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Research Paper

A Risk Management Analysis on Project Construction of Integrated Student Dormitory Building MTSN 1 Malang City

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ABSTRACT: *A crucial matter in a project is the ability to anticipate risks emergence and understand many risks that may affect the project. The construction project of MTsN 1 Malang Integrated Student Dormitory Building has been well planned, however, there must be certain risks occured in the implementation of project. The purpose of this study is to identify risks on the implementation construction project of MTsN 1 Dormitory building and how to respond to those risks. This study uses the Risk Management method whereas for the source of data study was obtained from documents of Budget Plan and Time Schedule of construction project for Integrated Student Dormitory Building at MTsN 1 Malang city. As the result of the risk analysis, it was found that the prominent (most dominant) risks was amounted in structure work, meanwhile the moderate risk was found in the roof work, and the small risk was found in preparatory work and earthwork. As the last step in this study was to control the most dominant risk. The control deliver on the dominant risks (that occur) was taking form in preventing the emergence of dominant risks to minimize losses which could be escalating during work implementation*

KEYWORDS: *Risk Identification, Risk Management, Risk Analysis, Dormitory, MTsN 1 Malang.*

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I. INTRODUCTION

A risk management is an activity to compensate the uncertainty embedded in a project management and as a proactive activity (not reactive activity) in the effort to achieve the desired project performance which will reduce the unexpected events and bring about a better understanding of the outcomes from any negative events. Meanwhile, an ability to identify project risks at all levels of the project management will bring significant effect into the improvement of project perfomance. When a risk management able to handle risks before the project starts or when the risk occurs, it can minimize cost, delays, pressure, and uncertainty within the project in such a way that it will ensure the project runs as expected or meets certain specifications.

In reality of project management aspect, to control the emergence of risks which unable to resolve or handle is tremendously difficult, starting from steps to identify risks into finding ways to reduce their impact on the achievement of project objectives. It opens the urgency of creating a flexible planning for looking at many possible risks and/or a contingency plan that takes into account all factors influencing risks from two sides of internal (the organization) and external (the environment), also from the possibility that risk may arise from consequences action from the project manager when planning and implementing the project.

The Integrated Student Dormitory Building of MTsN 1 in Malang city became one of the follow-up projects organized by MTsN 1 Malang. The integrated dormitory building is in four stories high and located at the back of the *madrasa* (school) facing to west direction, having several rooms with their own respective designations. These additions at the same time expands the function of the old adjoining dormitory building. The first floor designed as a hall and self-development place, the second floor designed as a worshipping and study place, meanwhile the third and fourth floors are designed for the student dormitories. Time plan for the dormitory construction process was carried out in 2020 for 140 working days with an implementation contract value of 10.2 billion IDR.

Land condition which located between the old buildings became one consideration during the construction of this dormitory alongside with materials procurement that experienced a slight delay because the

Bandung road is prone to heavy traffic jams. The difficult access to locations in the middle of school area, as well as manpowers which also can not be maximized due to location site and condition of new building that very close to old buildings were the other considerations in this work project Therefore, it needed a delicate care to ensure not to damage parts of the old buildings, besides the weather risk which was very influential at the beginning stage of project implementation where heavy rains poured almost every day.

II. LITERATURE REVIEW

2.1. Construction Project

A construction project is a series of civil engineering activities involving major civil engineering works and architectural engineering work. There are many activities in a construction project characterized as a complex work, meaning the project work will take a long period of time and requires allocation of certain funds to achieve the predetermined target, also from many activities and parties involvement during implementation of construction project, where can lead to complex problems [9]. According to Ervianto [5], parties in a construction project are those as shown in figure 1 below.

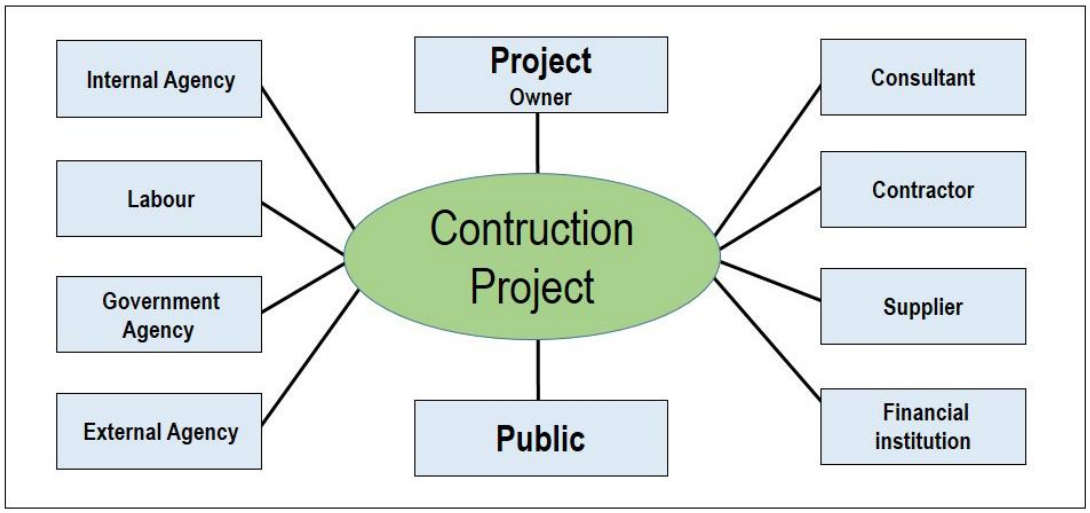

Figure 1: Parties involved in a construction project [5]

2.2. The Risk Management in A Construction Project

The risk definition in a construction project is a description of unfavorable consequences, both in financial also physical aspects as the result from the decision taken or due to environmental conditions at the location of an activity [4]. Further, Efrizon stated the construction project risk is a matter that cannot be eliminated, however, its impact can be minimized. Efrizon classifies the construction project risks into: (1) external risk groups and field conditions; (2) economic and financial risk groups; (3) tehnical and contractual risk groups; and (4) managerial risk group as displayed in figure 2 below.

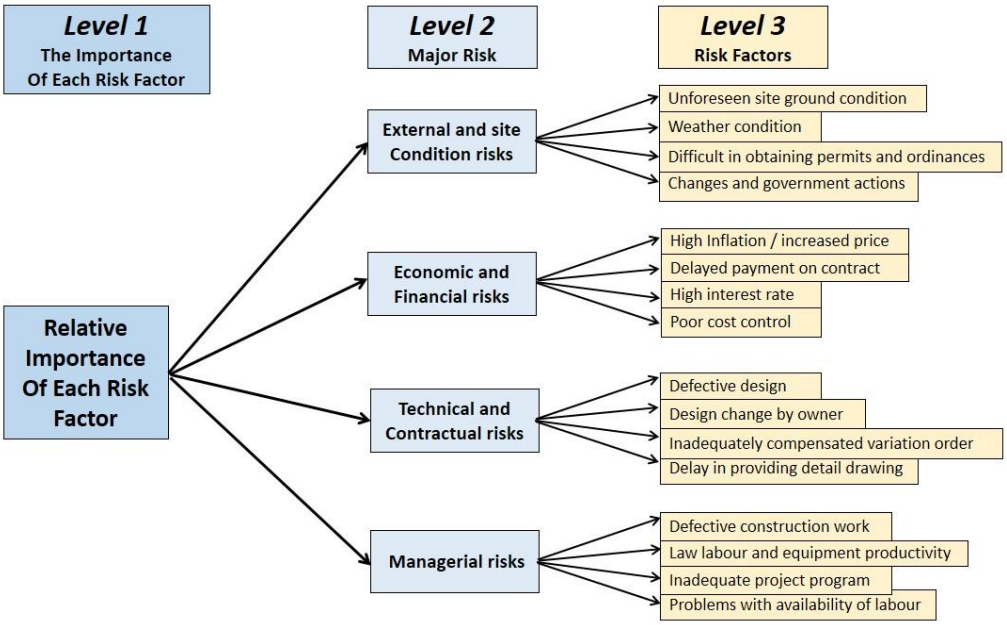

Figure 2: The hierarchy of risks in a construction project [4]

2.3. Several Methods of Risk Management

1. The Risk Breakdown Structure (RBS) Method

The *Risk Breakdown Structure* (RBS) method primary applied for constructing the category of each risk. The RBS method is a grouping of organizational risks formatted in a hierarchical composition with a logical, systematic, and structured nature according to the organization structure or according to a project. The target implementation of RBS method are the clarity of risk stakeholder and enhancement of understanding to organization risk or project risk aspect within context of a logical and systematic framework [11].

2. The Analytical Hierarchy Process (AHP) Method

The *Analytical Hierarchy Process* (AHP) method is one of the methods to support decision making developed by Saaty [12]. AHP model describes a complex multifactor or multicriteria problem into a hierarchy format. Hierarchy is defined as a representation of a complex problem in a multi-level structure. With a hierarchy, a complex problem can be broken down into groups which are then arranged into a hierarchical form to make the problems appeared in a more structured and systematic way [4].

2.4. The Risk Management

A high-rise building project can be categorized as a high-risk project as seen from the magnitude of its workload and its height structure to be built. *Risk arises from uncertainty*. Soeharto stated that risk is generally associated with any probability of unexpected event occurences [14]. Thus, risk also can be a variation which may occur or the possibility of its natural emergence. In addition, Flanagan and Norman said the risk occurs in a construction project will appear as a failed completion, a failure in obtaining planning drawings or permits within the time availibility, unpredictable soil conditions, very bad weather, labor strikes, unexpected price increase, work accident, structural damage, unexpected event, contractors claim, or a failure in completing project according to the predetermined budget [6].

Moreover, Darmawi gave elaboration view about risk management that conducted to reduce, avoid and support a risk through a sequence of activities; a risk identification, a risk analysis, and a risk management [3]. Whereas, for the possible actions that can be taken in dealing with risks are: accepting risk, avoiding risk, reducing risk, and transferring risk. The principal/primary concern in a risk management is how to manage risks as a decision made by considering the potentialities of the project and employed the risk analysis to achieve the target where risks become the attached part to the project. A risk management can be performed during the contract negotiation of the related project (when the project has not yet been executed) and during the project running. Berkeley et.al., [2] explained there are three stages must be considered in the contract negotiations as follow:

1. to use the project risk profile generated from the risk analysis to identify the management skills and techniques to minimize the risk inherent in the project.

2. to identify, review, and intepret information in the project environment which is useful to ensure the sustainability and chance of success in obtaining the outcomes of the project.
3. to know, when, how, and whom to negotiate with, for facilitating project progress and the ability to achieve outcomes.

According to Gray and Larson [8], the risk management progress have four process phases as listed below:

1. Risk identification. Analyze the project to identify sources of risk.
2. Risk assessment. An assessment of the effect caused (by risk), the likelihood of the emergences and its control.
3. Response development. Develop responses to risks including the possibility of reducing damage and develop contingency plans.
4. Response control. Control the response to risk which includes improving the risk strategy, monitoring and adjusting planning for new risks, as well as making changes to management.

2.5. The Risk Identification

The cause and effect analysis is a technique where the problem is studied to seek causes and effects of the problem. The problem must be analyzed to observe its causes and effects until those causes and effects will not produce symptoms of other problems. The Cause and Effect Analysis will lead to a correct understanding of the problem and able to lead into less obvious, but more creative and valuable solutions [17]. The following explanation are the Cause and Effect Analysis tool which applied to analyze a problem:

1. *A Fishbone Diagram* is a method to analyze causes of a problem or conditions as well as able to identify and organize possible causes of an effect and then separate the root causes. The stages of fishbone diagram are as stated below:
   - Identify the problem
   - Identify the main factors of the problem
   - Finding possible causes of each factor
   - Analyze the results of the diagram
2. *Whys* is a tool of root cause analysis for problem solving. This tool helps to identify the root cause of non conformity within a process or product. The use of whys is by an iteration technique of asking "Why" several times until it finds the root of the problem.

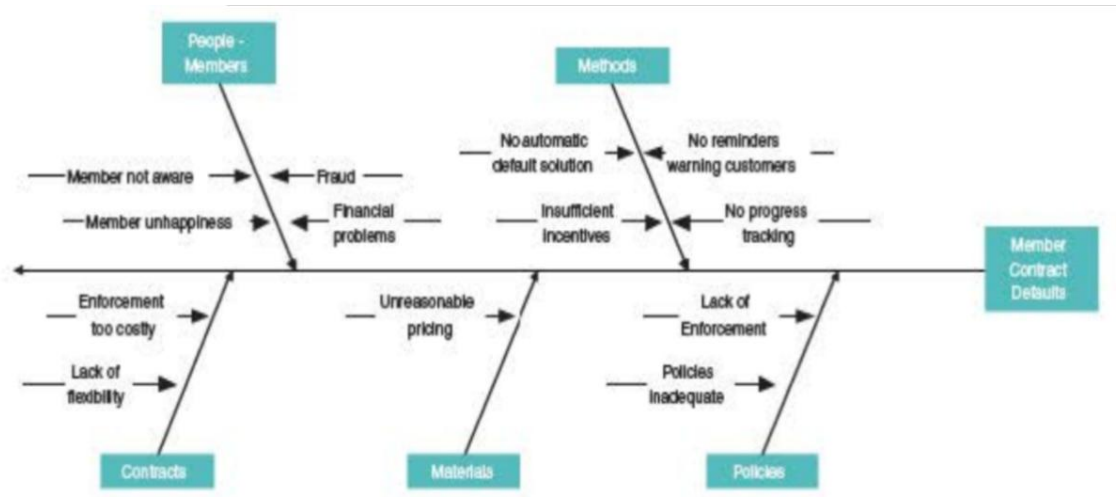

Figure 3: Fishbone diagram [17]

2.6. The Risk Analysis

A risk analysis is a procedure of identification and evaluation. According to Godfrey [7], a risk analysis which carried out in systematic ways can help to identify, assess and rank risks clearly, give focus on the main risks, clarify the losses limitation, minimize damage potential, and emphasize the function of each individual or entity involved in the risk management. Meanwhile, according to Thompson and Perry [16] the qualitative risk analysis and management has two objectives; a risk identification and initial risk assesment. From qualitative analysis, the individual will be able to determine influential risk by multiplying probability with impact of identified risk. When the result shows the probability is high with impact also high, then it will be resulted in a

high risk level and vice versa (if the probability is low and the impact is low then will be resulted in a low risk level). Afterwards, there is a treatment given to the main/dominant risks which then be called as the risk management.

The Standard Australia/New Zealand [1] established 4 (four) steps of risk management procedures as stated below:

1. Establish the content.
   Determining context has a meaning to determine internal and external boundaries / parameters that will put into consideration and being discussed in the risk management, also to determine the scope of work and risk criteria for the next process.
2. Risk identification.
   Risk identification is a stage for obtaining the relevant risk variables.
3. Target of risk identification is a developing a comprehensive list of risk sources and events that have an impact to the fulfillment of identified goals and targets from the context.
4. Risk analysis.
   Risk analysis includes consideration about risk sources, consequences and the likelihood of those risks. The risks will be analyzed by combining the likelihood (probability of frequency) and the consequences (impact or effect) values. Likelihood and consequences of each risk will determine the risk level. Furthermore, the standard Australia/New Zealand standard [1] added, each risk will be qualitatively in five categories. The measurement of each likelihood and consequence is presented in Table 1 and Table 2.

Table 1. The probability assessment

Level	Assessment	Definition
A	Very Often	Likely to happen most of the times
B	Often	Often occur
C	Average	Happen several times
D	Rare/Seldom	Happen occasionally
E	Very Rare	Very rare possibility

Source: AS/NZS 4360 : 1999 *Risk Management* [1]

Table 2. The impact assessment

Level	Assessment	Definition
1	Insignificant /very small	No injuries, low financial loss, has a small scope of impact in a very short period of time.
2	Small	Requires first aid, moderate financial loss, has little impact in the short term
3	Average	Requires medical treatment, has a high loss in financial aspect
4	Big	Causing extensive losses, serious injuries, impaired production capabilities, large financial losses.
5	Damaging / Very Big	Causing death, inflicting serious damage, and enormous financial losses.

Source: AS/NZS 4360:1999 *Risk Management* [1]

2.7. The Risk Evaluation

The purpose of risk evaluation is to assist the decision-making process according to the analysis result. The risk evaluation process will determine which risks require treatment and how to prioritize these risks. It can be done by grouping or make a classification of the likelihood and consequences into a risk matrix. After identifiying the existing likelihood and consequences values, then these values can be plotted on the risk matrix to find out how high the impact from the risk. The following section will explain the risk matrix as displayed in table 3 below.

Table 3. The risk matrix

Probability (*Likelihood*)	**Impact (*Consequences*)** (1) Insignificant/ Very small	(2) Small	(3) Average	(4) Big	(5) Damaging/ Very Big
(A) Very Often	H	H	E	E	E
(B) Often	M	H	E	E	E
(C) Average	L	M	E	E	E
(D) Seldom/rare	L	L	M	H	E
(E) Very rare	L	L	M	H	H

Source: AS/NZS 4360:1999 *Risk Management* [1]

Where:

E : *Extreme risk*, no tolerance, needs an immediate care.

H : *High risk*, unwanted, only acceptable when there was existed a risk reduction, unable to execute, needs special attention from management division.

M : *Moderate risk*, accept with further agreement and require a clear responsibility from the management division.

L : *Low risk*, accepted with agreement by the management division and able to be handled with the routine procedures.

The outcome from the risk evaluation is a risk rating data which requires further treatment on the basis of the remaining risks and on effectiveness of the existing risk control.

2.8. The Risk Analysis with PIM

Project risk within risk management is the cumulative effect of uncertain event opportunities which affect the project goals and objectives, or as a combination of functions from the frequency of events, probability, and consequences of risk hazards that happen [13]. In line with this statement, Kasidi [10] proposed 3 (three) stages in the risk management:

1. Risk identification
2. Risk measurement with PIM
3. Risk management

2.9. Probability Impact Matrix (PIM)

Probability impact matrix is a method to analyze risk through qualitative approach about the possibility of the appearance of a risk. Risk assessment is carried out based on the probability and its impact. This is conducted to provide an assessment about the probability of each risk and its impact by developing it into an index scale. Whereas the Index Scale in this study refers to the index scale shown in table 4 below:

Table 4. The index scale

SCALE	PROBABILITY	+/– IMPACT ON PROJECT OBJECTIVES		
		TIME	COST	QUALITY
Very High	>70%	>6 months	>$5M	Very significant impact on overall functionality
High	51-70%	3-6 months	$1M-$5M	Significant impact on overall functionality
Medium	31-50%	1-3 months	$501K-$1M	Some impact in key functional areas
Low	11-30%	1-4 weeks	$100K-$500K	Minor impact on overall functionality
Very Low	1-10%	1 week	<$100K	Minor impact on secondary functions
Nil	<1%	No change	No change	No change in functionality

From index scale on table 4, it can be seen that the index scale is divided into five level of risks starting from VHI (Very High), HI (High), MED (Medium), LO (Low) to VLO (Very Low). The next step is to calculate the level of importance from the risk poses by using the following formula:

Risk Score = Probability x *Impact*

Where:

Risk Score : Level of the risk importance
Probability : Value of the possibility of risk emergence
Impact : Value of risk impact that occur

After the probability, impact, and level of risk importance scales had been identified, the next step is mapping those three values into a matrix. Whereas the matrix form of risk assessment can be seen in table 5 below.

Table 5. The matrix of risk assessment by employing *probability impact matrix*

Probability	0.9	VHI	0.045	0.09	0.18	0.36	0.72
	0.7	HI	0.035	0.07	0.14	0.28	0.56
	0.5	MED	0.025	0.05	0.10	0.20	0.40
	0.3	LO	0.015	0.03	0.06	0.12	0.24
	0.1	VLO	0.005	0.01	0.02	0.04	0.08
			VLO	LO	MED	HI	VHI
			005	0.1	0.2	0.4	0.8
			Impact				

In table 5, the result from risk grouping can be explained by employing a matrix. Here, the types of risks are visible and can be predicted about which type of risks likely to occur, risks that brings significant impact and also risks that require serious treatment. Meanwhile, as the format of the risk grouping is displayed in the following figure (figure 4).

Probability	Threats Risk Score = Probability x Impact					Opportunities High (RED) / Med (YEL) / Low (GRN)				
0.90 Very Likely	0.05	0.09	0.18	0.38	0.72	High	High	High	Med	Low
0.70 Likely	0.04	0.07	0.14	0.28	0.56	High	High	Med	Med	Low
0.50 Possible	0.03	0.05	0.10	0.12	0.40	High	High	Med	Low	Low
0.30 Unlikely	0.02	0.03	0.06	0.12	0.24	High	Med	Med	Low	Low
0.10 Very Unlikely	0.01	0.01	0.02	0.04	0.08	Med	Low	Low	Low	Low
	0.05	0.10	0.20	0.40	0.80	Very High	High	Med.	Low	Very Low
	Example Impact Definitions – May Be Tailored to Each Project Objective Impact on an Objective (e.g. Cost, Schedule, Scope, Quality)									

Figure 4: Map risk probability impact matrix

III. RESEARCH METHOD

3.1. Time and Location of Research

The research implementation was deliver on the location of construction project for MTsN 1 Integrated Student Dormitory in Malang city. The implementation time starting from August 2020 to December 2020.

3.2. The Research Concept

Type of the research is a qualitative descriptive study where the result will not be a discovery of a new theory but a description of the nature of situation which currently occuring.

3.3. The Secondary Data

The secondary data was obtained from the Budget Plan and Time Schedule documents of the MTsN1 Integrated Student Dormitory Building Project. From the documents were visible the main issues and the initial environmental baseline of the project which later be tabulated and analyzed using the theory of AS/NZS-4360:1 (1999).

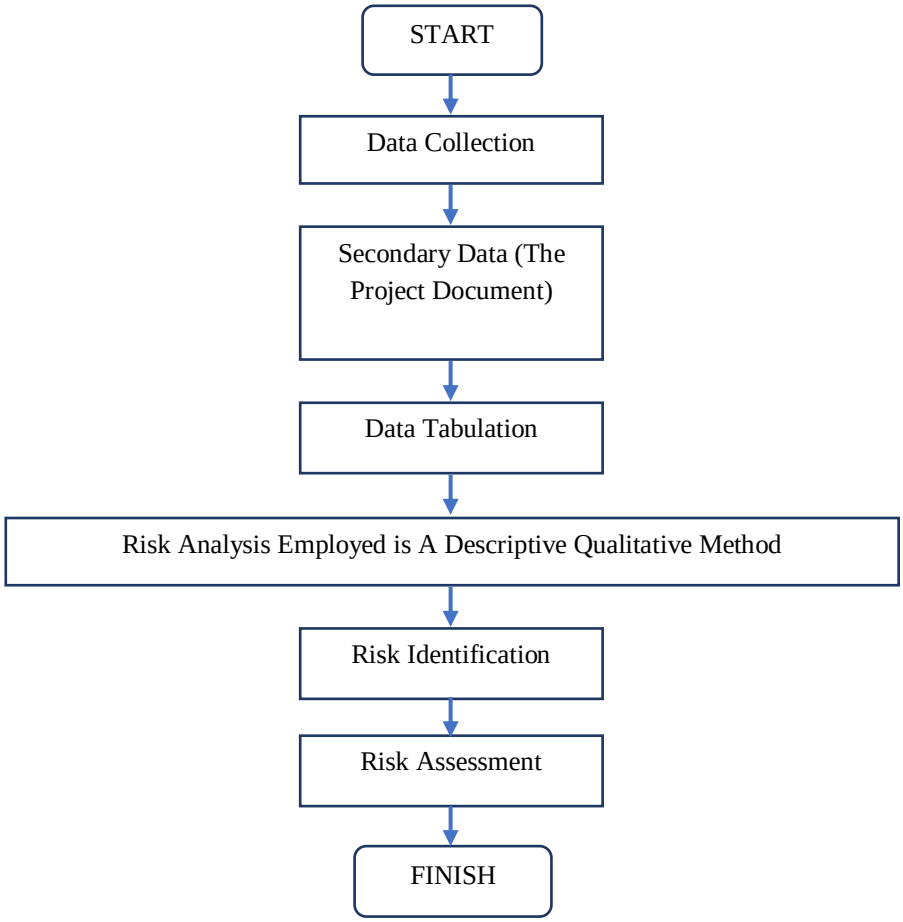

Figure 5: The research flowchart

IV. RESULT AND DISCUSSION

The construction project of MTsN1 Integrated Student Dormitory in Malang city is a construction of four-stories building which located in the school environment. For the surrounding environmental conditions asides from the school environment itself, there is a very dense transportation routes where traffic jam often occured around Bandung street.

As the effect from the situation posed in the location, several impacts occured during the work execution. Starting from bringing in and placing heavy equipments into the school area where teaching and learning activities are still in progress around the project, also from mobilizing and securing roads when the work requires heavy equipments. From this information, the following identification was obtained:

Table 6. Identification of types of risks on construction project of integrated student dormitory building for MTsN 1 Malang city

NO	WORK ITEMS	TYPE OF RISKS	RISK CODE	RISK FREQUENCY					RISK IMPACT				
				1	2	3	4	5	1	2	3	4	5
1	**Preparation and earthworks**	Delay in the mobilization of work equipments	**R1**			x						X	
		Road Safety	**R2**	x								X	
		Select the Implementation method	**R3**		x							X	
		Commotion during work implementation	**R4**	x					x				
		Rises of material prices	**R5**			x					x		
		Measurement and soil observation	**R6**	x						x			
		Delay in licencing / permit	**R7**		x						x		
2	**Concrete structure work**	Delay in work equipment mobilization	**R1**			x						X	
		Communication problems during work implementation	**R8**		x					x			
		Lack of equipment to implement the project work	**R9**				x					X	
		Select the implementation method	**R3**		x							X	
3	**Roof structure work**	Communication problems during work implementation	**R8**		x					x			
		Lack of equipment to implement the project work	**R9**				x					x	
		Select the implementation method	**R3**		x							x	
		Unutilized/residual of material waste	**R10**				x		x				

After data identification through the work items completed, part of items were visible and items that have a very large risk can be identified. Then, work items can be classified into 3 (three) group of works namely:

1. Land and preparation work, by time duration of 6 weeks, types of risk found in this item were 7 (seven) risks which then be coded as R1-R7 and shown in table 5.
2. Concrete Structure works, by time duration of 15 weeks, types of risks existed in this item found to be 7 (seven) risks coded as R1, R8, and R9 and shown in table 5.
3. Roof Structure works, with time duration of 7 weeks, types of risks existed in this item were 7 (seven) risks coded as R8, R9, R10 and R11 as shown in table 5.

The next treatment in this study was to put these data into a series of assessments (as displayed in table 7 for assesment of probabilities and in table 8 for assessment of impact) then will be categorized into a matrix in table 9.

Table 7. The assessment of probabilities on construction project integrated student dormitory building for MTsN 1 Malang City

Level	Assessment	Definition
A	Very often	Structure Work
B	Often	Structure Work
C	Average/Sometimes	Roof Structure work
D	Seldom	Earth Work
E	Rarely	Earth Work

Table 8. The assessment of impact on construction project integrated student dormitory building for MTsN 1 Malang City

Level	Work Items	Assesment	Definition
1	Preparation Work	Not significant/ Very small	For earthworks, relate to condition of the location that close to big road where congestion/traffic jam often occurs (especially during working hours) made the risk emerged more on mobilization and licencing activities. Meanwhile for work on site still can be carried out easily and risk level poses to workers almost none.
2	Earth Work	Small	Additional costs arose for licencing , conditioning and securing roads when bringing materials into the work site.
3	Roof Structure Work	Average	The risks often occured in roofing work were related to procurement of materials and work tools, which needed extra costs to get additional tools due to the difficult location of the building (in the middle of the existing building), other work risks sometimes occured from installing roofs and mobilizing frame trusses and the roof covers.
4	Concrete Structure Work for the 1st and 2nd floors	Big	The structure work has a relative complex risk which occured from work equipments and timing of material fabrication, the use of heavy equipments and late procurement became one of the risks affected to the cost and time of the work project.
5	Concrete Structure Work for 3rd and 4th floors	Damaging / Very Big	The narrow location and not too wide spaces for the fabrication of materials made materials often get damaged because falling, or worker hit by tools during fabrication, mobilization process of materials for the 2nd – 4th floors also constrained by insufficient space for movement which eventually caused delays and additional costs for the structure work item.

Table 9. The matrix of risks on construction project integrated student dormitory building for MTsN 1 Malang City

	Impact (*Consequences*)				
Probabilitas (*Likelihood*)	(1) Insignificant/ Very small	(2) Small	(3) Average	(4) Big	(5) Damaging/ Very Big
(5) Very Often					
(4) Often				R9	
(3) Average	R10		R5	R1	
(2) Seldom/rare		R8	R7	R3	
(1) Very rare	R4	R6		R2	

From the data analysis of this study, the result from the risk assessment in the construction project Integrated Student Dormitory Building for MTsN 1 Malang city are listed in four categories of risks as stated below.

E : *The extreme risk* was identified and located on:
R1 = A delay in equipment mobilization
R5 = An increase in material price
R9 = A lack of equipment in carrying out the work project

H : *The high risk*, was identified and located on:
R2 = Road Safety
R3 = Selection of implementation method

M : *The moderate risk*, was identified and located on:
R7 = A licencing/permit delay

L : *The Low risk* was identified and located on:
R4 = Noise during work
R6 = Soil measurement and investigation
R8 = Communication problems when carrying out work
R10 = Unutilized/Residual material waste

V. CONCLUSION

1. As the result for this research, there are (3) three variables obtained as the result of the risk level analysis:
   - Earth works (very rare risk) due to more risks occuring outside the site and during excavation
   - Roof work (occasional/sometimes happen) because the risk level has been reduced since there is an existing structure
   - Structure Work (often occurs) involving the use of heavy equipment with only limited space for workers to move.

2. For the description of risks that often occured in this project are found to be:
   - Mobilization of materials arrived into the site also affected the density of traffic jams on the road surrounding construction area (where this work is located).
   - While implementing the casting work, it must be completed outside the work location, because it is impossible to bring the work to the site location, bringing a cement mixer in the form of ready mix with potentiality to disturb pedestrians and vehicles crossing the road.
   - Additional costs rises for securing and controlling roads by officials and the community

3. The risk assessment in the construction project of MTsN1 Malang Integrated Student Dormitory resulted in three conclutions as listed below:
   - Delay in mobilization of work equipments
   - Increase in material prices
   - Lack of equipments to carry out the work

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