Risk Identification in Procurement of Glass facade in High-Rise Office Buildings in Jakarta

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Abstract.
This study aims to identify risks at the procurement stage of the glass facade of office buildings in Jakarta. In this study, the procurement phase was analyzed using the PMBOK reference (5th edition). In this research, the most dominant risk will be discussed at the stage of glass facade procurement in high-rise office buildings in Jakarta. After the dominant risk obtained from the analysis, the prevention and recommendations will be discussed. The number of risks that occur during the procurement process can certainly hamper the project. These risks can cause the project completion time that are not in accordance with the project schedule. Besides that, the risks could make the project cost even greater. This certainly can lead to big loss to the project. Therefore, it is very important to identify the main risks at the procurement stage from the beginning of the construction process. According to the PMBOK, the stages of the procurement is divided into 4, which consists of plan procurement, conduct procurement, control procurement and close procurement. Based on the research results, obtained 47 risks that are divided into 4 phases of the procurement. Based on expert validation, 42 risks out of 47 risks were used in the analysis. This study uses the SPSS program to determine the most dominant risk. The SPSS results show that the variables X33 and X39 are the most dominant risks in the procurement stage of high-rise office building glass facades in Jakarta. These variables are the risk of material defects (X33) and late in ordering material (X39).

1. Introduction
Indonesia is a developing country, especially in the field of construction industry. According to data from The Skyscraper Center, the number of buildings in the capital Jakarta has currently reached 382 building. Most of the buildings (about 42%) has a height above 150 meters, which are generally used for offices and use glass material for the facade. The higher the building is built, would make the construction process more complex. In the success of facade work process, there are good procurement process in the project. Procurement is a process in providing goods or services needed, with the appropriate quantity and quality, from the appropriate source, sent to the right place at the right price. Therefore, it makes procurement is a crucial stage in every construction project. With the development of the construction industry in Indonesia at this time, it can not be separated from the risks in every construction process, especially in façade works. Risks can be said can happen at any time - in unexpected ways. Risk can give effect to the productivity, performance, quality and cost constraints of the project. If there are no early prevention, it can lead to an increase in the cost of a project and could make the time schedule of the project longer than the initial plan. The
problems that will be discussed in this research are the risk that can happen in procurement phase of glass façade on the high-rise office buildings. If this research can be implemented well, it is expected to be able to minimize and prevent the risks that can occur at the procurement stage of glass facade in high-rise buildings

2. Research Methodology
2.1. Research Process
The data used in this study comes from projects that have already been completed in their construction and projects that are still under construction. Data obtained from the specialist contractors in multi-storey glass facade building.
The data taken by giving questionnaires and interviews to experts related to this research. The following is the analysis process carried out in this study.
1. The first stage
   Risk identification is obtained from literature studies through journals, books and other relevant research.
2. Second stage
   After identifying risks, conduct interviews with experts related to this research. Interviews were conducted with 5 experts from multi-storey building facade contractors. The results of this interview are used to correct, complete, or reduce risk variables that have been prepared previously.
3. Third stage
   The third stage was carried out by giving questionnaires to 35 respondents from facade specialist contractors that are involved in the procurement and construction phase.

2.2. Research Instrument
This study uses the SPSS program in analyzing data from questionnaire results

2.3. Factors and Variables
Based on identification that refer to 5th edition of PMBOK, risk factors in procurement stage consists of 4 phases as follows:
1. Plan Procurement
2. Conduct Procurement
3. Control Procurement
4. Close Procurement

3. Results and discussion
3.1. Result
The following are the result of risk identification that may occur at the procurement of glass facade in buildings can be seen in table 1 below:

| No | Risk Factors          | Risk Variables                                           |
|----|-----------------------|----------------------------------------------------------|
| a  | Plan Procurement      | X1 Change in Contract Value                              |
|    |                       | X2 Changes in requirements and specifications of the owner|
|    |                       | X3 Changes in scope of work                              |
|    |                       | X4 Errors in planning and specifications                  |
|    |                       | X5 Incomplete contract documents                         |
|   |   |
|---|---|
| X6 | Non-current project funding |
| X7 | Material type is not clearly defined in the contract |
| X8 | The accuracy of the estimated amount of material |
| X9 | The quality of the material used for construction |
| X10 | Project insurance is unclear |
| X11 | There is no initial survey in the making of Billing of Quantity |
| X12 | Increase in Material Prices |
| X13 | Changes in implementation schedule |
| X14 | Lack of information about vendor companies |
| X15 | Incorrect estimation of procurement budget |
| X16 | The appointment process is too late for vendors / subcontractors |
| b. | Conduct Procurement |
| X17 | Experience in working with stakeholders |
| X18 | Delivery location far from the warehouse |
| X19 | Limited workforce qualifications |
| X20 | Ordering a limited amount of material |
| X21 | Equipment mobilization delays |
| X22 | Deviation of material fabrication completion time |
| X23 | Vendor Financial Condition |
| X24 | Changes in material types during work implementation |
| X25 | Add work from owner |
| X26 | Material not yet available from the factory |
| X27 | Design changes in the middle of the work |
| X28 | Limited competent human resources |
| X29 | Insufficient material storage area |
| c. | Control Procurement |
| X30 | Loss of equipment and / or materials purchased |
| X31 | Material damaged when handling in the field |
| X32 | Late delivery of goods to the site |
| X33 | There is a defect in the material that arrived |
| X34 | Material specifications sent are not appropriate |
| X35 | Error interpreting images / specifications |
| X36 | Accident when shipping material |
| X37 | The amount of material sent is not appropriate |
| X38 | Damage to work equipment |
| X39 | Late in ordering materials |
| d. | Close Procurement |
| X40 | Problems with taxes |
| X41 | Problems in the audit |
| X42 | Inadequate project documentation |

3.2. Reliability Analysis
This test is conducted to measure the consistency of respondents in answering questions compiled in the questionnaire. A questionnaire is said to be reliable if the answer to the statement is consistent. The results of this test can be used to explain the confidence level of the questionnaire used in this study as a data collection tool. This study using the Cronbach Alpha technique. By using the Alpha Cronbach technique, high and low reliability, empirically shown by a number called the value of the reliability coefficient (alpha).
The results of the processed SPSS obtained a Cronbach’s Alpha value of 0.947, where this value is > 0.7 indicates that all items of questions in this study have high reliability

### Tabel 2. Reliability Test

| Reliability Statistics |
|------------------------|
| Cronbach's Alpha       | N of Items |
| 0.947                  | 42         |

3.3. Correlation Analysis

In correlation analysis, an independent variable is declared correlated with the dependent variable if the value of the correlation coefficient $r \geq 0.4$. Whereas the correlation coefficient $r \leq 0.4$ will not be included in the next step. The results of the correlation test can be seen in the following table 4.3.

### Tabel 4.3 Correlation Analysis

| No. | Risk Factors  | Risk Variables                                                                 |
|-----|---------------|-------------------------------------------------------------------------------|
| a.  | Plan Procurement | X2 Changes in requirements and specifications of the owner                     |
|     | Conduct Procurement | X19 Limited workforce qualifications                                           |
|     |               | X20 Ordering a limited amount of material                                      |
|     |               | X24 Changes in material types during work performance                          |
|     |               | X27 Design changes in the middle of the work                                   |
|     |               | X28 Limited competent human resources                                          |
|     |               | X29 Insufficient material storage area                                         |
| c.  | Control Procurement | X30 Loss of equipment and / or materials purchased                              |
|     |               | X31 Material damaged when handling in the field                                |
|     |               | X32 Late delivery of goods to the site                                         |
|     |               | X33 There is a defect in the material that arrived                             |
|     |               | X34 Material specifications sent are not appropriate                           |
|     |               | X36 Accident when shipping material                                           |
|     |               | X37 The amount of material sent is not appropriate                             |
|     |               | X38 Damage to work equipment                                                   |
|     |               | X39 Material order delays                                                      |
| d.  | Close Procurement | X40 Problems with taxes                                                        |
|     |               | X42 Inadequate project documentation                                           |

3.4. Regression Analysis and Stepwise Method

Regression analysis in this study used the stepwise method. With this method, all the analyzed variables are filtered so that they get the most independent variables that can explain the
dependent variable. With the result of the SPSS program, the following are the results of the regression analysis using the stepwise method.

**Tabel 4.4 Regression Analysis**

| Model | R     | R Square | Adjusted R Square | Std. Error of Estimate | Durbin-Watson |
|-------|-------|----------|-------------------|------------------------|---------------|
| 1     | 0.881a | 0.776    | 0.769             | 0.226                  |               |
| 2     | 0.900b | 0.810    | 0.798             | 0.212                  | 2.310         |

a. Predictors: (Constant), X33
b. Predictors: (Constant), X33, X39
c. Dependent Variable: Y

3.5. Discussion

Based on the results above, X33 variable is the most determining variable with the greatest contribution to the performance of project completion. This shows that a defect in the material that arrived at the project is the most influential factor. Based on the results of the regression analysis using the SPSS statistical program (Statistical Product and Service Solutions) in table 4.4 above, the number of regression models that are formed are 2 variables. Based on the results obtained, the R square value of the X33 is 0.776. This value means that the variable X33 affects variable Y by 77.6%. This means that the defects in the material that arrived at the project, has effect on the performance of project completion by 77.6%.

As for the value of R square on the X39 variable obtained from the regression model is 3.4%. This shows that delays in ordering materials affect the performance of project completion by 3.4%.

4. Conclusion

The risk identification results obtained 47 risks are potentially affect at the procurement stage of the glass facade of high-rise office buildings in Jakarta. Of these 47 risks, validation was conducted to experts so there were 5 risk variables that were considered not very influential in this study. From the results of this validation, in this study will be use 42 risks variables.

Based on the results of the analysis with the SPSS program, there are 2 most dominant variables, that are variable X33 (a defect in the material that arrived in the project) and variable X39 (delay in the material order). From the results of the SPSS program the risk variable X33 affects the performance of project completion by 77.6%. As for the risk variable X39 has an effect to the performance of project completion by 3.4%.

For the risk variable X33, the following are some action that can be done to prevent and overcome defects in the material that has arrived at the project.

1. Make a request for inspection and testing of material before it is sent to the project site.
2. Place quality control at the supplier to check the quality of the material to be supplied.
3. Make an initial agreement with the supplier regarding the possibility of material defects provided by the supplier. This can be done by a system of penalty to suppliers if there is a defect in the material being supplied.
4. Making reports on quality inspection data and material quality which are always evaluated periodically

As for the risk variable X39, here are some actions that can be done to prevent and overcome the delay in ordering material.
1. Consider adding the minimum inventory / stock to the warehouse.
2. Make coordination evaluation meetings periodically between the warehouse and the purchasing division.
3. Make a schedule for the estimated use of material in the project that is always updated with project conditions regularly.

Based on the results obtained in this study, here are some recommendations for improvement found in this study.
1. Make a project risk management analysis as a report that must be made in every construction activity so that the risks that occur can be anticipated from the beginning.
2. Conduct periodic evaluations of each construction activity so that they can make decisions quickly on risks that may occur as well as those that have already occurred.
3. Conduct risk mapping in every construction work, starting from the risks that have a low impact to the risks that have a high impact on the construction process.
4. Conduct financing planning and project schedule, in accordance with the results of the risk analysis.

5. References
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