

PROJECT RISK MANAGEMENT INFORMATION SYSTEM USING THE FAILURE MODE AND EFFECT ANALYSIS METHOD AT PT. HILAL MITRA PERKASA

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ABSTRACT

PT. Hilal Mitra Perkasa is a company engaged in the services of building contractors. In the work of some company, projects experienced obstacles such as the occurrence of risk resulting in the cost of the project plan does not correspond to the cost of project realization so that Project manager difficulties in determining the level of risk importance and difficulties in knowing the cost of the occurrence of the risk. Less optimal in risk management that occurs especially in the handling of risk because the project work has not known how much impact is caused, so the project manager has difficulty in knowing Measures to eliminate or mitigate the risks that occur. Based on the description of the problem, a project risk management information system is needed at PT. Hilal Mitra Perkasa. To assist the field responsibility in identifying risk as well as determining the level of risk assessment occurring using the Failure Mode and Effect Analysis (FMEA) method, and to calculate the cost of each risk Using the Expected Monetary Value (EMV) method. Based on the results of the test it can be concluded that the system has assisted project managers in identifying risk and determining the level of risk importance by displaying high or low-risk types on each job as well as the handling of each risk and make it easy to know the cost of risk by displaying the cost of each risk on the project in progress.

Keywords: Cost, Expected Monetary Value, Failure Mode and Effect Analysis, Risk

1. INTRODUCTION

PT. Hilal Mitra Perkasa is a company engaged in the services of building contractors, trade (building materials/construction materials) that includes planning and implementation such as decoration, renovation, rehabilitation and chartering of buildings, up to Currently PT. Hilal Mitra Perkasa has been working on tender projects such as commercial building renovation, apartment, banking building, and a university building.

Based on the interview with Mr. XYZ as project manager of PT. Hilal Mitra Perkasa in the work of the last three projects exceeding the planned budget plan,

because in the process of a project there are risks that arise Risk-based data recapitulation.

Project manager difficulties in determining the level of risk importance occurring, based on the data recapitulation risk. As in the project of renovation of the Chamber of Commissioners and the Board of Directors of XYZ Bank, in the 3rd week that on the wall work occurs addition of two types of work caused the implementation of some materials do not correspond to the design plan also Work tool malfunction. Project manager in handling or planning a response strategy to the risk-based on which risks are first reported by the site manager, so the project manager does not know the action to eliminate or reduce the High-category risk, which can affect the project either in terms of cost or time of project execution.

Based on the results of the interview can be concluded that the project is not separated from uncertain risk, to approach the uncertainty can be anticipated through project risk management using the Failure Mode and Effect methods Analysis. The FMEA is a structured procedure to identify and prevent as many modes of failure as possible. A failure mode is anything that is included in the defect, conditions outside the specified specifications, or changes in the product resulting in the disruption of the function of the product (Gasperz, 2002) [1]. The use of the FMEA method is based on individual functions, where every possible failure occurs is identified to be made priority handling. Based on previous research conducted by Jo Apriyan, Haris Setiawan, Wulframe I. Ervianto examined the "risk analysis of occupational accidents on building projects with FMEA method", (1999). This research focuses on the FMEA (Failure Mode and Effects Analysis) method to identify which work accidents are occurring and then determine the risk level. In general, this research is focused on the work accident that occurred in the building project in Yogyakarta [2]. The equation of this research with the research to be conducted is on the identification of risk and assessment of the identified risks. Related to the ability of the FMEA method, this research is aimed to determine the priority and risk management, which will be implemented in a Web-based system and is

expected to help the project manager in addressing Problems in PT. Hilal Mitra Perkasa.

1.1 Research Methodology

The method used in this final task study is a descriptive research method, which is the research method aimed at making descriptions, describing facts and information systematically. The steps of research that will be done in the development of the Risk Management Information System project at PT. Hilal Mitra Perkasa can be seen in Figure 1.

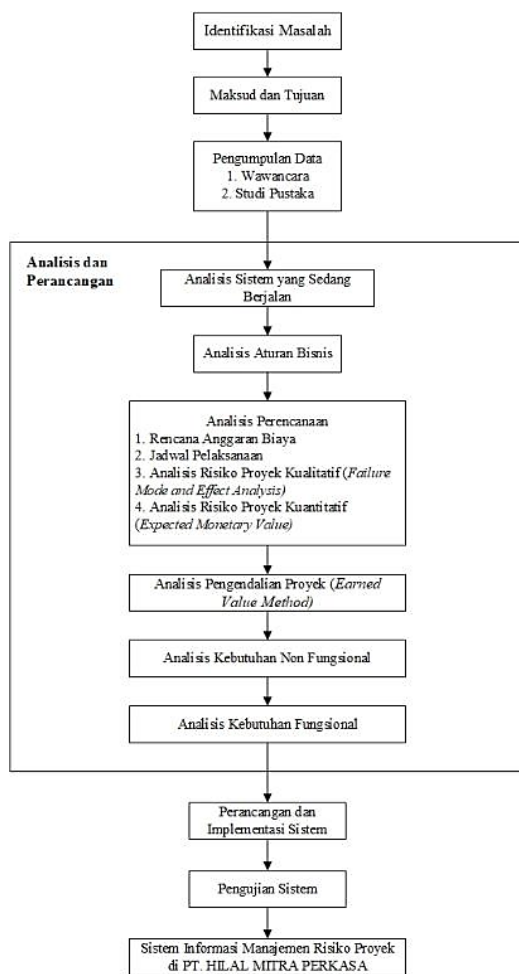


Figure 1. Research Methodology

1.2 Failure Mode and Effect Analysis (FMEA)

Failure Mode and Effect Analysis (FMEA) is a technique used to define, identify and eliminate problems, errors, and other known or potentially potential systems, designs, processes or services before it gets Customers. [1]

FMEA is a systematic methodology intended to perform the following activities:

1. Identifying and recognizing potential failures including their causes and effects.
2. Evaluate and prioritize any identified failures.
3. Identify and suggest actions that can eliminate or reduce the likelihood of potential failures.

Identifying known and potential failures is an important task in the FMEA. By using data and

knowledge about the process or product, any potential failures and their effects are assessed respectively in the following three factors: [1]

1. Severity: Consequences of failure when occurring.
2. Occurrence: probability or frequency of failure occurring.
3. Detection: The probability of failure detected before the impact is realized.

1.2.1 Specifying Severity, Occurrence and Detection

Setting the severity, occurrence, and detection is usually done on a scale of 1-10 were described in Table 1, Table 2, and Table 3.

Severity is the first step to analyze the risk of calculating how large the impact/intensity of the event affects the process output. The impact is taken from a scale of 1 to 10, of which 10 is the worst impact. [2]

Table 1. Severity

Rangking	Effects	Variable Criteria
10	Akibat berbahaya	Pengujian gagal dilaksanakan dengan kerusakan yang berdampak pada sistem alat tanpa ada peringatan
9	Akibat serius	Pengujian gagal dilaksanakan dengan kerusakan yang berdampak pada sistem alat namun masih ada peringatan
8	Akibat ekstrem	Pengujian tidak dapat dilaksanakan karena kerusakan yang cukup parah
7	Akibat major	Pengujian tidak dapat dilaksanakan karena kerusakan yang cukup parah pada peralatan
6	Akibat signifikan	Pengujian tidak dapat dilaksanakan karena sedikit kerusakan
5	Akibat moderat	Pengujian tidak dapat berjalan normal dengan atau tanpa kerusakan
4	Akibat minor	Pengujian dapat dilaksanakan, namun ada penurunan performa yang signifikan
3	Akibat ringan	Pengujian dapat terus dilaksanakan, namun ada penurunan performa alat
2	Akibat sangat ringan	Pengujian tetap berjalan, hanya sedikit gangguan
1	Tidak ada akibat	Tidak mengakibatkan apa-apa, tidak memerlukan penyesuaian

Source: Wang, et al (2009)

Occurrence is likely that such causes will occur and result in a form of failure during the use of the product. By estimating the incidence on a scale of 1 to 10. [2]

Table 2. Occurrence

Rangking	Genesis	Variable Criteria	Probability
10	Hampir selalu	Risiko selalu terjadi	> 9
9	Sangat tinggi	Risiko yang terjadi sangat tinggi	> 8 – 9
8	Tinggi	Risiko yang terjadi tinggi	> 7 – 8
7	Agak tinggi	Risiko yang terjadi agak tinggi	> 6 – 7
6	Medium	Risiko yang terjadi agak tinggi	> 5 – 6
5	Rendah	Risiko yang terjadi pada tingkat rendah	> 4 – 5
4	Sedikit	Risiko yang terjadi sedikit	> 3 – 4

Rangking	Genesis	Variable Criteria	Probability
3	Sangat sedikit	Risiko yang terjadi sangat sedikit	> 2 – 3
2	Remote	Risiko jarang terjadi	> 1 – 2
1	Hampir tidak pernah	Risiko tidak pernah terjadi	0 – 1

Source: Wang, et al (2009)

Detection is associated with current control. Detection is a measurement of the ability to control/control failures that can occur. [2]

Table 3. Detection

Rangking	Effects	Criteria
10	Tidak Pasti	Tidak dapat terdeteksi
9	Sangat kecil	Sulit terdeteksi
8	Kecil	Relatif sulit terdeteksi
7	Sangat Rendah	Sangat jarang terdeteksi
6	Rendah	Relatif jarang terdeteksi
5	Sedang	Cukup mudah terdeteksi
4	Cukup Tinggi	Dapat terdeteksi
3	Tinggi	Mudah terdeteksi
2	Sangat Tinggi	Sulit terdeteksi
1	Hampir Pasti	Pasti terdeteksi

Source: Wang, et al (2009)

To reflect the detected failure of the wanted Risk Priority Number (RPN) value. The RPN is duplicated by multiplying the severity value, occurrence value, and detection value [1], as in Equation 1.

$$RPN = Severity \times Occurrence \times Detection \quad (1)$$

o set the risk category sought critical values. The critical value is calculated by dividing the total RPN value by the number of risk lists as in Equation 2. High-risk categories are risks that have an RPN value greater than or equal to a critical value (RPN value $\geq$ critical value). [1]

$$critical\ value = \frac{total\ RPN}{Number\ of\ risk\ lists} \quad (2)$$

1.3 Expected Monetary Value (EMV)

The Expected Monetary Value (EMV) method is a statistical concept analysis method that calculates the average future expenditure that may occur or does not occur. The EMV positive value shows an opportunity, whereas the negative EMV value indicates a threat or threat that could harm the company [5]. EMV is calculated by multiplying the probability value of each risk multiplied by the likelihood of the money incurred when the risk occurred. The formula for risk costing calculation can be seen in Equation 3.

$$EMV = Probability \times Consequences \quad (3)$$

Description :

EMV : (Expected Monetary Value) or the expected money when the risk occurs

Probability : Risk probability value

Consequences : Risk Impact Value

2. RESEARCH CONTENT

2.1 Project Risk Management Analysis

Risk management is an approach to risk by understanding, identifying, and evaluating the project's risk, then considering what it will do to the impacts and possible risks or mitigating Risk occurring. Risk management is all series of planning activities, assessments, risk handling or responses, and risk monitoring. [4]

The purpose of risk management is to minimize the chances of risk in the implementation of projects that can cause harm to the company, in terms of cost or time. So the results of the various risk management processes will be carried out to be a reference to the project manager when the project risk occurs. The stages of project risk management on this research are based on Project Management Body of Knowledge (PMBOK) [3], in Figure 2.



Figure 2. Stages of risk management

2.1.1 Risk Analysis with FMEA

At the stage of risk management using the Failure Mode and Effect Analysis (FMEA) method, including identifying the risk, determining the likelihood of the impact of the risk that will occur, and the handling of risks by conducting Interview with the Project manager of PT. Hilal Mitra Perkasa.

1. Risk Identification

Risk identification is a process for determining the risks that can affect the project. The risk identification process is done by conducting a brainstorming method or discussion and interview approach [3], with the company's project manager. The data used in the risk identification process are three previously completed project data and similar projects with the project being used as case study materials, including the renovation project of the Board of Commissioners and Directors of XYZ Building, Replacement of the auditorium chamber granite Civil Engineering xyz, and the store renovation of the Civil Student Association XYZ can be seen in Table 4.

Table 4. Risk Identification

Risk Type	Risk	Risk Code
Eksternal	Harga bahan material naik	R1
Alat dan Bahan	Keterlambatan bahan material	R2
	Rusaknya bahan material	R3
	Rusaknya alat kerja	R4
	Hilangnya bahan material	R5
	Rancangan desain dengan implementasi berbeda	R6
	Penambahan pekerjaan	R7
	Kecelakaan kerja	R8
Tenaga Kerja	Tenaga kerja sakit	R9
	Tenaga kerja kurang paham dengan konsep pekerjaan	R10

2. Determining Severity, Occurrence, Detection and RPN values

The first step to analyzing the risk assessment is to calculate how large the impact/intensity of an event affecting the project (Severity) can be seen in Table 5.

Table 5. Severity (S)

Rangking	Effects	Criteria
10	Akibat berbahaya	Pengujian gagal dilaksanakan dengan kerusakan yang berdampak pada sistem alat tanpa ada peringatan
9	Akibat serius	Pengujian gagal dilaksanakan dengan kerusakan yang berdampak pada sistem alat namun masih ada peringatan
8	Akibat ekstrem	Pengujian tidak dapat dilaksanakan karena kerusakan yang cukup parah
7	Akibat major	Pengujian tidak dapat dilaksanakan karena kerusakan yang cukup parah pada peralatan
6	Akibat signifikan	Pengujian tidak dapat dilaksanakan karena sedikit kerusakan
5	Akibat moderat	Pengujian tidak dapat berjalan normal dengan atau tanpa kerusakan
4	Akibat minor	Pengujian dapat dilaksanakan, namun ada penurunan performa yang signifikan
3	Akibat ringan	Pengujian dapat terus dilaksanakan, namun ada penurunan performa alat
2	Akibat sangat ringan	Pengujian tetap berjalan, hanya sedikit gangguan
1	Tidak ada akibat	Tidak mengakibatkan apa-apa, tidak memerlukan penyesuaian

Source: Wang, et al (2009)

Occurrence is a possibility that the risk will occur during the workmanship process, obtained by estimating possible risk events in referring projects can be seen in Table 6.

Table 6. Occurrence (O)

Rangking	Genesis	Effects	Probability
10	Hampir selalu	Risiko selalu terjadi	> 9
9	Sangat tinggi	Risiko yang terjadi sangat tinggi	> 8 – 9
8	Tinggi	Risiko yang terjadi tinggi	> 7 – 8
7	Agak tinggi	Risiko yang terjadi agak tinggi	> 6 – 7
6	Medium	Risiko yang terjadi agak tinggi	> 5 – 6
5	Rendah	Risiko yang terjadi pada tingkat rendah	> 4 – 5
4	Sedikit	Risiko yang terjadi sedikit	> 3 – 4
3	Sangat sedikit	Risiko yang terjadi sangat sedikit	> 2 – 3
2	Remote	Risiko jarang terjadi	> 1 – 2
1	Hampir tidak pernah	Risiko tidak pernah terjadi	0 – 1

Source: Wang, et al (2009)

Detection is a probability of risk detected before its impact is realized to control the risks that can occur as can be seen in table 7.

Table 7. Detection (D)

Rangking	Effects	Criteria
10	Tidak Pasti	Tidak dapat terdeteksi
9	Sangat kecil	Sulit terdeteksi
8	Kecil	Relatif sulit terdeteksi
7	Sangat Rendah	Sangat jarang terdeteksi

Rangking	Effects	Criteria
6	Rendah	Relatif jarang terdeteksi
5	Sedang	Cukup mudah terdeteksi
4	Cukup Tinggi	Dapat terdeteksi
3	Tinggi	Mudah terdeteksi
2	Sangat Tinggi	Sulit terdeteksi
1	Hampir Pasti	Pasti terdeteksi

Source: Wang, et al (2009)

Assessment S, O, D for any list of identified risks from the previous three projects then carried out the process of identification of job descriptions that exist on the project floor work, interior renovation and procurement Mebelair Vice space Dean II of building C XYZ. It then gives the risk assessment of each job description done by experts (expert judgment) in making decisions for assessments, such as Project Stakeholders, Project Manager, industry groups and consultants [3]. In this study, the S, O, D value was determined by the project manager obtained based on the results of the interview with Mr. XYZ which can be seen in table 8.

Table 8. S, O, D, and RPN values

No	Job description				
1	Pekerjaan Pembongkaran				
Risk Code	Risk	S	O	D	RPN
R4	Rusaknya alat kerja	5	5	2	50
R8	Kecelakaan Kerja	2	3	4	24
No	Job description				
2	Pekerjaan Plafon				
Risk Code	Risk	S	O	D	RPN
R1	Harga bahan material naik	4	6	5	120
R2	Keterlambatan bahan material	7	5	4	140
R3	Rusaknya bahan material	7	5	5	175
R6	Rancangan desain dengan implementasi berbeda	7	7	3	147

After identifying the risk of project job descriptions, Severity, Occurrence and Detection values, then the next process is calculating the RPN (Risk Priority Number), the RPN calculation is an important part of the FMEA because of the RPN value will be known risk priorities which include critical risks. The RPN value is calculated by multiplying the values of Severity (S), Occurrence (O) and Detection (D).

3. Determining Critical Value

Critical values are used to determine the risks that belong to high-risk categories. The risk that belongs to the high category is the risk with the RPN value greater than or equal to the critical value (RPN value $\geq$ critical value). The critical value is calculated by using equation 2. [1]

$$\text{critical value} = \frac{\text{total RPN}}{\text{Number of risk lists}} \quad (2)$$

To calculate the critical value is required the total value of RPN and the total number of risk lists of each job description already identified. The total value of RPN is derived from the total number of RPN at any risk identified in the job description. Here's an

example of critical value calculations on demolition jobs and ceiling work.

Demolition work

$$\text{critical value} = \frac{50 + 24}{2} = 37 \approx 37$$

Ceiling work

$$\text{critical value} = \frac{120 + 140 + 175 + 147}{4} = 145,5 \approx 146$$

From the calculation of the above then obtained a critical value, for example for a ceiling work of 146 which means if the value of RPN every risk is worth above 146 or equal to 146, then included in the high risk.

4. Risk Management

Based on the results of the analysis of identified risks, it can then be used as a reference for risk mitigation or risk control. The action of handlers against each risk can be seen in Table 9.

Table 9. Risk Management

Job description			
Pekerjaan Pembongkaran			
Risk	RPN	Category	Mitigation
Rusaknya alat kerja	50	Tinggi	Melakukan penambahan alat kerja sesuai dengan jenis alat kerja yang telah rusak
Kecelakaan Kerja	24	Rendah	Memberikan pengarahan kepada tenaga kerja mengenai prosedur dan keselamatan kerja
Job description			
Pekerjaan Plafon			
Risk	RPN	Category	Mitigation
Harga bahan material naik	120	Rendah	Melakukan kesepakatan harga dengan pihak pemasok bahan material guna menangani harga material naik
Keterlambatan bahan material	140	Rendah	Melakukan komunikasi dengan pihak pemasok bahan material, guna menangani keterlambatan bahan material
Rusaknya bahan material	175	Tinggi	Melakukan penambahan jenis bahan material berdasarkan jumlah bahan material yang rusak
Rancangan desain dengan implementasi berbeda	147	Tinggi	Melakukan pekerjaan ulang jenis pekerjaan yang tidak sesuai dengan rancangan desain yang telah direncanakan
Job description			
Pekerjaan Lantai			
Risk	RPN	Category	Mitigation
Harga bahan material naik	96	Rendah	Melakukan kesepakatan harga dengan pihak pemasok bahan material guna menangani harga material naik
Keterlambatan bahan material	84	Rendah	Melakukan komunikasi dengan pihak pemasok bahan material, guna menangani keterlambatan bahan material
Rusaknya bahan material	210	Tinggi	Melakukan penambahan jenis bahan material berdasarkan jumlah bahan material yang rusak
Rancangan desain dengan	126	Tinggi	Melakukan pekerjaan ulang jenis pekerjaan yang tidak sesuai dengan

implementasi berbeda			rancangan desain yang telah direncanakan
Penambahan pekerjaan	84	Rendah	Melakukan penambahan jam kerja (Lembur) guna terpenuhinya bobot pekerjaan
Tenaga kerja kurang paham dengan konsep pekerjaan	75	Rendah	Memberikan pemahaman kepada tenaga kerja mengenai konsep kerja yang baik dan benar sesuai dengan rencana

2.1.2 Risk Analysis with EMV

Risk cost analysis is done to be able to know the cost estimate that should be issued by the company in handling a risk, were to analyze risk cost is done quantitatively or with statistical analysis, concept Calculate the average [5]. As for determining the probability value determined by the frequency of the risk occurrence to the job description divided by the total number of Project description job list multiplied by 100%, where 4 is the incidence rate risk of material price rises while 8 Is the total number of project risk listings, the following examples of probability calculation of the price of material rises:

$$\text{Probability} = \frac{4}{8} \times 100\% = 50\%$$

While the value of the consequences is determined by the cost or other compensation to be incurred, the value of this consequence is the most approximate number of risks. The following table of the EMV assessment results from each risk can be seen in Table 10.

Table 10. Risk Cost Assessment

Risk	Probability	Consequences	EMV
Harga bahan material naik	40	2.500.000	1000000
Keterlambatan bahan material	20	1.500.000	300.000
Rusaknya bahan material	25	3.000.000	750.000
Rusaknya alat kerja	20	2.000.000	400.000
Rancangan desain dengan implementasi berbeda	40	3.500.000	1.400.000
Penambahan pekerjaan	40	2.500.000	1.000.000
Kecelakaan Kerja	15	1.000.000	150.000
Tenaga kerja kurang paham dengan konsep pekerjaan	35	2.000.000	700.000

2.2 None Functional Needs Analysis

The analysis of non-functional needs is a description of the system needs to be needed to run a built system. The purpose of the nonfunctional needs analysis is for the built-in application to be used according to needs. The user characteristics in the current and required PT. Hilal Mitra Perkasa can be seen in table 11.

Table 11. User Needs Analysis

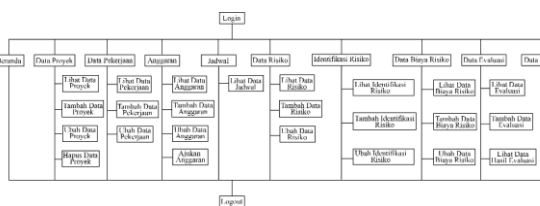
No	Position	Responsibility	Education
1	Director	Memimpin perusahaan, mengawasi tugas dari karyawan, dan memonitoring jalannya proyek.	S1



Figure 5. Relationship Diagram

2.4.2 Menu Structure Design

The design of the menu structure is used to provide an image of any menu that the user can access the system. The structure of the menu to be constructed consists of several menu structures based on system users. Designing the Project Manager menu structure can be seen in Figure 6.



Gambar 6. Struktur Menu Project Manager

2.5 System Implementation

System implementation is a stage of implementation of system analysis and design, so that system users can provide input to system development [9].

2.5.1 Database Implementation

Database creation is done using DBMS MySQL. Implementation of the database on the project Risk Management Information System in PT. Hilal Mitra Perkasa, for example, Query creation of databases can be seen in Table 12.

Table 12. Database Implementation

Database Name	SQL Commands
m_resiko	CREATE DATABASE m_resiko;

2.6 System Testing

System testing is the most important thing that aims to find errors or flaws in the system of tested information. System testing is conducted to determine the performance of information systems that have been built by the design objectives of information systems.

2.6.1 Black Box Testing

Testing the black box is a test used to test the new system. Black box testing focuses on testing the functional requirements of information systems [8], as an example of the case and test results of logins as user Administration users on the system can be viewed in Table 13.

Table 13. Login Testing

Kasus dan Hasil Uji (Data Benar)			
Input Data	What to Expect	Observation	Conclusion
Contoh masukan Username : administration Password : administration	Mengisikan data login yang sudah terdaftar berupa username dan password. Jika data login benar maka masuk ke masing-masing antarmuka.	Data login benar, berhasil masuk ke antarmuka user pengguna administrasi.	[√] diterima [] ditolak

Based on the results of the black box test that has been done in the project Risk management Information System in PT. Hilal Mitra Perkasa, has the following conclusions:

1. Assisting the project manager in making risk planning based on features of the added risk identification data, add risk data and add risk cost data to determine the level of importance and cost of risk.
2. Assist project manager in risk monitoring based on the Add Report data feature and see project evaluation results so that projects can run according to the plan. Identify risk, add risk data and increase risk cost data so that it can Interest rates and risk costs.

3 CLOSING

3.1 Conclusion

Based on the results of research and testing conducted on the project Risk Management Information System in PT. Hilal Mitra Perkasa, then the conclusion is obtained as follows:

1. The system can help project managers to identify risk and determine the level of risk interest occurring by displaying high or low-risk types on each job as well as handling of each risk on the project That is running.

2. The system can help project managers to determine the cost of risk by displaying the cost of each risk on the project in progress.

3.2 Suggestion

Based on the results of research and testing conducted on the project Risk Management Information System at PT. Hilal Mitra Perkasa, some suggestions can be done to add things that can complement this system in the future. These suggestions are project risk management information systems can be added budget or RAB print features, project schedules, and weekly reports, so they can help Director, project manager, and site manager manage projects.

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