PROJECT MANAGEMENT INFORMATION SYSTEM AT PT. DIANTAMA REKANUSA

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ABSTRAK

PT. Diantama Rekanusa is a consultant company. From some of the problems that occur in the company, the purpose of this research is to help the Technical Responsibility to find out the attachment between project work and knowing the work should not be late because it can affect other work, help determine the needs of project workers so that the project is completed in accordance with the time planned, helps in managing and identifying risks with their impacts before the project is implemented, and helps control project performance, costs and time so that funds are budgeted in accordance with what is stipulated. The stages of this research start from problem identification, data collection, system analysis, requirements analysis, system design, system implementation, system testing and the final stage is the use of the system. The method used in this project management is Critical Path Method (CPM) to determine the critical path, Workload Analysis to determine labor requirements, Expected Monetary Value (EMV), and Earned Value Management (EVM) for project control. System testing uses black boxes and interviews for end users. The results of this study can be concluded that the methods used can help the Technical Person in determining the engagement between project work, determining project workforce, managing and identifying risks, and controlling the project in terms of cost and time.

Keywords: Project Management, Critical Path Method, Workload Analysis, Expected Monetary Value, Earned Value Management

1. INTRODUCTION

PT. Diantama Rekanusa is one of the companies in the field of Engineering Consultant in the city of Bandung which is located at Jalan Cikutra Baru XI No. 15 Bandung. Jobs that are usually handled by PT. Diantama Rekanusa are Feasibility Study, Measurement or Mapping, and others.

Based on the analysis and the results of interviews with the Technical Responsible Agency, explained in some projects there was a shortage of workers to complete the target, such as the National Road Planning project in East Nusa Tenggara Province 2, that the planned road inventory survey was completed within 4 weeks, ie 9 to 12 weeks are completed within 5 weeks or are delayed until the 13th week. In the obstacle report in the 9th week there was a decrease in targets due to weather factors, namely rain which had an impact on the performance of human resources. At the 10th to 11th week the company estimates that problems can still be handled by minimizing the deviation that occurs. Furthermore, in the 12th week the company adds employment by assuming that all targets are in accordance with the planning schedule. However, in the 12th week there was rain again which resulted in the work target not being fully completed and work being extended to the 13th week. Delays in the project will also have a direct impact on the cost and time of the project so that the company suffers losses or gets sanctions from the project owner because it has exceeded a predetermined time limit.

Based on the problems that have been described, a solution is needed to overcome the problems that occur at PT. Diantama Rekanusa, namely the need for a system that can help Technical Personnel to find out the link between work, determine the needs of the project workforce, identify risks before the project is implemented, manage the time and costs needed and can control the project in terms of performance, cost and time. The system to be built must be accessible wherever the user is. Therefore, a web-based information system for project management will be built that is expected to help the problems projected by PT. Diantama Rekanusa.

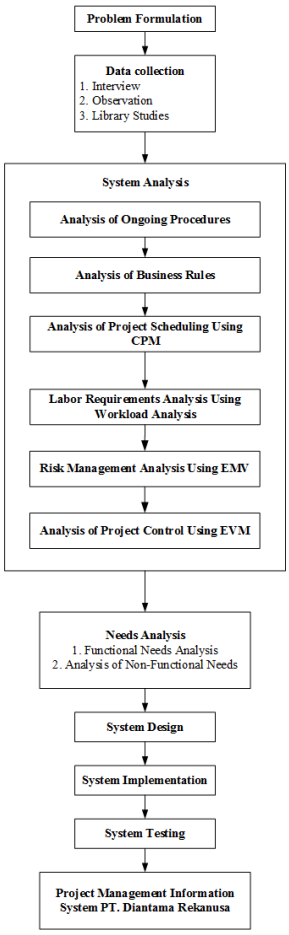
In making this research, referring to the first few journals is to determine labor requirements using 2 methods, namely NASA-TLX and workload calculation with an appropriate position approach, with the method being able to determine labor requirements with results similar to this study because the same uses data that runs well, whether past or running [1]. Second, both use the CPM method to determine work that cannot be postponed and evaluate using EVM, where the difference with this study is only in the risk management method because in this journal using the Probability Impact Matrix (PIM) method [2]. Third, the method used is CPM, EVM and EMV, it can be ascertained that either the results or the system will produce the same output

because using the same method, the most visible difference or difference with this study is the absence of determination of the number of workers and cannot conclude or monitor project profits or losses [3]. Fourth, using the Precedence Diagram Method (PDM) method as a critical work determinant method, PDM and CPM are actually similar in their calculations because they will produce the same output as Earliest Start (ES), Earliest Finish (EF) and others, but the use of the Resource Leveling method is very It is good for some companies that have limited workforce and the shortcomings of this journal system are the absence of labor determination before using Resource Leveling [4]. Finally, using the Time Study method, which is the workload calculation data using the upper control limit and the lower control limit, then look for the average to produce the performance that will be used in determining the workforce, the excess use of this method is not requiring the target limit to be achieved due to time already counted from the beginning, this method is suitable in the use of sustainable work, but there are disadvantages, namely requiring data and variable needs very much so that this method runs optimally [5].

2. SEARCH RESULTS

2.1 Research Methodology

The method used is descriptive research method. The following research methodology can be seen in Picture 1.



Picture 1 Research Methodology

2.2 Project Scheduling Analysis (Critical Path Method)

Critical Path Method is a method for determining jobs that cannot be abandoned or critical work because it will affect the original schedule planning [6].

Table 1 Project Activities

Activity	Activity Code	Prior Activities	Duration (Day)
Administration and Coordination	A	-	154 Days
Preliminary Survey	B	-	28 Days
Land Investigation Survey (DCP)	C	B	28 Days
Road Survey Inventory	D	C	28 Days
Topographic Survey	E	B	56 Days
Traffic Survey	F	C	35 Days
Analysis of Land Investigation Survey Data (DCP)	O	B	**7** Days
Analysis of Road Inventory Survey Data	G	C	7 Days
Analysis of Topographic Survey Data	H	D	7 Days
Analysis of Traffic Survey Data	I	E	7 Days
Geometric Design	J	F	7 Days
Pavement Design	K	G,H,I,J	7 Days

Drainage Design and Complementary Buildings	L	K	7 Days
Unit Volume and Price Analysis	M	L	7 Days
Presentation and Assistance of Preliminary Survey	N	M	7 Days
Assistance of Topographic Survey Data	P	E	7 Days
Assistance of DCP Data Survey and Test Pit	Q	C	7 Days
Assistance to LHR Survey Data	R	F	7 Days
Assistance of Geometric Design	S	K	7 Days
Assistance of Pavement Thickness Design	T	L	7 Days
Employment Volume Assistance Per Km	U	N	7 Days
Assistance for Work Unit Prices	V	U	7 Days
Final Report Draft Presentation	W	Y	7 Days
Final Report Presentation	X	Y	7 Days
Monthly report	Y	V	7 Days
Preliminary Report	Z	B	7 Days
Planning Final Report	AA	Y	7 Days

Forward Computation and Backward Computation are used to determine the completion time by CPM method [6], [10].

The formula for calculating forward computation on work activities 1:

$EF = ES + D$

= 0 + 154 = 154

The formula for calculating backward computation in work activities 1:

$LS = LF - D$

= 154 – 154 = 0

Calculation formula for Float Total in work activities 2.3:

$TF = LF - EF$

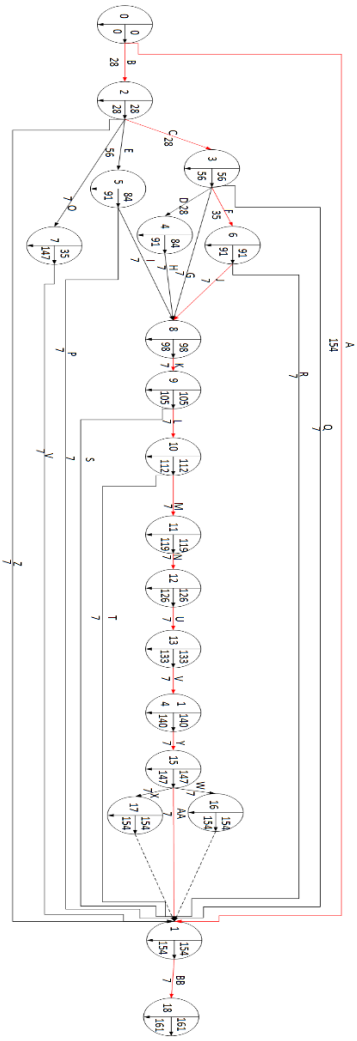
= 91 – 84 = 7

The following are all the results of calculations with CPM can be seen in table 2.

Table 2 Recapitulation of CPM Calculation Results

Activity /Activities	Duration (Day)	ES	EF	LS	LF	TF	Status
A	154 Days	0	154	0	154	0	Critical
B	28 Days	0	28	0	28	0	Critical
C	28 Days	28	56	28	56	0	Critical
D	28 Days	56	84	56	91	7	Not Critical
E	56 Days	28	84	28	91	7	Not Critical
F	35 Days	56	91	56	91	0	Critical
O	7 Days	28	154	28	154	0	Critical
G	7 Days	56	98	56	98	0	Critical
H	7 Days	84	98	91	98	0	Critical
I	7 Days	84	98	91	98	0	Critical
J	7 Days	91	98	91	98	0	Critical
K	7 Days	98	105	98	105	0	Critical
L	7 Days	105	112	105	112	0	Critical
M	7 Days	112	119	112	119	0	Critical
N	7 Days	119	126	119	126	0	Critical
P	7 Days	84	154	91	154	0	Critical
Q	7 Days	56	154	56	154	0	Critical
R	7 Days	91	154	91	154	0	Critical
S	7 Days	105	154	105	154	0	Critical
T	7 Days	112	154	112	154	0	Critical
U	7 Days	126	133	126	133	0	Critical
V	7 Days	126	140	133	140	0	Critical
W	7 Days	147	154	147	154	0	Critical
X	7 Days	147	154	147	154	0	Critical
Y	7 Days	140	147	140	147	0	Critical
Z	7 Days	28	154	28	154	0	Critical
AA	7 Days	147	154	147	154	0	Critical
BB	7 Days	154	161	154	161	0	Critical

Explanation of the table above, work that is in a critical status is work that cannot be postponed. The following is the result of the CPM method calculation which is made in the form of an Activity on Arrow diagram (AOA) which can be seen in Picture 2.



Picture 2 AOA CPM Diagram with Critical Paths

2.3 Project Workforce Needs Analysis (Workload Analysis)

Workload Analysis (WLA) is a method used to determine labor requirements by calculating the workload of each previous job that runs well [7].

For project data as a reference used in this method is the PR-10 project and the PR-11 Project which are both done in 2017 and the whole work is done well. The following project data can be seen in Table 3.

Table 3 Data Recapitulation Results of PR-10 and PR-11

No	Project	Job Average /Days
3	Average Accumulation of PR-10 + PR11	
3.1	Team Leader	0.635
3.2	Highway Engineer	0.635
3.3	Geodetic Engineer	0.635
3.4	Cost / Quantity Engineer	0.635
3.5	Surveyor BB Test	0.625
3.6	DCP Surveyor Test	0.625
3.7	Topographic Surveyor	0.313
3.8	Road Inventor Surveyor	0.625
3.9	LHR Surveyor	0.625
3.10	Soil Technician	0.000
3.11	Computer Operators	0.208
3.12	Draftman / Acad Computer	0.127
3.13	Soil Technician	0.133
3.14	Labor Survey BB Test and DCP Test	0.610
3.15	Labor Survey Road Inventory	0.112
3.16	Topographic Labor Survey	0.000
3.17	Labor Land Survey	0.253

Implementation of labor requirements on PR-12 projects with a distance of 100km and the progress report of the 12th week are as follows.

Job load = Total Distance / Weight Percentage
= 100 KM / 6.78 = 14.75 KM

Progress that has been done (%) = 4.39

Progress in Km = 14.75 * 4.39 = 64.75 KM

The rest of the job = 100 – 64.75 = 32.25 KM

By using the WLA formula, namely:

$$\frac{\sum Workload}{Average\ Ability\ Standards} x\ 1\ person$$

Then the calculation results can be seen in Table 4.

Table 4 WLA Calculation Results

Labor	Week-	Job Average / Day	Rest of job (KM)	Target (Day)	Total Needs
Road Surveyor Inventory	12	0.625	35.25	7	9
Labor Road Inventory	12	0.610	35.25	7	9

The conclusion from the Table above, is that the workforce needs to complete the road inventory work in the 12th week with a target of 7 Days of work and with work of 35.25 KM are 9 surveyors and 9 people labor.

2.4 Risk Management Analysis (Expected Monetary Value)

Risk management analysis consists of three stages, namely the stage of identifying risks, the stage of determining the probability value, the stage of determining the impact of risk, and the stage of determining the handling of these risks [8].

2.4.1 Risk Identification

The first stage of risk management is risk identification that aims to identify risks that are likely to occur during project implementation. The following can be seen in table 5.

Table 5 Risk Identification

Code	Type of Risk	Risk Description
R1	Estimation	The work schedule is not in accordance with the plan
R2		Costs are not according to planning
R3	Personal	Workers who cannot be present in the field can be sick, permitted, and others
R4		Workers who do not understand the work in their field
R5	Construction Support Tools	Damage to tools (survey tools, office equipment and mobilization)
R6		The tool was lost because of being stolen and so on
R7		Late delivery from suppliers
R8	External	Natural disasters (Floods, landslides and others that cause project work cannot be carried out)
R9	Internal	Calculation error
R10	Work safety	Workforce accidents

2.4.2 Risk Evaluation

Furthermore, the risk is determined by the probability value and the impact of the costs obtained from the results of interviews with the technical person in charge of the company.

Table 6 Risk Eavluation

Code	Probabilities (%)	Consequences (Rp.)	EMV
R1	50	20.000.000	-10.000.000
R2	40	10.000.000	-4.000.000
R3	5	3.000.000	-150.000
R4	10	4.000.000	-400.000
R5	10	20.000.000	-2.000.000
R6	5	3.000.000	-150.000
R7	5	3.000.000	-150.000
R8	15	8.500.000	-1.275.000
R9	30	4.000.000	-1.200.000
R10	5	2.000.000	-100.000

As seen from the table above, it is known how much the cost of each risk is. Therefore, the company must pay these costs if one of these risks arises when the project is carried out. The costs used to handle these risks come from the company's reserve costs.

2.4.3 Handling of Risk

After the stages of risk assessment, mitigation or response to risk management is carried out. Following is mitigation for each risk can be seen in Table 7.

Table 7 Handling of Risk

Code	Risk Description	Handling of Risk
R1	The work schedule is not in accordance with the plan	Through the Technical Person in Charge utilizing the existing workforce by increasing working

		hours and understanding of the project being worked on
R2	Costs are not according to planning	Through the Technical Person in Charge utilizing the existing workforce in the hope that the costs do not continue to swell
R3	Workers who cannot be present in the field can be sick, permitted, and others	Technical Responsible and Team Leaders provide more understanding and maintain communication with workers
R4	Workers who do not understand the work in their field	Through the Technical Person in Charge utilizing the existing workforce by increasing working hours and understanding of the project being worked on
R5	Damage to tools (survey tools, office equipment and mobilization)	The team leader uses makeshift tools first, taking into account whether they can pursue the job target and make a report to the Technical Responsible Staff and Field Administration Staff regarding damage to the equipment to rent or replace the damaged tool to the supplier who rents out.
R6	The tool was lost because of being stolen and so on	The team leader uses makeshift tools first, taking into account whether they can pursue the job target and make a report to the Technical Responsible Staff and Field Administration Staff regarding damage to the equipment to rent or replace the damaged tool to the supplier who rents out.
R7	Late delivery from suppliers	The field administration staff continues to contact the supplier, if anything can be done in the project, then the work takes precedence.
R8	Natural disasters (Floods, landslides and others that cause project work cannot be carried out)	The Team Leader directs all workers who are in the field to evacuate, look for locations that are not affected, stop the project work first and wait for further instructions.
R9	Calculation error	The Team Leader and the workforce concerned are reworking and confirming (revising) the wrong calculations during the planned time does not hinder other project work.
R10	Workforce accidents	Workers involved in the field help injured workers, treat P3K if minor injuries, and report to the Team Leader for further efforts.

2.5 Project Control Analysis (Earned Value Management)

The project control analysis contains steps to assist in evaluating the project by controlling project costs and time. Project control using the Earned Value Management method [9].

2.5.1 Project Evaluation Analysis

Project evaluation analysis uses 3 indicators for assessment, namely Planned Value (PV), Earned Value (EV), and Actual Cost (AC). While for project control based on time and cost using several variants, namely the deviation between EV and AC using the Cost Variance (CV) calculation, the calculation of the deviation between PV and EV uses Scheduling Variance (SV), time based performance calculations using the Schedule Performance Index (SPI), cost-based performance calculations using the Cost Performance Index (CPI), cost estimation calculations using Estimate at Completion (EAC) and time estimation calculations using Estimate to Complete (ETC) [9].

Table 8 Recapitulation of EVM Calculations

Week-	Variant Analysis		Job Analysis		Estimation Analysis	
	Time (SV)	CV	Time (SPI)	Cost (CPI)	Time (ETC)	Cost (EAC)
3	Rp 18,142,824.75	Rp -3,353.30	1.521	1.000	15.120	Rp 1,457,255,000.00
4	Rp 89,839,770.75	Rp 13,592.70	3.581	1.000	6.424	Rp 1,457,255,000.00
8	Rp -50,348,160.25	Rp 5,432.45	0.596	1.000	38.584	Rp 1,457,255,000.00
9	Rp -17,109,630.96	Rp -17,167,859.55	0.861	0.860	26.723	Rp 1,693,759,471.00
12	Rp -45,963,279.96	Rp -1,543,666.05	0.595	0.978	38.676	Rp 1,490,602,721.97
13	Rp -1,517,002.46	Rp 30,646.45	0.970	1.001	23.715	Rp 1,456,348,031.96
14	Rp 3,205,961.00	Rp -7,217.80	1.135	1.000	20.256	Rp 1,457,255,000.00
15	Rp 3,788,863.00	Rp -625,629.80	1.193	0.974	19.272	Rp 1,496,259,351.62

Based on the final results of calculations using the EVM method above, conclusions can be drawn as follows:

Total Planned Time = 23 Weeks
Total Actual Time = 23 Weeks
BAC = 1,457,255,000.00
PV = 1,457,255,000.00
AC = 1,476,410,000.00
CV = -19,155,000.00
Remaining time = 23 - 23 = 0 Weeks.
Remaining costs incurred
= 1,476,410,000 - 1,457,255,000
= Rp. -19,155,000.00

In the above project has a remaining time of 0 weeks, it can be concluded that the work on the project in accordance with what had been planned previously. For the remaining project costs of Rp. -19,155,000.00, meaning that the cost of completing the project exceeds that already planned.

2.6 User Needs Analysis

The user analysis needed to use the system can be seen in the following Table 12.

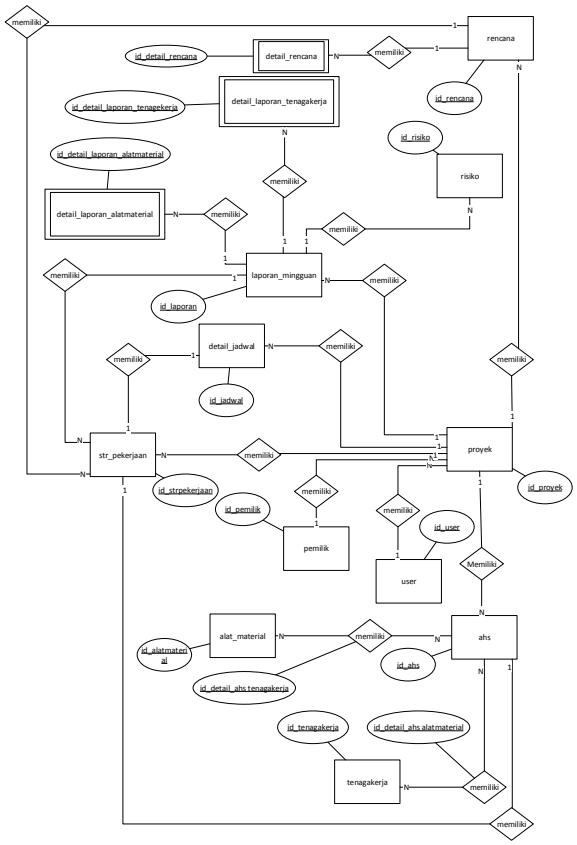
Table 9 Required User Analysis

User	Access	Skill Level
Technical person in charge	Manage project data Manage work data Manage AHS data See Budget Plan data Manage scheduling data Manage risk data Manage weekly plan data Manage evaluation data	Understand web-based application usage and understand project management concepts
Team Leader	View project data Manage weekly reports View evaluation data	Understand the use of web-based applications and understand the concept of project management.

Field Administration Staff	View project data Manage data on tool and material needs Managing workforce See Budget Plan Data	Understand the use of web-based applications

2.7 Database Analysis

Database analysis is a step of analysis to predict or design a system that will be built in the form of relationships between entities in the project management information system at PT. Diantama Rekanusa. The following are the results of database analysis in the form of Entity Relational Diagrams (ERD) that can be seen in Picture 3.



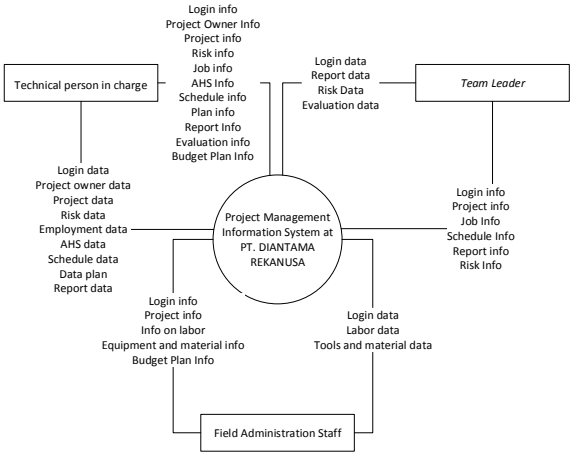
Picture 3 ERD Project Management Information System at PT. Diantama Rekanusa

Table 10 Entity Attributes on ERD

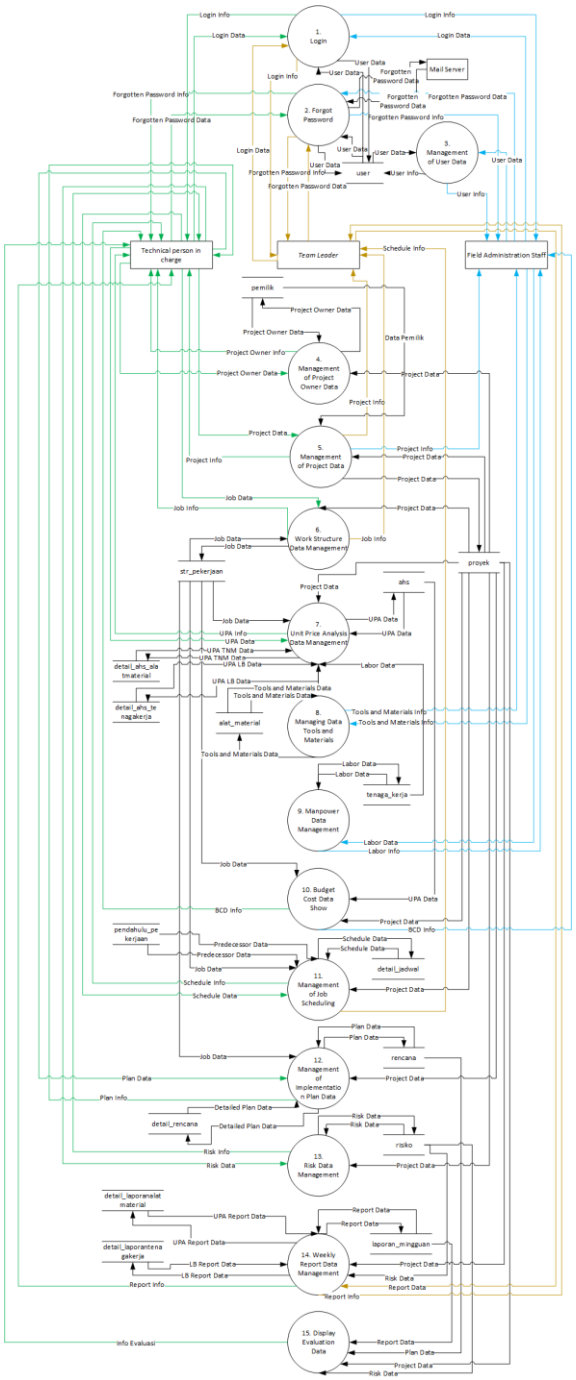
No	Name of Entity	Attribute
1	user	id_user, username, nama, password,status,email
2	pemilik	id_pemilik, nama, kontak, instansi
3	proyek	id_proyek, kode_proyek, nama_proyek, biaya, tanggal_mulai, tanggal_mulai, tanggal_selesai,durasi
4	str_pekerjaan	id_strpekerjaan, nama_pekerjaan, no_pekerjaan, ket
5	alat_material	id_material, nama_alatmaterial, satuan,harga
6	ahs	id_ahs, nama_analisa, ket, total,sub_total_material, sub_total_upah,
7	detail_ahs_tenagakerja	id_detail_ahs_tenagakerja, nama_sumberdaya , koefisien, satuan, harga_satuan, harga
8	detail_ahs_alatmaterial	id_detail_ahs_alatmaterial,nama_sumberdaya , koefisien, satuan ,harga_satuan, harga
9	detail_jadwal	id_ detail_jadwal, mulai, selesai, durasi, es, ef, ls, lf, tf, pendahulu
10	pendahulu_pekerjaan	id_ pendahulu_pekerjaan, id_strpekerjaan
11	tenaga_kerja	id_tenagakerja, jenis_pekerja, satuan, harga, koefisien
12	risiko	id_risiko, nama_risiko, probabilitas, biaya_konsekuensi, biaya_risiko, penanganan
13	rencana	id_rencana, minggu, bobot_rencana, pv, sub_total_upah, total
14	detail_rencana	Id_detail_rencana, nama_sumberdaya , koefisien, satuan, harga_satuan,sisa,target, total_kebutuhan, harga
15	laporan_mingguan	id_laporan, minggu, bobot_realisasi, total, keterangan, sub_total_upah, sub_total_material, aktual_cost
16	detail_laporanalatmaterial	id_detail_laporantenagakerja, nama_sumberdaya , koefisien, satuan, harga_satuan, harga
17	detail_laporantenagakerja	id_detail_laporantenagakerja, nama_sumberdaya , koefisien, satuan, harga_satuan, harga

2.9 Functional Needs Analysis

Analysis of functional requirements is to describe the process of activities that will be applied in the system and explain the needs needed for the system to function properly and according to needs.



Picture 4 Context Diagram



Picture 5 DFD Level 1

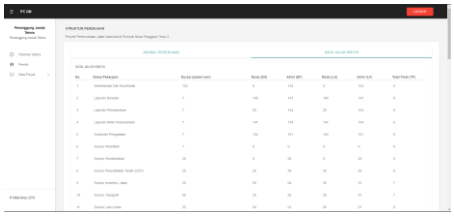
2.9 System planning

System Design is representation, planning, and realization of sketches or arrangements from several different systems into a unified whole. This step includes configuring the software and hardware components of a system.

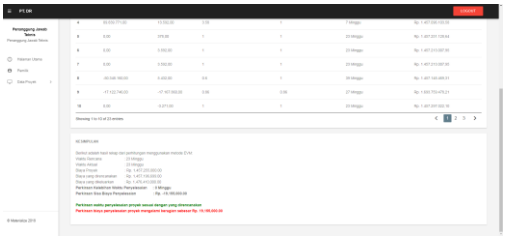
Picture 6 Relation Scheme

2.9 System Implementation

Implementation of project management information systems at PT. Diantama Rekanusa using the methods that have been used can be seen in Picture 7 and Picture 8.



Picture 7 CPM Calculation Results Page



Picture 8 EVM Evaluation Page

2.10 Testing

2.10.1 Black Box Testing

Testing the system in this study is to use the blackbox testing method, namely by testing the operation of everything on the system to determine whether the function has worked as expected or not [11]. The conclusion of the blackbox testing in this

study is that the system will display the results expected if the user enters the correct data, and will display a warning if the user entered the wrong data. But in terms of functions, there are those that have not functioned, namely nodes or critical path diagrams cannot be displayed.

2.10.2 Beta Testing

Beta testing is a test carried out to End-Users or end users in a direct way in the company. Based on the results of answers from the speakers, namely the Technical Responsible, Team Leader, and Field Administration Staff on the questions posed in beta testing, it can be concluded that the system built is considered easy enough to be used by the Technical Personnel, Team Leader, and Field Administration Staff and their functions are in accordance with predetermined goals, where the system can handle project management starting from managing schedules, determining project workforce needs, identifying risks and the system can control project costs and time.

3. CLOSING

3.1 Conclusion

The conclusion that can be drawn from this study is that the system built can help the Technical Person in making scheduling with attachments between jobs and determining which jobs should not be late, the system can determine the needs of the project workforce in the event of a shortage or Technical Responsible to add workers in order to be efficient between time and cost, the system can identify possible risks to the project and the estimated costs that will arise at the time of the project, and the system can control costs and time on the project.

3.2 Suggestion

The advice for this project management information system is to improve its features so that it runs optimally and can be used according to its purpose.

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