



ANALYSIS OF DELAYS USING RISK CHRONOGRAM AT RISK MANAGEMENT STAGE

Oryza Lhara Sari, Institut Teknologi Kalimantan, Kampus ITK Karang Joang Balikpapan, Indonesia

Andika Ade Indra Saputra, Institut Teknologi Kalimantan, Kampus ITK Karang Joang Balikpapan, Indonesia

Armelia Megawati Lestari, Institut Teknologi Kalimantan, Kampus ITK Karang Joang Balikpapan, Indonesia

Abstract- The construction world will always continue to exist as a form of the development of world civilization. One of the cities in East Kalimantan Province that is undergoing facility improvement is generally Bontang City with Rawa Indah Market Project. Project delays result in an increased risk that will arise. Risk is analyzed and handled by the impact of risk management. The stages of risk management are determining risk context, risk identification, risk analysis, risk evaluation, and risk handling. The risks that arise will then be visualized into work items against the scheduling and risk arising called Risk Chronogram. At the risk identification stage, there are 42 indicators and 12 project delay variables that are distributed to 20 respondents of the project consisting of contractors and subcontractors. Risk Analysis Stage There are 5 very high risks, 13 high risks, 11 medium risks, and 13 low risks that affect project delay. Risk evaluation Stage There are 5 very high-risk work items, 2 high-risk job items, 4 low-risk job items, and 16 very low-risk job items. The dominant risk cause of delay in Pasar Rawa Indah Bontang project is that and less provide labor, the difficulty of obtaining a work permit by a third party, limited material on the market, the occurrence of repeated design changes, problems with the surrounding population and delays in the payment process. Jobs that experience high delay risk are preparatory work, earthwork, foundation work, 4 and 4A floor mechanical work as well as 3-storey mechanical work building. Risk management efforts can be done by mitigating the risk by 3 experts in the construction field is to ask the recommendation of working experience Subkon, project owner complete the licensing before the project starts, good material management, making soft drawing approved all parties, coordination meetings with regional devices and detailing the source of the project funds.

Keywords: Risk Chronogram, risk management, soft drawing

I. INTRODUCTION

The construction world will always continue to exist as a form of the development of world civilization. With technological advances, the construction of developed and developing facilities continues to be developed. Indonesia is a developing country that continues to build public facilities to increase people's productivity. One of the areas currently in the spotlight is East Kalimantan because the province was announced in place of the Capital of DKI Jakarta. One of the cities in East Kalimantan Province that is undergoing facility improvement is generally Bontang City with Rawa Indah Market Project. This project was built to provide a place or selling for traders because in 2013 the Rawa Indah Market building burned down. The type of contract used is Multi Years Contract (MYC) with the initial contract of the project starting on February 27, 2018, and completed on February 11, 2019. The addendum was carried out three times on this project where in the first addendum the project could be completed by September 09 2019 but by the date specified the project could not be completed and in the last addendum the project could be completed by December 26 2019 but the project could not be completed until the last addendum limit.

In its implementation, there are some factors causes the implementation of the work to reverse resulting in changes in the first and second addendums that have a period time of 7 months. The main factor causing the delay the land conflict that occurs for 5 months from January – May 2019. The factors that arise will be analyzed by the impact and risk of existing research. The stages of risk management are the first to determine the context of Risk Identification, Risk Analysis, Risk Evaluation, and Risk Treatment (AS/NZS ISO 31000:2009). The risks that arise next will be visualized in each work item in the Rawa Indah Market Project. The visualization form of each work against scheduling and the risks that arise are called Risk Chronogram.

This research aims to conduct risk management stages from the identification stage to the risk response with existing variables and indicators and has been analyzed by experts using the analysis of risk management stages. The dominant risk arising from delays will be displayed in visual form and addressed using a risk response.

II. LITERATURE REVIEW

2.1 Construction Delays

Project delays are also defined as completion times that exceed between the working time and the completion time of the contract, or the time that exceeds the time of the project handover to the owner of the project (Alsharif 2016).

2.2 Risk

Risk has two elements: likelihood which means the probability of an event and consequence which means the impact that occurs as a result of the event (Cooper et al, 2005). Risk is also commonly used in construction companies continuously in the face of various situations involving many factors including unknown, unforeseen, and often non-desirable factors.

2.3 Risk Management

Risk management is a systemic process of an organization to understand what risk is, who can pose a risk, and how to control existing risks by providing the assessment needed to meet the criteria of risk control. If it has not met then it is necessary to manage the risk level from the highest to the lowest risk by giving the reason and the level of occurrence on each – each label, especially to large organizations that have official permission and many values – the moral value of the company to protect the other workers (Malik and Holt, 2013). Risk management on the project cannot be issued because it can be managed in order to be used as a guideline. Project Management Body of Knowledge or PMBOK (2013) explains risk management is a process that starts with a risk management plan, identification, analysis, response, monitoring, and risk control of the project.

2.4 Risk Management Stages

The stage of risk management is a process to know, analyze and control the risks in the legislative stage of the company's activities indicated or applied to the higher effectiveness of management in dealing with potential opportunities and losses incurred (AS/NZS ISO 31000:2009). The stages of risk management from the beginning to the end are shown.

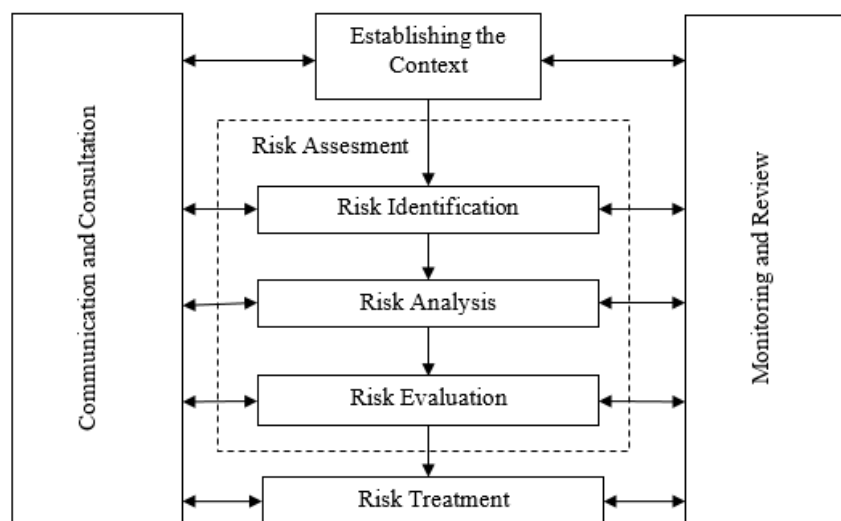


Fig. 1. Risk Management Stage

(Source: AS/NZS ISO 31000:2009)

III. RESEARCH METHODOLOGY

3.1 Preliminary Survey

Preliminary surveys are conducted to validate the variables of previous research results. This survey is useful for assessing the relevance of existing indicators. This survey was conducted using the interview form.

3.2 Pilot Data Survey

The pilot survey was conducted to find out the feasibility of the draft questionnaire that has been created. The sample that can be used in the pilot survey is at least 10% of the total sample used (Conelly, 2008).

3.3 Questionnaire Survey

The results of the questionnaire will then be analyzed for each indicator item using the SPSS assistive program and if they have fulfilled the questionnaire will be distributed to 20 project respondents representing contractors and sub-contractors with non-probability sample sampling techniques in the Rawa Indah Bontang Market Project.

3.4 Data Analysis

Data analysis is a stage that contains the results of validity and reliability tests in questionnaires that have been disseminated to 20 project respondents. At this stage determine the number of indicators and variables to be processed at the next stage of risk management. The assistive program used to test data in SPSS software with Pearson Correlation. Risk management phase analysis will also be carried out at this stage of risk identification, risk analysis, risk evaluation, and risk treatment.

3.5 Risk Chronogram

Evaluation is a stage to determine the dominant risk of delays resulting in the duration of work that also experiences delays in its implementation. This stage will display an image of the scheduling and risk level of each job using color. The combined results of project scheduling, duration and level of risk are called risk chronograms.

IV. RESULT AND DISCUSSION

4.1 Preliminary Survey Result

Preliminary surveys are conducted using questionnaires given to experts to validate project delay factors based on the level of relevance sourced from previous research. There are 85 indicators of results from previous research that will be validated by four experts. Questionnaires at this stage were given a scale of 1-5 to assess the relevance level of each indicator and obtained a percentage of 81.8% for the maximum score and the number of indicators included in the "relevant" category (Sugiyono, 2010).

4.2 Pilot Survey Data Result

Respondents from the questionnaire survey pilot were five people selected to represent contractors on the rawa indah bontang market project. The indicators in the pilot survey are 62 indicators. Questionnaires that have been filled by five randomly selected respondents will then to tested valid and reliable using SPSS software and used a range of correlation coefficient values of 0.41 – 0.60 with "sufficient validity" to assess indicators to be processed at a later stage (Arikunto, 2010).

Table 1. Invalid Indicator Validity

No.	Invalid Indicator	No.	Invalid Indicator
1.	Lack of supervision from contractor staff	9.	Restrictions on working hours in the field by project owners
2.	The amount of material in the field is not enough	10.	Lack of contractor experience in handling projects
3.	The contractor loses communication with the material provider vendor	11.	Lack of effectiveness in the oversight of projects
4.	Equipment limitations in the field	12.	Lack of supervision and location management
5.	Poor equipment management	13.	A work stoppage by the project owner
6.	Delay sending equipment by vendor	14.	Difficulty coordinating between project parties in the project
7.	Lack of job supervision	15.	Delay in approval of work images and material examples to project owners
8.	Poor implementing attitude when monitoring work		

From the reliability test results in the pilot survey, Cronbach's Alpha score was 0.936. Alpha values with an $\alpha \geq$ range of 0.9 then the questionnaire is "superior valid" (George and Mallery, 2009).

4.3 Data Collection and Analysis

Data collection by distributing questionnaires to contractor staff as well as subcontractors directly involved in the implementation of Rawa Indah Bontang Market Project. The questionnaire is distributed to 20 representative respondents from project contractors and subcontractors where the respondent's profile is shown following image.

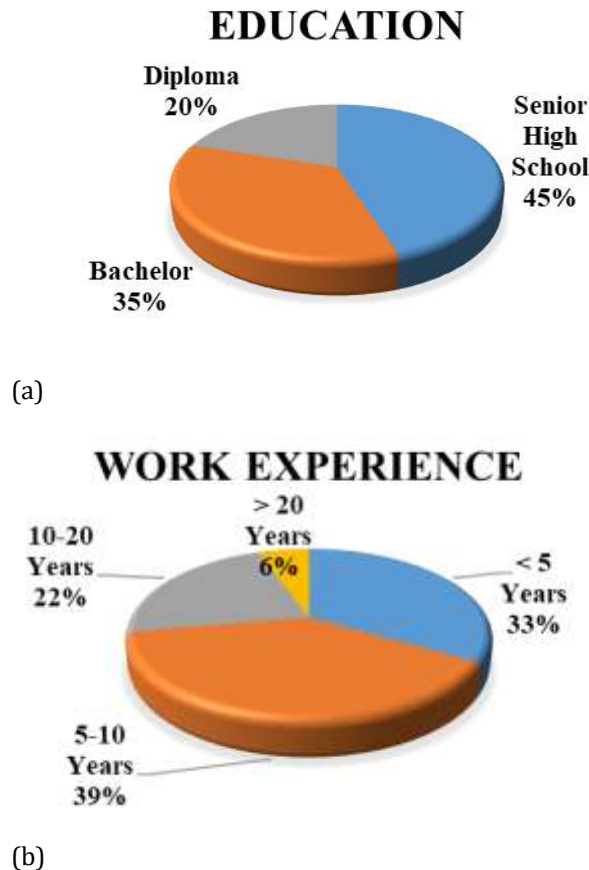


Fig. 2. Pie Diagram Based on (a) Education and (b) Respondent's Work Experience

Table R-value for 20 respondents with a significant value of 10% is 0.3783. From the validity test results using a SPSS assist program with Pearson Correlation, from 47 indicators of results from the pilot survey there are 5 indicators whose R-value is calculated under R table and obtained 42 valid indicators that will be used as indicators of project delay.

Table 2. Invalid Indicators

No.	Indicator	R-Count	Conclusion
1.	Material damaged due to poor packing/transport	0,293	Invalid
2.	Schedule plan cannot present actual field	0,272	Invalid
3.	Delays in the process of payment of work by project owners	0,339	Invalid
4.	Poor project management on the part of contractors	0,153	Invalid
5.	Inconsistent technical specifications	0,381	Invalid

Table R-value for 20 respondents with a significant value of 10% is 0.3783. From the validity test results using a SPSS assist program with Pearson Correlation, from 47 indicators of results from the pilot survey there are 5 indicators whose R-value is calculated under R table and obtained 42 valid indicators that will be used as indicators of project delay.

Table 3. Invalid Indicators

No.	Indicator	R-Count	Conclusion
1.	Material damaged due to poor packing/transport	0,293	Invalid
2.	Schedule plan cannot present actual field	0,272	Invalid
3.	Delays in the process of payment of work by project owners	0,339	Invalid
4.	Poor project management on the part of contractors	0,153	Invalid
5.	Inconsistent technical specifications	0,381	Invalid

Retrieved Cronbach's Alpha score of 0.925. Alpha values with a range $\alpha \geq 0.9$ then the questionnaire is worth "superior" (George and Mallery, 2009).

4.4 Risk Management Stages

Risk management phases that will be carried out include risk identification, risk analysis, risk evaluation, and risk treatment (AS/NZS ISO 31000:2009). These stages are described as follows.

4.4.1 Risk Identification

Risk assessment at this stage is an explanation of the project delay indicator obtained after the validity and reliability test in the questionnaire that has been spread to project respondents. There are 42 questionnaire indicators that affect the delay of the beautiful swamp market project. These indicators are shown in the table as follows.

Table 4. Project Delay Indicators

Code	Variable	Indicator
X1	Manpower	Sub-con lacks the manpower to suit field needs
X2		Worker productivity provided by sub-con is still low
X3		The workforce provided by the sub-con is less competent
X4		Labor planning planned by contractors has not met the needs of jobs in the field
X5		Workers from sub-con undergo labor strike
X6		The motivation given by contractor or sub-con staff to workers is still low
X7	Material	Material delay sending by vendors
X8		Project owner changes material specifications while construction is underway
X9		A limited number of materials on the market
X10		Unreliable material vendors
X11		Material damaged due to poor packing/transport
X12		Poor material management oversight by contractors
X13	Equipment	The absence of faulty equipment
X14		Low tool productivity
X15	Planning Factors	Conflict with other construction activities
X16		Work plan procedures that do not correspond to the circumstances in the field
X17	Financial	Lack of facilities provided by the owner
X18		Late payments made by contractors to suppliers or subcontractors
X19		Less precisely the project owner in planning the finances
X20		Delays in the process of payment of work by project owners
X21		Poor management of project cash arrangements by contractors
X22		The project owner does not supervise the course of the project properly
X23	External	The difficulty of obtaining a work permit transports third parties
X24		Weather conditions that do not support for operations
X25		Problems with the surrounding population
X26		Delay of work from the owner
X27		Flood
X28		Rain
X29	Project Related	Water and electricity utilities not available on site
X30		Problems with sub-contractors
X31		Rework due to execution error
X32		Late payment by owner
X33	Contract	Change order and variance order
X34		Errors and discrepancies in contract documents
X35		Inconsistency of terms on contracts

Code	Variable	Indicator
X36		Inconsistent technical specifications
X37	Site Related	An Unclear channel of communication/correspondence of contractor division with other subdivisions
X38		Inexperienced co-owners
X39	Communication	Lack of communication between parties in the project
X40	Design	Repeated design changes by project owners
X41		Unworkable drawings by planner consultants who are not on time
X42		Contractors do not use optimal software in the design creation

4.4.2 Risk Analysis

The risk analysis stage is an advanced stage of risk identification. Questionnaires that have been spread to 20 project respondents by assessing indicators based on probability and their impact will be plotted into a matrix of probabilities and impacts. Of the 20 respondents, for each value based on a scale of 1-5 for each probability and impact the result will be flattened and obtained values as in the following table.

Table 5. Average Rating Respondent Scoring

Code	Probability	Impact	Code	Probability	Impact
X1	3.65	3.50	X22	2.45	2.30
X2	3.50	3.25	X23	3.60	3.55
X3	3.50	3.35	X24	3.50	3.40
X4	2.45	2.90	X25	3.55	3.50
X5	2.45	3.10	X26	3.45	3.40
X6	3.35	3.40	X27	3.50	3.20
X7	3.50	3.45	X28	3.00	3.25
X8	3.30	3.20	X29	2.25	2.45
X9	3.45	3.70	X30	1.75	1.85
X10	3.45	2.45	X31	3.35	3.20
X11	2.35	2.40	X32	2.45	3.45
X12	2.20	2.45	X33	2.30	2.65
X13	3.35	3.45	X34	2.45	3.00
X14	3.10	2.45	X35	3.20	2.45
X15	3.15	2.35	X36	2.35	2.45
X16	2.20	2.20	X37	1.75	1.95
X17	2.45	2.45	X38	2.45	2.45
X18	3.15	2.35	X39	2.20	2.45
X19	2.40	2.45	X40	3.25	3.50
X20	2.40	3.50	X41	3.10	3.40
X21	1.80	2.15	X42	2.40	3.10

The values that have been obtained above will then be entered into the matrix of probabilities and impacts according to the risk map. Risk maps are used to see where indicators are located according to the risk rating. The probability and impact values that have been input on the risk map are shown in the following image.

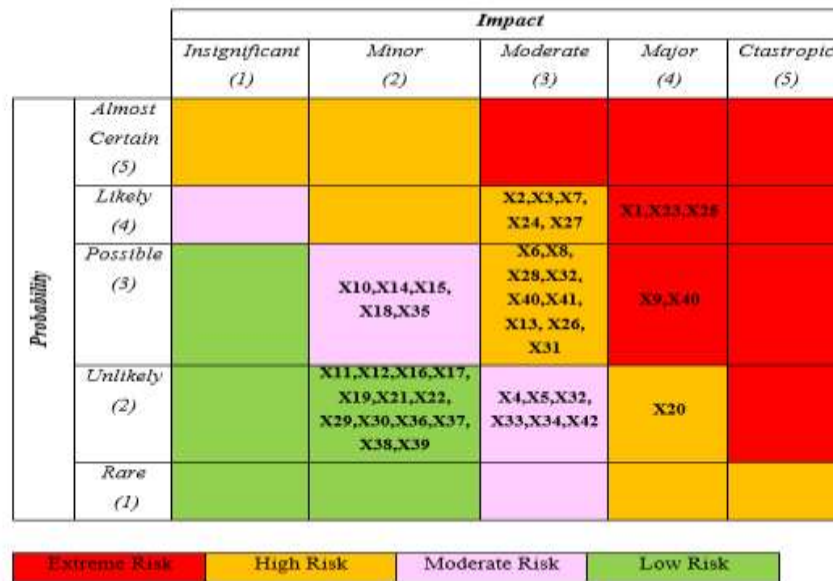


Fig. 3. Risk Mapping

4.4.2 Risk Chronogram

The jobs to be analyzed include major market buildings including preparatory work, groundwork, foundation work, reinforced concrete work, tap fund steel structure work, major market parker equipment jobs, mechanical and electrical jobs, lost mechanical and electrical jobs. Actual work execution data is obtained through project scheduling tailored to the risk map created using Ms. Excel's assistive program. The combination of scheduling, risk, and duration of project delays is a risk chronogram. Risk Chronogram for main building work and risks arising can be seen in the following figure.



Fig. 4. Risk Chronogram Project

In the image above the color is input according to the questionnaire results on the project delay impact criteria. Based on Table where the scale is 1 for the category of delay 0-1 month, scale 2 for delay 1-2 months, scale 3 for delay 2-3 months, scale 4 for delay 3-4 months, and scale 5 for delay >4 months. For that, the picture is as if presented in the form of a table shown in the following.

4.4.2 Risk Treatment

Risk mitigation is used to minimize and mitigate the impact. To find out the risk mitigation strategy on risk is conducted interviews and questionnaires with project expert respondents about the response to the risks that have been obtained from the risk analysis.

The response in the form of risk mitigation at any risk of delay arising is as follows.

- Sub-contractors are less able to provide manpower according to field needs by requesting recommendations from previous work experience and analyzing the work that has been done.

- b. The difficulty of obtaining a work permit transports a third party by conducting a coordination meeting at least once a week and the project owner completes the permit before the activity begins but otherwise allows better construction activities to be postponed.
- c. Limited number of materials in the market by mapping the type and volume of materials so that in actual construction is not hampered by the availability of materials and conducts material management well on the arrival and availability of materials at the construction stage.
- d. Repeated design changes by project owners with soft drawing approved by all parties so that for construction images can be published and image changes are large in value and time so rescheduling should be done.
- e. Problems with the surrounding population by conducting coordination meetings with RT, local indigenous leaders, and must get an agreement before construction activities are carried out so that the process can run smoothly.
- f. Delays in the process of payment of work by the project owner is before entering into an agreement on the contract must be known in advance the source of funds that will be used and tolerate the completeness of the administration but if the project owner is protracted in the payment process then it can have an impact on the termination of a project or activity.

V. CONCLUSION

Conclusions from this study using risk chronograms to present a display of work delays and risks posed are the dominant risks caused by delays in Rawa Indah Bontang Market Project are sub-con lack of manpower, difficulty obtaining permission by third parties e.g. in local communities and local organizations, material limitations in the market, repeated design changes, problems with the surrounding population, and delays in the payment process by owner. Work that is at high risk of delay is preparatory work, groundwork, foundation work, mechanical work on the 4th and 4th floors as well as mechanical work of the 3rd-floor building. Risk management efforts that can be done by risk mitigation by 3 experts in the construction field are by requesting recommendations for sub-con work experience, project owners completing licensing before the project starts, good material management, soft drawing manufacturing approved by all parties, coordination meetings with regional devices and detailing project funding sources.

REFERENCES

- [1] Australian/New Zealand Standard.: ISO 31000:2009. Risk Management Principles and Guidelines. Australia. (2009)
- [2] Sugiyono.: Metode Penelitian Kuantitatif, Kualitatif dan R&D, Alfabeta, Bandung (2010)
- [3] Conelly, L., M.: "Pilot Studies", Medsurg Nursing, No. 17, pp. 411-412 (2008)
- [4] Arikunto, Suharsimi.: Prosedur Penelitian Suatu Pendekatan Praktek, Rineka Cipta, Jakarta (2010)
- [5] George, G. B., dan Mallery, M. C.: "How Can We Improve School Discipline", Journal of Education Research, Vol. 39, pp. 48-58 (2009)
- [6] Alsharif, Samer dan Aslihan Karatas. (2016), "A Framework for Identifying Casual Factors of Delay in Nuclear Power Plant Project", Procedia Engineering, International Conference of Sustainable Design, Engineering and Construction, No. 145, hal. 1486-1492.
- [7] Cooper, F. Grey, S., Raymond, G. dan Walker, P. (2005). Project Risk Management Guideline, Managing In Large Projects and Complex Measurement. USA.
- [8] Malik, S.A., dan Holt, B. (2013), "Factors that Effect the Adoption of Enterprise Risk Management (ERM)", Journal of OR Insight, Vol. 26, No. 4, hal. 253-269.