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Research Paper

Analysis Model and Financial Risk Mitigation Strategy in Decision Making For Investment Feasibility in Developing the Development of a Gas Engineering Power Plant Project in Riau Province

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ABSTRACT

The power plant construction project is a dynamic strategic project and has various risks that have the potential to cause realization to not go according to plan. The success of the construction project implementation can be seen from the accuracy in maintaining triple constraints (cost, quality, and time). Risk analysis on a project for long-term investment and the success of project development according to planning is very important, so it is necessary to carry out analytical modeling to mitigate risks due to the complexity of the problems faced in the construction of the power plant project, especially in Riau Province with the development of a gas engine power plant project. The results showed that there are still risks that can hamper the smooth development of the PLTMG power plant project in Riau Province by focusing on investment financial risks, including risk events for implementation time management, project cash flow governance, incidents of risk of material fulfillment difficulties and risk events of contract detail specifications. From the results of the analysis of mitigation, the main risk mitigation priority consists of several groups according to the results of the analysis, namely Identifying critical and alternative processes that can be carried out, Optimizing work methods and resources that are implemented in the time schedule, implementing WBS in project work schedule planning and monitoring and Periodic progress evaluation with each mitigation value of 0.38, 0.29, 0.17 and 0.16. Furthermore, planning project financial resources, Availability of project budget according to RKAU and project business processes, Good work scheduling and project resource management according to cash flow plans, Creating planning schedules for budget verification and control, Timely project progress with project documentation in accordance with procedures, System Implementation Quality Management 9001: 2015, coordination and simple bureaucratic processes with respective mitigation values of 0.27, 0.17, 0.17, 0.13, 0.12, 0.09 and 0.06. Furthermore, Contract with material providers so that the Material is ordered in advance (either using DP or not) for arrival according to the project schedule, Monitoring and evaluation of material procurement according to the project schedule, Alternative Material Manufacturing Planning, Substitution of similar materials and reengineering and Contracting with expeditions so that it has control on the delivery of materials with each mitigation value of 0.46, 0.28, 0.11, 0.08 and 0.06 and furthermore a detailed explanation of technical specifications at the time of anwijzing, having a reliable engineering and construction team, contract details both drawings and needs detailed materials and modeling the design following changes with the respective mitigation values of 0.33, 0.26, 0.25 and 0.16.

Keywords: *Mitigation Strategy, Decisions, Financial Risks and Investment Feasibility*

INTRODUCTION

Electricity has a very complex role in accelerating the productivity of increasing the country's economy. The industrial sector as a consumer of premium electrical energy causes the need (demand) for electricity to increase, while the availability of electricity supply is not balanced, resulting in an electricity deficit. To meet the demand for electrical energy and to reduce diesel generation, efforts are made to produce electrical energy in order to use it. renewable energy or by using energy sources that are still abundant and provide sufficient energy, including for peak load needs (peaking load).

According to the PT PLN (Persero) RUPTL electricity supply business plan document for the period 2019-2028 the highest peak load of the Riau system reaches 681 MW and under certain conditions it still requires power transfer from West Sumatra and North Sumatra. The sales demand for the last 10 years has grown by an average of around 8.31%. The growth of Riau Province is estimated to remain high in the coming year and attracts attention of investors to invest in Riau Province, thus increasing the industry. To meet the need for electricity and pay attention to the potential energy sources, Riau Province has an energy source consisting of petroleum, it is estimated that around 2,875.2 million barrels / MMSTB tank stock, natural gas is around 1.09 trillion of standard cubic feet / TSCF. The company is planning the development of the Gas Engine Power Plant / PLTMG, Mobile Power Plant project by taking into account the potential energy sources stored in several regions in Indonesia, including in the Sumatra Region, namely in Riau Province.

The power plant construction construction project is a dynamic strategic project and has various risks that have the potential to cause realization to not go according to plan. Risks that arise can have an impact on the performance and financial cost limits of the project from pre-construction, construction and post-construction, which are very significant for the sustainability of the project. The success of the construction project implementation can be seen from the accuracy in maintaining triple constraints (cost, quality, and time). Risk analysis on a project for long-term investment and the success of project development according to planning is very important, so it is necessary to carry out analytical modeling to mitigate risks due to the complexity of the problems faced in the construction of the generator project. Like several similar power plant construction projects located in North Sumatra and Aceh that have been undertaken, there are so many problems that have become obstacles to this development. Of course, these experiences become a reference in determining the potential risks that may occur in subsequent projects.

The construction of PLTMG MPP is one solution, where the generator fuel uses dual fuel which can operate using natural gas and diesel Marine Fuel Oil / MFO, with the assumption that if gas supply is hampered, the generator can still be operated by using MFO which is much cheaper than high-diesel diesel. speed diesel (HSD). Electricity development of PLTMG MPP is a strategic program from the government (National Capacity Building) to utilize and improve the capabilities of domestic technological and economic aspects. The planning of the generating system aims to obtain a configuration for the development of the plant in which the BPP and MFO are only around Rp. 1,500 / kWh, the difference is Rp. 500 / kWh compared to HSD which reached Rp. 2,000 / kWh. Using gas can be much more efficient, ranging from Rp. 1,188 / kWh.

According to Suparno et. al, (2013) the success of a construction project depends on the ability of the project manager to manage the risks that occur. In an effort to maintain project success, it is necessary to control potential risks by carrying out comprehensive identification for the purpose of mitigating potential risks, especially the potential for financial risks that significantly affect project success. According to Dixit and Pindyck (1994), financial risk has various forms, the most common of which are valatility in the investment market, bankruptcy, high inflation, and recession. Financial risk is one of the main concerns of any business across fields and geographies. Financial risk is one type of high priority risk for any business. Financial risks caused by market movements and market movements can include a number of factors. Based on this, financial risk can be classified into various types such as market risk, credit risk, liquidity risk, operational risk and legal risk.

According to Hopkinson (2011) risk management is an activity carried out to respond to known risks. The steps for implementing risk management will always begin with the setting of goals and processes or aspects to achieve them. Everything related to the achievement of goals is never separated from the uncertainty factor that can occur due to the absence or lack of information about events that will occur in the future, both positive and negative events. Meanwhile, Minister of Finance Regulation No. 191 / PMK.09 / 2008, risk management is a systematic approach to determine the best course of action in conditions of uncertainty.

The construction of electricity generation centers cannot be separated from the factor of financing. In order to realize the construction of PLTMG plants, investment is needed to support development activities. According to Todaro in Rini et al (2012: 35) investment plays an important role in moving the life of the nation. Investment is investment in a company or project for the purpose of making a profit. Therefore, the financial risk factor on the investment value is an important highlight that needs to be controlled by investors through the company managing the power plant construction project activities. The investment in the construction of PLTMG MPP requires a very large cost, so it requires financial analysis in terms of project financing and funding.

Project funding risks can arise from sources of funds, which mostly come from equities and bonds. In addition, the impact is in the form of cost overrun and delays in project completion. Cost overrun results in losses for the contractor because the types of contracts used are engineering, procurement, & construction / EPC contracts, and for the project owner it has an impact on the construction work schedule that has the potential to experience delays. Therefore it is very important to identify potential risks in order to reduce losses that might result.

Identification of the risk probability that may occur is the first step in controlling the achievement of targets as expected by measuring the level of each risk that may occur and mapping each level of risk. Risk identification is a combination of deterministic, probability, and quantitative methods. Risk management is a coordinated activity to direct and control an organization in dealing with risk (ISO 31000: 2018). Then proceed with the mitigation process and monitoring methods. This aims to increase the possibility of positive impacts and decision making by the Management of events or activities carried out in the construction of the MPP PLTMG project and mitigate events that have a negative impact. Various potential risks can occur in a project. The right mitigation will certainly bring benefits to the project. Correct identification and analysis of the factors that cause financial loss in the completion of the project will be able to maintain the triple constraint.

LITERATURE REVIEW

Project management

Project management is all planning, implementation, control, and coordination of a project from the start (idea) to the end of the project to ensure that the project is carried out in a cost-effective, on-quality, and on-cost manner.

Risk

Risk is the uncertainty that has an impact on the target (objective centric). the influence of uncertainty is centered on the achievement of company goals or targets.

Risk management

Risk management is defined as a directed and coordinated organizational activity that deals with risks. Risk management is based on principles, frameworks and processes as shown in the figure. In simple terms, the company's risk management process needs to understand the objectives and context of risk, risk identification, risk analysis, risk evaluation, risk treatment, and risk reporting.

Risk Evaluation

Risk evaluation aims to assist the decision-making process. Risk evaluation includes the process of comparing the results of the analysis of each risk against predetermined risk criteria, to determine whether further action against these risks is required.

RESEARCH METHODS

The research was conducted using the causal effect research method. The causal effect research in question is research that aims to determine the relationship or influence between two or more variables (Sugiyono, 2012). The causal effect research in this study is used to identify and analyze the effect of project financial investment analysis on potential sources of risk in the PLTMG MPP plant development plan in Riau province, to identify and analyze the effect of risk mitigation on the management of critical risk sources.

This research was conducted at the Sumatra Power Plant Development Parent Unit Company which is located in Medan. This parent unit handles development for the Sumatra island region. The location of the project plan to be analyzed in this study is located in Riau Province. The population in the study were employees of the Sumatra Power Plant Development Main Unit who already had experience in power plant construction projects in the island of Sumatra. The determination of this pollulation is because the project has very unique characteristics, where each type of project has a different risk from one another, so that the research results focus on risk issues that are sometimes in power plant construction projects, the data population is taken in the same environment. The number of research samples is based on the research population, where the larger the sample taken, the more it represents the shape and character of the population and is more generalizable. then the sample size is at least 30 subjects.

The data used in this study are primary data used in this study using data collection methods carried out by questionnaires and brainstorming on key persons or those directly related to the PLTMG MPP generator project in Riau province and or similar projects. Secondary data are obtained through data processing, and data analysis, and drawing conclusions as an evaluation of research results. Through benchmarks, and documentary studies of similar projects that have been carried out on risk factors that are relevant to risk analysis and mitigation models in construction projects.

RESULT AND DISCUSSION

Description of the PLTMG Project Plan in the Riau Region

PLTMG or Gas Engine Power Plant, is an alternative to the provision of electricity in Indonesia by PT. PLN (Persero). PLTMG or Gas Engine For Power Generation, is a power plant that uses a reciprocrating type engine which has a four-step otto cycle working principle, where mechanically there is no much difference from the diesel engine used in PLTD (Diesel Power Plant). the basis is on the fuel used.

Risk Identification

The risk identification in the PLTMG development plans in the Riau region is based on the financial risks that arise from the project feasibility analysis as detailed in the sub-chapter. Based on this analysis, interviews and brainstorming were conducted with a person in charge (PIC) or risk owner who has capabilities in similar development projects, experience and documentation of previous work to help identify critical risks that contain triple contrain risk. The risk list is then documented and managed for later in accordance with the research objectives for further analysis.

Based on the risk documentation list, it is then classified into 9 (nine) lists of risk events. The assumptions used in the project feasibility study, such as exchange rate risk and other macro risks, are included in the category of economic events, where 11 (eleven) sources of risk are identified which usually cause these risks to affect the project's feasibility. By using the project risk owner / PIC point of view, in this case the PLN Project Manager, there is a source of risk, namely project financing governance with 6 (six) sources of risk. With a project value of nearly Rp. 500 billion (estimated exchange rate of Rp. 14,000 / USD), the procurement of project financing is critical, and becomes the main problem if not met. By using the operational technical point of view where the work is carried out, it is known that there are 9 (nine) risk events. The overall identification of risk events and sources of risk can be seen in the following table:

Table of Criteria for the Value of the Possible Frequency and Impact of Risk

Score	Possible Frequency		Impact	
	Criteria	Description	Criteria	Description
5	Almost certain	Always occur in every condition (more than> 4 times in a span of 5 years)	Awfully	There was a project cost overrun of 7.5 - 10%
4	Most likely	Potential for each condition (3 times in a span of 5 years)	Crisis	There was a project cost overrun of 5 - 7.5%
3	Maybe	May occur under certain conditions (2 times in a span of 5 years)	Moderate	There was a project cost overrun of 2.5 - 5%
2	Small possibility	Probability under certain conditions (1 time in 5 years)	Small	There was a project cost overrun of <2.5%
1	Impossible	Impossible (0 times in a span of 5 years)	Can be ignored	Has no impact on project costs

Source: (Liu & Tsai, 2012)

Risk Priority

Risk priority calculation aims to determine the priority level of all risk events. The data is calculated based on the data in the table with the calculation of the risk index for each risk event. The calculation of the risk index is done by multiplying the average value of the frequency of risk events with the risk impact for each risk source and then the risk index value for each Risk Event is calculated which is derived from the average of the results of the calculation of all risk sources. The results of the risk index calculation of risk events.

Table of Calculation Results Average Frequency X Impact of Risk Events

No	Incident risk	Mean F x D
K1	Economic Situation	11,922
K2	Project Financing Governance	11,635
K3	Difficulty Fulfilling Contract Conditions	8,041
K4	Project Cash Flow Governance	12,942
K5	Billing Difficulty	11,609
K6	Implementation Time Management	14,966
K7	Material Fulfillment Difficulties	12,852
K8	Late Payment to Suppliers	11,816
K9	Contract Details Specifications	13,457

Source: Questionnaire I Data Processing

Based on it is known that 4 (four) high-level risk events are indicators of the need for more handling, namely:

- Implementation Time Management with an average value of 14,966
- Contract Detail Specifications with an average value of 13.457
- Project cash flow governance with an average value of 12,942
- Material Fulfillment Difficulties with an average value of 12,852

Risk Map Matrix

Apart from calculating the risk index, determining risk priorities can be done by using a probability impact matrix. Probability impact matrix is a risk detection method that aims to determine risk priority areas for which risk responses need to be discussed. In the probability impact matrix method only uses two main criteria to determine risk priority, namely the value of severity (impact) and occurrence (frequency). . The data for calculating the average value of severity and occurrence is obtained from the results of questionnaire I, rounding up is performed for decimal values greater than 0.5 (≥ 0.5) and rounding down for decimal values smaller than 0.5 (<0.5). This needs to be done because the risk level assessment in the probability impact matrix method refers to whole numbers. The reference for the risk matrix map image is the following figure is the result of the risk event matrix map in questionnaire I.

Risk Map Matrix Table

			Impact				
			1	2	3	4	5
			Can be ignored	Small	Moderate	Critical	Awfully
frequency	5	Almost certain					
	4	Most likely				4,6,7,9	
	3	Maybe			3,8	1,2,5	
	2	Small chances					
	1	Impossible					

Source: Questionnaire I Data Processing

The probability impact matrix provides an illustration related to the assessment of existing risk events. In this case, risk events are grouped into four levels, namely mild risk, medium risk, high risk and extreme risk (ISO 31000, I. O, 2018). From the results of the probability impact matrix assessment in Table 4.8, it can be concluded that risk events that have a risk level are classified as critical and must be mitigated. There are four risk events that are classified as the most risky according to the assessment using the probability impact matrix method, namely:

K4 - Project Cash Flow Management
K6 - Implementation Time Management
K7 - Material Fulfillment Difficulty
K9 - Contract Details Specifications

The results of the risk priority assessment obtained by the probability impact matrix method are almost the same as the risk priority levels obtained from the risk index calculation. To reduce both the risk level and the failure rate in the power plant construction project, it is necessary to mitigate the risk of these four risk events.

Risk Mitigation Design

A. Collecting Risk Mitigation

To obtain mitigation measures related to the four risk events with a high priority level above, a focus group discussion (FGD) was conducted and used a brainstorming form as an initiation. These activities are carried out for parties who have qualified capabilities both from career paths and length of work. Activities carried out with project managers and senior managers who are within the scope of the PLN UIP KITSUM. In the FGD it was agreed that risk events that have a high area of the probability impact matrix, namely project financing governance (K2) and difficulty collecting collection (K5) have also been accommodated for risk events Project cash flow governance (K4), where mitigation for K2 and K5 is included as defined in the mitigation of K4 risk. As for the economic situation (K1), the risk mitigation will be adjusted so that it can be accommodated in K4, K6, K7 and K9 risk mitigation. For this reason, the discussion of mitigation steps is considered as one and the same risk event. Mitigation measures for each risk event obtained from the process can be presented in the following table:

The table below describes what mitigation can be done to manage risk events, with the hope of reducing the scale of the risk to be lower than before. This mitigation is a sub-attribute of a risk event, so there is a possibility for mitigation details according to the risk event sub-attribute, but it is still within the scope of the risk mitigation sub-attribute. The mitigation that is presented in the table does not have an order of importance or order of necessity, so further data processing is required to determine the sequence of mitigation based on the priority level of the mitigation. The data processing uses the AHP model.

Table List of Mitigation at Risk Events

K4 – Project Cash Flow Management	A	Project financial resource planning
	B	Availability of project budget according to RKAU and project business processes
	C	Creating a planning schedule for budget verification and control
	D	Project progress on time with appropriate project documentation
	E	Good job scheduling and project resource management according to a cash flow plan
	F	Simple bureaucratic coordination and processes
	G	Implementation of the Quality Management System 9001: 2015
K6 - Implementation Time Management	H	Periodic Monitoring and Progress Evaluation
	I	WBS implementation in project work schedule planning
	J	Identify critical processes and alternatives that can be done
	K	Optimization of work methods and resources that are implemented in the time schedule
K7 – Material Fulfillment Difficulties	L	Contract with the material provider so that the material is ordered in advance (either using a DP or not) for arrival according to the project schedule
	M	Planning for alternative material manufacturers
	N	Similar material substitution and reengineering
	O	Contracting with the expedition so that they have control over the delivery of material
	P	Monitoring and evaluation of material procurement according to the project schedule
K9 - Contract Details Specifications	Q	Detailed explanation of technical specifications during anwijzing
	R	Contract details both pictures and detailed material requirements
	S	Have a reliable engineering and construction team
	T	Perform design modeling following changes

Source: Brainstorming Form and FGD to the PLN UIP KITSUM Manager

B. Determining Priority for Mitigas Measures with AHP

By using the AHP model, the researcher will determine the mitigation sequence model based on the priority level. The AHP model begins with the creation of a II questionnaire, based on the mitigation steps in Table 4.5, which aims to determine the priority order of mitigation steps that need to be carried out. Questionnaire II was prepared using a pairwise comparison matrix pattern and was given to respondents in questionnaire I. Questionnaire II consisted of 4 parts, part A was a paired matrix to assess the priority of mitigation measures for the three identified risk events. Sections B, C, D and E respectively to assess the priority of mitigation measures for each risk event.

Questionnaire II was given to 4 managers who had the ability and expertise because they had already carried out a similar power plant project, and were also the occupants of the project that was planned to run. The following are the steps to determine the priority of mitigation measures:

I. Determining Priority for Risk Events

From the results of the data processing of Questionnaire II, it is obtained data to determine priorities for risk events as follows:

Pairwise Comparison Matrix Table Between Risk Event Attributes

	K4	K6	K7	K9
K4	1	0,7	2,0	2,3
K6	1,5	1	2,9	2,2
K7	0,5	0,3	1	0,6
K9	0,4	0,4	1,7	1
Total	3,43	2,46	7,61	6,16

Source: Questionnaire Data Processing II

In this case the pairwise comparison matrix between the risk event attributes has an order of 4 x 4, while the J column and the I row are represented by the attribute type, respectively 1) is represented by attributes K4, 2) is represented by attributes K6, 3) is represented by attributes K7 and 4) are represented by the attribute K9. The next step is weighting the priority of the elements in row i and column j which have been normalized.

If C1 is the number of comparison scales in the 1st column, then the total value in the table then becomes the value of Ci, so that C1 = 3.43, C2 = 2.46, C3 = 7.61 and C4 = 6.16. After determining the value of Ci, the next step is to determine the normal weight value for the attribute, by dividing the value by Ci, so that the weighting of the matrix is obtained as follows:

Table of Pairwise Comparison Matrix Normalization Between Attributes of Risk Events.

	K4	K6	K7	K9	Jumlah	Bobot
K4	0,29	0,27	0,26	0,38	1,20	0,30
K6	0,44	0,41	0,39	0,36	1,59	0,40
K7	0,15	0,14	0,13	0,10	0,51	0,13
K9	0,12	0,18	0,22	0,16	0,69	0,17
Total					4,00	1,00

Source: Questionnaire Data Processing II

After doing the whole pairwise comparison, then looking at the consistency ratio, which is a validation of the consistency of the respondent to the questionnaire that has been given. The following is a calculation to obtain a consistency ratio (CR) in accordance with the procedure described above in the Literature Review:

a. The first step is to get the maximum eigenvalue (λmaks) as follows:

λmaks = (C1 x W1) + (C2 x W2) + (C3 x W3) + (C4 x W4) = 4,052

b. The second step is to calculate the consistency index (CI), namely:

$$CI = \frac{\lambda_{maks} - n}{n - 1} = \frac{4{,}052 - 4}{4 - 1} = 0{,}0174$$

c. Furthermore, after the consistency index is known, the new consistency ratio (CR) can be determined as below.

$$CR = \frac{CI}{RI} = \frac{0{,}0174}{0{,}9} = 0{,}0193$$

the random index value refers to Table 2.5, for n = 4, the RI = 0.9.

d. The conclusion is that the value of CR = 0.0193 or less than 0.1, then the results of the pairwise comparison matrix assessment are consistent.

According to the results of the calculation of the normal attribute weight value in Table 4.7 and checking the consistency value, it is known that the respondent determines the weighting value for risk priority for risk events in order to place the priority order of risk event mitigation as follows:

• Implementation Time Management (weight 0.40).

• Project cash flow governance (with a weight of 0.30).

• Contract Detail Specifications (with a weight of 0.17).

• Material Fulfillment Difficulties (with a weight of 0.13).

From the weighted values above, the implementation time management is a risk event that has the highest priority compared to other risk events. For the second priority, there is a difference in the priority order of risk event mitigation when compared to the risk event priority calculation using the risk index method in the Table. This happens because when the severity and occurrence weight assessment of each part is assessed by different respondents, there is a subjective judgment and the perception of each respondent causes a difference in the weight assessment of each risk event

II. Determining Priority for Mitigation Measures in Risk Event Sub-attribute Governance Project Cash Flow (K4)

Based on the results of the data processing of Questionnaire II, it is obtained data to determine priorities for risk events as follows:

Matrix Table Pairwise Comparison on Risk Event Sub-attribute Project
Cash Flow Governance (K4)

	A	B	C	D	E	F	G
A	1	1,73	2,59	2,82	2,28	3,87	1,73
B	0,58	1	1,73	2,28	1,00	1,14	2,24
C	0,39	0,58	1	0,76	0,58	3,64	2,82
D	0,35	0,44	1,32	1	0,76	2,59	1,63
E	0,44	1,00	1,73	1,32	1	2,59	3,00
F	0,26	0,88	0,27	0,39	0,39	1	0,51
G	0,58	0,45	0,35	0,61	0,33	2,94	1
Total	3,59	6,08	9,00	9,17	6,34	17,77	12,92

Source: Questionnaire Data Processing II

The table above presents the pairwise comparison matrix between the risk event sub-attributes of project cash flow governance, the matrix has an order of 7 x 7, while the J column and the I row are represented by the type of attribute. The next step is weighting the priority elements in row I and column j which have been normalized. If C1 is the number of comparison scales in the 1st column, then the total value then becomes the value Ci, so that C1 = 3.59, C2 = 6.08, C3 = 9.00, C4 = 9.17, C5 = 6.34, C6 = 17.77 and C6 = 12.92.

After determining the value of Ci, the next step is to determine the normal weight value for the attribute, by dividing the value by Ci, so that the weighting of the matrix is obtained as follows:

Pairwise Comparison Matrix Normalization Table on Sub Attributes of Risk Events for Project Cash Flow Governance (K4)

	A	B	C	D	E	F	G	Total	Weight
A	0,278	0,285	0,288	0,307	0,360	0,218	0,134	1,87	0,27
B	0,161	0,165	0,192	0,248	0,158	0,064	0,173	1,16	0,17
C	0,107	0,095	0,111	0,083	0,091	0,205	0,218	0,91	0,13
D	0,099	0,072	0,146	0,109	0,120	0,146	0,126	0,82	0,12
E	0,122	0,165	0,192	0,143	0,158	0,146	0,232	1,16	0,17
F	0,072	0,145	0,031	0,042	0,061	0,056	0,039	0,45	0,06
G	0,161	0,074	0,039	0,067	0,053	0,166	0,077	0,64	0,09
Total								7	1

Source: Questionnaire Data Processing II

After doing the whole pairwise comparison, then analyzing the consistency ratio, which is a validation of the consistency of the respondent to the questionnaire that has been given. The following is a calculation to obtain a consistency index (CR) in accordance with the procedure described above in the Literature Review:

a. The first step is to get the maximum eigenvalue (λmaks) as follows:

λmaks = (C1 x W1) + (C2 x W2) + (C3 x W3) + (C4 x W4) + (C5 x W5) + (C6 x W6) + (C7 x W7) = 7,565

b. The second step is to calculate the consistency index (CI), namely:

$$CI = \frac{\lambda_{maks} - n}{n - 1} = \frac{7{,}565 - 7}{7 - 1} = 0{,}0941$$

c. Furthermore, after the consistency index is known, the new consistency ratio (CR) can be determined as below.

$$CR = \frac{CI}{RI} = \frac{0{,}0941}{1{,}32} = 0{,}0713$$

RI = random index value refers to Table for n = 7 then RI = 1.32.

d. The conclusion is that the value of CR = 0.0713 or less than 0.1, then the results of the pairwise comparison matrix assessment are consistent.

According to the results of the calculation of the normal attribute weight value in the table and checking the consistency value, it is known that the respondent determines the weighting value for risk priority on the risk event sub-attribute or managing cash flow project (K4) sequentially as follows:

- Planning for project financial resources (with a weight of 0.27).
- Availability of project budget according to RKAU and project business processes (weight 0.17).
- Good job scheduling and project resource management according to the low cash flow plan (weight 0.17).
- Creating a planning schedule for budget verification and control (with a weight of 0.13).
- Project progress on time with project documentation in accordance with procedures (weighing 0.12).
- Implementation of the Quality Management System 9001: 2015 (with a weight of 0.09).
- Simple bureaucratic coordination and processes (with a weight of 0.06).

III. Determining Priority Mitigation Measures for Sub Attribute Risk Events Implementation Time Management (K6)

Based on the results of the data processing of Questionnaire II, it is obtained data to determine priorities for risk events as follows:

Pairwise Comparison Matrix Table on Sub Attributes of Risk Event Management Implementation Time (K6)

	H	I	J	K
H	1	1,24	0,41	0,41
I	0,81	1	0,58	0,61
J	2,43	1,73	1	1,73
K	2,43	1,63	0,58	1
Total	6,67	5,59	2,57	3,76

Source: Questionnaire Data Processing II

In this case, the pairwise comparison matrix between the sub-attributes of the project time management risk event has the order of 4 x 4, while the J column and the I row are represented by the type of attribute. C1 is the sum of the scale of the comparison in the 1st column, so that C1 = 6.67, C2 = 5.59, C3 = 2.57 and C4 = 3.76. After determining the value of Ci, the next step is to determine the normal weight value of the attribute, by dividing the value by Ci, so that the weighting of the matrix is obtained as follows:

Pairwise Comparison Matrix Normalization Table on Risk Events Attributes of Management Implementation Time (K6)

	H	I	J	K	jumlah	bobot
H	0,15	0,22	0,16	0,11	0,64	0,16
I	0,12	0,18	0,23	0,16	0,69	0,17
J	0,36	0,31	0,39	0,46	1,52	0,38
K	0,36	0,29	0,23	0,27	1,15	0,29
jumlah					4,00	1,00

Source: Questionnaire Data Processing II

After doing the whole pairwise comparison, then analyzing the consistency ratio, which is a validation of the consistency of the respondent to the questionnaire that has been given. The following is a calculation to obtain a consistency index (CR) in accordance with the procedure described above in the Literature Review:

a. The first step is to get the maximum eigenvalue (λmaks) as follows:

λmaks = (C1 x W1) + (C2 x W2) + (C3 x W3) + (C4 x W4) = 4.087

b. The second step is to calculate the consistency index (CI), namely:

$$CI = \frac{\lambda_{maks} - n}{n - 1} = \frac{4{,}087 - 4}{4 - 1} = 0{,}0288$$

c. Furthermore, after the consistency index is known, the new consistency ratio (CR) can be determined as below.

$$CR = \frac{CI}{RI} = \frac{0{,}0288}{0{,}9} = 0{,}032$$

RI = random index value refers to the table, for n = 4 then RI = 0.9.

d. The conclusion is that the value of CR = 0.032 or less than 0.1, then the results of the pairwise comparison matrix assessment are consistent.

According to the results of the calculation of the normal attribute weight value in the table and checking the consistency value, it is known that the respondent determines the weighting value for risk priority for the sub-attribute risk event management time of implementation (K6) in order to mitigate as follows:

- Identifying critical processes and alternatives that can be done (with a weight of 0.38).
- Optimization of work methods and resources that are implemented in the time schedule (with a weight of 0.29).
- implementing WBS in the planning of the project work schedule (with a weight of 0.17).
- Periodic Progress Monitoring and Evaluation (with a weight of 0.16).

IV. Determining Priority Mitigation Measures for Sub Attribute Risk Events of Material Difficulty Compliance (K7)

Based on the results of the data processing of Questionnaire II, it is obtained data to determine priorities for risk events as follows:

Pairwise Comparison Matrix Table on Sub Attribute Risk of Material Compliance Difficulty Events (K7)

	L	M	N	O	P
L	1	5,44	4,79	5,44	2,14
M	0,18	1	1,72	1,94	0,41
N	0,21	0,58	1	1,94	0,21
O	0,18	0,51	0,51	1	0,21
P	0,47	2,43	4,79	4,79	1
Total	2,04	9,97	12,81	15,11	3,97

Source: Questionnaire Data Processing II

In this case, the pairwise comparison matrix between the risk event attributes, the project time management sub-attribute has an order of 5 x 5, while the J column and the I row are represented by the type of attribute. The next step is weighting the priority of the elements in row i and column j which have been normalized. If C1 is the number of comparison scales in the 1st column, then the total value in the table then becomes the value of Ci, so that C1 = 2.04, C2 = 9.97, C3 = 12.81, C4 = 15.11 and C5 = 3 , 97. After determining the value of Ci, the next step is to determine the normal weight value of the attribute, by dividing the value by Ci, so that the weighting of the matrix is obtained as follows:

Table of Pairwise Comparison Matrix Normalization on Sub-Attributes of Events Risk of Material Compliance Difficulty (K7)

	L	M	N	O	P	jumlah	bobot
L	0,49	0,55	0,37	0,36	0,54	2,31	0,46
M	0,09	0,10	0,13	0,13	0,10	0,56	0,11
N	0,10	0,06	0,08	0,13	0,05	0,42	0,08
O	0,09	0,05	0,04	0,07	0,05	0,30	0,06
P	0,23	0,24	0,37	0,32	0,25	1,41	0,28
Total						5,00	1,00

Source: Questionnaire Data Processing II

After doing the whole pairwise comparison, then analyzing the consistency ratio, which is a validation of the consistency of the respondent to the questionnaire that has been given. The following is a calculation to obtain a consistency ratio (CR) in accordance with the procedure described above in the Literature Review:

a. The first step is to get the maximum eigenvalue (λmaks) as follows:

λmaks = (C1 x W1) + (C2 x W2) + (C3 x W3) + (C4 x W4) + (C5 x W5) = 5,161

b. The second step is to calculate the consistency index (CI), namely:

$$CI = \frac{\lambda_{maks} - n}{n - 1} = \frac{5{,}161 - 5}{5 - 1} = 0{,}0401$$

c. Furthermore, after the consistency index is known, the new consistency ratio (CR) can be determined as below.

$$CR = \frac{CI}{RI} = \frac{0{,}0401}{1{,}12} = 0{,}035$$

RI = random index value refers to Table for n = 5 then RI = 1,2.

d. The conclusion is that the value of CR = 0.035 or less than 0.1, then the results of the pairwise comparison matrix assessment are consistent.

According to the results of the calculation of the value of the normal attribute weight in the consistency value check table, it is known that the respondent determines the weighting value for the risk priority of the sub-attributes of the risk of material fulfillment difficulty (K7), sequentially placing the mitigation priority order as follows:

- Contract with the material provider so that the material is pre-ordered (whether using Down Payment or not) for arrival according to the project schedule (with a weight of 0.46).
- Monitoring and evaluation of material procurement according to the project schedule (with a weight of 0.28).
- Planning for alternative material manufacturers (weight 0.11).
- Similar material substitution and reengineering (weight 0.08).
- Contracts with the specialist so that it has control over the delivery of material (weight 0.06).

V. Determining Priority for Mitigation Steps for Risk Events in Attributes Attribute Specifications Contract Details (K9)

Based on the results of the data processing of Questionnaire II, it is obtained data for the determination of priority on risk events as follows:

Pairwise Comparison Matrix Table on Sub Attributes Risk Events Attributes Contract Details Specifications (K9)

	Q	R	S	T
Q	1	1,32	1,32	1,97
R	0,76	1	1,14	1,32
S	0,76	0,88	1	1,97
T	0,51	0,76	0,51	1
Total	3,03	3,96	3,96	6,25

Source: Questionnaire Data Processing II

In this case, the pairwise comparison matrix between the risk event attributes, the sub-attribute of the contract detail specification has an order of 4 x 4, while the J column and the I row are represented by the type of attribute. The next step is weighting the priority of the elements in row i and column j which have been normalized. If C1 is the number of comparison scales in the 1st column, then the total value in the table then becomes the value of Ci, so that C1 = 3.03, C2 = 3.96, C3 = 3.96 and C4 = 6.25. After determining the value of Ci, the next step is to determine the normal weight value for the attribute, by dividing the value by Ci, so that the weighting of the matrix is obtained as follows:

Pairwise Comparison Matrix Normalization Table on Sub Attributes Risk Events Attributes Specifications Contract Details (K9)

	Q	R	S	T	jumlah	bobot
Q	0,33	0,33	0,33	0,31	1,31	0,33
R	0,25	0,25	0,29	0,21	1,00	0,25
S	0,25	0,22	0,25	0,31	1,04	0,26
T	0,17	0,19	0,13	0,16	0,65	0,16
Total					4,00	1,00

Source: Questionnaire Data Processing II

After doing the whole pairwise comparison, then analyzing the consistency ratio, which is a validation of the consistency of the respondent to the questionnaire that has been given. The following is a calculation to obtain a consistency index (CR) in accordance with the procedure described above in the Literature Review:

a. The first step is to get the maximum eigenvalue (λmaks) as follows:

λmaks = (C1 x W1) + (C2 x W2) + (C3 x W3) + (C4 x W4) = 4.025

b. The second step is to calculate the consistency index (CI), namely:

$$CI = \frac{\lambda_{maks} - n}{n - 1} = \frac{4{,}025 - 4}{4 - 1} = 0{,}0084$$

c. Furthermore, after the consistency index is known, the new consistency ratio (CR) can be determined as below.

$$CR = \frac{CI}{RI} = \frac{0{,}0084}{0{,}9} = 0{,}009$$

RI = random index value refers to Table for n = 4 then RI = 0.9.

d. The conclusion is that the value of CR = 0.009 or less than 0.1, then the results of the pairwise comparison matrix assessment are consistent

In accordance with the results of the calculation of the normal attribute weight value in the table and checking the consistency value, it is known that the respondent determines the weighting value for risk priority for the sub-attribute risk event, the contract detail specification is sequential as follows:

- Detailed explanation of technical specifications at the time of anwijzing (with a weight of 0.33).
- Have a reliable engineering and construction team (weighing 0.26).
- Contract details, both drawings and detailed material requirements (with a weight of 0.25).Conduct design modeling following changes (with a weight of 0.16).

C. Priority for Mitigation Measures

Based on the results of questionnaire II data processing using the AHP method, the following is attached

Table of Priority List of Mitigation Measures in Risk Events

Risk Events		Priority Risk	Mitigation Priorities		Mitigation Measures
K6	Implementation Time Management	1	0,38	J	Identify critical processes and alternatives that can be done
			0,29	K	Optimization of work methods and resources that are implemented in the time schedule
			0,17	I	WBS implementation in project work schedule planning
			0,16	H	Periodic Progress Monitoring and Evaluation
K4	Project Cash Flow Management	2	0,27	A	Project financial resource planning
			0,17	B	Availability of project budget according to RKAU and project business processes
			0,17	E	Good job scheduling and project resource management according to a cash flow plan
			0,13	C	Creating a planning schedule for budget verification and control
			0,12	D	Project progress on time with appropriate project documentation
			0,09	G	Implementation of the Quality Management System 9001: 2015
			0,06	F	Simple bureaucratic coordination and processes
K9	Contract Details Specifications	3	0,46	L	Contracting with material providers so Booked materials in advance (either using DP or not) for arrival according to the project schedule
			0,28	P	Monitoring and evaluation of material procurement according to the project schedule
			0,11	M	Alternative Material Manufacturing Planning
			0,08	N	Similar material substitution and reengineering
			0,06	O	Contracting with the expedition so that they have control over the delivery of material
K7	Material Fulfillment Difficulties	4	0,33	Q	Detailed explanation of technical specifications during anwijzing
			0,26	S	Have a reliable engineering and construction team
			0,25	R	Contract details, both drawings and detailed material requirements
			0,16	T	Perform design modeling following changes

Source: Questionnaire Data Processing II

Based on the table, it is known that the risk management event during implementation with the first priority mitigation step is to identify critical processes and alternatives that can be carried out. This first priority is in accordance with the results of the brainstorming that was carried out where, for a large-value development project (nearly Rp. 500 billion), careful planning is needed related to the integrity of the project, especially critical processes, which need to be identified first, especially mitigation alternatives to overcome the identification of this critical process. Budget planning by identifying wrong critical processes will cause systemic risks that start from delays in meeting project schedules. The source of financial planning also requires the calculation or analysis of the feasibility of investing in the project, which for this research is represented by the results (feasibility study) carried out by an independent party. A good investment feasibility analysis projection with a positive IRR reflection and several good key indicators will have a direct impact on the process of fulfilling financial resources for project sustainability.

D. Managerial Implications of the PLTMG Development Project Plan

Based on the results and analysis produced by the study, there are several things that can be proposed which are expected to have a managerial impact related to the PLTMG Riau project plan, including:

The main focus is based on mitigation priorities where it is found that mitigation with the first priority is identifying critical processes and alternatives that can be carried out. This priority comes from the risk of delays in project completion due to poor implementation time management. Each project has its own characteristics, even projects that have the same form of process have different critical processes, this is very much influenced by various processes that are interdependent on one another. So that further analysis is needed on all critical process identification. One way that can be used is to estimate the value of each process, where a process with a high estimated value is a critical process. Another way that can be done is to determine the availability of alternative processes, where a process that has no alternative is a critical process.

When viewed from the project cost structure which is reflected in the table which is then completed with detailed EPC estimation costs, it is known that the procurement of equipment has the greatest value compared to other activities so that this can be identified as a critical process. The mitigation process for risk events for this critical process can be identified as a risk event for material fulfillment difficulties (K7) where the solution that can be done is to apply the first priority to the risk event, namely by contracting with a material provider so that the Material is ordered at the beginning (either using Down Payment or no) for arrival according to the project schedule.

On the other hand, the civil work process / construction work has insignificant value but based on several notes on similar projects, this process often becomes an obstacle, causing additional costs to delay the overall project. With the results of the research above, it is known that this risk can be mitigated by means of good project planning so that it is expected that the detailed technical specifications during anwijzing can accommodate the entire development project, so that it can control this process.

CONCLUSION AND SUGGESTION

Conclusion

Based on the results of the research and discussion, the research entitled "Analysis Models and Financial Risk Mitigation Strategies in Decision Making for Investment Feasibility for the

Development of the Gas Engine Power Plant Project in Riau Province", the following conclusions can be drawn:

1. There is a risk event that could hamper the smooth development of the PLTMG power plant construction project in Riau Province by focusing on investment financial risks. Following are the risk events identified later, after measurement and analysis, the priority risks that must be managed first are obtained, including:

a) Incident risk management implementation time.

b) Risk incidence of project cash flow governance.

c) Incidents of risk of material fulfillment difficulties.

d) The occurrence of the contract detail specification risk.

2. These risk events are managed by interpreting the risk mitigation management of financial losses in the implementation of the PLTMG power plant construction in Riau Province. Following are the results of an analysis of risk mitigation that comes from risk events to then get risk mitigation priority, including:

Risk Priority	Mitigation Priorities	Mitigation Measures	
1	0,38	J	Identify critical processes and alternatives that can be done
	0,29	K	Optimization of work methods and resources that are implemented in the time schedule
	0,17	I	WBS implementation in project work schedule planning
	0,16	H	Periodic Monitoring and Progress Evaluation
2	0,27	A	Project financial resource planning
	0,17	B	Availability of project budget according to RKAU and project business processes
	0,17	E	Good job scheduling and project resource management according to a cash flow plan
	0,13	C	Creating a planning schedule for budget verification and control
	0,12	D	Project progress on time with appropriate project documentation
	0,09	G	Implementation of the Quality Management System 9001: 2015
	0,06	F	Simple bureaucratic coordination and processes
3	0,46	L	Contracting with material providers so Material in advance message (whether using DP or not) for arrival according to the project schedule
	0,28	P	Monitoring and evaluation of material procurement according to the project schedule
	0,11	M	Material Manufacturing alternative planning
	0,08	N	Similar material substitution and reengineering
	0,06	O	Contracting with the expedition so that they have control over the delivery of material
4	0,33	Q	Detailed explanation of technical specifications at the time of anwijzing
	0,26	S	Have a reliable engineering and construction team
	0,25	R	Contract details both drawings and detailed material requirements
	0,16	T	Perform design modeling following changes

Suggestion

Based on the results and discussion, there are several suggestions that can be submitted:

1. PLN managerial implications

Applying the results of the research is risk mitigation priority where it is necessary to identify critical processes and immediately take an approach to be able to provide alternative control measures for the identified critical processes. For example, if the total cost approach is a reference for a critical process, the procurement of PLTMG materials is considered a critical process. Control of this critical process can use a research result approach, namely by entering into a contract with the material provider so that the material is ordered at the beginning (either using DP or not) for arrival according to the project schedule. For other critical processes identified by other approaches, the results of risk mitigation priority can be used based on risk events as attached in the Table of Implementation of mitigation, which can be done flexibly according to the further identification obtained.

2. Further Research

Future research is expected to be able to apply other approaches to accommodate other risks. Further research can also use the approach of the contractor who carries out project work to add a risk perspective, namely from the side of the project owner and from the side of the project implementer.

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