THESIS

THE IMPLICATION RISK-IMPACT OF PROJECT ACCELERATION ON PAVEMENT RUNWAY PROJECT

(IMPLIKASI DAMPAK RISIKO TERHADAP PERCEPATAN PROYEK PADA PROYEK PERKERASAN LANDASAN PACU)

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FACULTY OF CIVIL ENGINEERING AND PLANNING
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THESIS VALIDATION PAGE

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Made As One Of The Requirements To Get A Master Techniques Degree

By :

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State that my thesis was made by myself accompanied by a supervisory team and not plagiarism. If there is an element of plagiarism in this thesis, then I am willing to accept academic sanctions from the Islamic University of Indonesia according to the applicable regulations.

Therefore, I made this statement in a conscious state and without any coercion from anyone.

Yogyakarta, October 2020

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THE IMPLICATION RISK-IMPACT OF PROJECT ACCELERATION ON PAVEMENT RUNWAY

Abstract

The process of building a new Yogyakarta airport in Kulon Progo District or New Yogyakarta International Airport (NYIA) continues to accelerate. The document on the analysis of environmental impacts (Amdal) is still in the process of preparation. Airport development, has implications for productive land grabbing, settlement evictions, lost probability at the site plan and at the location of supporting infrastructure. In fact, there was no study on tsunami risk reduction in the formulation of environmental impact (Amdal), so there is no guarantee of safety. 2. On the analysis of the risk level in the pavement runway project is divided into five levels of risk for three samples. The average risk level in assumption 50% duration on 7 weeks the highest risk is on work item C.1.1. P-401 AC-WC, t=5 cm at the variable R8 (runway area susceptible to tsunamis) 3,6%. The lowest risk is on work item C.1.1. P-401 AC-WC, t=5 cm at the variable R5 (the actual length of the runway surface does not meet aircraft operational requirements) 1,2%. The highest loss is in work item C.1.1. P-401AC-WC, t = 5 cm where the risk factor for the prone to tsunamis runway area is 9,722,551.17 rupiahs with an aggregate risk of 3,6%. The smallest loss on work items C.2.5. Tack Coat where risk factor tack coat spreader works is not optimal 227,126.21 rupiahs with an aggregate risk of 2,2%.

key words : runway, risk impact, risk probability, project acceleration, value of loss.

PREFACE

Praise the presence of Allah SWT. Because of His grace and gift the writer can complete the thesis proposal. This thesis proposal is titled "The Implication Risk-Impact of Project Acceleration".

For this reason, any positive criticism and suggestions will be accepted with all humility and grace, because this is a step to improve the quality of self and also the provision of knowledge in the future.

In addition to thanking Allah SWT. which has provided an opportunity for writers, do not forget to thank them profusely shown to all parties who have helped the course of this thesis proposal, starting from the implementation until the completion of this thesis proposal, which include:

1. My father and mother who are a source of encouragement, thank you also for the prayers, efforts and advice that has been given to me.
2. Mr. Ir. Akhmad Suradji., MT., Ph.D., IP-M as my first proctor, Mam Fitri Nugraheni, ST., MT., Ph.D as my second proctor and Setya Winarno, ST., MT., Ph.D as my examiner also third proctor who have been given me help, knowledge and time to consul while writing this thesis.
3. All of my friends on Master of Construction Management 2018 who can not be said one by one.

The author realizes that there are still many shortcomings in writing this thesis. Therefore, constructive criticism and suggestions are highly expected for the progress of this paper.

Finally, the authors hope that this thesis can be useful for all of us, especially for personal writers and for the Civil Engineering Study Program Magister Program in Civil Engineering and Planning at the Indonesian Islamic University in Yogyakarta.

Yogyakarta, October 2020

Penulis

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CHAPTER 1
INTRODUCTION

1.1. Background

The construction project is one type of project that has a relatively high risk potential compared to other projects. The potential development of construction projects in Indonesia can be seen from the use of new methods and technologies as well as an increase in the number of parties involved. The construction industry, unlike other industries, is more complicated and difficult to manage because it requires special skills and techniques (Jamil, 2008). Project risk is an uncertain event or condition, if it occurs has a positive or negative effect on one or more project objectives such as scope, schedule, cost and quality. Risk may have one or more causes and if it does, there may be one or more effects. The cause may be needs, assumptions, constraints or potential conditions that are likely to have negative or positive results (PMBOK, 2013). Project risk management includes the process of carrying out risk management planning, identification, analysis, response planning, and risk control for a project. 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 in the project (PMBOK, 2013).

From the study of building failures and buildings that were established between 1996-2008 in Central Java, the results of a study by the Regional Construction Services Development Institute (LPJKD) found symptoms of deviations from building construction service providers averaged around 7-8% of the construction value (Hermawan et al., 2013). It was found that 34 buildings investigated obtained the fact that the type of construction and building failures that occurred in the area according to structural elements, the highest occurred in the main structure of the building (11.91%) and the second was the roof structure (4.68%). Our concern about the construction of buildings in the area because the buildings that should be intended for small people are of poor quality. For example, buildings such as puskesmas at the sub-district level, traditional market buildings and school buildings in rural areas do not pay attention to human safety impacts anymore (Hermawan et al., 2013).

The girder concrete of the Depok-Antasari Toll Road project collapsed due to being hit by heavy equipment. This project was undertaken by PT Citra Marga Nusaphala Tbk through its subsidiary PT Citra Waspphutowa and in collaboration with PT Girder Indonesia. Luckily, there were no fatalities in this accident, while the loss was estimated at Rp2 billion. Wednesday 22 January 2018, the accident incident at the national strategic project re-occurred. This time, the concrete grinder for the light rapid transit (LRT) project on Kayu Raya Street, Pulo Gadung, East Jakarta, collapsed. This accident resulted in five project workers being injured. Sunday, February 4, 2018, a double-double track (DDT) concrete hauling crane on Matraman Raya Street, Central Jakarta, collapsed. This accident even killed four project workers while a number of other workers were injured. The day after the DDT incident, the Soekarno Hatta Airport railroad track collapsed after heavy rains flushed the capital on Monday (5/2/2018) afternoon. Landslides and concrete piled up a car that was passing in the underpass under the train track. The incident caused one passenger of the car to die and another injured (https://tirto.id/cE4M).

The process of building a new Yogyakarta airport in Kulon Progo District or New Yogyakarta International Airport (NYIA) continues to accelerate. The document on the analysis of environmental impacts (Amdal) is still in the process of preparation. Airport development, has implications for productive land grabbing, settlement evictions, lost livelihoods at the site plan and at the location of supporting infrastructure. In fact, there was no study on tsunami risk reduction in the formulation of environmental impact (Amdal), so there is no guarantee of safety (Sandera, 2017). However, at the end the development of the New Yogyakarta International Airport (NYIA) continued without regard to the dangers or risks that would occur in the future. The NYIA development project is a strategic project which is able to attract the attention of ordinary people and show the project's performance can be calculated. However, the reality is inversely proportional and so far the performance of the project has not been maximized to be used because there are still many obstacles that have not been resolved.

In short, from the description above we can appeal a relationship between project acceleration and the risks that can occur. Then, the thesis topic "The Implication Risk-Impact of Project Acceleration on Pavement Runway Project" is proposed.

1.2. Research Question

Based on the description in the background, the problem that occurs in the project is the achievement of maximum infrastructure performance. Many documents and requirements that have not been met and unresolved social obstacles in the pavement runway project are capable of creating risks, so the formulation of the problems discussed in this study are:

1. How to identify risks caused by The Implication of Risk Level Project Acceleration on Pavement Runway Project?
2. How to analyze the risks caused by The Implication of Risk Level Project Acceleration on Pavement Runway Project?
3. How to maps the risks caused by The Implication of Risk Level Project Acceleration on Pavement Runway Project?
4. How to control or response the risks caused by The Implication of Risk Level Project Acceleration on Pavement Runway Project?

1.3. Research Objectives

Based on the problems that arise in the description, the objectives of this thesis is to determine the implication of project acceleration toward risk level.

1.4. Research Aims

1. To identify risks caused by The Implication of Risk Level Project Acceleration on Pavement Runway Project
2. To analyze the risks caused by The Implication of Risk Level Project Acceleration on Pavement Runway Project
3. To maps the risks caused by The Implication of Risk Level Project Acceleration on Pavement Runway Project

4. To control or response the risks caused by The Implication of Risk Level Project Acceleration on Pavement Runway Project

1.5. Limitation of the Research

Limitation of the problem on this research is just focusing to calculate the relationship between risk level and project acceleration and knowing the implication of that on the pavement runway project.

1.6. Writing Systematic

The systematic writing plan of the thesis proposal entitled The Impact of Project Acceleration on Pavement Runway Project consists of six chapters, are:

1. Introduction
2. Previous Research
3. Theories
4. Methodology Research
5. Result and Discussion
6. Conclusions and Suggestions

References

CHAPTER 2
LITERATURE REVIEW

2.1. Project Acceleration

Some definitions of project acceleration in English are project time acceleration, which means accelerating project time and project comperession, which means compacting project schedule (Clough et al. 2000; Gould & Joyce 1994). Both of these definitions can be interpreted directly and are easy to find an equivalent in Indonesian. While other terms in English are the least cost expediting and time cost trade off (Cloug et al. 2000). First definition concerns the basic word expidete which means accomplish (business quickly) (Pearsall, 1999). At least cost expediting means that the project is completed as soon as possible with the least cost. But also the term expediting in the world of the American construction industry also means sufficient time support for construction operations (Clough et al. 2000).

Than, the definition of time cost trade off can be interpreted freely that changes in time on this case the acceleration of project time will have an impact on the cost of project implementation both increase and decrease costs. But generally projects that are already critical in terms of schedules and have a lot of work activities will have a significant increase in cost when accelerated. This is in return (trade off) changes in time. There is also another definition, crashing, which means that it also shortens the total project time, resulting in one or several activities being shortened (Iould & Joyce 1994).

So that, project acceleration can be defined as a change in project schedule by shortening one or more activities, either sequential or non-sequential, which consequently shortens the total project implementation time as predetermined through an agreement between the service user and the construction service provider (Prihanantyo, 2013).

Speeding up the project completion time is an attempt to complete the project earlier than the completion time under normal circumstances. There are times when the project schedule must be accelerated with various considerations from the project owner. The process of speeding up this time period is called a crash program (Novitasari, 2014). The maximum of acceleration is limited by the area of the project or work site, but there are some factors to implement the acceleration of an activity, which includes increasing the number of workers, scheduling overtime, use of heavy equipment, and changing construction methods in the field (Frederika, 2010).

So that's why, contractor will arranges a project scheduling before starting the construction project. Although the schedule has been arranged, in reality in the field there are still often delays in project completion. Based on the above problems, of course the contractor will increasingly be demanded to be able to control the scheduling of the project so as to reduce the risk of project delays. In general, contractors use scheduling methods that can reduce project completion times faster and also lower project completion costs (Stefanus Et. all, 2017).

2.1.1. Crash Analyze Program Method

Crash program is one way to speed up the project completion time, is by reducing the completion time of activities that are on the critical path that will affect the project completion time. The work that is on the critical path is the work of couples and painting in building B. The acceleration of the completion of the Dewarna Hotel Phase II Bojonegoro Project is carried out using overtime hours. (Stefanus Et. all, 2017).

Work plan that will be carried out in accelerating the completion time of an activity using the overtime method, are :

1. Normal activities use 8 hours of work and 1 hour of rest (08.00-17.00 WIB), while overtime is done after normal working time for 4 hours per day (18.00-22.00 WIB). Overtime labor is the same as regular workforce.
2. The price of the worker's wages for overtime work is calculated twice the hourly wage at normal work time.
3. Productivity for overtime is calculated at 60% of normal productivity. This decrease in productivity is due to fatigue, limited vision at night and cooler weather conditions.

The process of crashing is a way of estimating the variable costs in determining the reduction in the maximum duration with the most economical costs of activities that are still possible to be reduced (Ervianto, 2004). Crashing is completely done by crossing time and costs by increasing the number of work shifts, the number of hours worked, the amount of labor, the amount of material availability and using more productive equipment and faster installation methods as a component of direct cost. The method is done by improving scheduling using network planning which is on a critical trajectory. The consequence of crashing is the increase in direct costs such as the cost of workers' wages and the addition of equipment (Husein, 2011).

The addition of resources to crash will makes the direct cost component increase. As for the indirect cost component, because the duration of work is shortened the indirect cost component will decrease. In theory, the increase in the direct cost component can be offset by a decrease in the indirect cost component. However, for real projects in the field, the components of direct costs and indirect costs are very far adrift. So the decrease in the indirect cost component will not have much effect on the increase in the direct cost component (Wibowo, Et. all, 2016).

Every activity in the critical path of the project is analyzed by increasing the direct cost and indirect cost components. To find out the increase in costs from each activity. After the cost increase is known, each activity can be searched for the cost slope value. The value of cost slope shows the increase in cost per day from each activity. From the value of the cost slope, the work to be accelerated is determined. Work indicators that can be chosen to be accelerated are jobs with the lowest cost slope value. Because the value of the smallest cost slope interprets the smallest cost increase (Wibowo, Et. all, 2016).

After the all data are collected from both the time variable and the cost variable, crashing can be done. The steps of crashing are as follows (Wibowo, Et. all, 2016):

1. From the S Curve, the activity components are arranged according to the logic of dependency. After that the scheduling is done using the Critical Path Method (CPM) to find out the critical and non-critical trajectories of some of the activities in the construction project. Figure 2.1 shows the shape of the S curve of the project being reviewed. From this curve the researchers reviewed the biggest project delay, namely in April 2014 in the fourth week (Wibowo, Et. all, 2016).

No	Item Pekerjaan	Durasi										
			Mar-14	Apr-14				May-14				
		Bobot	IV	I	II	III	IV	I	II	III	IV	V
A	Pekerjaan DED	1.104%	0.939%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%	0.002%
B	Pekerjaan Site Legal Permit	1.988%	1.689%	0.004%	0.003%	0.003%	0.003%	0.003%	0.003%	0.003%	0.003%	0.003%
C	Pekerjaan Sub Structure	15.106%			0.174%	0.174%	0.174%	0.174%	0.174%	0.174%	0.174%	0.174%
D	Pekerjaan Struktur Bawah	11.752%										
E	Pekerjaan Struktur Atas	41.099%										
F	Pekerjaan Preminalis Arsi	2.005%										
G	Pekerjaan Arsitektur	17.249%										
H	Pekerjaan MEP	0.769%										
I	Pekerjaan Other Facilities	1.161%										
J	Pekerjaan Façade	7.766%										
	Total	100.000%										
	Rencana		2.628%	0.005%	0.180%	0.180%	0.180%	0.180%	0.180%	0.180%	0.180%	0.180%
	Komulatif Rencana		2.628%	2.634%	2.813%	2.993%	3.[illegible]	3.352%	3.531%	3.711%	3.891%	4.070%
	Realisasi Progress		2.022%	2.022%	2.022%	2.022%	2.022%	2.389%	2.770%	3.286%	3.571%	4.047%
	Selisih Realisasi-Rencana		-0.606%	-0.611%	-0.791%	-0.971%	-1.150%	-0.963%	-0.762%	-0.425%	-0.319%	-0.023%

Figure 2.1. S Curve

Based on the S Curve above, scheduling with CPM is then formed. So that the network diagram is formed as in Figure 2.2. The thick lines in the figure indicate the critical path, whereas for thinner lines the non-critical path. The normal total duration of structural work on the 7th Floor to the Roof Level (RL Floor) after forward and backward calculation of the flow rate is 203 days. If the delay is not resolved, the duration of the work will be 215 days (Wibowo, Et. all, 2016).

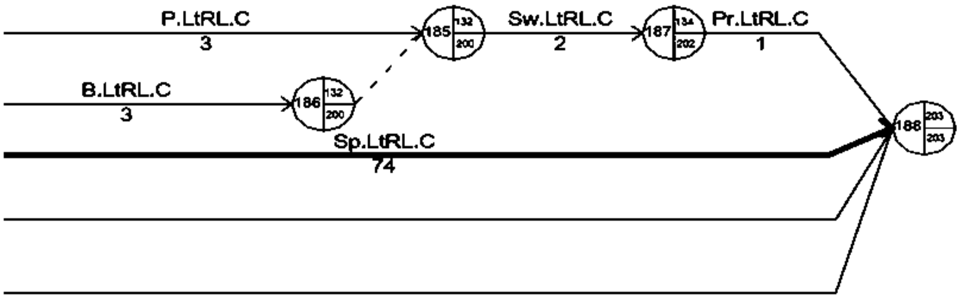


Figure 2.2. *Critical Path Method* (CPM) Normal Duration

2. Crashing speeds up the work of columns that are in critical paths (Scenario 1). Each column work for each zone on each floor is accelerated by 1 day. As shown in Figure 2.3, the thick lines in the figure indicate the critical path, whereas for thinner lines the non-critical path. The total duration of acceleration in Scenario 1 is 191 days or accelerates the overall duration by 12 days.

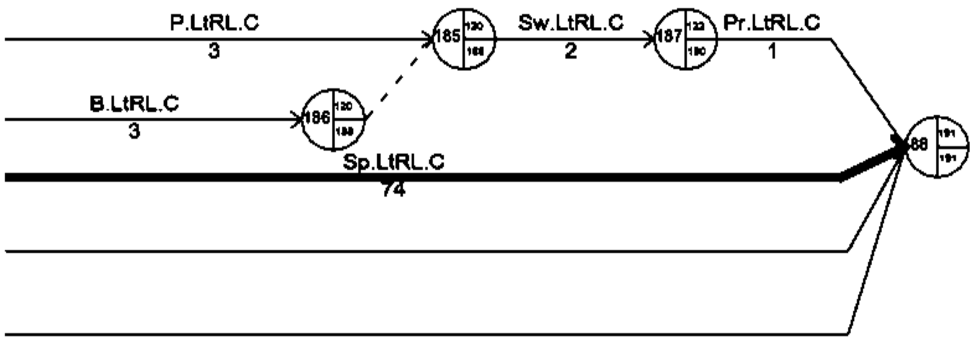
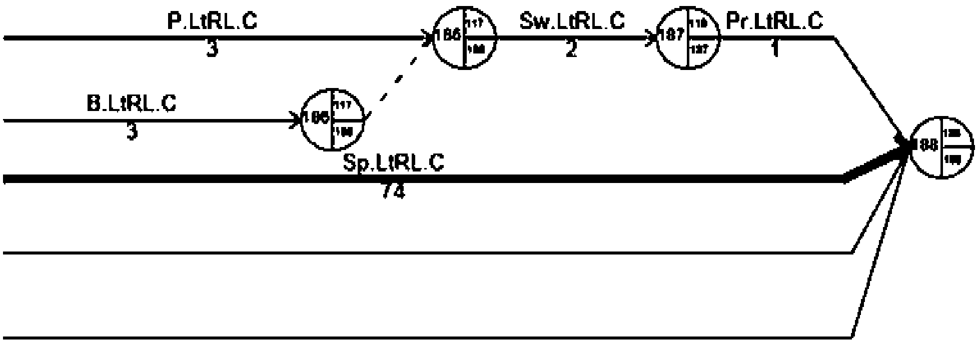


Figure 2.3. *Critical Path Method* (CPM) Scenario 1

3. Calculate the direct cost, indirect cost, and total cost under normal conditions and crashing conditions on column work on critical paths.
4. Speed up the work of floor plates and beams found in critical paths (Scenario 2). Each floor plate and beam work for each zone on each floor is accelerated by 1 day. As seen in Figure 2.4, the thick lines in the figure indicate the critical path, whereas for thinner lines the non-critical path. The total duration of acceleration in Scenario 2 is 188 days or accelerate the overall duration by 15 days.



2.4. *Critical Path Method* (CPM) Scenario 2

5. Calculate the direct cost, indirect cost, and total cost under normal conditions and crashing conditions on floor slabs and beams found on critical paths.
6. Speed up the work of columns, floor plates and beams found in critical paths (Scenario 3). Each column, floor plate and beam work for each zone on each floor is accelerated by 1 day. As seen in Figure 2.5, the thick lines in the figure indicate the critical path, whereas for thinner lines the non-critical path. The total duration of acceleration in Scenario 3 is 176 days or accelerates the overall duration by 27 days.

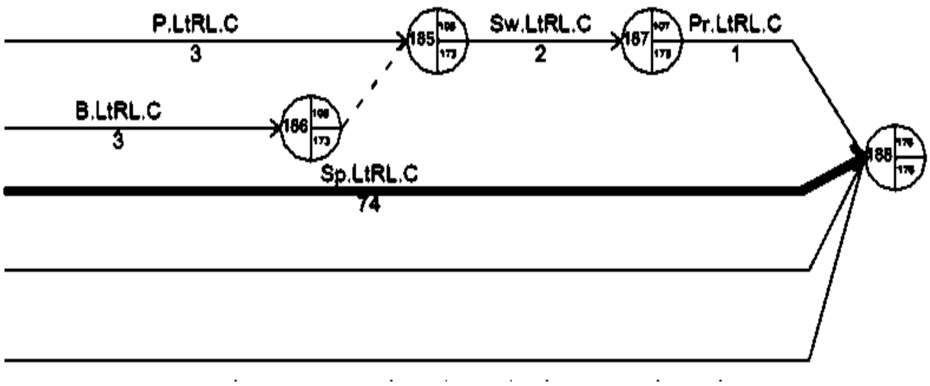


Figure 2.5. *Critical Path Method* (CPM) Scenario 3

7. Calculate the direct cost, indirect cost, and total cost under normal conditions and crashing conditions on column work, floor plates and beams found on critical paths.

8. Simulate on the comparison chart between time and cost to find the most optimum point so that the fastest work duration with the optimal cost is obtained.

2.1.2. Crash Duration Calculation

2.1.2.1. Crash Duration

In preparing a construction project schedule it is usually not directly produced an ideal schedule, one of the goals of drafting a schedule is to produce a realistic schedule based on reasonable estimates. Many times the determination of the duration of a project is determined by the project owner without considering the type of activity and the complexity of the work. This makes the schedulers make adjustments in the duration of each job in order to meet the demands of the project owner, so that it can produce inefficient and sometimes unreal schedules, such as shifts in work performance, overtime work or mobilizing workers in large groups (Oetomo, Et. all, 2017).

The process of crashing is to reduce a job that will affect the project completion time. Crashing is a deliberate, systematic and analytic process by testing all activities in a project that are focused on activities that are on a critical path. The process of crashing by estimating variable costs in determining the maximum and most economical duration reduction of an activity that is still possible to be reduced (Oetomo, Et. all, 2017).

In carrying out a construction project activity there are various jobs, especially in building projects these types of activities can reach tens, hundreds or even thousands of activity items. Activities in a project can be accelerated in various ways (Ervianto, 2004), are:

1. Hold a work shift. Divide the number of workers into several groups that work alternately, which aims to minimize the decline in the ability of labor due to overtime work.
2. Extend working time (overtime) Overtime work is the addition of hours worked from the time specified for each day. Calculation of overtime wages in Indonesia refers to the decree of the Minister

of Manpower No: KEP-72 / MEN / 84 concerning the basis of overtime pay.

3. By using more productive tools.
4. Increase the number of workers. By increasing the number of workers, the implementation time will be shorter. Things to consider, are:
   a. Project land capacity to accommodate a number of workers.
   b. Worker productivity, for the value of productivity can be obtained from experience.
   c. Effectiveness in labor inspection.
   d. Workforce security.
   e. Labor costs.

   The amount of labor is closely related to the value of labor productivity to match the time required (Ervianto, 2004).
5. By using materials that can be used faster. Things to note, are:
   a. Productivity of these additives.
   b. Whether or not experts need to handle the tool.
   c. Prices, costs and maintenance.
6. Use other construction methods that are faster.

If the method being carried out is less efficient, then changes to the method of implementation can also be done as a solution so that work can be done more quickly and in line with expectations.

2.2. Factors of Project Acceleration

Project acceleration is identical to response riks in management riks. It's just that the risk that has occurred, aspects that need to be done is based on priority if there are quite a lot of factors causing delays. With the special characteristics of construction projects and the causes of project delays. So the factors that influence the acceleration of construction projects (Prihanantyo, 2013).

2.2.1. Managerial

Managerial is the part that coordinates activities in order to achieve the organization's goals or objectives. The function of managerial itself is planning (planning), organizing (organizing) and directing (directing). The influential factors are as follows (Prihanantyo, 2013):

1. The critical path must be communicated and agreed upon by the project team.
2. Maintain the discipline of the project team.
3. Conduct daily meetings that discuss everything related to efforts to ensure that the project can be completed according to a predetermined schedule.
4. Actively digging information about potential problems to subcontractors and foremen.
5. Perform regular updates on the critical path (CPM)
6. Always provide the best motivation for employees and workers.
7. Maintaining the quality of work in order to avoid repetition of work.
8. Ensuring the availability of funds and matching funds for emergencies.
9. Give rewards for achieving each milistone stage
10. The project team must focus on safety.

2.2.2. Scopes of Work

The scope of project work is a reference to all work included must be done in order to produce the project product, along with the processes carried out to make the product in question. The influential factors are as follows (Prihanantyo, 2013):

1. Make a checklist of the remaining jobs (WBS update).
2. List the remaining work by looking through the contract documents thoroughly.
3. Like the picture, BQ, and specifications.
4. Minimizing changes in scope and added-or-less work.

2.2.3. Critical Path Method (CPM)

Critical path method (CPM) or critical path analysis is a mathematical based algorithm for scheduling a group of project activities. CPM is one of the most important tools for project management. The influential factors are as follows (Prihanantyo, 2013):

1. Make a schedule of the rest of the work where the target completion of the work is made more advanced to anticipate unexpected events.
2. Creating a CPM based on a WBS update that is quite detailed and schedules the rest of the implementation.
3. Prioritize work that falls into the critical work path.
4. Reduce as much as possible the amount of critical work contained in the series of critical work paths (CPM).
5. Combining two or more jobs in the critical path to only 1 critical work.
6. Reducing the duration of work that is on the critical path.
7. Determine work milestone targets.

2.2.4. Material dan Supplier

Material is one component of direct costs for project implementation which is the largest part of all project costs. The percentage of material usage is the largest composition of the total project cost which consists of 20-25% bulk material (Ritz, 1994). So that in handling in the field there needs to be a supplier who is able to supply materials that are in accordance with the needs and the required quality. The influential factors are (Prihanantyo, 2013):

1. Check directly the location of material to be sent to the project.
2. The number of suppliers for a type of material is more than one.
3. Replacing imported materials with ready stock materials with equivalent specifications.
4. Replace rare materials with ready stock materials with equivalent specifications.

2.2.5. Tools

Equipment requires a cost of 20-25% of the total project cost which is the cost of renting and purchasing construction equipment needed in the execution of work (Ritz, 1994). The influential factors are (Prihanantyo, 2013):

1. Replace inappropriate or unsuitable tools.
2. Increase the number of tools to meet the implementation needs.
3. Replacing tools that have a larger capacity.

2.2.6. Subcontractor

A subcontractor is a contractor who receives work from a larger contractor but is still under construction work. The influential factors are (Prihanantyo, 2013):

1. Reducing the scope of work of problematic subcontractors and replacing them with trusted subcontractors.
2. Taking over subcontractor work that is potentially late.
3. The number of subcontractors is more than one.
4. Each subcontractor places a representative who can decide the problem.

2.2.7. Labor

Labor factors greatly affect the speed or speed of a construction project. In the implementation of construction projects, the preparation and provision of human resources (workers) are the main factors that are very dominant in realizing the shape of the building being built. The influential factors are (Prihanantyo, 2013):

1. Replacing less productive workforce with more productive workforce.
2. Increase working hours or overtime.
3. Actively monitoring labor discipline.
4. Workers deployed to the work area in such a manner can still be properly monitored by the contractor.

2.2.8. Desaign and Framework

Design is the most important thing in the construction of a construction project because from there, what is on paper will be realized in a real way, so a design must be really clear and precise. The method of implementation is no less important than design because it determines whether or not the construction of a construction project is appropriate. The influential factors are (Prihanantyo, 2013):

1. Actively finding new methods of implementation that are more efficient and effective.
2. Actively evaluating existing implementation methods.
3. Review designs so that critical work volume is reduced.

2.2.9. Contract

In construction projects, contracts are documents that must be obeyed and implemented jointly between parties who have agreed to be mutually bound. So the contract must be read in earnest to minimize the occurrence of mistakes caused by not in accordance with what is in the contact itself. The influential factors are (Prihanantyo, 2013):

1. Renegotiate the contract if the cause of the delay is due to the contract.
2. Take notes daily and document the things that cause delays and convey to the owner.

2.2.10. Location or Site

Site or location is the location of the building placed or built in a place. The importance of knowing the situation sit or location is to identify and record data needed for the benefit of the design process and construction process. Data collection must be able to represent the actual field conditions / project location. Buildings around the project site that are expected to affect the construction process in the field must also be noted. The influential factors are (Prihanantyo, 2013):

1. Evaluate the site and its arrangement.

2. Identify any problems at the site that can obstruct the flow of processes and materials.
3. Reducing puddles due to rain.
4. Ensuring project access so that material in and out is not obstructed.

2.3. Risk Management

Risk is a measure of future uncertainty about what can affect objectives within the limits set by cost, time frame and performance (DOD, 2006). Risk doesn't mean only events or events that are not desirable, but also how likely and likely the consequences will occur (Modarres, 2006). Risk is the center of innovation, but in order to be both theoretically interesting and practical in use, the relationship between risk and innovation needs to be investigated in more specific situations (Berglund, 2007). Project risk is an uncertain event or condition, if it occurs has a positive or negative effect on one or more project objectives such as scope, schedule, cost and quality. Risk may have one or more causes and if it does, there may be one or more effects. The cause may be needs, assumptions, constraints or potential conditions that are likely to have negative or positive results (PMBOK 2013).

Project risk management includes the process of carrying out risk management planning, identification, analysis, response planning, and risk control for a project. 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 in the project (PMBOK, 2013). Risk management as a series of interconnected processes involving special techniques and tools (PMI, 2008, Keelling, 2006). Risk management can be defined as *"the systematic application of management policies, procedures and practices to the tasks of communicating, consulting, establishing the context, identifying, analyzing, evaluating, treating, monitoring and reviewing risk"* (ISO/IEC Guide 73, 2002). Six risk management processes such as risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning, and risk monitoring (PMI, 2008). There are some types of risks in construction projects (Flanagan dan Norman, 1993) consists of:

1. Completion that fails according to a predetermined design / determination of construction time.
2. Failure to obtain planning drawings, planning / permit details with available time
3. Unexpected soil conditions
4. Very bad weather
5. Labor strikes
6. Unexpected price increases for labor and materials
7. Accidents that occur at the location that causes injury
8. Damage caused to the structure due to poor work methods
9. Unexpected events (floods, earthquakes, etc.)
10. Claims from contractors due to loss and costs due to production delays due to design details by the design team
11. Failure to complete the project with a predetermined budget.

There are some steps or research methods to implement comprehensive risk management that must be carried out by a company such as risk identification, risk measurement (risk assessment), risk mapping and risk control, or often referred to as risk response (Fahmi, 2010).

2.3.1. Risk Identify

On identifying a risk, it is done by looking at potential risks that have been seen and will be seen. Then, proceed with classifying each potential risks that can occur as shown below (Fahmi, 2013).

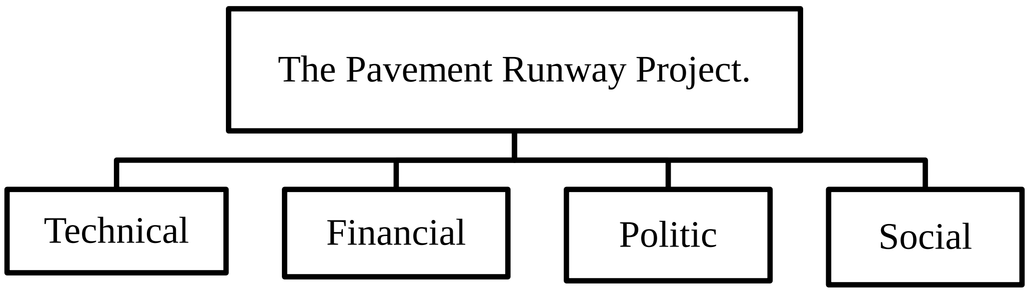


Figure 2.6. Risk Identification Chart

2.3.2. Risk Measures (Risk Assessments)

In a risk measure, the data collected both qualitatively and quantitatively based on a methodological approach are processed according to a predetermined scale. The table that explains the probability scale and the impact that will occur, below (Fahmi, 2013).

Table 2.1. Scale of Probability

No.	Rating			Quantitative Criteria	Qualitative Criteria
	Name	Code	Value		
1.	Very Small	VS	1	Chance to occur <10%	Tend not likely to occur
2.	Small	S	2	10% <probability of occurrence <40%	Small chance of happening
3.	Medium	M	3	40% <probability of occurrence <60%	Equally likely to occur & not happen
4.	Large	L	4	60% <probability of occurrence <80%	Possible happen
5.	Extra Large	XL	5	80% <probability of occurrence <95%	Very possible / certain

Table 2.2. Scale of Impact

No.	Rating			Criteria	
	Name	Code	Value	Target deviations	Impact of loss value
1.	Very Light	VL	1	0% < deviation < 2%	Doesn't mean
2.	Light	L	2	2% < deviation < 5%	Influences internal areas
3.	Medium	M	3	5% < deviation < 10%	Affect the external area
4.	Heavy	H	4	10% < deviation < 15%	Influence on core business & assets

5.	Exstrem	E	5	Deviation > 15%	Influence on main assets & reputation

Table. 2.3. Criteria of Probability

Scale	Probability	Impact
Very Small	Almost impossible	Small impact
Small	Sometimes happens	Small impact on cost, time and quality
Medium	Maybe not happens	Moderate impact on cost, time and quality
Large	Very possible	Substantial impact on cost, time and quality
Extra Large	Almost certainly happening	Condemning the success of the project

Table.2.4. Criteria of Impact

Impact	Cost	Time	Quality
Very Light	A fund sufficient	Some deviated from the target	The quality is some reduced but can still be used
Light	Requires additional funds	Some deviated from the target	Failed to satisfy appointment
Medium	Requires additional funds	Delays have an impact on stakeholders	Some functions can't be utilized
Heavy	Requires a significant additional funds	Failed to satisfy the deadline	Failed to satisfy overall needs
Exstrem	Requires substantial funds	Delay damages the project	Projects are ineffective and useless

2.3.3. Risk Analysis

In analyzing each alternative, it is done by presenting the point of view and the effects or impacts that may arise. Impacts that may arise both in the short term and long term put forward in a comprehensive and systematic manner are useful for assertiveness so that effective decision making. As for the table that explains the relationship between the scale of the impact and the probability scale where R has the meaning of low risk, M has the meaning of medium risk and T has the meaning of high risk (Fahmi, 2013).

Table 2.5. Risk Analysis Level

		Scale of Impact				
		Very Light (VL)	**Light (L)**	**Medium (M)**	**Heavy (H)**	**Very Heavy (VH)**
Scale of probability	**Very Small (VS)**	**L**	**L**	**L**	**L**	**M**
	Small (S)	**R**	**R**	**M**	**M**	**H**
	Medium (M)	**R**	**M**	**M**	**H**	**H**
	Heavy (H)	**R**	**M**	**M**	**H**	**H**
	Very Heavy (VH)	**M**	**M**	**H**	**H**	**H**

2.3.4. Risk Maps

In deciding an alternative, it is done by describing or explaining both in oral and written form by the project management regarding alternative decisions that can be taken or used. Project management is needed that understands specifically and deeply to be able to take an alternative decision that is appropriate (Fahmi, 2013).

In implementing the chosen alternative, the project manager is resolute to implement this. The project management is able to issue a decree (SK) which is equipped with various cost details. Details of these costs have been approved by the financial department or the authorized part in this case (Fahmi, 2013).

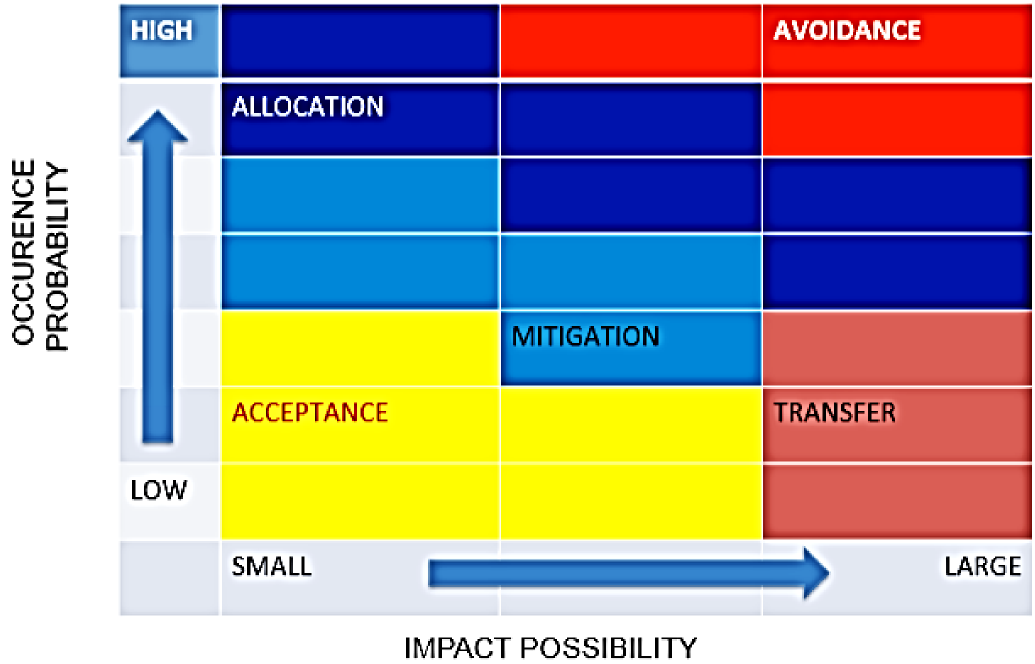


Figure 2.7. Risk Maps

2.3.5. Risk Control (Risk Response)

In controlling the chosen alternative, the main task of the project manager is to exercise maximum control in order to avoid the emergence of various unwanted risks. In this case carried out by the management team and the project manager (Fahmi, 2013).

In evaluating the alternatives chosen, the project management team reports to the project manager. The report takes the form of fundamental and technical data. This is done aiming for the work to be carried out in accordance with what has been planned.

Table 2.6. Risk Response

No.	Risk	Risk Level	Risk Response	Risk Response Strategy	Responsible Party
1.	Politic				
a.	Changes in government policy	4	Mitigate	Coordination meeting between owner and contractor	*Owner* & Contractor
b.	Change of job directors	9	Transfer	Coordination meeting between the new directors and the contractor / owner	*Owner* & Contractor
c.	Gangsterism	4	Mitigate	Control of the project situation on the surrounding environment	Contractor
d.	Regional head election	8	Transfer	Control of the project situation to the community	Contractor
e.	Adipura Assessment	10	Transfer	Control of the project situation on the scope	Contractor

2.4. The Factor Affects The Risk

Risk is a variation in things that might occur naturally in a situation (Fisk, 1997). No one will ever know when a risk will occur. Therefore, risk can also be interpreted as the probability of an event occurring over a period of time (Society, 1991). From these definitions and views, risk can be associated with probability because risk is never known with certainty the existence and time of occurrence.

Table 2.7. Factors that Caused by Risk

No	Factor	Factors Resources	Sub Factor
1	Natural Risk (X_1)	1,4,6,8	Natural disasters (X1-1) Bad Weather (X1-2) Fire (X1-3) Environmental damage (pollution and waste) (X1-4)
2	Design Risk (X_2)	1,6	Difficulties using new technology (X2-1) Differences in specifications and images (X2-2) Change in field conditions (differing site condition) (X2-3)
3	Resource Risk (X_3)	1,2,3,6,8	damage / delays / loss of material (X3-1) damage / delay / loss of construction equipment (X3-2) Unavailability of needed labor (X3-3)
4	Risk Financial (X_4)	1,2,6,8	Project cash flow failure (X4-1) Change in currency values (X4-2) Inflation (X4-3) Incorrect / low cost estimate (X4-4)
5	Legal and Regulatory Risks (X_5)	1,2,6,8	Difficulties in licensing regulations / construction Non-compliance with legal conditions / requirements regulations (X5-2) Disputes between parties involved in the contract (X5-3)
6	Construction Risk (X_6)	1,4,6	Low quality (X6-1) Low productivity (X6-2) Low occupational health and safety on site project (X6-3) Labor strike (X6-4)

2.5. Relationship Between Project Acceleration and Risk of Construction Failure

Calculate the cost of accelerating construction projects not only with direct and indirect costs of the project. Working under pressure creates an environment that increases the likelihood of mistakes and repeats the job. Speeding up the project means more work on the critical path and reducing project floating time. Thus, the project risk will increase. Calculating the increased risk due to project acceleration has not been investigated. The most popular method for accelerating projects with minimum costs is the Time-Cost-Trade-Off method.

This method shows the direct cost-time curve for each activity. This method does not consider the effects of changing project risk. This article proposes a method that works with Time-Cost-Trade-Off to estimate the increase in project risk with respect to accelerating project time. This method uses Total Float (TF) of non-critical activities as an indicator to change project risk. Illustrative examples have been used to show the proposed method (Khalid, 2013).

2.5.1. Factors of Project Acceleration

There are many conditions where the owner or contractor is needed to accelerate the project. The five factors that influence it, are (Khalid, 2013):

1. To realize incentive payments related to project completion before a certain date.
2. To shorten the project schedule to match the time determined by the contract. This reason can be influenced by the bid price.
3. To make up for the time from procrastination to avoid paying compensation. Getting it done on time can affect the company's relationship and reputation.
4. To complete the project early and move to another project. Although the profits determined by the work can be reduced, as a result the company profile can increase.
5. To complete the project when weather conditions make the offer price cheaper. For example, avoid temporary heating; avoid completing site work during the rainy season.

Dealing with the first three reasons it's easy to define income per day. However, the situation for the last two reasons may be difficult to determine income per day.

2.5.2. Crashing The Duration of Activity Method

When making a decision to speed up a project, the contractor has many ways to speed up an activity. Each method has negative side effects. The five of them, are (Khalid, 2013):

1. Labor work overtime. This increases labor costs because it increases wage rates and decreases productivity.
2. Bring additional workers to increase the work team. This increases labor costs due to overcrowding and poor patterns.
3. Using more advanced equipment. This will usually add to the costs due to rental and transportation costs. If labor costs (per unit) are reduced, this can reduce costs.
4. Add subcontract workforce to activities. This almost always increases the cost of an activity unless the subcontracted workforce is far more efficient.
5. Rescheduling the project. This will usually add to the costs of mobilizing project equipment and materials.

When making a decision to shorten project duration, costs will be affected by compressed work. The five cost claims for acceleration are (Levin, 1998):

1. Additional labor, equipment, materials (purchase and / or delivery), supervision, and the head of the foreman.
2. Reduction in efficiency due to increased workforce.
3. Interruption of the schedule designed for equipment, labor, and optimal utilization of overhead.
4. Overtime (and the accompanying inefficiencies) and quality of time.
5. Stacking of work.

One of method for calculating inefficiency costs is to compare unit costs with acceleration and unit costs without acceleration. Another method that is sometimes used to calculate price inefficiencies, especially for upfront price claims, is to implement statistical data (Khalid, 2013).

2.5.3. Acceleration That Related to The Risk

Acceleration can be defined as the action taken by a contractor to accelerate progress on a task to have an initial completion or to make up for lost time (Levin, 1998). Acceleration can be directed by the owner to compensate for the delay that is the responsibility of the owner, the acceleration of the owner. Another name for this type of acceleration is the acceleration ordered or ordered where the owner expressly directs the contractor to speed up work. The contractor also has the right to complete earlier by allocating more resources or by making changes in project implementation according to the 'facilities and methods' rights specified in the contract, the acceleration of the contractor.

An alternative name for contractor acceleration is voluntary acceleration in which the contractor, on his own initiative, seeks to overcome his own delays or complete activities earlier than planned (Levin, 1998). The third type of acceleration is scheduling acceleration. No one is responsible for this type of acceleration. For examples, accelerate scheduling are improved weather conditions and the arrival of initial material to the location. So, neither the owner nor the contractor pays money for this acceleration (Gahtani, 2006).

In all cases of acceleration, the contractor makes reasonable efforts to accelerate and incur additional costs. However, there is another type of acceleration called constructive acceleration in which activities are accelerated by the contractor to complete the work according to the planned schedule where the delays that have been understood have occurred but no extension of time is given, as shown in Figure 2.8. This type of acceleration is difficult to define its responsibilities. In general, accelerating the critical path provides credit to those who bear acceleration costs to minimize prior delays in the schedule. At any time, the contractor must know from the adjusted schedule how much he has delayed the project so far and how to speed up the project for his benefit. The contractor must manage the project in a way that does not affect him later when analyzing late claims (Khalid, 2013).

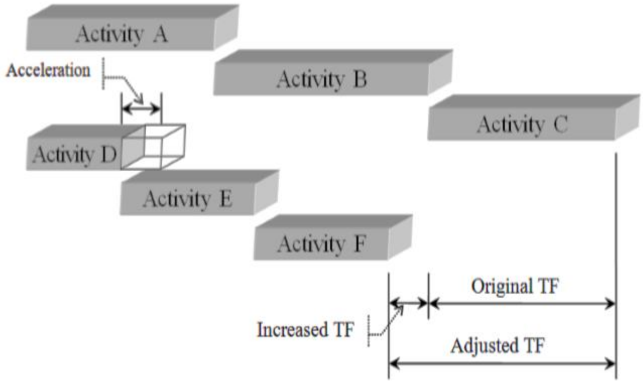


Figure 2.8. Increase Total Float of Non-Critical Paths

Float is another problem related to project acceleration. This is reduced as a result of accelerating the critical path as shown in Figure 2.9, which causes an increase in project risk (Gahtani, 2006). As a result, those who carry the contract risk will suffer as a result. Acceleration does not only affect the critical path, but also the noncritical pathway. If acceleration occurs in the noncritical pathway, additional TF will result from successor activity on the same path. This increase in floating time has an impact on reducing project risk. Figure 2.10 shows how floating time can increase the resultant from accelerating noncritical pathways. Although accelerating noncritical activities does not produce significant results in accelerating projects, it can be used as a contracting tactic to provide additional floating time to replace noncritical activities that have large uncertainties in their time which in turn can delay the project.

However, many studies have shown that how to spend floating time has a direct impact on overall project risk in terms of cost and time (Khalid, 2013). Consumption of total unplanned float can actually increase the cost of noncritical activities, and increase the likelihood of project delays. It is well known in the field of construction management that it is easy to use floating time at the start of a project, only left with a real challenge to manage that time at a later stage of the project (Gong dan Rowings, 1995) and updated by (Gong, 1997) recognizes the increased risk of schedule overruns caused by the use of total float that follows a parabolic curve similar to Figure.2.11 (Gong dan Rowings, 1995). Studies show that project costs can be increased if Total Floats are consumed up to a certain point.

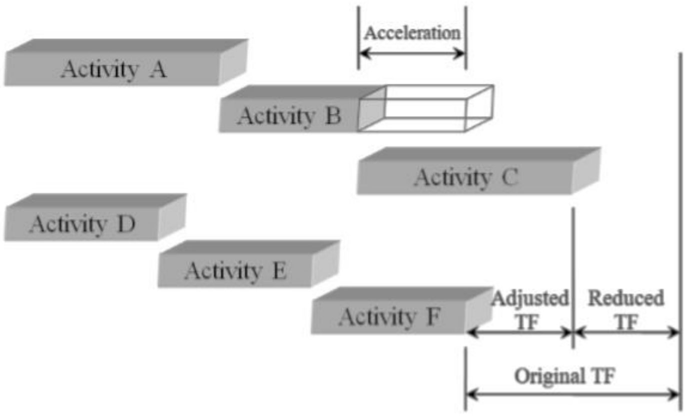


Figure 2.9. Results of Total Float Reduction in Critical Paths

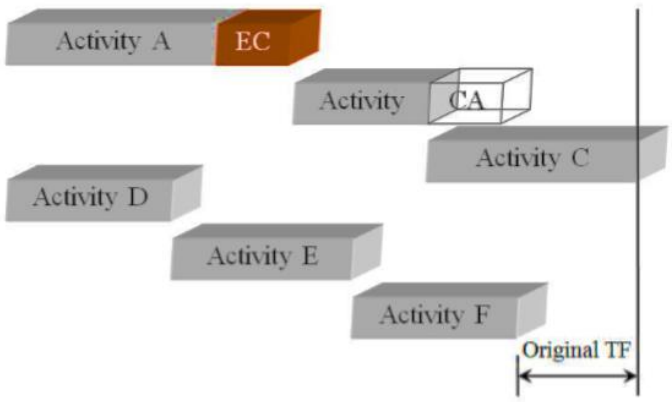


Figure 2.10. Constructif Acceleration

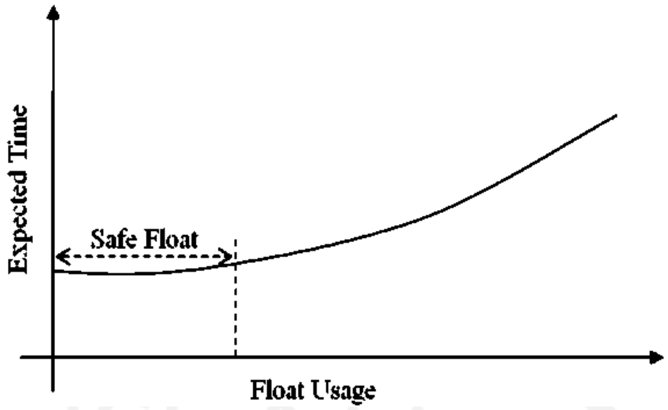


Figure 2.11. Float Reduction Affects Expected Project Time

The contractor has the option to start activities A, C, and B because they have a lower risk ratio. However, it is up to the contractor to consider risks with a minimum cost slope to choose which activities to accelerate. In this model, the increased risk becomes separate from the minimum cost slope because it depends on the contractor to consider the risk factor or accelerate the project based on minimum direct costs only. In other words, the contractor may or may not want to pay money to reduce project costs (Khalid, 2013).

A method that may be permited for calculating the increased risk associated with project acceleration was developed in this paper. This method is a trial to estimate the increase in project risk in every acceleration in the project schedule. This increased risk can be significant if the project is in conflict between the project team and the risk value is high. From the perspective of project control, the party responsible for the project risk must track any changes to the project risk from the increase or reduction and completion of the obligations during the project (Khalid, 2013).

CHAPTER 3
THEORETICAL FRAMEWORK

3.1. Acceleration Simulation on Project Duration

Project is a complex business activity, is not routine, has limited time, budget and resources and has its own specifications for the products to be produced. With the limitations in working on a project, then a project organization is needed to manage the available resources in order to carry out synchronous activities so that project objectives can be achieved. Project organization is also needed to ensure that work can be completed in an efficient, timely and in accordance with the expected quality.

Efforts or activities organized to achieve important goals, objectives and expectations using budget funds and available resources, which must be completed within a certain period of time (Nurhayati, 2010). A series of tasks directed at a main outcome (Heizer dan Render, 2006). A project is a temporary effort to produce a unique product or service. In general, the project involves several people who are interconnected with their activities and the main sponsor of the project is usually interested in the effective use of resources to complete the project efficiently and on time (Schwalbe translated by Dimiyati and Nurjaman, 2014).

Next, definition of time cost trade off can be interpreted freely that changes in time in this case the acceleration of project time will have an impact on the cost of project implementation both increase and decrease costs. But generally projects that are already critical in definition of schedules and have a lot of work activities will have a significant increase in cost when accelerated. This is in return (trade off) changes in time. There is also another definition, crashing, which means that it also shortens the total project time, resulting in one or several activities being shortened (Iould & Joyce 1994). Then, project acceleration can be defined as a change in project schedule by shortening one or more activities, either sequential or non-sequential, which consequently shortens the total project implementation time as predetermined through an agreement between the service user and the construction service provider. (Prihanantyo, 2013).

In this research in accelerating the duration of work using assumptions where the normal duration is 100% 14 weeks and just focus on the duration of the assumption is 50% or 7 weeks. The step to calculate the project acceleration simulation in this study is to calculate the percentage of assumptions with the duration of the pavement runway work per week.

In this research to find the percentage of project acceleration simulation assumptions obtained from the following formula:

RW	d (weeks)
Normal 100%	14
Assumption 50%	A

1. Asumtion 50% = 50% × d_{normal} ……………………………………(1)

Where:

RW = is a variable of percentage simulation on normal duration and asumtion duration.

d = is a duration (weeks).

3.2. Risk Management Research Method

3.2.1. Risk Identify

In identifying a risk, it is done by looking at potential risks that have been seen and will be seen. Then, proceed with classifying each potential risks that can occur as shown below (Fahmi, 2013).

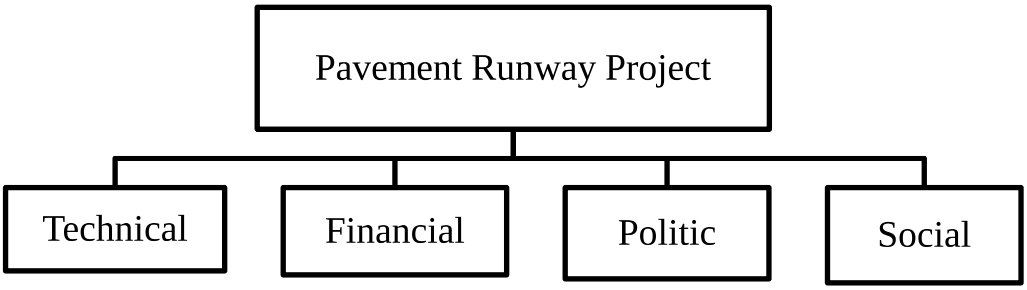


Figure 3.1. Risk Identify Flow Chart

3.2.2. Risk Measurement (Risk Assessment)

In a risk measure, the data collected both qualitatively and quantitatively based on a methodological approach are processed according to a predetermined scale. The table that explains the probability scale and the impact that will occur, below (Fahmi, 2013).

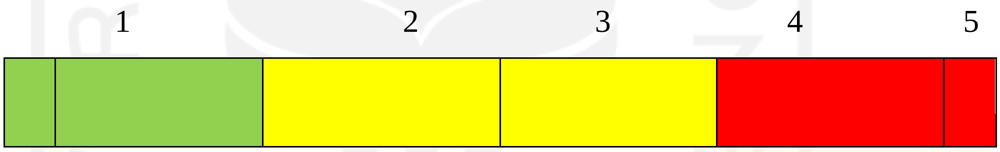


Figure 3.2. Scale of Probability Rating

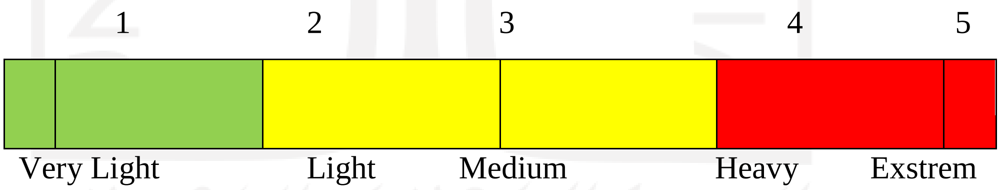


Figure 3.3. Scale of Impact Rating

Table 3.1. Scale of Probability

No.	Rating			Quantitative Criteria	Qualitative Criteria
	Name	Code	Value		
1.	Very Small	VS	1	Chance to occur <10%	Tend not likely to occur
2.	Small	S	2	10% <probability of occurrence <40%	Small chance of happening
3.	Medium	M	3	40% <probability of occurrence <60%	Equally likely to occur & not happen
4.	Large	L	4	60% <probability of occurrence <80%	Possible happen
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No.	Rating			Criteria	
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3.2.3. Risk Analysis

In analyzing each alternative, it is done by presenting the point of view and the effects or impacts that may arise. Impacts that may arise both in the short term and long term put forward in a comprehensive and systematic manner are useful for assertiveness so that effective decision making. As for the table that explains the relationship between the scale of the impact and the probability scale where R has the meaning of low risk, M has the meaning of medium risk and T has the meaning of high risk (Fahmi, 2013).

Table 3.5. Risk Analysis Level

		Scale of Impact				
		Very Light (VL)	**Light (L)**	**Medium (M)**	**Heavy (H)**	**Very Heavy (VH)**
Scale of probability	**Very Small (VS)**	**L**	**L**	**L**	**L**	**M**
	Small (S)	**L**	**L**	**M**	**M**	**H**
	Medium (M)	**L**	**M**	**M**	**H**	**H**
	Heavy (H)	**L**	**M**	**M**	**H**	**H**
	Very Heavy (VH)	**M**	**M**	**H**	**H**	**H**

3.2.4. Risk Maps

In deciding an alternative, it is done by describing or explaining both in oral and written form by the project management regarding alternative decisions that can be taken or used. Project management is needed that understands specifically and deeply to be able to take an alternative decision that is appropriate (Fahmi, 2013).

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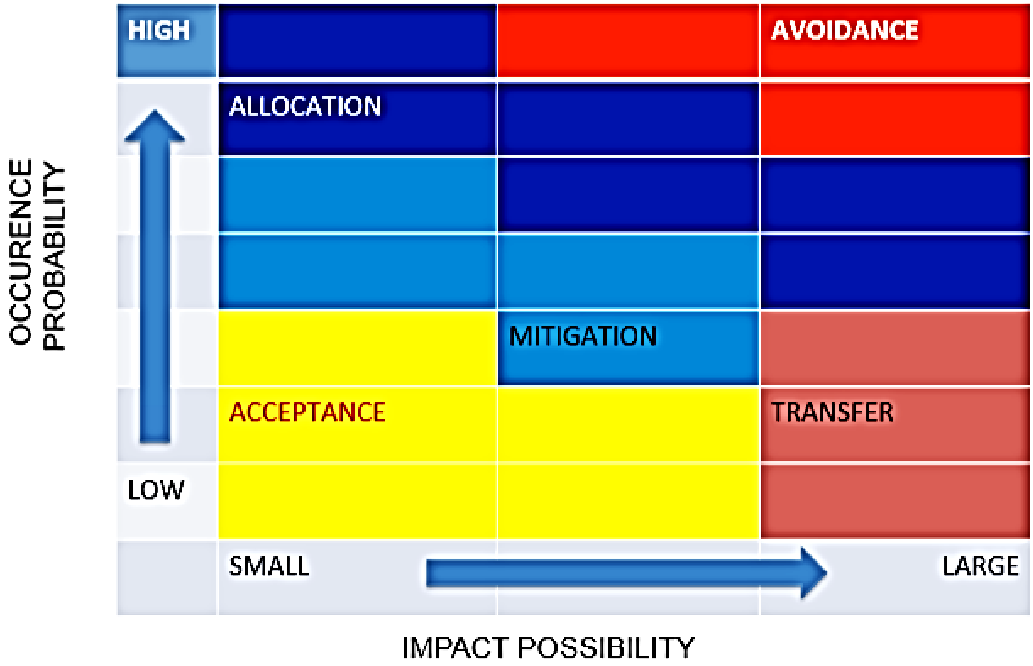

Figure 3.4. Risk Maps

3.2.5. Risk Control (Risk Response)

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In evaluating the alternatives chosen, the project management team reports to the project manager. The report takes the form of fundamental and technical data. This is done aiming for the work to be carried out in accordance with what has been planned.

Table 3.6. Risk Response

No.	Risk	Risk Level	Risk Response	Risk Response Strategy	Responsible Party
1.	Politic				
a.	Changes in government policy	4	Mitigate	Coordination meeting between owner and contractor	*Owner* & Contractor
b.	Change of job directors	9	Transfer	Coordination meeting between the new directors and the contractor / owner	*Owner* & Contractor
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d.	Regional head election	8	Transfer	Control of the project situation to the community	Contractor
e.	Adipura Assessment	10	Transfer	Control of the project situation on the scope	Contractor

3.3. Relationship Between Project Acceleration and Risk Level

Project acceleration is a change in project schedule by shortening one or more sequential and non-sequential activities which consequently shortens the total project implementation time as previously determined through an agreement between the service user and the construction service provider (Prihanantyo, 2013).

Project risk is an uncertain event or condition, if it occurs has a positive or negative effect on one or more project objectives such as scope, schedule, cost and quality. Risk may have one or more causes and if it does, there may be one or more effects. The cause may be needs, assumptions, constraints or potential conditions that are likely to have negative or positive results (PMBOK 2013).

The relationship between project acceleration and risk is crucially related to the possibility of a construction accident or construction failure. There are several variables that are indicators of a risk if a project is accelerated, it can be seen in Table 3.7. Based on table outlines several indications of a risk that is included in the variable, where the variable shows the number of factors of a risk.

Table 3.7. Common Problem on Runway Pavement Projects (Feng and Chung, 2013)

Flight procedure	Risk occurrence area	Failure mode (risk item)
Standing (STD)	Apron-gate area	ADRM, F-NI, RAMP, SEC
	Holding pad	ADRM, ATM, F-NI, RAMP,
Pushback/towing (PBT)	Apron-gate area	ADRM, ATM, F-NI, RAMP, ICE, LOC-G, SEC
Taxi (TXI)	Taxiway system	ADRM, ATM, F-NI, RAMP, GCOL, ICE, LOC-G, SEC
	Holding pad	ADRM, ATM, F-NI, RAMP, ICE, LOC-G, SEC
	Runway	ARC, ADRM, ATM, F-NI, RAMP, GCOL, ICE, LOC-G, RE, RI-A, RI-VAP, SEC
Takeoff (TOF)	Terminal airspace	ARC, ADRM, ATM, CFIT, F-NI, SEC
Approach (APR)	Terminal airspace	ADRM, ATM, CFIT, F-NI, SEC
Landing (LDG)	Taxiway system	ADRM, ATM, F-NI, RAMP, GCOL, ICE, LOC-G, SEC
	Runway	ARC, ADRM, ATM, CFIT, F-NI, RAMP, GCOL, ICE, LOC-G, RE, RI-A, RI-VAP, SEC, USOS

After identifying the risks and makes it into table 3.7 where there are many risk factor variables that may occur during the pavement runway, then calculate the percentage of the probability of the risk occurrence and the impact of these risks with the results of the level of risk in the form of a percentage. Then, it is continued by determining the risk categorization whether the risk is categorized as acceptance, allocation (transfer), mitigation or avoidance. After knowing the risk categories, it is continued by responding to those risks and explaining the impacts that will occur related to the acceleration of the pavement runway project.

In this research, in determining the risk category according to Nielsen, 2005. Where in table 3.8 explains that there are five probability scales which when entered into the form of a probability scale have a scale of 1 to 5 with a scale of 1 is a very low scale, scale 2 is a scale low, scale 3 is a medium scale, scale 4 is a high scale and scale 5 is a very high scale for the occurrence of a risk as well as a scale of risk impact. According to Nielsen, 2005 states that in the determination of risk categories there are 6 scales in the categorization of risks such as on scale 0 is an invalid risk category, on a scale 1 risk is acceptable, on a scale 2 risks are mitigated, on a scale 3 risks are allocated, on a scale 4 risks are transferred and on a scale of 5 risks are avoided.

As for some of the definitions of risk categories, as follows:

1. Risk acceptance, means:
    a. This option is to accept the consequences of this risk occurance as it is.
    b. The project team to deal with the risk as they occur.
    c. Develop a contingency plan to execute if the risk occurs that implies cost and schedule.
2. Risk allocation, means:
    a. To allocate the consequence of some specified risk to a contracting party or a third party, such as subcontractor, allowing time extension but not any additional cost between contractors and owners.
3. Risk transfer, means:
    a. To transfer the impact of a risk element along with the ownership of the response to a third party.
    b. A risk can be transferred through insurance, warranties, guarantees, bonds, etc.
4. Risk mitigation, means:
    a. To reduce the probability of occurrence and /or consequence of an adverse risk elements to an acceptable limit.
    b. Introduce a new alternative execution plan, new construction method/ technology or reschedulling or changing subcontractors, changing conditons: adding resouces or changing project manager.
5. Risk avoidance, means:
    a. To decline a project because of there being too big a risk.

In this research there are several calculation formulas based on 27 risk factors (Rn) variables with statistic formulas, as follows:

$$RF = f(R_1, R_2, R_3, \ldots Rn) \quad (5)$$

$$RL = P(E_i) \times I(E_i) \quad (6)$$

$$RL_{mean} = \frac{\Sigma\,(P_{Rn}(E_{iRn}) \times I_{Rn}(E_{iRn}))}{\Sigma\,N_R} \quad (7)$$

$$RL_{mean}\,(\%) = \frac{\Sigma\,(P_{Rn}(E_{iRn}) \times I_{Rn}(E_{iRn}))}{\Sigma\,N_R} \times 100\% \quad (8)$$

Where:

RF : Risk factors included in variables R1 through Rn.

Rn : Variable number of technical risk factors in runway pavement projects.

RL : The level of risk that results from the possibility of risk occurrence with the impact of the risk occurrence.

$P(E_i)$: Probability of the occurrence of risk to the event or risk event that may occur.

$I(E_i)$: Impact of the occurrence of risk on an event or risk event that may occur.

RL_{rerata} : The average level of risk for 5 research samples (quesioner).

RL_{rerata} (%) : Percentage of average risk level for 5 research samples (quesioner).

N_R : The number of variables in the technical risk factors for pavement runway projects.

P_{Rn} : Probability of the technical risk factor variables in runway pavement project.

E_{iRn} : Events for the many impacts of technical risk factor variables in the runway pavement projects.

I_{Rn}	: Impact on the number of technical risk factor variables in runway pavement projects.
$\Sigma (P_{Rn}(E_{iRn}) \times I_{Rn}(E_{iRn}))$	: The sigma results of the level of risk to the probability and impact of technical risk factors on the pavement runway projects.
ΣN_R	: The sigma of technical risk factor variables in runway pavement projects.

3.4.Relationship Between Risk Level and Expected Monetary of Loss

In this section, we explain how to calculate the value of project losses by connecting the percentage risk level to the pavement runway work. The value of the project loss is obtained from the calculation of the number of unit prices per job in the pavement runway work.

The first step in calculating the value of the project loss or in other words the expected monetary of loss is assign a probability of occurrence for the risk. The second step in calculating the value of project losses is assign monetary value of the impact of the risk when it occurs. And the last step in calculating the value of project losses is multiply step 1 and step 2 (Winarno, 2018).

$$EML = \Sigma(Pi \times Ii) \quad (5)$$

Where:

P = Percentage probability of occurrence for the risk.

I = Monetary value of the impact of the risk when it occurs.

CHAPTER 4
RESEARCH METHODOLOGY

This research methodology used in this study is the method of data collection, assumptions using percentages for project acceleration, and risk analysis.

From the results of the risk analysis, it is expected to identify risks caused by acceleration of the project, can analyze risks caused by acceleration of the project, be able to know the risk mapping caused by acceleration of the project and be able to know the control or risk response caused by acceleration of the project.

4.1. Literature

The steps of literature study are collecting and studying the material discussed in the research and preparation of the final project. The material was obtained from scientific papers, laboratory practicum instructions, books and the internet related to the problem under study. The data obtained in the form of literature relating to the problem under study, namely about The Risk Impact of Project Acceleration.

4.2. Research Flow

The research flow is a flow chart used as a research standard for conducting research planning and process analysis to facilitate the research stages. The flow chart in this study can be seen in Figure 4.1 the study was divided into five stages.

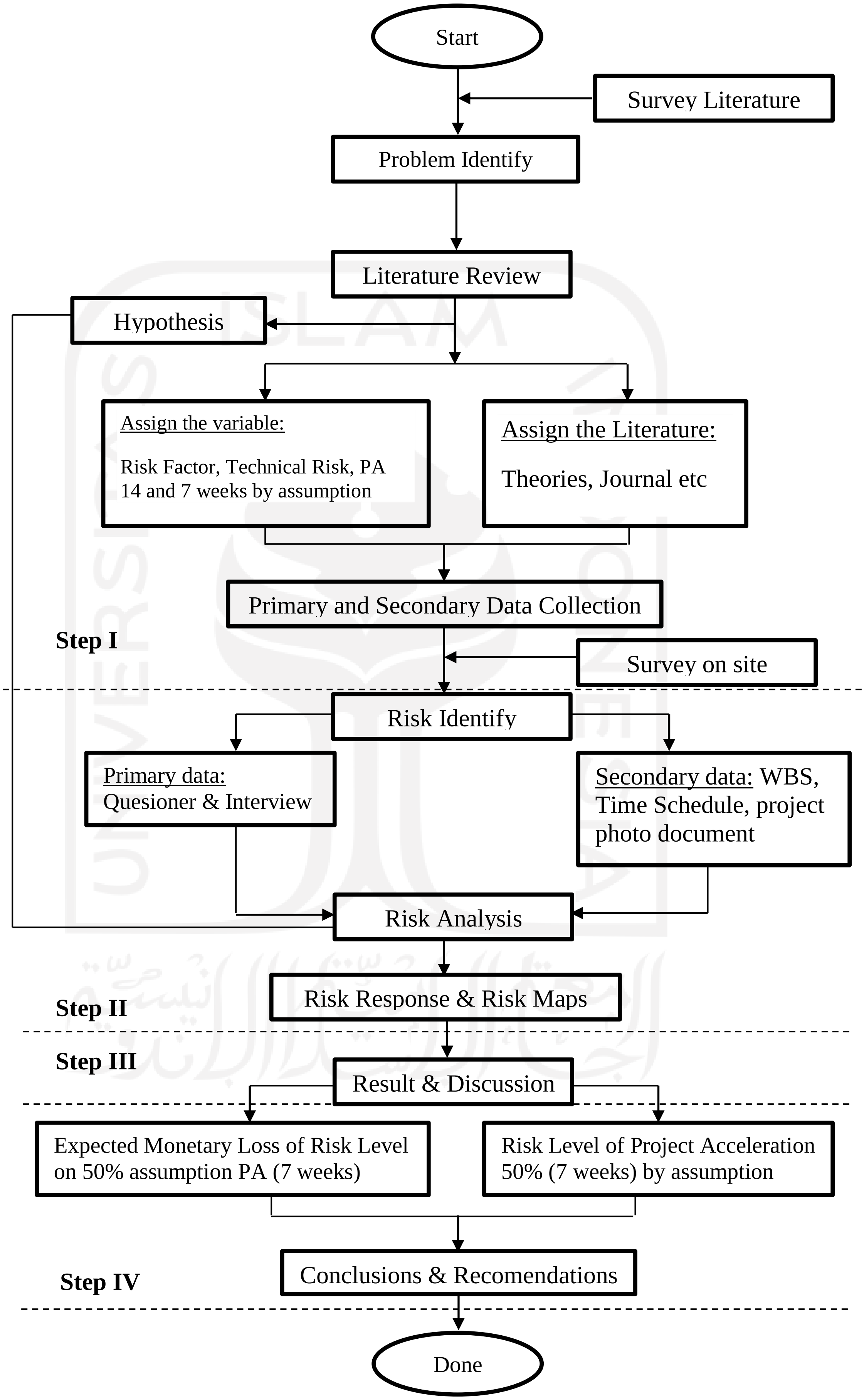

Figure 4.1. Research Methodologies Flow Chart

4.3. Step by Step of Research

There are some steps of research in the project. This research must be carried out clearly and regularly so that it gets good and true results and can be justified.

4.3.1. Step I

At this step, start from survey literature than trying to identify even or problem that happened on project with research question. After that, make sure with literature review to get the hypothesis so we know how to assign the variable and literature such as risk factor, technical risk and assumpting duration on project acceleration 50% (7 weeks) from normal duration (14 weeks). So, we can collacting the primary and secondary data by consisting of general data of the pavement runway project by survey on site.

4.3.2. Step II

At this step, starting to identify the risk as what we get an even on site by questioner and interview for primary data and Work Breakdown Structure (WBS) pavement runway project, time scheduling data for the pavement runway project and photo document as the secondary data. Than, analyzing that risk so we can get the value of the risk. The last but not least, we've to make some responses and maps the risk. As for some documentation photo data on the pavement runway project as below:

Figure 4.2. An overall view of the airside project

Figure 4.3. Top view of the front-airside project

Figure 4.4. Top view of the pavement runway work

Figure 4.5. The top view of the runway

4.3.3. Step III

At this step, we get the result of all those things that we've done from step I through step II named Risk Level that could be happened on pavement runway project. We need to discuss about how we can get those data by using formula, literature also theories on step I. Than, we just need to compare primary and secondary data to the formula and theories on step I.

4.3.4. Step IV

At this step, we just focus on how important the expected monetary of loss between risk level on 50% assumption project acceleration (7 weeks). We've to know what kinds of implication if it happened, how high the risk was and how much the money lossed away. The last part is concluding from step I through step IV than give some recommendation for this research to get better or to be used as material for future correction.

CHAPTER 5
RESULT AND DISCUSSION

In the results and discussion chapter we get the results of the impact or risk implications of the project acceleration in the form of risk identification, risk analysis, risk categories and risk responses that we can find out the risk implications of accelerating a pavement runway project.

5.1. The Acceleration Simulation on Project Duration Calculation

In this research in accelerating the duration of work using assumptions where the normal duration is 14 weeks, the duration of the assumption is 50% to be accelerated. The reason why this project to be accelerated by assumption 50% is base on interview with project manager and supervisor engineering manager said that if this project could not be accelerated more than 50% from normal duration. The step to calculate the project acceleration simulation in this project is to calculate the percentage of assumptions with the duration of the pavement runway work per week.

In this research to find the percentage of project acceleration simulation assumptions obtained from the following formula:

1. Assumption 50% = $50\% \times d_{normal}$

   $= 50\% \times 14$ weeks

   $= 7$ weeks.

5.2. Risk Identification

In identifying a risk there is some data that must be known. Risk is traditionally defined as uncertainty or the possibility of loss. The uncertainty of events is subjective and the existence of "whether or not," "when," "circumstance," and "severity." While the loss caused by the occurrence of an event is objective, emphasizing the possibility of loss. The definition of risk may differ in research but always emphasizes the expected value combining probability and severity.

Detecting risks helps control the occurrence of airport risks during operations. This paper introduces the concept of detection in airport risk management and defines risk as an expected value combining probability, severity, and detection. In this study, risk identification is obtained from a runway work chart or often called the Work Breakdown Structure in Figure 5.1.

Figure 5.1 explains that the airside work consists of five jobs in the form of pavement runway work, parallel taxiway work, holding bay work, rapid exit taxiway work and apron work. However, this study only reviews the impact of risk on pavement runway work. There are several jobs in working on pavement runway such as flexible work of the runway and flexible work of the runway. In doing the two types of work there are several jobs that must be done such as AC-WC work, CT-BC work, work Crushed Aggregate Subbase, tack coat work and prime coat work.

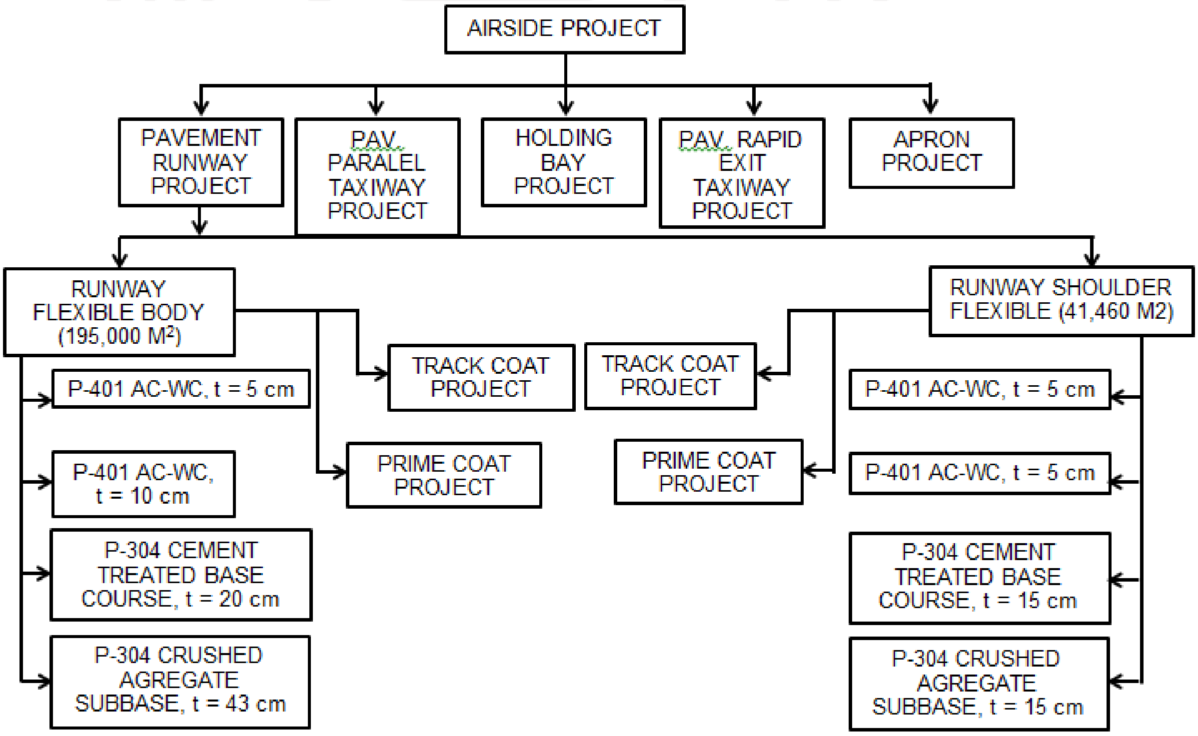

Figure 5.1. Work Breakdown Structure Airside Work

From some of the work we can identify the risks that occur when doing the work. The results of risk identification are entered into a table and then classified in the order of work. In Table 5.1 we can see risk identification in accordance with the order in which each job is replaced by the Xn variable for each risk factor.

After identifying risks and classifying risks, proceed with making a risk chart or what is often referred to as the Risk Breakdown Structure. In Figure 5.2 explains the various possible risks that occur when doing pavement runway work. After the Risk Breakdown Structure is arranged, the next step is to analyze the risk.

Table 5.1. Common Problem (Event) on Pavement Runway Project

Rn	E
R_1	Runway original land contours are uneven
R_2	Soil compaction is not according to specifications
R_3	Uneven runway surface
R_4	Runway shoulder pad runway is not wide enough
R_5	Runway turn pad irregular surface
R_6	The runway slope is not according to specifications
R_7	Unstable runway soil structure
R_8	The earthquake-prone runway area
R_9	Runway area prone to tsunamis
R_{10}	The actual length of the runway surface does not meet aircraft operational requirements
R_{11}	Runway turn pad is not according to specifications
R_{12}	The average texture depth of the new runway surface is less than 1.0 mm
R_{13}	Corrugated runway surface
R_{14}	Runway surface is too slippery
R_{15}	Runway shoulders do not have the same width on both sides
R_{16}	Runway shoulders more than 2.5%
R_{17}	Runway shoulder surface is bumpy / not flat with runway surface
R_{18}	The runway shoulder surface for jet aircraft is not coated in asphalt / bitumen / concrete
R_{19}	The shoulder surface of the runway for the Boeing 737-800 / A380 is not widened by 7 m outside the shoulder
R_{20}	Runway shoulders are not resistant to erosion due to aircraft engine bursts
R_{21}	Inefficient material supply
R_{22}	Aggregate and cement layouts are not optimal
R_{23}	Extreme weather (rainy season)
R_{24}	Asphalt / bitumen spread is not optimal
R_{25}	Limited support machines
R_{26}	Human error due to 24 hours of work

5.3. Risk Analysis

In analyzing risk, there are several steps that are carried out such as the preparation of a risk breakdown structure, determining the level of risk and categorizing the risk.

5.3.1. Risk Breakdown Structure

In this study, the risk of runway work is described in the Risk Breakdown Structure in Figure 5.2 below. Risk Breakdown Structure as the following form:

Risk Breakdown Structure Pavement Runway Project

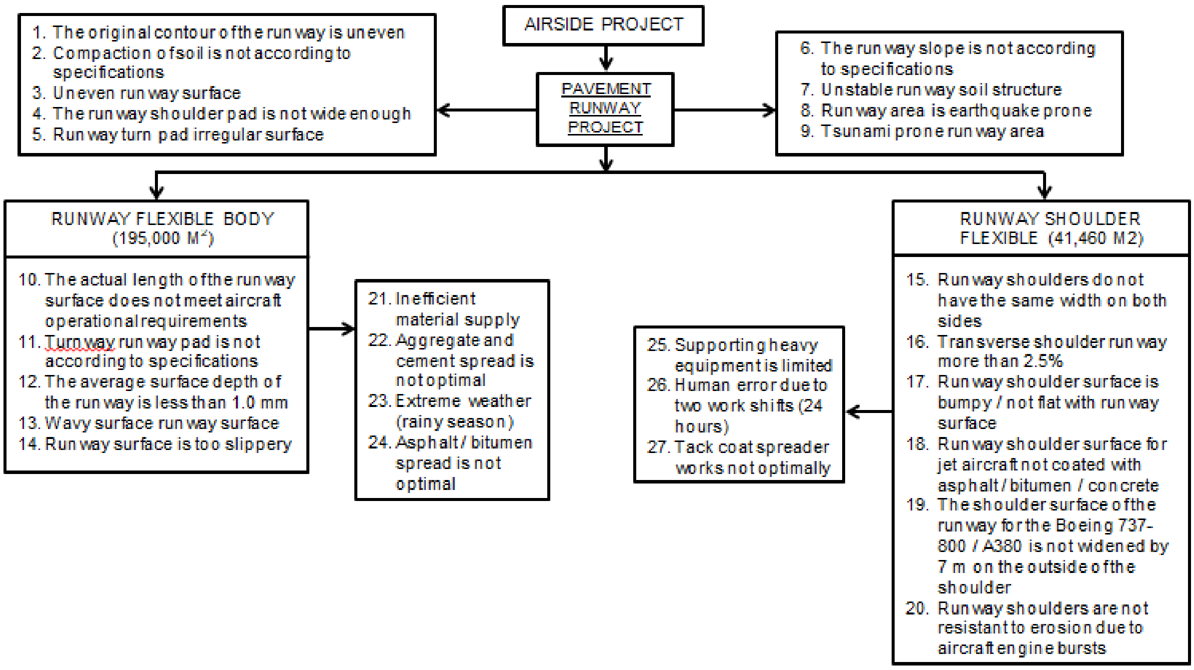

Figure 5.2. Airside Risk Breakdown Structure at the Pavement Runway Work

In Figure 5.2 it is known that there are 27 technical risk factors that might occur in the pavement runway work. These risks have been classified according to their respective sub jobs. After outlining the technical risk factors that might occur into the risk breakdown structure, the next step is to calculate the level of risk from probability and impact. This aims to determine the size of the risk that may occur in the pavement runway.

5.3.2. Risk Level Calculation

Table 5.2. Probability Scale

No.	Rating			Quantitative Criteria	Qualitative Criteria
	Name	Code	Value		
1.	Very Small	VS	1	Chance to occur <10%	Tend not likely to occur
2.	Small	S	2	10% <probability of occurrence <40%	Small chance of happening
3.	Medium	M	3	40% <probability of occurrence <60%	Equally likely to occur & not happen
4.	Large	L	4	60% <probability of occurrence <80%	Possible happen
5.	Extra Large	XL	5	80% <probability of occurrence <95%	Very possible / certain

Table 5.3. Impact Scale

No.	Rating			Criteria	
	Name	Code	Value	Target deviations	Impact of loss value
1.	Very Light	VL	1	0% < deviation < 2%	Doesn’t mean
2.	Light	L	2	2% < deviation < 5%	Influences internal areas
3.	Medium	M	3	5% < deviation < 10%	Affect the external area
4.	Heavy	H	4	10% < deviation < 15%	Influence on core business & assets
5.	Exstrem	E	5	Deviation > 15%	Influence on main assets & reputation

The rating scale must also be detailed before we conduct a risk analysis.

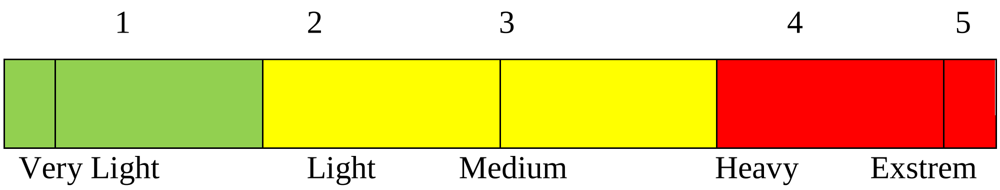

Figure 5.3. Scale of Impact Rating

The results of the probability and impact assessment are included in the Treshold of Risk Level table below. In this study, the assessment results in the form of a percentage from 1% to 10% of the acceleration of the project starting from the normal duration to the 50% assumption duration. Table 5.4 is a table that describes the level of risk in pavement runway work in normal duration or 14 weeks, it is known that the risk of the runway area prone to earthquakes and tsunamis (R8 and R9) is a risk that must be avoided so that runway building failure does not occur. In table 5.4, it is also known that the risk of extreme weather in the rainy season (R23) also has a high risk that can hinder the work of laying tack coat and prime coat. In table 5.4, it is known that the risk of the runway surface is too slippery (R14) has a moderate risk which can be mitigated by using the construction method of adding material which can increase the friction force so that the runway surface is not slippery. In table 5.4 it is also known that the risk of runway unstable soil structure (R7) has a low risk because this risk can be lowered by testing the soil structure first before starting the runway work. For example on variable R_{10}:

Risk Level $= P(E)I \times P(I)E \times 100\%$

$= 10.5 \times 11 \times 100\%$

$= 11.55\%$

So, we can know that the risk level for R_{10} is 11.5%

Where:

P(E)I is probability that may be occured.

P(I)E is possibility-impact that may be occurred.

Table 5.4. Risk Level For Pavement Runway Work Normal Duration (14 weeks)

No.	Rn	$P(E)_i$ (%)	$P(I)_E$ (%) Defect/Failure	$R=P(E_o) \times P(i)_E$ (%)
1	R_1	10	9.5	9.5
2	R_2	14	9	12.6
3	R_3	12	9.5	11.4
4	R_4	10.5	7	7.35
5	R_5	9.5	7.5	7.125
6	R_6	8.5	7.5	6.375
7	R_7	5.5	8.5	4.675
8	R_8	22	23.5	51.7
9	R_9	23	24.5	56.35
10	R_{10}	10.5	11	11.55
11	R_{11}	10.5	10	10.5
12	R_{12}	13.5	12	16.2
13	R_{13}	11.5	11	12.65
14	R_{14}	14	13	18.2
15	R_{15}	9	10.5	9.45
16	R_{16}	8.5	7.6	6.46
17	R_{17}	7	7	4.9
18	R_{18}	7.5	7.5	5.625
19	R_{19}	9	11.5	10.35
20	R_{20}	11	12	13.2
21	R_{21}	14	11.6	16.24
22	R_{22}	12.5	12.5	15.625
23	R_{23}	19	18.5	35.15
24	R_{24}	8.5	7	5.95
25	R_{25}	13.5	13	17.55
26	R_{26}	15.5	15	23.25
27	R_{27}	13.5	12	16.2

Figure 5.4 describes the graph of the relationship between probability and impact at normal duration or 14 weeks. It was explained that the highest level of probability and impact risk is at R8, R9 and R23 at 80% to 100%. Therefore, these risk factors must be avoided in order to avoid a failure in the runway construction or building. However, these risk factors cannot be avoided due to natural factors. This can be done by conducting earthquake and tsunami dynamics tests as well as extreme weather before working on a project.

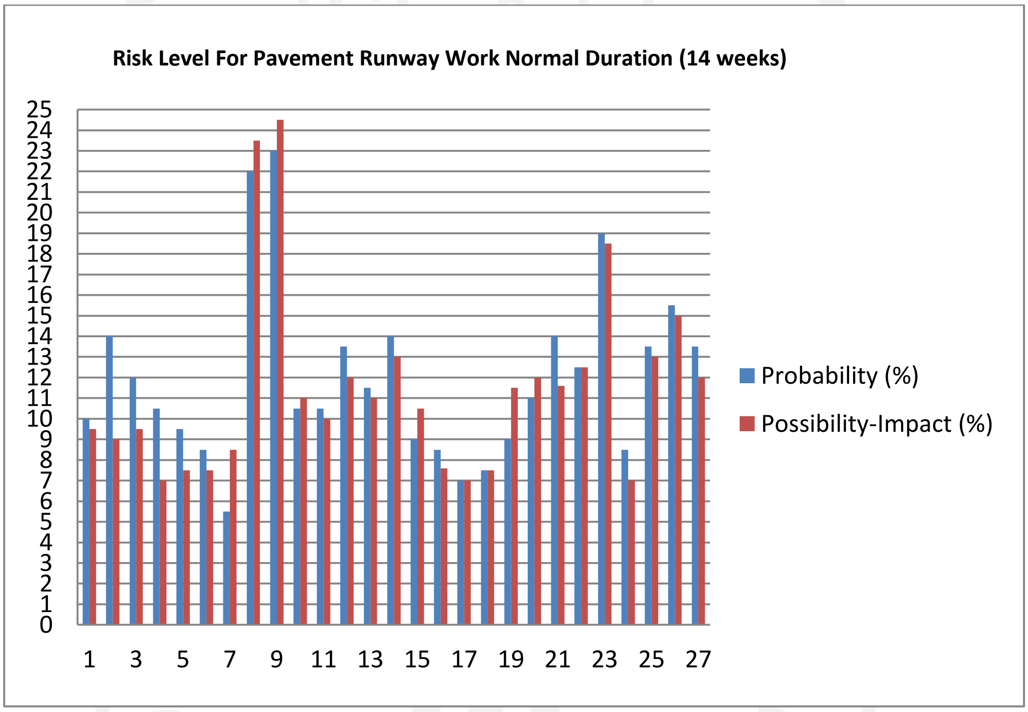

Figure 5.4. Risk Level for Pavement Runway Work Normal Duration (14 weeks)

Table 5.5 is a table that explains the level of risk in pavement runway work where the assumption of X = 50% can be seen that the highest risk is still occupying the variables R_8 and R_9, namely the risk of earthquake and tsunami prone runway areas. This risk cannot be transferred or absorbed, the risk must be avoided because if it is likely to occur in the earthquake or tsunami runway area it will be dangerous or hazard to the runway user. Because these risk factors occur due to natural factors, it is necessary to test the dynamics of earthquake and tsunami before the runway work is carried out. Risk on variable R_4 or runway turn pad shoulder risk is not wide enough, on variable R_5 or runway runway turn pad risk is irregular, on variable R_{14} or runway surface risk is too slippery, and on variable R_{21} or the risk of inefficient material supply has moderate risk because some of the risks above can be mitigated by appropriate and efficient construction methods. The risks in variables R_{15} to R_{20} or the risk of runway shoulders do not have the same width on both sides until the risk of runway shoulders is not resistant to erosion due to aircraft engine bursts having a low risk due to the probability of these risks being related to quality where the quality side takes precedence well.

Table 5.5. Risk Level For Pavement Runway Work (Assumption 50%)

No.	Rn	$P(E)_i$ (%)	$P(I)_E$ (%) Defect/Failure	$R=P(E_o) \times P(i)_E$ (%)
1	R_1	14	13	18.2
2	R_2	16	15.5	24.8
3	R_3	14.5	13.5	19.575
4	R_4	17	15.5	26.35
5	R_5	16.5	16	26.4
6	R_6	14.5	13.5	19.575
7	R_7	11	12	13.2
8	R_8	25	25	62.5
9	R_9	26	26	67.6
10	R_{10}	14.2	13.5	19.17
11	R_{11}	14.2	13.5	19.17
12	R_{12}	17.2	16.5	28.38
13	R_{13}	16.7	17.5	29.225
14	R_{14}	14.7	13.5	19.845
15	R_{15}	11.2	10.5	11.76
16	R_{16}	11.2	10.5	11.76
17	R_{17}	10.7	10.5	11.235
18	R_{18}	11.2	13	14.56
19	R_{19}	15.7	15.5	24.335
20	R_{20}	14.7	15	22.05
21	R_{21}	18.5	14.5	26.825
22	R_{22}	16.7	15.5	25.885
23	R_{23}	14.7	14.5	21.315
24	R_{24}	12.7	11.5	14.605
25	R_{25}	17.7	16.5	29.205
26	R_{26}	20.2	18.5	37.37
27	R_{27}	17.7	15.5	27.435

For example on variable R_{10}:

Risk Level $= P(E)I \times P(I)E \times 100\%$

$= 14.2 \times 13.5 \times 100\%$

$= 19.17\%$

So, we can know that the risk level for R_{10} is 11.5%

Where:

P(E)I is probability that may be occured.

P(I)E is possibility-impact that may be occurred.

Figure 5.5 explains the graph of the relationship between probability and impact when the duration of the crash is 1 or X = 50% where the highest probability and impact are in the variables R_8, R_9 and R_{23} which have a risk impact of 75% to 99%. This must be avoided so that construction failure on the runway does not occur by carrying out treatment on the runway soil structure. Conducting structural and tsunami dynamics tests and increasing the number of workers so that the work of spreading is more efficient.

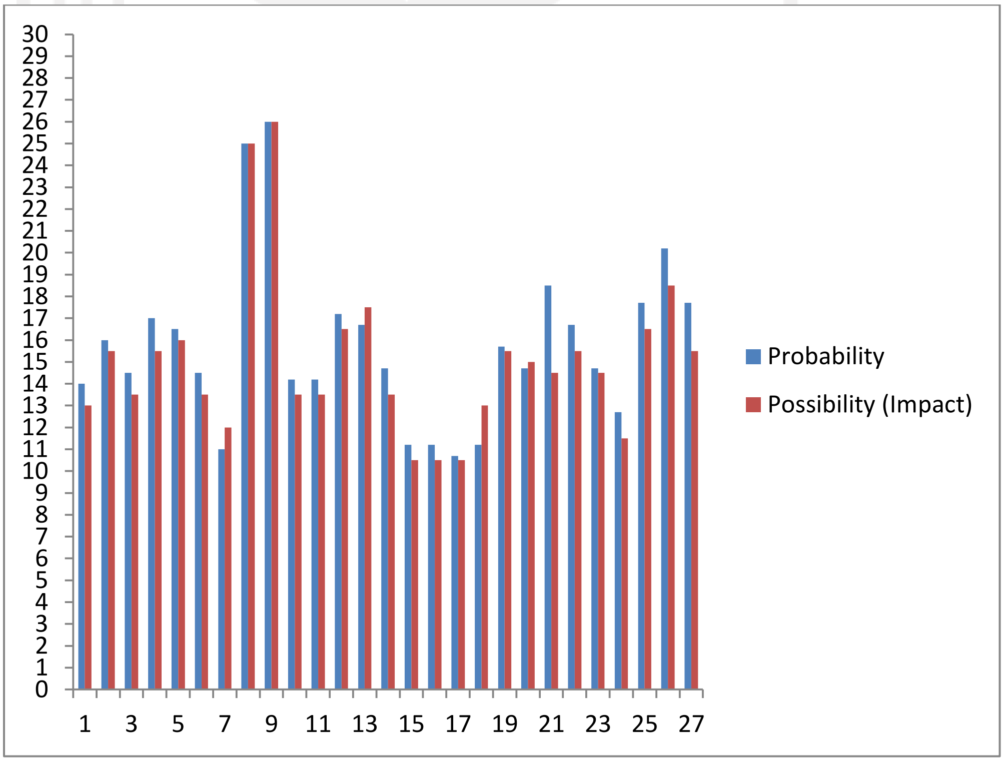

Figure 5.5. Risk Level for Pavement Runway Work
(Assumption 50%)

5.4.Risk Response and Risk Maps

This chapter discusses the level of risk to the risk response and the risk strategy and the parties responsible for the risk. This response, risk response strategy and responsible party was get from interview with Project Manager and Supervisor Engineering Manager in Pavement Runway Project which is relatable in every risk factor.

Table 5.6. Response Strategy and Risk Allocation in Pavement Runway Projects

No.	Risk Factor	Risk Response	Risk Response Strategy	Responsible Party
R1	The original land of runway contour weavy	Mitigate	Do leveling the soil structure / doing excavation.	Contractor
R2	Soil compaction is not according to specifications	Mitigate	Survey of original soil conditions, selection of hill material, compaction layer by layer and inspection of layer by layer compaction.	Contractor
R3	Runway surface is weavy	Mitigate	Do leveling the soil structure / doing excavation.	Contractor
R4	Runway shoulder pad runway is not wide enough	Mitigate	Adjustment of the runway turn pad surface with widening per layer.	Contractor
R5	Runway turn pad irregular surface	Mitigate	Adjustment of the runway turn pad surface by carrying out excavations on the runway.	Contractor
R6	The runway slope is not according to specifications	Mitigate	Do the runway back slope test.	Contractor
R7	Unstable runway soil structure	Mitigate	Carry out treatment on runway soil structure.	Contractor
R8	The earthquake-prone runway area	Avoidance	Conduct an AMDAL test on the runway.	Owner, Consultant Planner & Contractor

Table 5.6. Response Strategy and Risk Allocation in Pavement Runway Projects (Continue..)

No.	**Risk Factor**	**Risk Categories**	**Risk Response Strategy**	**Responsible Party**
R9	Runway area prone to tsunamis	Avoidance	Carry out a Tsunami Wave test	Owner, Consultant Planner & Contractor
R10	The actual length of the runway surface does not meet aircraft operational requirements	Mitigate	Do the actual runway surface length test again.	Contractor
R11	Runway turn pad is not according to specifications	Mitigate	Do runway turn pad specifications.	Contractor
R12	The average texture depth of the new runway surface is less than 1.0 mm	Mitigate		Contractor
R13	Corrugated (weavy) runway surface	Mitigate	Adjustment of runway ground level by carrying out excavations on the runway.	Contractor
R14	Runway surface is too slippery	Mitigate	The addition of material that can increase the friction force so that the runway surface is not slippery.	Contractor
R15	Runway shoulders do not have the same width on both sides	Mitigate	Adjustment of the runway turn pad surface with widening layer by layer.	Contractor
R16	Runway shoulders more than 2.5%	Mitigate	Adjustment of the crossing shoulder surface of the runway by carrying out excavations on the runway.	Contractor

Table 5.6. Response Strategy and Risk Allocation in Pavement Runway Projects (Continue..)

No.	**Risk Factor**	**Risk Categories**	**Risk Response Strategy**	**Responsible Party**
R19	The shoulder surface of the runway for the Boeing 737-800 / A380 is not widened by 7 m outside the shoulder	Mitigate	Adjustment of the runway shoulder surface with widening layer by layer.	Contractor
R20	Runway shoulders are not resistant to erosion due to aircraft engine bursts	Mitigate	Survey of original soil conditions, selection of sheet pile material and inspection of runway shoulder endurance against erosion due to aircraft engine bursts.	Contractor
R21	Inefficient material supply	Mitigate	Time management between the distance and the time the material arrived at the site.	Contractor
R22	Aggregate and cement layouts are not optimal	Mitigate	Time management between the distance and the time the material arrived at the site.	Contractor
R23	Extreme weather (rainy season)	Avoidance	Control the weather.	Owner, Consultant Planner & Contractor
R24	Asphalt / bitumen spread is not optimal	Mitigate	Time management between the distance and the time the material arrived at the site.	Contractor
R25	Limited support machines	Mitigate	Use that machines effectively and alternately / add heavy equipment.	Contractor
R26	Human error due to 24 hours of work	Mitigate	Increased work motivation and adjustment of work time.	Contractor
R27	Tack coat spreader works not optimal	Mitigate	Operate the tool regularly so that there is no damage to the tack coat spreader.	Contractor

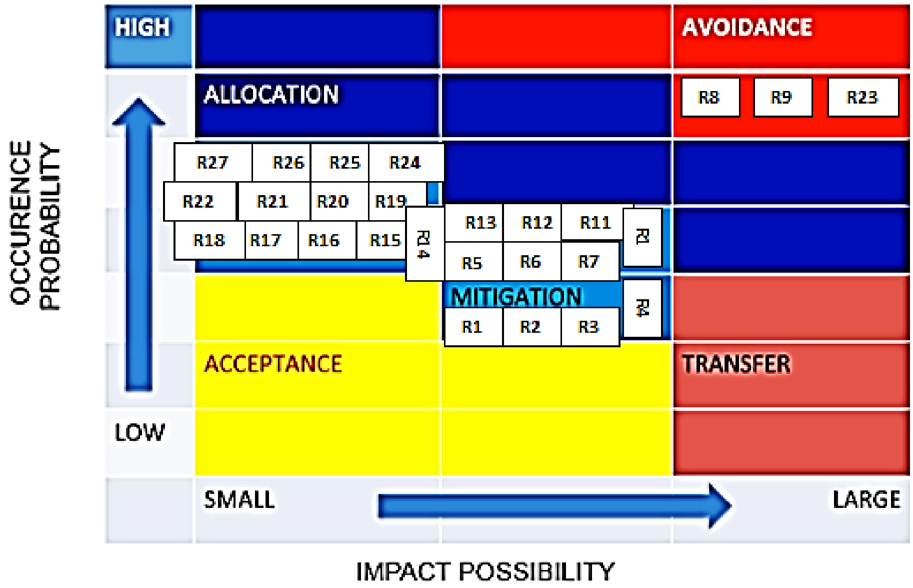

Figure 5.6. Risk Maps on Pavement Runway Project

5.5. The Implication Risk-Impact of Project Acceleration

5.5.1. Probability Criteria and Impact Criteria

This chapter discusses the impact of the occurrence of a risk on project acceleration on pavement runway work. In this case there are several risk factors that have been taken and have been calculated using the assumption of numbers one to five to determine the probability criteria and the criteria for the impact of the likelihood of the risk of acceleration of the project on the pavement runway work. The probability criteria table and the risk impact criteria are as follows:

Tabel 5.7. Probability Criteria

No.	Rating			Criteria	
	Name	Code	Value	Target deviations	Impact of loss value
1.	Very Light	VL	1	0% < deviation < 2%	Doesn’t mean
2.	Light	L	2	2% < deviation < 5%	Influences internal areas
3.	Medium	M	3	5% < deviation < 10%	Affect the external area
4.	Heavy	H	4	10% < deviation < 15%	Influence on core business & assets
5.	Exstrem	E	5	Deviation > 15%	Influence on main assets & reputation

Tabel 5.8. Impact Criteria

Impact	Cost	Time	Quality
Very Light	A fund sufficient	Some deviated from the target	The quality is some reduced but can still be used
Light	Requires additional funds	Some deviated from the target	Failed to satisfy appointment
Medium	Requires additional funds	Delays have an impact on stakeholders	Some functions can't be utilized
Heavy	Requires a significant additional funds	Failed to satisfy the deadline	Failed to satisfy overall needs
Exstrem	Requires substantial funds	Delay damages the project	Projects are ineffective and useless

Based on the table 5.10 and table 5.11 we can see that there are five levels of risk likelihood and the impact of the occurrence of risk which is very influential on the acceleration of a project if it does not consider the control of these risks. After knowing the probability criteria and what impacts might occur, then we can find out what the impact will be if the risk is not controlled. Regarding these risks, in this study there are twenty-seven technical risk factors that are discussed in the form of several variables R ranging from R_1 to R_{27} in table 5.12. There are five samples taken in this research, probability criterion data and impact criteria on sample 1 are in table 5.14. In table 5.14 the probability criteria explain that in variables R_1 to R_7 these risks are small sometimes occur with a small impact on cost, time and quality and that risk is almost impossible to occur with a small impact. For variables R_8 and R_9 the risk is moderate or may not occur with a moderate impact on cost, time and quality. For variables R_{10} to R_{27} some of these risks sometimes occur and almost occur with little impact on cost, time and quality.

Based on the table 5.13 the impact criteria explain that the variable R_1 is a risk with a moderate impact which if viewed from the cost requires additional funding, if viewed from the time experiencing delays that have an impact on stakeholders and if viewed from the quality experience some functions cannot be utilized. In variables R_2 to R_7, variables R_{10} to R_{18}, variables R_{20} and R_{21} and variables R_{23} to R_{25} R_{27} variables are also risks with severe impacts where in terms of costs require significant funding, if viewed from the time it fails to meet deadlines and if viewed from the quality of experience failed to meet the overall needs. In variables R_8, R_9, R_{19}, R_{22} and R_{26} are risks with extreme impacts where, when viewed from costs, substantial funds are needed, if viewed from the time experiencing delays damaging the project and if viewed from the quality of the project experiences ineffectiveness and are inefficient or useless.

5.5.2. Relationship Between Risk Level and Project Acceleration

In this chapter describes the relationship between the level of project risk and project acceleration on the impact of risk. The level of risk is obtained from the percentage of probability and the percentage of impact that results in the level of risk. The acceleration of the project in this study is assumed to be in weeks.

In table 5.17, the table of the relationship between the level of risk that might occur with the possible impact on the acceleration of this project explains that if the project is not accelerated or is in conditions of normal duration (14 weeks) and in this study only focuses on the assumption of the duration of the acceleration where 50 % or project duration for 7 weeks.

In the condition that the duration of the project acceleration assumption is 50% (7 weeks), the heavy risk is in the R7 variable or the runway area is prone to earthquakes where the risk is 3.6%. In this condition, an additional 3.4% of funds are required in costs, experiencing delays that adversely affect stakeholders by 3.4% at a time, some functions cannot be utilized by 3.4% on quality and workers are susceptible to work accidents due to runway surfaces. experienced an earthquake when viewed from the safety of health work. This condition is a serious risk condition.

In the condition that the duration of the project acceleration assumption is 50% (7 weeks), the risk is moderate in the variable R25 or the tack coat spreader does not work optimally where the risk is 2.2%. In this condition, an additional 2.6% of funds are required in costs, experiencing a deviation of the target by 2.6% at a time, failing to fulfill a promise to clients of 2.6% on quality and workers are susceptible to work accidents due to not spreading the tack coat. work optimally when viewed from the safety of occupational health.

In the condition that the duration of the project acceleration assumption is 50% (7 weeks), the light risk is in the R5 variable or the actual length of the runway does not meet the aircraft operational requirements where the risk is 1.2%. In this condition, additional funds of 2% are required in costs, experience a target deviation of 2% at a time, fail to fulfill promises to clients of 2% on quality and workers are susceptible to work accidents because the original ground surface is uneven and the plane is prone to slipping due to the ground surface. original runway bumpy when viewed from the occupational health safety.

For example on normal duration (14 weeks), relationship between risk level and project acceleration (Normal Duration 14 weeks) on variable C.2.4. P-209 Crushed Agregate Subbase, t = 15 cm where risk factor is tack coat spreader is not works optimal:

Base on table 5.9 where RP = P(E)I; RI = P(I)E

Risk Level = P(E)I × P(I)E

= 0.6 × 2.6%

= 0.02%

So, we can know that is the risk level for variable C.2.4. P-209 Crushed Agregate Subbase, t = 15 cm where risk factor is tack coat spreader is not works optimal on normal duration 14 weeks is 0.02%.

For example assumption 50% duration (7 weeks), relationship between risk level and project acceleration (Assumption 7 weeks) on variable C.2.4. P-209 Crushed Agregate Subbase, t = 15 cm where risk factor is tack coat spreader is not works optimal:

Base on table 5.9 where RP = $P(E)_I$; RI = $P(I)_E$

Risk Level = $P(E)_I \times P(I)_E$

$= 7.5 \times 2.6\%$

$= 2.0\%$

So, we can know that is the risk level for variable C.2.4. P-209 Crushed Agregate Subbase, t = 15 cm where risk factor is tack coat spreader is not works optimal on normal duration 14 weeks is 2.0%.

Table 5.9. Relationship between Risk Level and Project Acceleration (Normal Duration 14 weeks)

No.	Work Item	PA (weeks)	RF	RP	RI	RL
C.1	Runway Flexible Body(195000 m2)	14	Soil compaction is not according to specifications	1.0	2.6%	0.03%
C.1.1	P-401 AC-WC, t = 5cm	14	Uneven runway surface	1.3	2.2%	0.03%
		14	Runway turn pad irregular surface	1.1	2.2%	0.02%
		14	The actual length of the runway surface does not meet aircraft operational requirements	0.7	2%	0.01%
		14	Unstable runway soil structure	0.7	-	-
		14	The earthquake- susceptible runway area	0.6	3.4%	0.02%
		14	Runway area susceptible to tsunamis	0.5	3.2%	0.02%
		14	The runway slope is not according to specifications	5.2		
C.1.2	P-401 AC-BC, t = 10cm	14	Runway turn pad is not according to specifications	5.6		
		14	The average texture depth of the new runway surface is less than 1.0 mm	1.2	-	-
		14	Corrugated runway surface	1.1		
		14	Aggregate and cements layouts are not optimal	1.6	-	-
C.1.3	P-304 Cement Treated Base Course, t = 20 cm	14	Limited support machines	1.3	2.4%	0.03%
C.1.4	P-209 Crushed Agregate Subbase, t = 43 cm	14	Extreme weather (rainy season)	1.8	3%	0.05%
C.1.5	Tack Coat	14	Runway surface is too slippery	0.9	-	-
C.1.6	Prime Coat	14	Asphalt/bitumen spread is not optimal	0.6	-	-
		14	Runway shoulder surface is bumpy / not flat with runway surface	0.5	-	-

Table 5.9. Relationship between Risk Level and Project Acceleration (Normal Duration 14 weeks) (Continue..)

No.	Work Item	PA (weeks)	RF	RP	RI	RL
C.2	Runway Flexible Sholulders (41460 m2)	14	The runway shoulder surface for jet aircraft is not coated in asphalt / bitumen / concrete	0.6	2.2%	0.01%
C.2.1	P-401 AC-WC, t = 5cm	14	The shoulder surface of the runway for the Boeing 737-800 / A380 is not widened by 7 m outside the shoulder	1.0	-	-
C.2.2	P-401 AC-BC, t = 5cm	14	Runway shoulder pad runway is not wide enough	1.3	2.2%	0.03%
C.2.3	P-304 Cement Treated Base Course, t = 15 cm	14	Runway shoulders do not have the same width on both sides	1.6	-	-
		14	Runway shoulders more than 2.5%	1.6	-	-
C.2.4	P-209 Crushed Agregate Subbase, t = 15 cm	14	Runway shoulders are not resistant to erosion due to aircraft engine bursts	3.5	-	-
		14	Tack coat spreader works not optimal	0.6	2.6%	0.02%
C.2.5	Tack Coat	14	Human error due to 24 hours of work	1.8	-	-
C.2.6	Prime Coat	14	Inefficient material supply	2.3	-	-

Table 5.10. Relationship between Risk Level and Project Acceleration (Assumption 7 weeks)

No.	Work Item	PA (weeks)	RF	RP	RI	RL
C.1	Runway Flexible Body(195000 m2)	7	Soil compaction is not according to specifications	6.6	2.6%	1.7%
C.1.1	P-401 AC-WC, t = 5cm	7	Uneven runway surface	6.6	2.2%	1.5%
		7	Runway turn pad irregular surface	6.4	2.2%	1.4%
		7	The actual length of the runway surface does not meet aircraft operational requirements	5.4	2%	1.1%
		7	Unstable runway soil structure	5.0	-	-
		7	The earthquake- susceptible runway area	5.1	3.4%	1.7%
		7	Runway area susceptible to tsunamis	10.2	3.2%	3.3%
		7	The runway slope is not according to specifications	11.1	-	-
C.1.2	P-401 AC-BC, t = 10cm	7	Runway turn pad is not according to specifications	6.1		
		7	The average texture depth of the new runway surface is less than 1.0 mm	5.3		
		7	Corrugated runway surface	7.6		
		7	Aggregate and cements layouts are not optimal	6.1	-	-
C.1.3	P-304 Cement Treated Base Course, t = 20 cm	7	Limited support machines	7.0	2.4%	1.7%
C.1.4	P-209 Crushed Agregate Subbase, t = 43 cm	7	Extreme weather (rainy season)	5.3	3%	1.6%
C.1.5	Tack Coat	7	Runway surface is too slippery	5.4	-	-
C.1.6	Prime Coat	7	Asphalt/bitumen spread is not optimal	5.7	2.2%	1.3%
		7	Runway shoulder surface is bumpy / not flat with runway surface	6.4	-	-

Table 5.10. Relationship between Risk Level and Project Acceleration (Assumption 7 weeks) (Continue..)

No.	Work Item	PA (weeks)	RF	RP	RI	Ra
C.2	Runway Flexible Sholulders (41460 m2)	7	The runway shoulder surface for jet aircraft is not coated in asphalt / bitumen / concrete	5.9	-	-
C.2.1	P-401 AC-WC, t = 5cm	7	The shoulder surface of the runway for the Boeing 737-800 / A380 is not widened by 7 m outside the shoulder	6.6	-	-
C.2.2	P-401 AC-BC, t = 5cm	7	Runway shoulder pad runway is not wide enough	7.0	2.2%	1.5%
C.2.3	P-304 Cement Treated Base Course, t = 15 cm	7	Runway shoulders do not have the same width on both sides	5.4	-	-
		7	Runway shoulders more than 2.5%	6.6	-	-
C.2.4	P-209 Crushed Agregate Subbase, t = 15 cm	7	Runway shoulders are not resistant to erosion due to aircraft engine bursts	6.9	-	-
		7	Tack coat spreader works not optimal	7.5	2.6%	2.0%
C.2.5	Tack Coat	7	Human error due to 24 hours of work	7.6	-	-
C.2.6	Prime Coat	7	Inefficient material supply	7.3	-	-

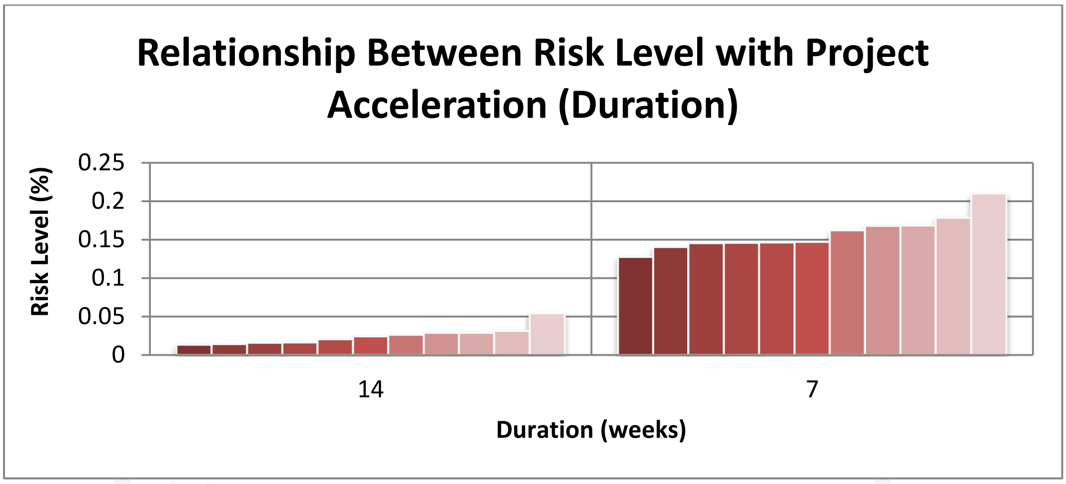

Figure 5.7. Graphic of The Relationship Between Risk Level And Project Acceleration

5.5.3. Relationship Between Risk Level and Expected Monetary Loss of Project

In this section, explain the level of risk with the value of the project loss. The project loss value is obtained from the calculation of the total price per work item on runway project. For example based on table 5.11 we can calculating the expected monetary of loss on variable R_{17} where asphalt/bitumen spread is not optimal as followed:

Expected Monetary of Loss (EML) = Σ(Pi × Ii) × Value (Budget Plan)

= 5.7 × 2.5% × Rp. 5.015.205.000

= Rp. 7.107.360.46

So, we can know that is the expected monetary of loss on variable R_{17} where asphalt/bitumen spread is not optimal is Rp. 7.107.360.46.

Where:

P = Percentage probability of occurrence for the risk.

I = Monetary value of the impact of the risk when it occurs.

Value (Budget Plan) = Value on work item.

EML = Estimated value of loss when the risk may be occurred on project.

Table 5.11. Possibility (Impact) Criteria (Assumption 50%, 7 weeks) of cost, time and safety

No.	Work Item	Value	PA (weeks)	RF	RI			
					Cost	Time	Quality	Safety
C.1	Runway Flexible Body(195000 m2)		7	Runway original land contours are uneven	Requires additional funds of 2.4%	Experienced deviation on target 2.4%	Failed to fulfill the promise to the client 2.4%	Workers are susceptible to work accidents because the original ground surface is uneven and the plane is susceptible to slipping due to the bumpy runway's original ground surface.
C.1.1	P-401 AC-WC, t = 5cm	Rp 26,752,105,575	7	Soil compaction is not according to specifications	Requires additional funds of 2.6%	Experienced deviation on target of 2.6%	Failed to fulfill promises to clients 2.6%	Workers are susceptible to work accidents because the original ground surface is uneven and the plane is susceptible to slipping due to the bumpy runway's original ground surface.
			7	Uneven runway surface	Requires additional funds of 2.2%	Has deviation from target of 2.2%	Failed to fulfill the promise to the client 2.2%	Workers are susceptible to work accidents because the original ground surface is uneven and the plane is susceptible to slipping due to the bumpy runway's original ground surface.
			7	Runway turn pad irregular surface	Requires additional funds of 2.2%	Has deviation from target of 2.2%	Failed to fulfill the promise to the client 2.2%	Workers are susceptible to work accidents because the original ground surface is uneven and the plane is susceptible to slipping due to the bumpy runway's original ground surface.
			7	The actual length of the runway surface does not meet aircraft operational requirements	Requires additional 2% funds	Has deviation on target of 2%	Failed to fulfill the promise to the client 2%	Workers are susceptible to work accidents because the original ground surface is uneven and the plane is susceptible to slipping due to the bumpy runway's original ground surface.
			7	Unstable runway soil structure	-	-	-	-
			7	The earthquake-susceptible runway area	Requires additional funds 3.4%	Experiencing procrastination affects stakeholders 3.4%	Some functions cannot be utilized 3.4%	Workers are susceptible to work accidents because the surface experiences an earthquake
			7	Runway area susceptible to tsunamis	Requires additional funds 3.2%	Experiencing procrastination affects stakeholders 3.2%	Some functions cannot be utilized 3.2%	Workers are susceptible to work accidents because high waves can come at any time.

Table 5.11. Possibility (Impact) Criteria (Assumption 50%, 7 weeks) of cost, time and safety (Continue..)

No.	Work Item	Value	PA (weeks)	RF	RI			
					Cost	Time	Quality	Safety
C.1.2	P-401 AC-BC, t = 10cm	Rp 52,934,257,350	7	The runway slope is not according to specifications	-	-	-	-
			7	Runway turn pad is not according to specifications				
			7	The average texture depth of the new runway surface is less than 1.0 mm				
			7	Corrugated runway surface				
C.1.3	P-304 Cement Treated Base Course, t = 20 cm	Rp 29,925,090,000	7	Aggregate and cements layouts are not optimal	-	-	-	-
C.1.4	P-209 Crushed Agregate Subbase, t = 43 cm	Rp 35,092,231,200	7	Limited support machines	Requires additional funds of 2.4%	Experienced deviation on target 2.4%	Failed to fulfill the promise to the client 2.4%	Workers are susceptible to work accidents due to using tools simultaneously in a small work scope
C.1.5	Tack Coat	Rp 4,919,460,000	7	Extreme weather (rainy season)	Requires a significant additional 3% funding	Failed to meet the 3% target	Failure to meet overall needs 3%	Workers are susceptible to work accidents due to slippery surfaces.
C.1.6	Prime Coat	Rp 5,015,205,000	7	Runway surface is too slippery	-	-	-	-
			7	Asphalt/bitumen spread is not optimal	Requires additional funds of 2.2%	Has deviation from target of 2.2%	Failed to fulfill the promise to the client 2.2%	Workers are susceptible to work accidents and airplane wheels can break during landing due to uneven bitumen laying.
C.2	Runway Flexible Sholulders (41460 m2)	Rp 5,687,789,920	7	Runway shoulder surface is bumpy / not flat with runway surface	-	-	-	-
C.2.1	P-401 AC-WC, t = 5cm		7	The runway shoulder surface for jet aircraft is not coated in asphalt / bitumen / concrete	-	-	-	-

Table 5.11. Possibility (Impact) Criteria (Assumption 50%, 7 weeks) of cost, time and safety (Continue..)

No.	Work Item	Value	PA (weeks)	RF	RI			
					Cost	Time	Quality	Safety
C.2.2	P-401 AC-BC, t = 5cm	Rp 5,627,200,718	7	The shoulder surface of the runway for the Boeing 737-800 / A380 is not widened by 7 m outside the shoulder	-	-	-	-
C.2.3	P-304 Cement Treated Base Course, t = 15 cm	Rp 4,771,808,813	7	Runway shoulder pad runway is not wide enough	Requires additional funds of 2.2%	Has deviation from target of 2.2%	Failed to fulfill the promise to the client 2.2%	The runway shoulder walls are susceptible to erosion due to bursts during takeoff
			7	Runway shoulders do not have the same width on both sides	-	-	-	-
C.2.4	P-209 Crushed Agregate Subbase, t = 15 cm	Rp 2,602,675,907	7	Runway shoulders more than 2.5%	-	-	-	-
			7	Runway shoulders are not resistant to erosion due to aircraft engine bursts	-	-	-	-
C.2.5	Tack Coat	Rp 1,045,931,941	7	Tack coat spreader works not optimal	Requires additional funds of 2.6%	Experienced deviation on target of 2.6%	Failed to fulfill promises to clients 2.6%	Workers are susceptible to work accidents because the tack coat laying tool is not working properly
C.2.6	Prime Coat	Rp 1,066,288,393	7	Human error due to 24 hours of work	-	-	-	-
			7	Inefficient material supply	-	-	-	-

Table 5.12. Possibility (Impact) Criteria (Assumption 50%, 7 weeks)

No.	Work Item	Value	PA (weeks)	Rn	RP	RI Cost	EML (Rp)
C.1	Runway Flexible Body(195000 m2)	Rp 26,752,105,575	7	R1	6.5	2.6%	Rp 44,950,225.39
C.1.1	P-401 AC-WC, t = 5cm		7	R2	6.6	2.9%	Rp 50,606,623.71
			7	R3	6.6	2.5%	Rp 43,776,476.76
			7	R4	6.4	2.5%	Rp 41,750,673.57
			7	R5	5.4	2.3%	Rp 32,503,808.27
			7	R6	5.0	-	-
			7	R7	5.1	3.7%	Rp 50,491,389.02
			7	R8	10.2	3.6%	Rp 97,225,511.69

Table 5.12. Possibility (Impact) Criteria (Assumption 50%, 7 weeks) (Continue..)

No.	Work Item	Value	PA (weeks)	Rn	RP	RI Cost	EML (Rp)
C.1.2	P-401 AC-BC, t = 10cm	Rp 52,934,257,350	7	R9	11.1	-	-
			7	R10	6.1		
			7	R11	5.3		
			7	R12	7.6		
C.1.3	P-304 Cement Treated Base Course, t = 20 cm	Rp 29,925,090,000	7	R13	6.1	-	-
C.1.4	P-209 Crushed Agregate Subbase, t = 43 cm	Rp 35,092,231,200	7	R14	7.0	2.7%	Rp 66,324,316.97
C.1.5	Tack Coat	Rp 4,919,460,000	7	R15	5.3	3.3%	Rp 8,661,877.70
C.1.6	Prime Coat	Rp 5,015,205,000	7	R16	5.4	-	-
			7	R17	5.7	2.5%	Rp 7,107,360.46
C.2	Runway Flexible Sholulders (41460 m2)	Rp 5,687,789,920	7	R18	6.4	-	-
C.2.1	P-401 AC-WC, t = 5cm		7	R19	5.9	-	-
C.2.2	P-401 AC-BC, t = 5cm	Rp 5,627,200,718	7	R20	6.6	-	-
C.2.3	P-304 Cement Treated Base Course, t = 15 cm	Rp 4,771,808,813	7	R21	7.0	2.5%	Rp 8,154,424.78
			7	R22	5.4	-	-

Table 5.12. Possibility (Impact) Criteria (Assumption 50%, 7 weeks) (Continue..)

No.	Work Item	Value	PA (weeks)	Rn	RP	RI cost	EML (Rp)
C.2.4	P-209 Crushed Agregate Subbase, t = 15 cm	Rp 2,602,675,907	7	R23	6.6	-	-
			7	R24	6.9	-	-
C.2.5	Tack Coat	Rp 1,045,931,941	7	R25	7.5	2.9%	Rp 2,271,262.13
C.2.6	Prime Coat	Rp 1,066,288,393	7	R26	7.6	-	-
			7	R27	7.3	-	-
		Rp 175,440,044,816			17.8		**Rp 453,823,950.46**

From figure 5.6 we can see that the highest loss is in work item C.1.1. P-401AC-WC, t = 5 cm where the risk factor for the prone to tsunamis runway area is 97,225,511.69 rupiahs with an aggregate risk of 3,6%. The smallest loss on work items C.2.5. Tack Coat where risk factor tack coat spreader works is not optimal 2,271,262.13 rupiahs with an aggregate risk of 2,2%. In short, the higher of risk impact occurs, the higher of losses to response.

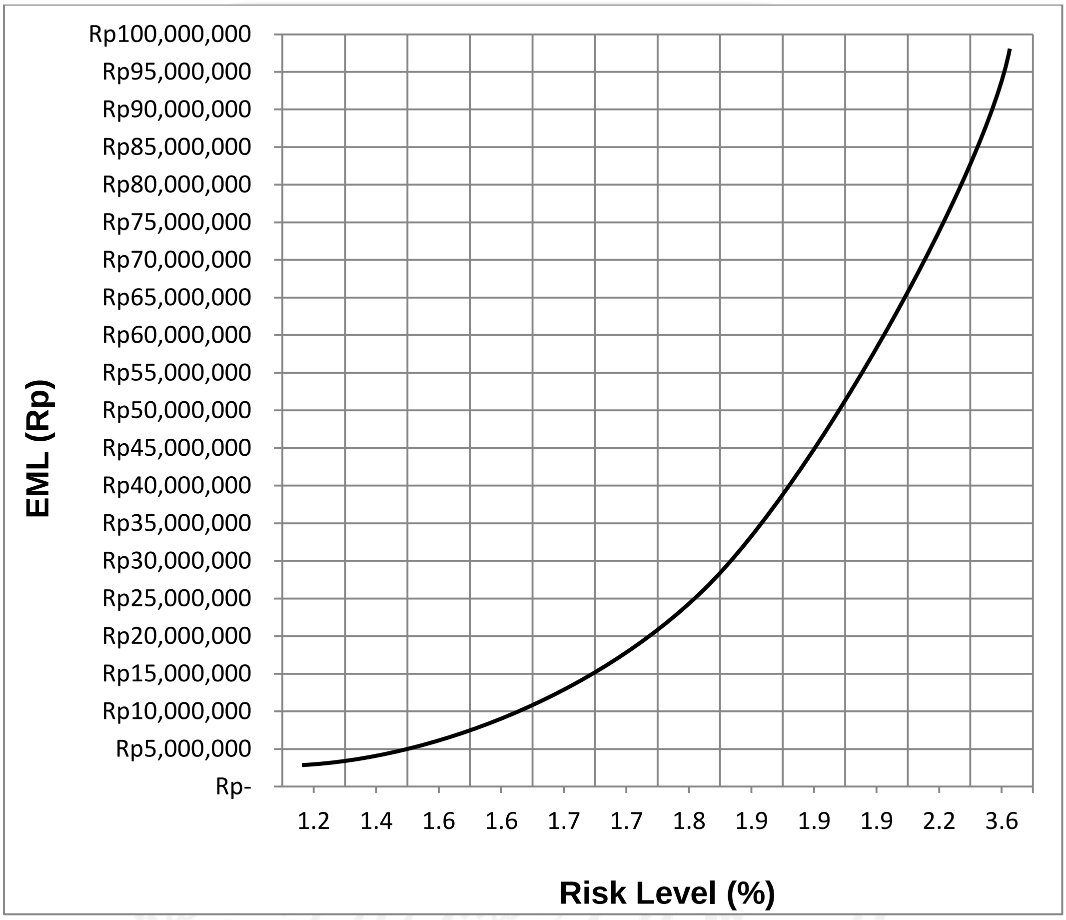

Figure 5.8. Graphic Relationship between Loss Value and Risk Agregate per work item at Pavement Runway Project

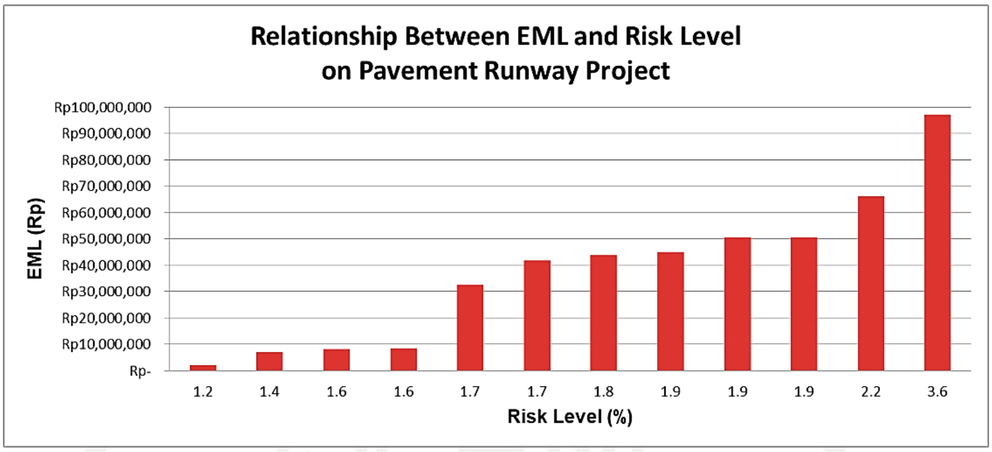

Figure 5.9. Graphic Relationship between Loss Value and Risk Agregate per work item at Pavement Runway Project (1)

CHAPTER 6
CONCLUSION AND RECOMENDATION

6.1. Conclusions

The conclusions of the several descriptions in chapters 1 through 5 regarding the implications of the risk impact on project acceleration are:

1. On the indentification a risk we just need a framework on pavement runway project. Starting from a variety of airside works to focus on runway projects then brings them in the table with variables R_1 to R_{27} on each runway project.
2. On the analysis of the risk level in the pavement runway project is divided into five levels of risk for three samples. The average risk level in assumption 50% duration on 7 weeks the highest risk is on work item C.1.1. P-401 AC-WC, t=5 cm at the variable R8 (runway area susceptible to tsunamis) 3,6%. The lowest risk is on work item C.1.1. P-401 AC-WC, t=5 cm at the variable R5 (the actual length of the runway surface does not meet aircraft operational requirements) 1,2%.
3. In mapping or categorizing risks to the level of risk in this research based on the value of the percentage of probabilities and impacts explained that twenty-four of twenty-seven technical risk factors are categorized as mitigable risks while three of them are categorized as risks to avoid.
4. On the risk response or risk allocation strategy if viewed from the risk category that can be mitigated, the risk can be minimized by changing work or technical methods. If viewed from the category of risk that must be avoided, the risk can be minimized by carrying out risk control in the form of field testing or laboratory testing to avoid hazards during the project or after the project is completed.
5. In the condition that the duration of the project acceleration assumption is 50% (7 weeks), the heavy risk is in the R7 variable or the runway area is susceptible to earthquakes where the risk is 3.6% in

cost, time and quality the safety of occupational health. In the condition that the duration of the project acceleration assumption is 50% (7 weeks), the risk is moderate in the variable R25 or the tack coat spreader does not work optimally where the risk is 2.2% in cost, time and quality the safety of occupational health. Last is In the condition that the duration of the project acceleration assumption is 50% (7 weeks), the light risk is in the R5 variable or the actual length of the runway does not meet the aircraft operational requirements where the risk is 1.2% in cost, time and quality the safety of occupational health.

6. The highest loss is in work item C.1.1. P-401AC-WC, t = 5 cm where the risk factor for the prone to tsunamis runway area is 9,722,551.17 rupiahs with an aggregate risk of 3,6%. The smallest loss on work items C.2.5. Tack Coat where risk factor tack coat spreader works is not optimal 227,126.21 rupiahs with an aggregate risk of 2,2%.

6.2. Recomendations

The suggestions that can be submitted in this research regarding the implications of the impact of risks on project acceleration are:

1. In carrying out a project if you want to accelerate the time of project implementation, it should pay attention to the risks that may occur and the impact of the risks when the project is implemented and after the project is completed by considering the strategy or risk response allocation so that the risk can be minimized.
2. This research should be continued in order to know the implications of losses from the impact of risk on the accelerated pavement runway project.

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