SCHEDULING AND PROJECT RISK MANAGEMENT INFORMATION SYSTEM USING CRITICAL PATH METHOD AND EXPECTED MONETARY VALUE IN PT. ADYAWINSA TELECOMMUNICATION & ELECTRICAL

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ABSTRACT

PT. Adyawinsa Telecommunication & Electrical is a company engaged in the Site Acquisition of Civil Mechanical Electrical (SACME) and civil works implementation services. In some projects that were undertaken, there was a delay in the execution of the project. This is because the project schedule is only made in the form of start date to the finish date on each work item and there is no focus on the critical path of work on the scheduling. Frequent neglect of internal and external risks that arise during project work and the absence of risk registering causes Project Managers to experience difficulties in handling early. Based on the existing problems, it is necessary to develop a scheduling information system and project risk management at PT. Adyawinsa Telecommunication & Electrical. The goal is to build a scheduling and risk management information system using critical path method (CPM), Probability Impact Matrix (PIM) and expected monetary value (EMV) so that it can help the Project Manager to determine the focus of critical path work can be delayed and cannot be delayed, and Helps Project Manager in conducting risk management to identify risks that occur during the project and know the costs that must be prepared. Based on the test results it can be concluded that the information system that was built can assist the Project Manager in scheduling projects to determine the critical path of work and assisting Project Managers in managing risks that arise and how they are handled.

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Kata kunci : Scheduling, Risk, Critical Path Method, Probability Impact Matrix, Expected Monetary Value

1 INTRODUCTION

PT. Adyawinsa Telecommunication & Electrical located at Jl. Pegangsaan Dua Km 2 No.64, Kelapa Gading, Jakarta City, was established in 2003 which is one of the Adyawinsa business group companies engaged in the construction of Site Acquisition Civil Mechanical Electrical (SACME) and civil works implementation services, architectural work services, supplier services, contractor services, mechanical services, electrical services, landscape work services.

Based on the results of an interview with Mr. Erwin Rafidi as Project Manager at PT. Adyawinsa Telecommunication & Electrical in planning project work using the Gantt Chart scheduling process. In this method only estimates the parties involved in making the project schedule, the creation of project scheduling estimates obtained from the results of discussions by Site Manager with the project estimator and supervisor. Also, this method does not specifically indicate dependency relationships between activities, so it is difficult to know the impact of a delay in an activity on the overall project schedule. In some projects works using these methods, what happens is that the project experiences delays. That is because the project schedule is only made in the form of start date to the finish date on each work item. In this case, the Project Manager who arranges decisions during the project has difficulty in determining which work can be postponed and which cannot be postponed.

Also, what can hamper project work is often overlooked risks that arise during project work and lack of risk recording. So that in handling risks, Project Managers have difficulty in handling early. This causes the impact of the risks that have occurred in the previous project, reoccurred in the project being worked on. Various obstacles in the field including, internal and external factors. In addition to hampering the project network, it will also have an impact on the costs to be incurred by the company.

From the problems that have been explained above, the need for a system that helps the Project Manager in making scheduling plans and to determine work that can be postponed and cannot be

postponed by the Critical Path Method (CPM). The next solution is a risk approach system developed using two criteria to measure risk so that the possibility of risks that arise during project work can be properly mitigated with the Probability Impact Matrix (PIM) method and to be able to control project risk costs with the Expected Monetary Value (EMV) method.). Then the information system that will be built must be able to plan the scheduling and management of project risks so that the risks that occur and can be expected to be minimized to meet the needs of PT. Adyawinsa Telecommunication & Electrical.

The objectives to be achieved in building a project scheduling and risk management information system using the Critical Path Method and Expected Monetary Value at PT. Adyawinsa Telecommunication & Electrical.

1. Assist the Project Manager in project scheduling to determine the critical path of work and find out work that can be postponed and cannot be postponed, to minimize the occurrence of delays.
2. Assist the Project Manager in risk management that may occur during the project and know the costs that must be prepared

1.1 RESEARCH METHOD

The research method used in this study is the Project Risk Scheduling and Management Information System Using the Critical Path Method and Expected Monetary Value at PT. Adyawinsa Telecommunication & Electrical in Figure 1.

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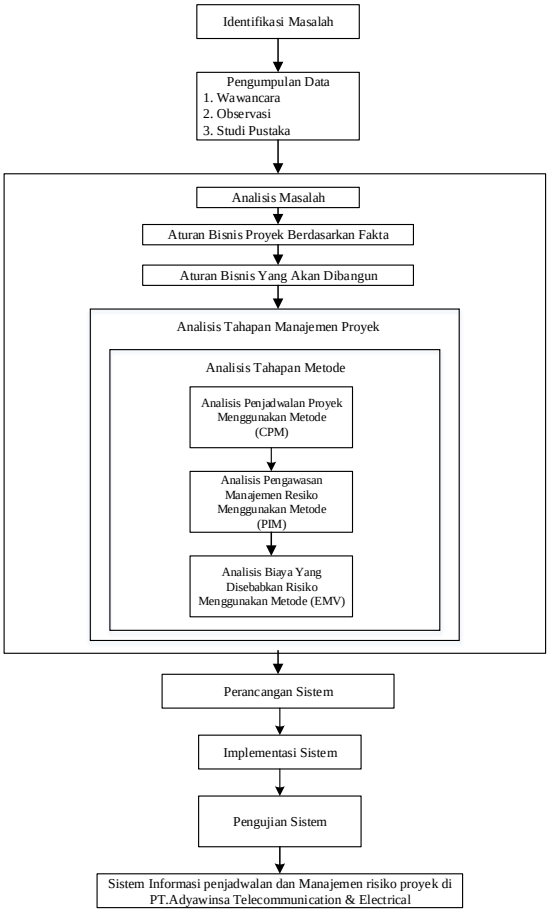


Figure 1. Metodologi Penelitian

2 CONTENTS OF RESEARCH

2.1 Information Systems

the information system is a system within an organization that can meet transaction processing needs, support operational, managerial and strategic activities of the organization's time and provide certain external parties with the necessary reports. Then it can be concluded that the information system is a set of elements that are regularly interrelated to manage data to produce useful information for the user. Information systems also have several components of brainware, hardware, software, data, procedures or methods.[3]

2.2 Project Management

Project Management is the application of science, skill, and expertise in the best technical way and with limited resources to achieve predetermined goals to obtain optimal results in terms of time, quality, and cost performance and work safety.[4]

2.3 Scheduling Analysis

Scheduling is one element of the results of planning that can provide information about the planned schedule and project progress. In this case the resources and duration of the project and the completion of the project. In this study, scheduling uses the Critical Path Method (CPM).

2.3.1 Metode Critical Path Method (CPM)

Critical Path Method (CPM) is a method that analyzes the path of each activity or activity by showing the longest total time and the fastest project completion time by predicting the total duration of time during the project. [1]

In CPM terms are as follows, [1]:

a. E (earliest event occurrence time) is the earliest time that activity occurs.

b. L (latest event occurrence time) is the last time that is still allowed for an activity.

c. ES (earliest activity start time) is the earliest start time of an activity if the start time is stated in hours, then this time is the earliest hour the activity starts.

d. EF (earliest activity finish time) is the earliest time finish of an EF activity for a previous activity = ES next activity

e. LS (latest activity start time) is the slowest time an activity can be started without slowing down the project as a whole.

f. LF (latest activity finish time) is the slowest time the activity is completed without slowing down project completion.

g. D (activity duration time) is the period required for an activity.

2.3.2 Job Activity Description

Scheduling analysis is an analysis of each work activity in this case a certain sequence and time. The details of the description of work activities on the 36m SST Tower construction project in Sukaraja, West Java Province.

Table 1. Job Activity Description

No	Nama Pekerjaan	Kode	Durasi	Tanggal Mulai	Tanggal Selesai
I	Site Preparition	I	4	13-Jun-18	16-Jun-18
II	Tower Structure	II	9	17-Jun-18	25-Jun-18
III	Tower Foundation	III	13	19-Jun-18	1-Jul-18
IV	Outdoor Cabinet Foundation	IV	2	2-Jul-18	3-Jul-18
V	Grounding system & Earthing	V	3	4-Jul-18	6-Jul-18
VI	Mechanical & Electrical (ME)	VI	6	4-Jul-18	9-Jul-18
VII	Cable Tray Outdoor	VII	2	10-Jul-18	11-Jul-18
VIII	Fence & Landscaping & Access Road	VIII	15	12-Jul-18	26-Jul-18
IX	Electrical Power PLN	IX	7	27-Jul-18	2-Aug-18
X	Other Works	X	2	3-Aug-18	4-Aug-18

2.3.3 Logical Relationships Between Jobs

The logical relationship between work on the 36m SST Tower construction project in Sukaraja, West Java Province can be seen in table 2.

Table 2. Logical Relationships Between Jobs

No	Nama Pekerjaan	kode	Kegiatan Pendahul	Pekerjaan Pengikuti	Durasi
I	Site Preparition	I	-	II,III	4
II	Tower Structure	II	I	IV	9
III	Tower Foundation	III	I	IV	13
IV	Outdoor Cabinet Foundation	IV	II,III	V,VI	2
V	Grounding system & Earthing	V	IV	VII	3
VI	Mechanical & Electrical (ME)	VI	IV	VII	6
VII	Cable Tray Outdoor	VII	V,VI	VIII	2
VIII	Fence & Landscaping & Access Road	VIII	VII	IX	15
IX	Electrical Power PLN	IX	VIII	X	7
X	Other Works	X	IX	SELESAI	2

2.3.4 Forward Calculation (Forward Pass)

Starting from the Start (initial event) to Finish (terminal event) to calculate the fastest completion time of an activity (EF), the fastest time of occurrence of an activity (ES) and when the fastest start of an event (E) can be seen in table 3.

$$EF(i-j) = ES(i-j) + D(i-j)$$

Table 3. Advanced CPM Calculation Results

KEGIATAN		KODE	DURASI	PERHITUNGAN MAJU	
I	J			ES	EF
0	1	I	4	0	4
1	2	II	9	4	13
1	3	III	13	4	17
3	4	IV	2	17	19
4	5	V	3	19	22
4	6	VI	6	19	25
6	7	VII	2	25	27
7	8	VIII	15	27	42
8	9	IX	7	42	49
9	10	X	2	49	51

2.3.5 Backward Calculation (Backward Pass)

Starting from Finish to Start to identify when the slowest occurrence of an activity (LF), the time the slowest occurrence of an activity (LS) and when the slowest event occurs (L) can be seen in table 4.

$$LS(i-j) = LF(i-j) – D(i-j)$$

Table 4. CPM Reverse Calculation Results

KEGIATAN		KODE	DURASI	PERHITUNGAN MUNDUR	
I	J			LS	LF
0	1	I	4	0	4
1	2	II	9	4	13
1	3	III	13	8	17
3	4	IV	2	17	19
4	5	V	3	19	25
4	6	VI	6	22	25
6	7	VII	2	25	29
7	8	VIII	15	27	57
8	9	IX	7	42	56

9	10	X	2	49	53

2.3.6 Total *Float*

Total Float shows the amount of time allowed for an activity to be postponed, without affecting the overall project completion schedule can be seen in table 5.

TF = LF(i-j) – EF(i-j) D(i-j)

Table 5. Total Float Calculation Results

KEGIATAN		KODE	DURASI	ES	EF	LS	LF	TF
I	J							
0	1	I	4	0	4	0	4	0
1	2	II	9	4	13	4	17	0
1	3	III	13	4	17	8	17	4
3	4	IV	2	17	19	17	19	0
4	5	V	3	19	22	19	25	0
4	6	VI	6	19	25	22	25	3
6	7	VII	2	25	27	25	27	0
7	8	VIII	15	27	42	27	42	0
8	9	IX	7	42	49	42	49	0
9	10	X	2	49	51	49	51	0

For the critical path network project work can be seen in Figure 2.

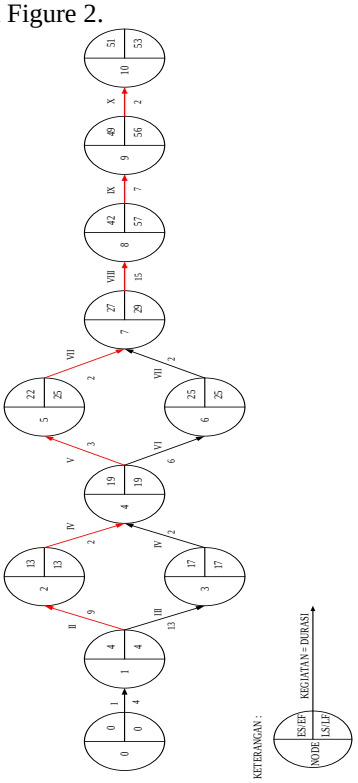


Figure 2. Jalur Kritis Jaringan Pekerjaan Proyek

For critical work can be seen in table 6.

Table 6. Critical Work Project

No	Item Pekerjaan	Kode	Status
I	Site Preparation	I	Jalur Kritis
II	Tower Structure	II	Jalur Kritis
III	Tower Foundation	III	-
IV	Outdoor Cabinet Foundation	IV	Jalur Kritis
V	Grounding system & Earthing	V	Jalur Kritis
VI	Mechanical & Electrical (ME)	VI	-
VII	Cable Tray Outdoor	VII	Jalur Kritis
VIII	Fence & Landscaping & Access Road	VIII	Jalur Kritis
IX	Electrical Power PLN	IX	Jalur Kritis
X	Other Works	X	Jalur Kritis

Based on the calculation of total float in table 5, it is known that work is in the critical path. The critical path of work as well as that which cannot be postponed lies in the work as follows:

a. I. Site Preparation
b. II. Tower Structure
c. IV. Outdoor Cabinet Foundation
d. V. Grounding system & Earthing
e. VII. Outdoor Cable Tray
f. VIII. Fence & Landscaping & Access Road
g. IX. Electrical Power PLN
h. X. Other Works

The work that can be postponed is as follows:

a. III. Tower Foundation
b. VI. Mechanical & Electrical (ME)

Is the longest amount of time which shows the fastest period of completion of the project for 51 days, then the track can be a reference for the Project manager.

2.4 Analysis of Risk Management

According to Wideman, project risk in risk management is a cumulative effect of the chance of an uncertain event, which influences the concept of project goals and objectives. The concept of risk management was introduced in the field of occupational safety and health in the 1980s after the development of the accident model theory from ILCI. Also increasingly widespread environmental and health issues. The purpose of risk management is to minimize losses and increase opportunities or opportunities. When seen the occurrence of losses with the accident model theory from ILCI, then risk management can cut the chain of loss events, so the domino effect will not occur. Risk management is prevention against loss or accident. [4]

2.4.1 *Probability Impact Matrix* (PIM)

Probability Impact Matrix is a matrix that is built by providing a level of risk (very low, low, medium, high, and very high) to risk as measured by a combination of probability and impact scales. Risks with high probability and impact tend to require further risk management analysis. This can be done to provide an assessment of the probability of each risk and the impact caused is to scale the risk index. [5]

R = P x I

Where :

R = Risk importance level.
P = Probability of the risk to occur.
I = Impact (Impact) if a risk occurs.

For the probability and impact matrix that is used is the Boston square matrix in Figure 3.

Probabilitas							
	Sangat Tinggi	5	5	10	15	20	25
	Tinggi	4	4	8	12	16	20
	Sedang	3	3	6	9	12	15
	Rendah	2	2	4	6	8	10
	Sangat Rendah	1	1	2	3	4	5
			1	2	3	4	5
			Sangat Kecil	Kecil	Sedang	Besar	Sangat Besar
			Dampak				

Figure 3. *boston square matrix*

Where to measure the risk used a scale value consisting of 1-25 which states the level of low, medium and high probability and the impact of each risk can be seen in table 7.

Table 7. Value of Risk Scale

Nilai Skala Risiko	Skala Level Risiko
1 – 5	Rendah
6 – 14	Sedang
15 – 25	Tinggi

2.4.1.1 Risk Identification

This risk management analysis is classified based on the identification of the type of risk and by providing a risk code for each risk.

Tabel 8. Risk Identification

Kode Risiko	Jenis Risiko	Variable Risiko
R1	Personil	Kekurangan tenaga kerja
R2		Terjadinnya miskomunikasi antara tenaga kerja
R3		Tenaga kerja tidak dapat melakukan tugas
R4		Rendahnya produktivitas tenaga kerja
R5	Alat penunjang	Kerusakan peralatan Civil Mechanical Electrical (CME)
R6		Rendahnya kualitas alat penunjang
R7		Keterlambatan penyedia alat berat
R8	Keselamatan Kerja	Tenaga kerja tertimpa alat penunjang kerja
R9		Tenaga kerja tertimpa bahan material
R10		Tenaga kerja kurangnya kedisiplinan
R11	Estimasi	Perkiraan jadwal tidak sesuai dengan rencana
R12		Harga material tidak menentu
R13	Karakteristik Lokasi Proyek	Lokasi Proyek sulit dijangkau
R14		Tempat peyimpanan tidak cukup
R15		Area kerja tidak cukup
R16	Eksternal	Terjadinya curah hujan tinggi
R17		Terjadinya angin kencang
R18		Terjadinya bencana alam
R19		Terhenti lembaga swadaya masyarakat (LSM)
R20		Terhenti oleh izin mendirikan bangunan (IMB)

2.4.1.2 Determine the Probability and Impact Value of Risk

The following are the possible values and impact risks that can be seen in table 9.

Table 9. Possible Value and Risk Impact

Kode Risiko	Jenis Risiko	Variable Risiko	Probabilitas	Dampak
R1	Personil	Kekurangan tenaga kerja	3	2
R2		Terjadinnya miskomunikasi antara tenaga kerja	3	4
R3		Tenaga kerja tidak dapat melakukan tugas	2	2
R4		Rendahnya produktivitas tenaga kerja	3	2
R5	Alat penunjang	Kerusakan peralatan Civil Mechanical Electrical (CME)	3	3
R6		Rendahnya kualitas alat penunjang	2	1
R7		Keterlambatan penyedia alat berat	2	3
R8	Keselamatan Kerja	Tenaga kerja tertimpa alat penunjang kerja	3	2
R9		Tenaga kerja tertimpa bahan material	3	2
R10		Tenaga kerja kurangnya kedisiplinan	3	2
R11	Estimasi	Perkiraan jadwal tidak sesuai dengan rencana	2	3
R12		Harga material tidak menentu	2	3
R13	Karakteristik Lokasi Proyek	Lokasi Proyek sulit dijangkau	2	2
R14		Tempat peyimpanan tidak cukup	3	1
R15		Area kerja tidak cukup	2	1
R16	Eksternal	Terjadinya curah hujan tinggi	2	3
R17		Terjadinya angin kencang	2	3
R18		Terjadinya bencana alam	1	2
R19		Terhenti lembaga swadaya masyarakat (LSM)	5	4
R20		Terhenti oleh izin mendirikan bangunan (IMB)	5	4

2.4.1.3 Determine the Importance Of Risk

The following are the importance levels of risk that can be seen in table 10.

Tabel 10. Results of Calculation of Risk Importance

Kode Risiko	Jenis Risiko	Variable Risiko	Tingkat Risiko
R1	Personil	Kekurangan tenaga kerja	Sedang
R2		Terjadinnya miskomunikasi antara tenaga kerja	Sedang
R3		Tenaga kerja tidak dapat melakukan tugas	Rendah
R4		Rendahnya produktivitas tenaga kerja	Sedang
R5	Alat penunjang	Kerusakan peralatan Civil Mechanical Electrical (CME)	Sedang
R6		Rendahnya kualitas alat penunjang	Rendah
R7		Keterlambatan penyedia alat berat	Sedang
R8	Keselamatan Kerja	Tenaga kerja tertimpa alat penunjang kerja	Sedang
R9		Tenaga kerja tertimpa bahan material	Sedang

R10		Tenaga kerja kurangnya kedisiplinan	Sedang
R11	Estimasi	Perkiraan jadwal tidak sesuai dengan rencana	Sedang
R12		Harga material tidak menentu	Sedang
R13	Karakteristik Lokasi Proyek	Lokasi Proyek sulit dijangkau	Rendah
R14		Tempat peyimpanan tidak cukup	Rendah
R15		Area kerja tidak cukup	Rendah
R16	Eksternal	Terjadinya curah hujan tinggi	Sedang
R17		Terjadinya angin kencang	Sedang
R18		Terjadinya bencana alam	Rendah
R19		Terhenti lembaga swadaya masyarakat (LSM)	Tinggi
R20		Terhenti oleh izin mendirikan bangunan (IMB)	Tinggi

2.4.1.4 Risk Management Analysis

Actions in controlling each risk can be seen in table 11.

Table 11. Risk Management

Kode Risiko	Jenis Risiko	Variable Risiko	Tingkat Risiko	Penanganan Risiko
R1	Personil	Kekurangan tenaga kerja	Sedang	Melakukan penambahan tenaga kerja apabila proyek mengalami keterlambatan sehingga mempengaruhi waktu selesai proyek
R2		Terjadinnya miskomunikasi antara tenaga kerja	Sedang	Melakukan kordinasi kembali antar tenaga kerja
R3		Tenaga kerja tidak dapat melakukan tugas	Rendah	Memperbanyak komunikasi intensif untuk pengarahan job desk lebih detail dengan tenaga ahli dan tim proyek lain yang terlibat
R4		Rendahnya produktivitas tenaga kerja	Sedang	Makukan perggantian tenaga kerja dengan bagian Site Manager
R5	Alat penunjang	Kerusakan peralatan Civil Mechanical Electrical (CME)	Sedang	Melakukan peningkatan pengawasan dan tanggung jawab pekerjaan proyek
R6		Rendahnya kualitas alat penunjang	Rendah	Melakukan pergantian alat kerja untuk mendukung proses pekerjaan proyek
R7		Keterlambatan penyedia alat berat	Sedang	Melakukan koordnasi dengan pengadaan alat berat
R8	Keselamatan Kerja	Tenaga kerja tertimpa alat penunjang kerja	Sedang	Memberi pengarahan kepada pekerja agar mengutamakan keselamatan kerja
R9		Tenaga kerja tertimpa bahan material	Sedang	Memberi pengarahan kepada pekerja agar mengutamakan keselamatan kerja
R10		Tenaga kerja kurangnya kedisiplinan	Sedang	Memberi pengarahan kepada pekerja agar memahami pekerjaan
R11	Estimasi	Perkiraan jadwal tidak sesuai dengan rencana	Sedang	Menambah jam kerja SDM yang menangani proyek dan melakukan percepatan pekerjaan dengan koordinasi tim proyek mengenai pemahaman tindak lanjut kinerja proyek.
R12		Harga material tidak menentu	Sedang	*Maintenance* biaya dengan melakukan Pengurangan jumlah biaya yang kurang diperlukan atau bisa diminimalisir
R13	Karakteristik Lokasi Proyek	Lokasi Proyek sulit dijangkau	Rendah	Mencari jalan alternatif proyek agar alat berat dan material dapat diakses
R14		Tempat peyimpanan tidak cukup	Rendah	Mencari luas tanah atau permukiman agar bisa menyewa tempat peyimpanan
R15		Area kerja tidak cukup	Rendah	Melakukan perluasan terhadap lahan
R16	Eksternal	Terjadinya curah hujan tinggi	Sedang	Melakukan pekerjaan lain yang tidak berpengaruh oleh kondisi hujan seperti pemasangan box shalter.apabila terjadi hujan pada tahap struktur tower, pengecora dan pondasi
R17		Terjadinya angin kencang	Sedang	Menunggu angin kembali normal dan melakukan pekerjaan selain pemasangan tower struktur
R18		Terjadinya bencana alam	Rendah	Menunggu kebijakan *project manager* dampak dari kerusakan proyek bencana alam
R19		Terhenti lembaga swadaya masyarakat (LSM)	Tinggi	Melakukan regulasi pada pihak LSM yang terkait atau memanggil pihak keamanan (polisi) untuk mengamankan pihak yang terkait sesuai dengan IMB yang dibuat.
R20		Terhenti oleh izin mendirikan bangunan (IMB)	Tinggi	Meminta surat izin sementara terkait izin pekerjaan proyek atau proses penerbitan IMB menyesul.

2.4.2 *Expected Monetary Value* (EMV)

The Earn Monetary Value (EMV) method is a statistical concept analysis method that calculates the average future expenses that might occur. A positive EMV value indicates an opportunity, while a negative EMV value indicates a threat that can be detrimental to the company. EMV is calculated by multiplying the probability value of each risk multiplied by the likelihood of money being spent when the risk occurs. [2]

Earn Monetary Value (EMV) is used to calculate the large portion of costs, which are numbered in the form of risk costs. EMV is the result of doubling the probability of an event with the magnitude of the consequences. [4]

EMV = Probabilitas * Konsekuensi

Where :

EMV = (Earn Monetary Value) or money expected when a risk occurs

Probability = risk probability value

Consequences = the value of the impact caused by the risk

2.4.2.1 Risk Cost Analysis

Calculation of the amount of costs that must be incurred by the company to deal with an emerging risk can be seen in table 12.

Table 12. Risk Cost Analysis

Kode Risiko	Variable Risiko	Probabilitas (%)	Konsekuensi	EMV
R1	Kekurangan tenaga kerja	30%	Rp. -3,000,000	Rp. -900,000
R2	Terjadinnya miskomunikasi antara tenaga kerja	10%	Rp. -3,000,000	Rp. -300,000
R3	Tenaga kerja tidak dapat melakukan tugas	22%	Rp. -3,000,000	Rp. -660,000
R4	Rendahnya produktivitas tenaga kerja	25%	Rp. -3,000,000	Rp. -750,000
R5	Kerusakan peralatan Civil Mechanical Electrical (CME)	30%	Rp. -10,000,000	Rp. -3,000,000
R6	Rendahnya kualitas alat penunjang	20%	Rp. -10,000,000	Rp. -2,000,000
R7	Keterlambatan penyedia alat berat	10%	Rp. -10,000,000	Rp. -1,000,000
R8	Tenaga kerja tertimpa alat penunjang kerja	23%	Rp. -10,000,000	Rp. -2,300,000
R9	Tenaga kerja tertimpa bahan material	24%	Rp. -10,000,000	Rp. -2,400,000
R10	Tenaga kerja kurangnya kedisiplinan	34%	Rp. -10,000,000	Rp. -3,400,000
R11	Perkiraan jadwal tidak sesuai dengan rencana	15%	Rp. -5,000,000	Rp. -750,000
R12	Harga material tidak menentu	15%	Rp. -5,000,000	Rp. -750,000
R13	Lokasi Proyek sulit dijangkau	10%	Rp. -5,000,000	Rp. -500,000
R14	Tempat peyimpanan tidak cukup	10%	Rp. -5,000,000	Rp. -500,000
R15	Area kerja tidak cukup	20%	Rp. -5,000,000	Rp. -1,000,000
R16	Terjadinya curah hujan tinggi	50%	Rp. -5,000,000	Rp. -2,500,000
R17	Terjadinya angin kencang	30%	Rp. -5,000,000	Rp. -1,500,000
R18	Terjadinya bencana alam	50%	Rp. -5,000,000	Rp. -2,500,000
R19	Terhenti lembaga swadaya masyarakat (LSM)	50%	Rp. -5,000,000	Rp. -2,500,000
R20	Terhenti oleh izin mendirikan bangunan (IMB)	50%	Rp. -5,000,000	Rp. -2,500,000

2.5 System Design Concepts

Unified Modeling Language (UML) is a modeling language that has become an industry standard for visualizing, designing and documenting software systems. UML offers a standard for designing a system model

2.6 User Analysis

Analysis of functional requirements in the form of use case diagrams can be seen in Figure 4.

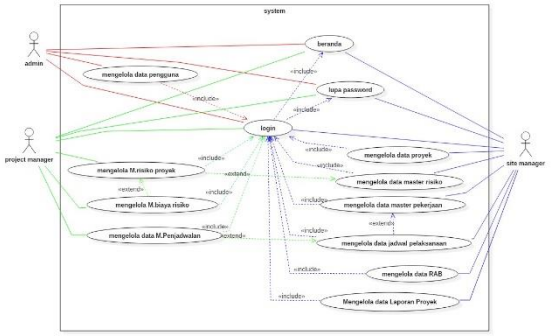


Figure 4. *Use Case Diagram*

For class diagrams can be seen in Figure 5.

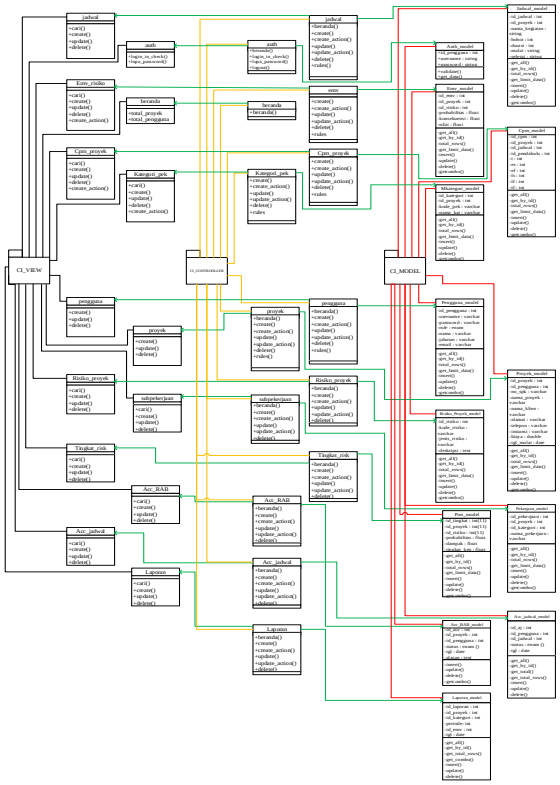
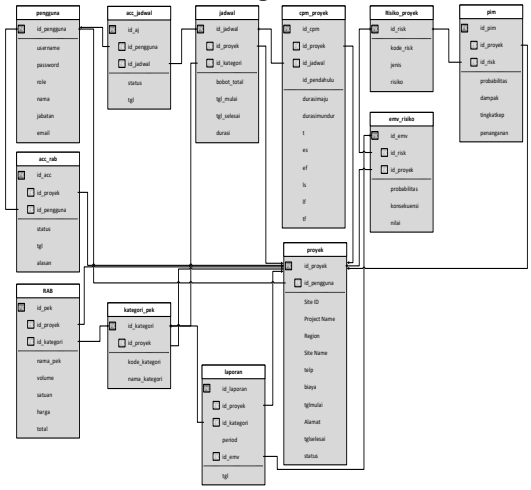


Figure 5. *Class Diagram*

2.7 Data Design

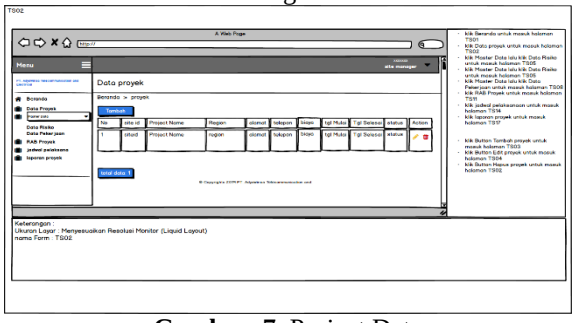
The data design in the form of a relation scheme can be seen in Figure 6.



Gambar 6. Skema Relasi

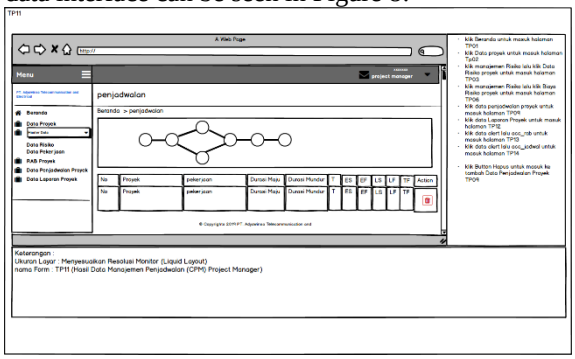
2.8 Perancangan Antarmuka

The design of the site manager project data interface can be seen in Figure 7.



Gambar 7. Project Data

The design of the project manager scheduling data interface can be seen in Figure 8.



Gambar 8. Data Penjadwalan

3 CLOSING

Based on the results obtained in this thesis research, the following conclusions can be drawn.

1. The information system that is built can help the Project Manager in scheduling projects to determine the critical path of work and know which work can be postponed and cannot be delayed to minimize project delays.
2. The information system built can help the project manager in project risk management by recording risks so that risks that have a negative impact can be dealt with immediately and know the costs to be prepared.

BIBLIOGRAPHY

[1] I. Soeharto, Manajemen Proyek : Jilid 1, Jakarta: Erlangga, 1999.

[2] P. M. Institute, PMBOK A Guide to the Project Management Body of Knowlegde Fifth Edition, USA: Project Management Institute, Inc., 2013.

[3] Jogiyanto, Metodologi Penelitian Sistem Informasi, Yogyakarta: Andi, 2008.

[4] A. Husein, Manajemen Proyek, Yogyakarta: Andi Offset, 2011.

[5] R. Miles and K. Hamilton, Learning UML 2.0: A Pragmatic Introduction to UML, Sebastopol, CA: O'Reilly Media, 2006.

[6] Sufa'atin,Implementasi Probability Impact Matriks (PIM) Untuk Mengidentifikasi Kemungkinan dan Dampak Risiko Proyek. ULTIMA InfoSys, 8, 43-47, 2017.

[7] M. Suyanto, Pengantar Teknologi Informasi untuk Bisnis, Yogyakarta: Penerbit Andi, 2005.

[8] R. Astamal, Mastering Kode HTML Edisi Kedua, Surabaya, 2006.

[9] M. Faridl, Fitur Dahsyat Sublime Text 3, LUG STIKOM, 2015.

[10] S. Suehring and J. Valade, PHP, MySQL, JavaScript & HTML5 All in one for Dummies, Canada: John Wiley & Sons, Inc., 2013.