares which will have 5 main towers and supporting facilities such as a sky bridge to connect each tower, swimming pools, sport venues and parks. This "X" project has a very strategic location, located in the golden triangle area of the central business district (CBD) of Surabaya. In addition, this project will be passed by two main roads namely Basuki Rahmat street and Panglima Sudirman street. It is close to the shopping center and the Surabaya city government. The construction of Tower A in the "X" Project in Surabaya is planned to be completed in 2021 starting with ground breaking in December 2017. The time period that spends approximately 4 years will provide various uncertainties and risks to the project. Thus, the risk management of the construction of Tower A in the Surabaya "X" Project will be urgently needed to reduce the impact of this risk. In addition, risk management can be an encouragement to achieve the company's vision. The risk analysis on the construction of Tower A in the Surabaya "X" Project is the qualitative risk map method and the Analytical Hierarchy Process (AHP) method. The use of qualitative risk map methods is for mapping risks based on the level of likelihood of occurring in one factor that impacts on other factors, as well as identifying risk factors for each work risk package. Meanwhile, Dikmen & Birgonul [6] stated that the use of the Analytical Hierarchy Process (AHP) method is to identify risk factors by using a hierarchical model to select the priority of risks to the project.

2. LITERATURE REVIEW

2.1 Risk Management

Risk is defined as an event that will occur and have an impact on an object, the impact can be either a positive or negative impact [7]. According to Khoedeir and Mohamed [8], risk management is closely related to the creation of activities to minimize losses and increase profitability. The construction industry in general has a high level of risk, due to many business activities carried out, its processes, impact to the environment, and the complex management. Smith [9] states, construction projects require a long period of time, complex processes, financial intensity and a very dynamic organizational structure. Akintoye and MacLeod [10] add, the type of risk associated to the construction project requires extensive attention from the construction project managers.

2.2 Risk Sources for Construction Projects

Risks associated to a certain construction project comes from various possibilities, such as time, cost, and quality of the project that can have a positive or negative impact on the project. According to Akintoye and MacLeod [10], sources of risk are grouped based on the process of the cause, such as due to natural factors or physical conditions of a project, environment, design, logistics, finance, law, politics, construction, and operational risk. In addition, Thuyet and Ogunlana [11] classify risks into internal and external risks. Internal risks include finance, design, contracts, construction, members, and operational risks. While external risks include economic, social, political, legal, community, logistics, and environmental risks.

2.3 Classification of risk

According to Khoedeir and Mohamed [8], risk classification is an integrated part of the risk identification process. The risk classification has the aim of structuring the different risks that affect the construction projects. The following are risk classifications based on the causal factors.

1) Political Factors
2) Economic Factors
3) Technologgy Factors
4) Operational Factors
5) Environmental Factors

2.4 Project Risk Management

Project risk management is included in the process that leads the risk management planning, identification, analysis, planning the response to risk, and monitoring and controlling the project. Project risk management aims to increase the probability and impact of positive events, as well as reduce the probability and impact of negative events on the project [5].

2.5 Risk Mapping

Risk map is an analysis tool in which the relevant parts of risk are obtained from business processes. Risk maps can be described as a systematic way to extract specific task information about how a process can fail and specific indications of different dimensions of risk measurement and

management. The design of a risk map requires a methodology to identify all the risks inherent in business processes. Mapping will then allow the risk to be analyzed to find out the cause of failure of a project and see the relationship of failure with financial losses caused by risks in the scope of the business process [12]. In the concept of risk mapping, there are two dimensions or scales that build a risk map graph. The first dimension is uncertainty. Uncertainty will be assessed in relation to the possibility of a risk. The second dimension is the potential impact given by a risk. Both dimensions on the risk map graph will be considered as important graphic representations to enable project managers to assess the relative importance of potential risks at an early stage [13].

3. RESULTS AND ANALYSIS

3.1 Architecture Section

In the results of data collection and processing, 11 risks were found in the architecture section. The risk consists of 7 internal risk factors and 4 external risk factors. All risk factors with large and very large levels must be reduced to be at a small or medium level. Each risk factor will have a level of likelihood of occurrence that can have an impact on three aspects, namely cost, quality, and time.

1) Internal Risk Factors in Architecture Section

Based on the results of internal risk identification in the architecture section, there are 7 risk factors that can influence the construction of Tower A in the Surabaya "X" Project. Internal risk factors have been assessed and ranked, risk assessment will be divided into three points of view namely cost, quality, and time. Following are the results of the assessment for each internal risk factor in the architecture section.

a) Changes in exterior / interior design
   This risk factor has a risk value of 12 for the cost perspective, based on this assessment the risk response made is to carry out risk transfer. For the quality perspective, the risk value is 9, the risk response that must be carried out is to carry out a risk transfer. And for the point of view of time has a value of the amount of risk of 12, and the risk response that must be done by transferring risk. In the architecture, exterior or interior design will always change, based on observations of changes in building design always occur for minor improvements that are adjusted to the conditions that occur in the field.
b) Delay in the completion of the design by the consultant
   This risk factor has a risk value of 16 for the cost perspective, based on this assessment the risk response carried out is to carry out a risk transfer. The Surabaya "X" project carries out risk transfer using contractual agreements to consultants to carry out architectural designs.
c) Lack of contractor experience
   This risk factor has a risk value of 20 for the cost perspective, based on this assessment the risk response made is to avoid risk. For the quality perspective, the risk value is 25, the risk response that must be carried out is to avoid the risk. And for the point of view of time has a value of the risk of 25, and the risk response that must be done by avoiding the risk.
d) Contractor's time delay in completing work
   This risk factor has a risk value of 20 for the cost perspective, based on this assessment the risk response made is to avoid risk. For the quality perspective, the risk value is 25, the risk response that must be carried out is to avoid the risk. And for the point of view of time has a value of the risk of 25, and the risk response that must be done by avoiding the risk.
e) Changes in type/specifications of the material
   This risk factor has a risk value of 20 for the cost perspective, based on this assessment the risk response made is to avoid risk. For the quality perspective, the risk value is 20, the risk response that must be carried out is to avoid the risk. And for the point of view of time has a value of the amount of risk of 20, and the risk response that must be done by avoiding the risk.
   This risk must be avoided, because the Surabaya "X" Project has made an agreement to the consumers regarding the apartment units sold which will have material with certain types and specifications. To avoid this, the Surabaya "X" Project must select vendors to be able to meet material requirements that have specifications and prices that are within budget.
f) Damage to the material
   This risk factor has a risk value of 25 for the cost perspective, based on this assessment the risk response made is to avoid the risk. For the quality perspective, the risk value is 25, the risk response that must be carried out is to avoid the risk. And for the point of view of time has a value of the amount of risk of 20, and the risk response that must be done by avoiding the risk.
g) Material delivery delays
   This risk factor has a risk value of 12 for the cost perspective, based on this assessment the risk response made is to carry out risk transfer. For the quality perspective, the risk value is 12, the risk response that must be carried out is to carry out a risk transfer. Risk transfer is carried out by using contractual agreements with vendors for material delivery times, so that vendors can estimate the right time for material delivery.

2) External Risk Factors in Architecture Section

Based on the results of the identification of external risks in the architecture section, there were 4 risk factors that could influence the construction of Tower A in the Surabaya "X" Project. External risk factors have been assessed and ranked, risk assessment will be divided into three points of view namely cost, quality, and time. Following are the results of the assessment and ranking for each of the external risk factors in the architecture section.

a) Delay in getting IMB and AMDAL
   This risk factor has a risk value of 12 for the cost perspective, based on this assessment the risk response made is to carry out risk transfer. For the quality perspective, the risk value is 12, the risk response that must be carried out is to carry out a risk transfer. And for the point of view of time has a value of the amount of risk of 20, and the risk response that must be done by avoiding the risk.
b) Regional regulations related to building design
   This risk factor has a risk value of 10 for the cost perspective, based on this assessment the risk response made is to carry out a risk transfer. For the quality perspective, the risk value is 6, the risk response that must be carried out is to reduce the risk. And for the point of view of time has a value of the amount of risk of 6, and the risk response that must be done by reducing these risks.
c) The condition or type of soil at the location
   This risk factor has a risk value of 10 for the cost perspective, based on this assessment the risk response made is to carry out a risk transfer. For the quality perspective, it has a risk value of 8, the risk response that must be carried out is to carry out a risk transfer. And for the point of view of time has a value of the amount of risk of 10, and the risk response that must be done by transferring risk.
d) Wind speed
   This risk factor has a risk value of 16 for the cost perspective, based on this assessment the risk response carried out is to carry out a risk transfer. For the quality perspective, the risk value is 16, the risk response that must be carried out is to carry out a risk transfer. And for the point of view of time has a value of 4 magnitude of risk, and the risk response must be done by accepting the risk. Wind speed will give effect to the higher floor. To reduce the risk caused by wind speed, the Surabaya "X".

3.2 Civil Part Structure

In the results of data collection and processing, 11 risks were found in the civil structure. The risk consists of 8 internal risk factors, and 3 external risk factors. All risk factors with large and very large levels must be reduced to be at a small or medium level. Each risk factor will have a level of likelihood of occurrence that can have an impact on three points of view, namely cost, quality, and time.

1) Internal Risk Factors Part Civil Structure

Based on the results of internal risk identification in the civilian and structural sections, 8 risk factors were found that could influence the construction of Tower A in the Surabaya "X" Project. Internal risk factors have been assessed and ranked, risk assessment will be divided into three points of view namely cost, quality, and time. Following are the results of the assessment and ranking for each internal risk factor in the civil section of the structure.

a) Mismatch of building structure design
   This risk factor has a risk value of 15 for the cost perspective, based on this assessment the risk response made is to carry out risk transfer. For the quality perspective, the risk value is 15, the risk response that must be carried out is to carry out a risk transfer. And for the point of view of time has a value of the risk of 15, and the risk response that must be done to transfer risk.
b) Difference in the number of volumes and items in the building structure between the project owner and the contractor
   This risk factor has a risk value of 8 for the cost perspective, based on this assessment the risk response made is to transfer risk. For the quality perspective, the risk value is 4, the risk response that must be carried out is to reduce the risk. And for the point of view of time has a value of the magnitude of risk of 8, and the risk response that must carry out risk transfer.
c) Delayed contractor's time in completing work
   This risk factor has a risk value of 12 for the cost perspective, based on this assessment the risk response made is to carry out risk transfer. For the quality perspective, the risk value is 4, the risk response that must be carried out is to reduce the risk. And for the point of view of time has a value of the amount of risk of 12, and the risk response that must carry out risk transfer.
d) Lack of contractor experience
   This risk factor has a risk value of 4 for the cost perspective, based on this assessment the risk response made is to reduce the risk. For the quality perspective, the risk value is 4, the risk response that must be carried out is to reduce the risk. And for the point of view of time has a value of the amount of risk of 4, and the risk response that must be done to reduce the risk.
e) Discrepancy of the method applied for construction
   This risk factor has a risk value of 4 for the cost perspective, based on this assessment the risk response made is to reduce the risk. For the quality perspective,

the risk value is 4, the risk response that must be carried out is to reduce the risk. And for the point of view of time has a value of the amount of risk of 2, and the risk response that must be done to accept the risk.

f) Quality in building structure materials
This risk factor has a risk value of 3 for the cost perspective, based on this assessment the risk response made is to reduce risk. For the quality perspective, the risk value is 4, the risk response that must be carried out is to reduce the risk. And for the point of view of time has a value of the magnitude of risk of 1, and the risk response that must accept the risk. To reduce the occurrence of these risks, the Surabaya "X" Project has made a draft material specification for building structures.

g) Late delivery of material
This risk factor has a risk value of 2 for the cost perspective, based on this assessment the risk response made is to accept risk. For the quality perspective, the risk value is 2, the risk response that must be carried out is to accept the risk. And for the point of view of time has a value of the magnitude of risk of 6, and the risk response that must reduce risk.

h) Increase in prices of structural materials
This risk factor has a risk value of 16 for the cost perspective, based on this assessment the risk response carried out is to carry out a risk transfer. For the quality perspective, the risk value is 4, the risk response that must be carried out is to reduce the risk. And for the point of view of time has a value of the amount of risk of 4, and the risk response that must be done by reducing these risks.

2) External Risk Factors Part Civil Structure

Based on the results of the identification of external risks in the civil section of the structure, 3 risk factors were found that could influence the construction of Tower A in the Surabaya "X" Project. External risk factors have been assessed and ranked, risk assessment will be divided into three points of view namely cost, quality, and time. Following are the results of the assessment and ranking for each of the external risk factors in the civil section of the structure.

a) The condition or type of soil at the location
This risk factor has a risk value of 15 for the cost perspective, based on this assessment the risk response made is to carry out risk transfer. For the quality perspective, the risk value is 15, the risk response that must be carried out is to carry out a risk transfer. And for the point of view of time has a value of the amount of risk of 15, and the risk response that must be done by transferring risk.

b) Wind speed
This risk factor has a risk magnitude of 9 for the cost perspective, based on this assessment the risk response made is to carry out a risk transfer. For the quality perspective, the risk value is 9, the risk response that must be carried out is to carry out a risk transfer. And for the point of view of time has a value of the amount of risk of 3, and the risk response that must be done by reducing risk. Wind speed will give effect to the higher floor.

c) The condition of the community around the site
This risk factor has a risk value of 3 for the cost perspective, based on this assessment the risk response made is to reduce risk. For the quality perspective, the risk value is 3, the risk response that must be carried out is to reduce the risk. And for the point of view of time has a value of the magnitude of risk of 6, and the risk response that must be done by reducing risk.

3.3 Project Operational Control (POP) / Cost Control

In the results of data collection and processing, 6 risks were found in the POP section. The risk consists of 3 internal risk factors, and 3 external risk factors. All risk factors with large and very large levels must be reduced to be at a small or medium level. Each risk factor will have a level of likelihood of occurrence that can have an impact on three points of view, namely cost, quality, and time.

1) Internal Risk Factors for Project Operational Control (POP)

Based on the results of internal risk identification in the POP section, there are 3 risk factors that can affect the construction of Tower A of Surabaya's "X" Project. Internal risk factors have been assessed and ranked, risk assessment will be divided into three points of view namely cost, quality, and time. Following are the results of the assessment and ranking for each internal risk factor in the POP section.

a) Increase in the total project budget
This risk factor has a risk value of 16 for the cost perspective, based on this assessment the risk response carried out is to carry out a risk transfer. For the quality perspective, the risk value is 16, the risk response that must be carried out is to carry out a risk transfer. And for the point of view of time has a value of the amount of risk of 12, and the risk response that must be done by transferring risk. To reduce the risk of an increase in the amount of the budget in the project, the Surabaya "X" Project carries out efficiency in budget allocation.

b) Late payments

This risk factor has a risk value of 20 for the cost perspective, based on this assessment the risk response made is to avoid risk. For the quality perspective, the risk value is 20, the risk response that must be carried out is to avoid risk. And for the point of view of time has a value of the amount of risk of 25, and the risk response that must be done by avoiding risk.

c) Unavailability of cash flow
This risk factor has a risk value of 16 for the cost perspective, based on this assessment the risk response carried out is to carry out a risk transfer. For the quality perspective, the risk value is 12, the risk response that must be carried out is to carry out a risk transfer. And for the point of view of time has a value of 16 magnitude of risk, and the risk response that must be done by transferring risk. This risk factor is ranked first because if the project does not have an adequate supply of cash flow, it will have an impact in the form of other risks that will arise such as late payments and budget increases because they have to pay the costs of violations.

2) External Risk Factors Project Operational Control (POP)

Based on the results of identification of external risks in the POP section, there are 3 risk factors that can influence the construction of Tower A of Surabaya's "X" Project. External risk factors have been assessed and ranked, risk assessment will be divided into three points of view namely cost, quality, and time. Following are the results of the assessment and ranking for each of the external risk factors in the POP section.

a) Rupiah exchange rate
This risk factor has a risk magnitude of 9 for the cost perspective, based on this assessment the risk response made is to carry out a risk transfer. For the quality perspective, the risk value is 6, the risk response that must be carried out is to avoid risk. And for the point of view of time has a value of the amount of risk of 9, and the risk response that must be done by transferring risk. The rupiah exchange rate becomes the first priority in POP external factors. Because some of the co-workers from the Surabaya "X" Project are from abroad, so the payment process uses foreign currencies. During the research period, the exchange rate of the rupiah against the dollar experienced significant fluctuations. Thus, it cannot be avoided to pose a risk of rising prices on materials that use the value of foreign currencies as a form of payment.

b) Inflation rate
This risk factor has a risk value of 1 for the cost perspective, based on this assessment the risk response made is to accept risk. For a quality perspective, the risk value is 1, the risk response that must be carried out is to accept risk. And for the point of view of time has a value of the amount of risk of 1, and the risk response that must be done by accepting the risk.

c) Bank interest rates
This risk factor has a risk magnitude of 9 for the cost perspective, based on this assessment the risk response made is to carry out a risk transfer. For the quality perspective, the risk value is 3, the risk response that must be carried out is to avoid risk. And for the point of view of time has a value of the amount of risk of 6, and the risk response that must be done by avoiding risk.

3.4 Mechanical, Electricity, and Plumbing (MEP) Section

In the results of data collection and processing, 13 risks were found in the MEP section. The risk consists of 10 internal risk factors, and 3 external risk factors. All risk factors with large and very large levels must be reduced to be at a small or medium level. Each risk factor will have a level of likelihood of occurrence that can have an impact on three points of view, namely cost, quality, and time.

1) Internal Risk Factors Part of MEP

Based on the results of internal risk identification in the MEP section, there were 13 risk factors that could influence the construction of Tower A in the Surabaya "X" Project. Internal risk factors have been assessed and ranked, risk assessment will be divided into three points of view namely cost, quality, and time. Following are the results of the assessment and ranking for each internal risk factor in the MEP section.

a) Late completion of the MEP design by the consultant
This risk factor has a risk value of 3 for the cost perspective, based on this assessment the risk response made is to reduce risk. For the quality perspective, the risk value is 3, the risk response that must be carried out is to reduce the risk. And for the point of view of time has a value of the amount of risk of 3, and the risk response that must be done by reducing risk.

b) Inability to create or read MEP designs
This risk factor has a risk value of 2 for the cost perspective, based on this assessment the risk response made is to accept risk. For the quality perspective, the risk value is 2, the risk response that must be carried out is to accept the risk. And for the point of view of time has a value of the amount of risk of 2, and the risk response that must be done by accepting the risk.

c) Error calculating the number of items in the design unit

This risk factor has a risk magnitude of 9 for the cost perspective, based on this assessment the risk response made is to carry out a risk transfer. For the quality perspective, the risk value is 3, the risk response that must be carried out is to reduce the risk. And for the point of view of time has a value of the magnitude of risk of 6, and the risk response that must be done by reducing risk.

To reduce this risk, the Surabaya "X" Project carries out a joint calculation of the contractor, construction management, and TeamWorx Indonesia as a quantity surveyor consultant. This will harmonize the calculations that exist between the three parties as evidenced in the minutes, so that there is no calculation error in the number of unit items.

d) Unavailability of electric power during construction
This risk factor has a risk value of 6 for the cost perspective, based on this assessment the risk response made is to reduce risk. For the quality perspective, the risk value is 6, the risk response that must be carried out is to reduce the risk. And for the point of view of time has a value of the magnitude of risk of 6, and the risk response that must be done by reducing risk.

e) Damage to the MEP system
This risk factor has a risk magnitude of 9 for the cost perspective, based on this assessment the risk response made is to carry out a risk transfer. For the quality perspective, the risk value is 9, the risk response that must be carried out is to carry out a risk transfer. And for the point of view of time has a value of the amount of risk of 9, and the risk response that must be done by transferring risk.

f) Inability to operate the MEP system used
This risk factor has a risk value of 2 for the cost perspective, based on this assessment the risk response made is to accept risk. For the quality perspective, the risk value is 2, the risk response that must be carried out is to accept the risk. And for the point of view of time has a value of the amount of risk of 2, and the risk response that must be done by accepting the risk.

g) Blockages in air or water ducts or circulation
This risk factor has a risk value of 6 for the cost perspective, based on this assessment the risk response made is to reduce risk. For the quality perspective, the risk value is 6, the risk response that must be carried out is to reduce the risk. And for the point of view of time has a value of the magnitude of risk of 6, and the risk response that must be done by reducing risk.

h) MEP material quality that is not according to specifications
This risk factor has a risk value of 4 for the cost perspective, based on this assessment the risk response made is to reduce risk. For the quality perspective, the risk value is 12, the risk response that must be carried out is to carry out a risk transfer. And for the point of view of time has a value of the amount of risk of 12, and the risk response that must be done by transferring risk.

i) Damage to the MEP material
This risk factor has a risk value of 6 for the cost perspective, based on this assessment the risk response made is to reduce risk. For the quality perspective, the risk value is 3, the risk response that must be carried out is to reduce the risk. And for the point of view of time has a value of the amount of risk of 9, and the risk response that must be done by transferring risk.

Damage to the MEP material usually occurs during the process of shipping material or installing material. Thus, the risk transfer is carried out by making an agreement with the sending vendor or contractor who will install the MEP material to safeguard the needs of the material.

j) Late delivery of material
This risk factor has a risk value of 2 for the cost perspective, based on this assessment the risk response made is to accept risk. For the quality perspective, the risk value is 2, the risk response that must be carried out is to accept the risk. And for the point of view of time has a value of the magnitude of risk of 6, and the risk response that must be done by reducing risk.

2) External Risk Factors MEP Section

Based on the results of the identification of external risks in the MEP section, there are 3 risk factors that can influence the construction of the Surabaya "X" Project in Tower A. External risk factors have been assessed and ranked, the risk assessment will be divided into three perspectives: cost, quality, and time. Following are the results of the assessment and ranking for each external risk factor in the MEP section.

a) Regional regulations requiring rainwater channels or reservoirs
This risk factor has a risk value of 6 for the cost perspective, based on this assessment the risk response made is to reduce risk. For the quality perspective, the risk value is 2, the risk response that must be carried out is to reduce the risk. And for the point of view of time has a value of the magnitude of risk of 6, and the risk response that must be done by reducing risk.

b) The feasibility of a rainwater channel or reservoir when arranging a building permit (IMB)
This risk factor has a risk value of 1 for the cost perspective, based on this assessment the risk response made is to accept risk. For a quality perspective, the risk value is 1, the risk response that must be carried out is to accept risk. And for the point of view of time has a value of the amount of risk of 3, and the risk response that must be done by reducing risk.

c) Regulations for having access to emergency facilities
This risk factor has a risk value of 5 for the cost perspective, based on this assessment the risk response made is to reduce risk. For the quality perspective, the risk value is 5, the risk response that must be carried out is to reduce the risk. And for the point of view of time has a value of the amount of risk of 5, and the risk response that must be done by reducing risk.

3.5 Risk Mitigation Actions

This section will discuss risk mitigation actions for risk factors with a scale of acceptance "undesirable" or have a value of the magnitude of risk with a value of 8 to 16, and for risk factors with a scale of acceptance "unacceptable" or have a value of risk magnitude of 20 up to 25. The assessment will cover 3 points of view, namely the point of view of cost, quality and time. This risk mitigation action is obtained by conducting a discussion with each respondent, then the respondent will fill in the risk mitigation action form from each risk factor.

3.6 Managerial Implications

This section explains the managerial implications for managing Tower A's construction risk in the Surabaya "X" Project. The implication in this research is the result of consideration from the assessment, ranking, and risk mitigation actions against risk factors. The following are the implications that can be made by the Surabaya "X" Project manager:

1) Examining and adding clauses to the work contract of consultants, vendors, and contractors

Work contract clauses related to completing the consultant's work schedule on architectural design, civil structure, and MEP. As well as completing the work schedule of each part for the contractor and arranging the contractor to maintain the quality of the material used.
Work contract clause stating the conformity of material purchase specifications to the vendor. Thus, vendors always keep delivery of materials that are in accordance with agreed specifications and prices. As well as ensuring the condition of goods with good quality when shipping material.
Use umbrella contracts to reduce the risk that the rupiah exchange rate can cause. This umbrella contract will keep material prices at the agreed upper and lower limits.

2) Improve supervision of contractor performance

Work closely with construction management (Hanmiglobal Co. Ltd.) to oversee contractor performance. The supervision includes completion of work based on schedule and quality for each part of the work. As well as supervision of the application of quality, safety, healthy, and environment (QSHE) for the construction of Tower A in the "X" Project in Surabaya.
Next, supervise the completeness of the required documents. This supervision is carried out to ensure that there are no differences of opinion due to incomplete documents on both parties. In addition, documents such as work contracts, design drawings, and work methods will provide the scope of work to be completed by the contractor.

3) Improve internal and external communication

Communication during project work is very necessary to harmonize the views of the parties involved. Internal communication to coordinate with each section such as architecture, civil structure, MEP, and POP. External communication is carried out in every part of the project to coordinate with consultants and contractors.

4) Complete the creation of sample units

unit examples are important enough to increase sales of each unit. Because with the example of the unit, it will increase consumer confidence to make a purchase of the unit in the "X" Project in Surabaya. In addition, with the example of units, consumers can feel the atmosphere offered from each unit available.

4. CONCLUSION

Based on the results of the analysis that has been done, there are some conclusions from this research as follows, The results of the identification of Tower A construction risks in the "X" Project in Surabaya obtained 41 risk factors, consisting of 11 risk factors for the architectural section, 11 risk factors for the civil structure, 6 risk factors for the project operational control (POP), and 13 risk factors mechanical, electricity, and plumbing (MEP). The results of the assessment and ranking of risk priorities, there are 7 risk factors in the architecture section that has a very high level of risk, with priority being the delay in the design completion by the consultant. In the civil part of the structure, there are no risk factors with a very high-risk level, but there are still 6 risk factors with a high-risk level, with priority being the mismatch of building structure

design. POP section has 1 risk factor that has a very high level of risk, with priority being the unavailability of cash flow. And in the MEP section, there are no risk factors with a very high-risk level, but there are still 4 risk factors with a high-risk level, with priority being material quality that is not according to specifications. There are 26 risk factors that require risk mitigation actions. The risk factors consist of 11 risk factors in the architecture section, 6 risk factors in the civil structure, 5 risk factors in the project operational control (POP), and 4 risk factors in the MEP section. This research identifies risk factors to carry out risk mitigation and has carried out validation of risk factors and risk mitigation actions. There are two suggestions for further research, namely first conducting research on risk management by involving external parties such as consultants, construction management, and contractors. The second suggestion is to conduct a thorough research on the project including marketing and finance, not only on project operations that are at the project work location.

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