DEVELOPMENT OF PROJECT MANAGEMENT INFORMATION SYSTEM IN PT. CIPAGAMAS PERKASA

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ABSTRACT

PT. Cipagamas Perkasa is a company engaged in construction services, the company can work on various projects such as construction of roads, construction of bridges, rehabilitation of irrigation networks and so forth. However, there are problems in scheduling planning perlaksanaan project that has been delayed work due to lead to errors in determining which jobs are included in the critical path and have not shown the relationship between the work of one another, the slow progress report of work by the head of field operators for a remote place and characteristics of the different projects that make a site manager difficulty in monitoring and evaluation of the project to fit the end of the planned, The lack of risk analysis was not done because of the risk that the listing of Site Manager difficult identify risks and impacts that may arise during the implementation of the exposure of the problems faced proyek.Berdasarkan company PT. Cipagamas mighty it takes a project management that can assist in the conduct of planning scheduling, risk management and control using the Critical Path Method (CPM), probablity Impact Matrx (PIM), Expected Monetary Value (EMV), Earned Value Management (EVM) and time Cost Trade Off (TCTO). the results of research and testing can be concluded that this project management system can make scheduling,

Keywords: Project Management, Critical Path Method, Probability Impact Matrix, Expected Monetary Value, Earned Value Management, Time Cost Trade Off

1. PRELIMINARY

PT.Cipagamas Perkasa is a company engaged in construction services, the company is located in Kp. Waru RT. 01/02 Wargasetra village, Tegal hibiscus - karawang.

Based on the interview with Mr. Ahadi Ahadian as a site manager, PT. Mighty Cipagamas often handle the project either through tender or appointed directly by the relevant agency, but in fact the company is often delayed work at the time of execution of the project is one example cigunungsari bridge construction project with a contract value of Rp. 2.731.3231.000,00 (two billion, seven hundred and thirty one million two hundred and thirty one thousand rupiah) and the duration of the project for 120 days, due to several factors: the scheduling is done by estimating or see from the experience of projects already completed,

The lack of risk analysis because not doing the recording of risk so that Site Manager difficult to identify risks and impacts that may arise during the implementation of the project, for example, as there are employees who are ill, resulting in their employees who do more work or additional time, the delay material which makes the project grow and impact on the costs of the company.

In addition, Site Manager reported that reports the progress of the progress of work made by the Chief Executive Officer Courses are experiencing delays, because the projects are far apart and the process can be carried out simultaneously in one time as well as the characteristics of the project are different, thus making the Site Manager difficulties in conducting surveillance and the final evaluation that the project as planned and it is a negative impact on cost control and project time.

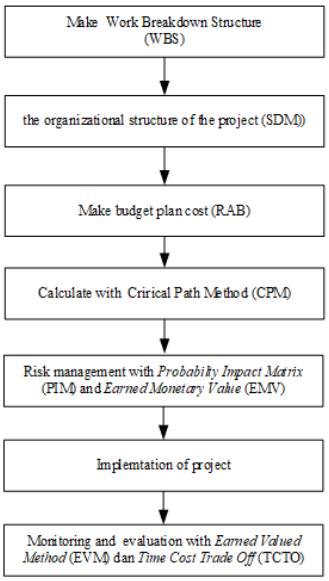
Based on the above, the exposure problem needed a solution to address the problems that often occur in the planning and implementation of projects in PT.Cipagamas Perkasa namely the need for an information system that can memanjemen a project, which means a system that can manage the project planning that the project schedule and project implementation both the cost and time and analyze the risks that may occur when projects are carried out so that the

risks that may occur during the project implementation can be managed well and the cost for each risk has been prepared in advance [1] [6].

2. RESEARCH

2.1 Analysis Project Phases

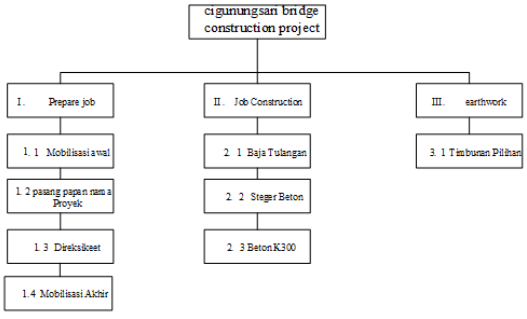
Analysis of project stages are stages in the project management tried to put the basic goals and objectives as well prepare all the technical and administrative programs to be implemented in the system [1]. then the phases of project management can be seen in the image below [1] [2].



Picture 1 stages of the project

2.1.1 *Work Break Down Structure* (WBS)

used to facilitate the planning and scheduling of a project by dividing the work into more detail, can be seen in Figure 2 [2].



Picture2 Work Break Down Structure (WBS)

2.1.2 Analysis of human resources (RACI)

Human resources is very important in a project so the relationship and the role of resources (manpower) owned by an individual must be used optimally to achieve the objectives [5] [6].

Table 1 diagram Raci

No	Uraian Pekerjaan	Orang				
		Ahadi Ahadian	Yadi Supriadi	Yadi Aryamo	Dudu Nahmadu	Vinondini Indriati
I	PEKERJAAN PERSIAPAN					
1.1	mobilisasi	I	A	R	R	C
1.2	pasang papan nama proyek	I	A	R	R	C
1.3	Direksikeet	I	A	R	R	C
II	PEKERJAAN KONTRKSI					
2.1	Baja tulangan BJ 24 Polos	I & C & A	A & C	R	R	C
2.2	Steger beton	I & C & A	A & C	R	R	C
2.3	beton K-300	I & C & A	A & C	R	R	C
III	PEKERJAAN TANAH					
3.1	Timbunan Pilihan	I & C & A	A & C	R	R	C

Information : R = Responsible A = Accountable C = Consulted I = Inform

2.1.3 Budget plan

Here is a budget plan for the bridge construction project cigunung sari.

Table 2 Budget plan

NO.	URAIAN PEKERJAAN	VOLUME	SATUAN (Rp.)	BIAYA (Rp.)	JUMLAH BIAYA (Rp.)
I.	PEKERJAAN PERSIAPAN				
1.1	Mobilisasi	1,00 Ls	15.000.000,00	15.000.000,00	
1.2	Pasang Papan Nama Proyek	1,00 Dh	500.000,00	500.000,00	
1.3	Direksikeet	24, 00 M²	300.000,00	7.200.000,00	
					22.700.000,00
II.	PEKERJAAN KONSTRUKSI				
2.1	Baja Tulangan Bj 24 polos	48822,99 Kg	25.141,88	1.227.501.755,82	
2.2	Steger Beton	27,00 M²	2.250.000,00	60.750.000,00	
2.3	Beton K-300	314,99 M³	1.316.148,55	414.573.631,76	
					1.702.825.143,47
III.	PEKERJAAN TANAH				
3.1	Timbunan Pilihan	3.649,91 M³	207.566,52	757.599.117,01	
					757.412.302,58
		JUMLAH			Rp 2.482.937.446,05
		PPN (10%)			Rp 248.293.941,61
		JUMLAH TOTAL			Rp 2.731.231.190,66
		DIBULATKAN			RP 2.731.231.000,00

2.2 analysis scheduling

Scheduling analysis is the analysis of activity and the work necessary to complete the cigunungsari bridge construction project, the project aims to optimize the scheduling of the project schedule by finding the critical path of a job by using critical path method (CPM) [1].

2.1.1 Estimated time jobs

At this stage the CPM requires three essential components, namely a list of all activities required to complete the project, the duration required to complete each project and dependencies between activities

Table 3 Bridge the Development Project activities cigunungsari

No.	uraian pekerjaan	Kode kegiatan	Kegiatan pendahulu	durasi (hari)
1.1	Mobilisasi	A	Start	6
1.2	pasang papan nama proyek	B	Start	1
1.3	Direksikeet	C	Start	3
2.1	Baja tulangan BJ 24 polos	D	1.1,1.2,1.3	45
2.2	Stager Beton	E	1.1,1.2,1.3	40
2.3	beton k-300	F	2.1,2.2	44
1.4	Mobilisasi akhir	G	2.3	6
3.1	Timbunan Pilihan	H	2.3	25

2.1.2 advanced computation

To perform advanced calculations on the CPM required p-value Early Start (ES) and Early Finish (EF).

1. *Early Start* (ICE)

ES is the start time of the beginning of an activity, if the activity time expressed in days, the following formula:

ES = ESsebelumnya + long past activities ..... (2.1)

2. *Early Finish*(EF)

EF adaalah time from the end of an activity, if the activity time expressed in days, hours completed at the beginning of an activity, the following formula:

EF: EF = ES + long kegiata .... (2.2)

Here Recap advanced calculations and Early Start Early Finish:

Table 4 Advanced Calculation Recap

No	Kode Kegiatan	Kegiatan		Waktu (t) dalam hari	Paling awal	
		i-node	j-node		Mulai (ES)	Selesai (EF)
1.1	A	1.1	2.1	6	0	6
1.2	B	1.2	2.1	1	0	1
1.3	C	1.3	2.1	3	0	3
2.1	D	2.1	2.3	45	6	51
2.2	E	2.2	2.3	40	6	46
2.3	F	2.3	3.1	44	51	95
2.3	F	2.3	1.1	44	51	95
1.4	G	3.2	4	6	95	101
3.1	H	3.1	4	25	95	120

2.1.3 countdown

To do a countdown on a CPM takes seek value Latest Start (LS) and Hot Finish (LF).

1. Latest Start (LS)

LS is the last time the activity starts without slowing down the overall project activities Latest Finish (LF).

LS = LF - long activities ..... (2.3)

2. *Latest Finish* (LF)

LF is the end time of a project activity, the following formula LF:

LF = LFsetelahnya - long activity .... (2.4)

Table 5 Backward calculations Recap

No	Kode Kegiatan	Kegiatan		Waktu (t) dalam hari	Paling akhir	
		i-node	j-node		Mulai(LS)	Selesai(LF)
1.1	A	1.1	2.1	6	0	6
1.2	B	1.2	2.1	1	0	1
1.3	C	1.3	2.1	3	0	3
2.1	D	2.1	2.3	45	6	51
2.2	E	2.2	2.3	40	6	51
2.3	F	2.3	3.1	44	51	95
2.3	F	2.3	1.1	44	51	95
1.4	G	3.2	4	6	95	120
3.1	H	3.1	4	25	95	120

2.1.4 float

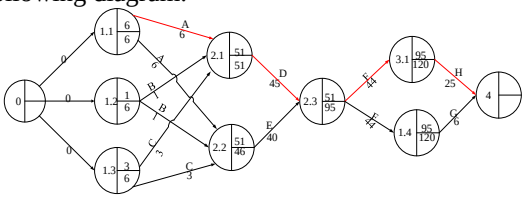
float a delay time that is allowed without affecting the total time of the project. with the formula

TF = LF - EF = LS - ES ..... (2.5)

Table 6 Recapitulation of the calculation of Total Float

No	Kode Kegiatan	Kegiatan		Waktu (t) dalam hari	Paling awal		Paling akhir		Total Float (TF)
		i-node	j-node		Mulai(ES)	Selesai(E F)	Mulai(LS)	Selesai(LF)	
1.1	A	1.1	2.1	6	0	6	0	6	0
1.2	B	1.2	2.1	1	0	1	0	1	0
1.3	C	1.3	2.1	3	0	3	0	3	0
2.1	D	2.1	2.3	45	6	51	6	51	0
2.2	E	2.2	2.3	40	6	46	6	51	5
2.3	F	2.3	3.1	44	51	95	51	95	0
2.3	F	2.3	1.1	44	51	95	51	95	0
1.4	G	3.2	4	6	95	101	95	120	19
3.1	H	3.1	4	25	95	120	95	120	0

Based on the analysis tables CPM method concluded that activities had a total value of float or TF = 0. 3 pieces available channels, namely A - D - F - H, B - D - F - H and C- D - F - H, but the track used and should not be delayed is a line A - D - F - H, then it will get the job the following diagram.



Picture 3 Network Diagram critical path

2.3 Analysis of risk management

Risk management is carried out during the design of a site manager can minimize the possibility of risks that may arise and have a negative impact during project implementation, There are several stages of the process in managing risk by using Probability Impact Matrix (PIM) [6] and Expected monetary value (EMV) [1].

2.3.1 identification of risk

risk identification is possible to recognize the possibilities that arise and hamper during the project [6].

Table 7 Variable Project Risk

kode risiko	Jenis Risiko	Deskripsi Risiko
R1	Estimasi	Jadwal yang direncanakan tidak sesuai dengan dilapangan
R2		biaya aktual dilapangan melebihi rencana anggaran
R3		pengulangan pekerjaan (*Rework*)
R4	Keselamatan kerja	kecelakaan karena alat kerja
R5		Tertimpa bahan bangunan
R6		kecelakaan lalu lintas
R7		Tertimbun tanah
R8	Personal	Kemampuan SDM yang tidak sesuai dengan standar
R9		Pekerja sakit atau tidak hadir pada saat pelaksanaan proyek
R10	Alat Penunjang Kontruksi	Hilang atau dicurinya barang kebutuhan kontruksi atau alat kerja
R11		kerusakaan alat konturiksi
R12	Ekternal	Protes dari organisasi atau lingkungan tertentu
R13		Gangguan cuaca
R14		keterlambatan pengiriman barang
R15		Kenaikan Harga material

2.3.2 Possible value and impact

Assessment is based on two parameters: the likelihood of the risk (probability) and the impact of risk itself.

Table 8 Parameter possibility Risk

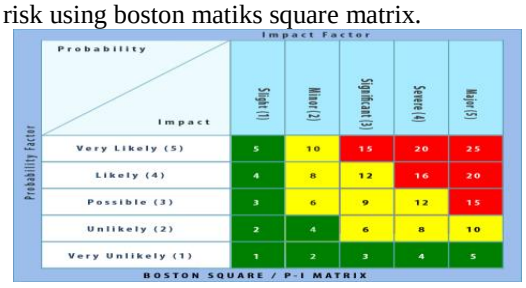
Nilai	Parameter	Deskripsi
1	Sangat rendah	Jarang terjadi, hanya pada kondisi tertentu
2	Rendah	kadang terjadi pada kondisi tertentu
3	Sedang	Terjadi pada kondisi tertentu
4	Tinggi	Sering terjadi pada kondisi Tertentu
5	Sangat Tinggi	Selalu terjadi pada kondisis tertentu

Table 9 Impact parameter risk

Nilai	Parameter	Dampak
1	Sangat rendah	Dampak tidak signifikan dirasakan, kerugian keuangan tidak berarti
2	Rendah	Perlu penanganan langsung ditempat, kerugian keuangan menjadi biaya pengeluaran tambahan (*over head*)
3	Sedang	Perlu ditangani oleh pelaksana, kerugian keuangan cukup berarti
4	Tinggi	Adanya keterlambatan pada jadwal yang direncakan
5	Sangat Tinggi	Perlu penanganan oleh *site manager*, kerugian besar, perlu penanganan khusus

2.3.3 Determining the Level of Risk

After determining the value of the likelihood and impact of risks, the next step is determining the value of the importance level of risk using boston matiks square matrix.



Picture 4 Boston Square Matrix

The level of importance of each risk is calculated by using the formula

Risk Exposure = probablity x loss ....(2.6)

Here are the full results of the assessment for each risk

Table 10 Kepetingan level of risk

kode risiko	Jenis Risiko	Deskripsi Risiko	Level risiko
R1	estimasi Estimasi	Jadwal yang direncanakan tidak sesuai dengan dilapangan	Sedang
R2		biaya aktual dilapangan melebihi rencana anggaran	Sedang
R3		pengulangan pekerjaan (*Rework*)	Rendah
R4	Keselamatan kerja	kecelakaan karena alat kerja	Sedang
R5		Tertimpa bahan bangunan	Rendah
R6		kecelakaan lalu lintas	Rendah
R7		Tertimbun tanah	Rendah
R8	Personal	Kemampuan SDM yang tidak sesuai dengan standar	Rendah
R9		Pekerja sakit atau tidak hadir pada saat pelaksanaan proyek	Sedang
R10	alat penunjang kontruksi	Hilang atau dicurinya barang kebutuhan kontruksi atau alat kerja	Sedang
R11		kerusakaan alat konturiksi	Sedang
R12	Eksternal	Protes dari organisasi atau lingkungan tertentu	Sedang
R13		Gangguan cuaca	Tinggi
R14		keterlambatan pengiriman barang	Sedang
R15		Kenaikan Harga material	Sedang

2.3.4 handlers Risk

From the results of the risk assessment of importance that has been done before then mitigation or risk management actions.

Table 11 handling Risk

kode risiko	Jenis Risiko	Deskripsi Risiko	Tingkat risiko	Mitigasi
R1	Estimasi	Jadwal yang direncanakan tidak sesuai dengan dilapangan	sedang	Melakukan Penambahan jam kerja
R2		biaya aktual dilapangan melebihi rencana anggaran	sedang	menyiapkan dana cadangan untuk menutupi kekurangan
R3		pengulangan pekerjaan (*Rework*)	rendah	mengecek kembali pekerjaan yang sudah selesai dikerjakan
R4	Keselamatan kerja	kecelakaan karena alat kerja	sedang	pekerja diwajibkan selalu menggunakan helm, sarung tangan dan sepatu bot
R5		Tertimpa bahan bangunan	rendah	pekerja diwajibkan selalu menggunakan helm, sarung tangan dan sepatu bot
R6		kecelakaan lalu lintas	rendah	mematuhi lalulintas dan menggunakan alat keselamatan berkendara
R7		Tertimbun tanah	rendah	pasang penahan tanah
R8	Personal	Kemampuan SDM yang tidak sesuai dengan standar	rendah	diawasi oleh pekerja berpengalaman dan diarahkan cara kerjanya
R9		Pekerja sakit atau tidak hadir pada saat pelaksanaan proyek	sedang	menambah jam kerja pekerja
R10	alat penunjang kontruksi	Hilang atau dicurinya barang kebutuhan kontruksi atau alat kerja	sedang	Sewa alat untuk sementara dan lebih ditingkatkan pengawasan terhadap alat kerja
R11		kerusakaan alat konturiksi	sedang	sewa alat untuk sementara, lalu memperbaiki alat yang akan digunakan
R12	Eksternal	Protes dari organisasi atau lingkungan tertentu	sedang	Melakukan musyawarah dengan masyarakan atau organisasi

2.4 Valuation risk (EMV)

At this stage, the risk assessment in a way to get the discussion of Mr. Ahadi Ahadian respondents as SiteManager PT. Cipagamas Perkasa to see the fee required for each risk by calculating the value of the probability and consequences budgeted cost of each risk [1].

Table 12 Probability scale risk assessment

Probabilitas	Keterangan
1-10%	Jarang terjadi, hanya pada kondisi tertentu
11-20%	Kadang terjadi pada kondisi tertentu
21-30%	Dapat terjadi pada kondisi tertentu
31-40%	Terjadi pada kondisi tertentu
41-50%	Sering terjadi pada kondisi tertentu

then following the results of the probability of each risk

Table 13 Possible Values EMV

kode risiko	Jenis Risiko	Deskripsi Risiko	Probabilitas (%)
R1	Estimasi	Jadwal yang direncanakan tidak sesuai dengan dilapangan	32%
R2		biaya aktual dilapangan melebihi rencana anggaran	24%
R3		pengulangan pekerjaan (*Rework*)	12%
R4	Keselamatan kerja	kecelakaan karena alat kerja	24%
R5		Tertimpa bahan bangunan	12%
R6		kecelakaan lalu lintas	8%
R7		Tertimbun tanah	12%
R8	Personal	Kemampuan SDM yang tidak sesuai dengan standar	12%
R9		Pekerja sakit atau tidak hadir pada saat pelaksanaan proyek	16%
R10	Alat Penunjang Kontruksi	Hilang atau dicurinya barang kebutuhan kontruksi atau alat kerja	24%
R11		kerusakaan alat konturiksi	32%
R12	Eksternal	Protes dari organisasi atau lingkungan tertentu	40%
R13	Ekternal	Gangguan cuaca	50%
R14		keterlambatan pengiriman barang	36%
R15		Kenaikan Harga material	40%

After knowing the probability, then calculated to determine the value of EMVnya formula

EMV = Probability x Consequence ..... (2.7)

Thus obtained EMV value of each risk as follows:

Table 14 Results Expected Monetary Value

kode risiko	Jenis Risiko	Deskripsi Risiko	Probabilitas (%)	Konsekuensi	EMV
R1	Estimasi	Jadwal yang direncanakan tidak sesuai dengan dilapangan	32%	Rp 9,000,000.00	Rp 2,880,000.00
R2		biaya aktual dilapangan melebihi rencana anggaran	24%	Rp 6,000,000.00	Rp 1,440,000.00
R3		pengulangan pekerjaan (*Rework*)	12%	Rp 5,000,000.00	Rp 600,000.00
R4	Keselamatan kerja	kecelakaan karena alat kerja	24%	Rp 3,000,000.00	Rp 720,000.00
R5		Tertimpa bahan bangunan	12%	Rp 2,500,000.00	Rp 300,000.00
R6		kecelakaan lalu lintas	8%	Rp 2,000,000.00	Rp 160,000.00
R7		Tertimbun tanah	12%	Rp 2,500,000.00	Rp 300,000.00
R8	Personal	Kemampuan SDM yang tidak sesuai dengan standar	12%	Rp 4,000,000.00	Rp 480,000.00
R9		Pekerja sakit atau tidak hadir pada saat pelaksanaan proyek	16%	Rp 3,000,000.00	Rp 480,000.00
R10	alat penunjang kontruksi	Hilang atau dicurinya barang kebutuhan kontruksi atau alat kerja	24%	Rp 2,000,000.00	Rp 480,000.00
R11		kerusakaan alat konturiksi	32%	Rp 2,000,000.00	Rp 640,000.00
R12	Eksternal	Protes dari organisasi atau lingkungan tertentu	40%	Rp 1,500,000.00	Rp 600,000.00
R13		Gangguan cuaca	50%	Rp 4,000,000.00	Rp 2,000,000.00
R14		keterlambatan pengiriman barang	36%	Rp 4,000,000.00	Rp 1,440,000.00
R15		Kenaikan Harga material	40%	Rp 3,750,000.00	Rp 1,500,000.00
TOTAL					Rp 14,020,000.00

Calculations indicate that there is a threat as the project progresses, Integration should spend so much moneyUSD 14,020,000.00to deal with the risk of the cost of each emerging risks

2.5 Project Monitoring Analysis

EVM is a method that mengistegrasikan the relationship between time and cost and provide an overview of the condition of the continuity of the project [7].

2.5.1 Calculation of the weight percentage of jobs

Job weight calculation used to find the weight of each job, the following weighting calculation formulas work [1].

$$\textbf{Bobot} = \left(\frac{\textbf{Biaya pekerjaan}}{\textbf{Nilai proyek}}\right) \boldsymbol{x}\ \mathbf{100}$$

The first job for weight calculation is mobilized as follows:

Total price of work: Rp. 2,482,937,446.05

The price of the job :Rp. 15,000,000.00

$$\textbf{Bobot} = \left(\frac{\mathbf{15.000.000,00}}{\mathbf{2.482.937.446,05}}\right) \boldsymbol{x}\ \mathbf{100\%}$$

= 0.6%

Fortunately calculations further work can be seen in the following table:

Table 15 Weight calculation jobs

No	Pekerjaan	Harga satuan	bobot (%)
1.1	Mobilisisasi	Rp 15,000,000.00	0.6
1.2	pasang papan nama	Rp 5,000,000.00	0.02
1.3	Direksikeet	Rp 7,200,000.00	0.01
2.1	Baja tulangan Bj 24 Polos	Rp 1,227,501,755.82	49.58
2.2	Steger Beton	Rp 60,750,000.00	2.45
2.3	Benton K-300	Rp 41,457,363,176.00	16.75
3.1	Timbunan pilihan	Rp 75,741,230,258.00	30.59
TOTAL			100,00

2.5.2 Analysis Planned Value (PV)

Yan is a cost plan has been approved to be spent on activities that have been planned, the following is a calculation of PV at weeks 1,

PV calculation on Sunday to -1

BAC = USD 2,482,937,446.00

Weights PV = 0.33%

PV = (% progress plan) x BAC

PV = 0.33% x 2,482,937,446.00= USD 8,193,693.00

For the next week can be seen in the results in Table 16 recap.

2.5.3 Analysis Earned Value (EV)

Earned Value is an estimate of the value of the physical realization of a calculation pekerjaan.berikut -1 EV in week:

EV calculations on Sunday to -1:

BAC = Rp. 2,482,937,446.00

Weights EV = 0:33%

EV = (% Of actual progress) x

BAC = 0:33% x 2,482,937,446.00

= Rp. 8,193,693.00

For the next week can be seen in the results in Table 16 recaps

2.5.4 Analysis Actual Cost (AC)

Analysis of Actual Cost is the total cost incurred during the project implementation, following the actual cost at week 1.

BAC = Rp. 2,482,937,446.00

air conditioning =Rp. 8,193,693.00

2.5.5 Scheduling Analysis of Variance (SV)

scheduling Variance is variable to identify the time that has been used, following the calculation of the SV at week 1.

SV calculation at week 1:

EV = 8,193,693.57

PV = 8,193,693.57

SV = EV -pv .... (2.9)

= 8,193,693.57 - 8,193,693.57

= 0

For the next week can be seen in the results in Table 16 recap.

2.5.6 Cost Analysis of Variance

Variables to identify the costs have been incurred whether larger or smaller than the cost of which has been planned, the following is a calculation of the CV in week 1.

CV calculations in week 1:

EV = USD 8,193,693.57

air conditioning = Rp 8,100,000

CV = EV - AC .... (2.8)

= 8,193,693.57 - 8,052,988.87

= Rp. 140,704.00

For the next week can be seen in the results in Table 16 recap.

2.5.7 *Schudle performanced Index (SPI)*

If the CPI value> = 1 means that the performance of the project both for the costs incurred in accordance with the planned budget, the following is a calculation of the SPI weeks to -1.

The calculation of the SPI at week 1:

EV = 8,193,693.57

PV = 8,193,693.57

SPI = EV / PV ..... (2.11)

= 8,193,693.57 / 8,193,693.57

= 1

For the next week can be seen in the results in Table 16 recap.

2.5.8 Cost Analysis Performace Index (CPI)

If the value of the CPI <1 means that the performance royek performance is not good, because in terms of cost in excess of funds that have been planned, following the CPI calculation in the week to -1.

CPI calculation in week 1:

EV = 8,193,693.57

AC = 8,052,988.87

CPI = EV / AC .... (2.10)

= 8,193,693.57 /8,052,988.87

= 1

For the next week can be seen in the results in Table 16 recap.

2.5.9 Estimate at Completion (EAC)

EAC Final cost of the project is to be issued, the following is a calculation of the EAC remedy week to -1 /

EAC calculation at week 1:

BAC = USD 2,482,937,446.00

CPI = 1

EAC = BAC / CPI ..... (2.13)

EAC = 2,482,937,446.00 / 1

= 2,482,937,446.00

For the next week can be seen in the results in Table 16 recap.

2.5.10 *Estimate to Completion (ETC)*

ETC will predict the timing of completion of the project, assuming the tendency of the project goes according to plan or not. Following the intentional ETC for weeks to -1

ETC calculations at week 1:

OD = 120 days

SPI = 1.000

ETC = OD / SPI ..... (2.14)

ETC = 120 / 1,000

= 120 days

For the next week can be seen in the results in Table 16 recap.

2.5.11 Results Recap EVM Analysis

Here is a recap of the results of the analysis method of EVM, can be seen in the table below.

Table 16 Recap The results of the analysis EVM

Minggu	Analisa Varian		Analisa Kerja		Analisa Estimasi	
	Waktu	Biaya	Waktu	Biaya	Waktu	Biaya
	SV (Rp)	CV (Rp)	SPI	CPI	ETC	EAC (Rp)
1	0	0	1.000	1	120	2,482,937,446
2	0	0	1.000	1	120	2,482,937,446
3	0	0	1.000	1	120	2,482,937,446
4	0	0	1.000	1	120	2,482,937,446
5	0	0	1.000	1	120	2,482,937,446
6	0	0	1.000	1	120	2,482,937,446
7	0	0	1.000	1	120	2,482,937,446
8	0	0	1.000	1	120	2,482,937,446
9	-Rp 2,979,524.00	0	0.957	1	125	2,482,937,446
10	-Rp 1,489,762.00	0	0.978	1	123	2,482,937,446
11	Rp 248,293.00	0	1.004	1	119	2,482,937,446
12	Rp 2,731,231.00	0	1.039	1	115	2,482,937,446
13	Rp 1,489,762.00	0	1.022	1	117	2,482,937,446
14	0	0	1.000	1	120	2,482,937,446
15	0	0	1.000	1	120	2,482,937,446
16	0	0	1.000	1	120	2,482,937,446

Based on the results recap 3:38 table analysis using EVM to 16 weeks, it can be concluded that the project is still as planned due to the time of completion (ETC) is 120 days, according to the estimated of 120 days and costs Rp. 2,482,937,446.00 sesauai with angggaran total (BAC) Rp. 2,482,937,446.00 but in terms of the scheduling of project activities is delayed for 2 weeks from week 9 through week 10, but in terms of the budgetary costs incurred the same project with a contract value of BAC is Rp. 2,482,937,446.00.

2.6 Acceleration of Work

Acceleration time and costs are calculated by adding hours of work centered on the work that passes through the critical path. Work on the critical path to the calculation of Critical Path Method (CPM) [3] ..

Table 17 Critical Work Project

No.	uraian pekerjaan	Kode kegiatan	Durasi (hari)	Status
1.1	Mobilisasi awal	A	6	Kritis
1.2	pasang papan nama proyek	B	1	Kritis
1.3	Direksikeet	C	3	Kritis
2.1	Baja tulangan BJ24 polos	D	45	Kritis
2.2	Stager Beton	E	40	---
2.3	beton k-300	F	44	Kritis
1.4	Mobilisasi akhir	G	6	---
3.1	Timbunan Pilihan	H	25	Kritis

After getting a job that passes further analyze the critical path monitoring project using Earned Value Method (EVM) to get the project penjdawalan, from the calculation of EVM in the previous analysis there is a delay in week 9 through week 10. Having obtained at week keberapa the delay is happening next in the week there is a check on what jobs are there in weeks 9 to the 10th week. Obtained jobs are in week 9 to week 10 are as follows:
F = Concrete K-300

2.6.1 Calculation of Normal Productivity

Normal daily productivity can be interpreted as the ability to finish the job with a certain volume each day without any extra time, alternative or acceleration, following the calculation of normal productivity.

$$\textbf{Produktivitas harian normal} = \frac{\textbf{Volume Pekerjaan}}{\textbf{Durasi Normal}}$$

The following is a calculation of employment Concrete k-300 should be accelerated.
Job volume = 314.99 Kg
normal duration = 44 days
normal productivity = 314.99 / 44
= 7.16 kg

So that the work to be completed within one day to be able to complete a volume of 7:19 kg.

2.6.2 Calculation Productivity Acceleration

The daily productivity acceleration obtained from the amount of normal daily productivity with productivity during hours of overtime per day in PT. Cipagamas mighty implement the rule of normal working hours is 8 hours / day. The addition of overtime hours is one hour / day with an increase of 1.5 wage / hour, while worker productivity is assumed to decline overtime hours and only accounted for 90% of normal productivity, following the daily calculation of the acceleration of Concrete K-300 should be accelerated.

a. Normal working hours = 8 hours / day
b. Extra hours (overtime) = 1 hour / day
c. Overtime pay = 1.5 wage / hour
d. worker productivity = 90%
e. Normal daily productivity = 7:16 kg
f. Normal daily productivity / h = e / a
= 7:16 / 8
= 0.89 kg
g. Productivity overtime = (Bxd) XF
= (1 x 0.9) x 0.89kg = 0801 kg
h. The daily productivity acceleration = e + g
= 7.16 + 0,801 = 7,961 kg

Then the work to be completed within one day after the accelerated should be able to complete a volume of 7,961 kg

2.6.3 Duration calculation Crash, Crash Cost and Cost Slope

The next step is to calculate the duration of the acceleration (Crash duration) and the direct costs of the acceleration (crash cost). Calculation crash duration used in order to obtain the maximum time for an activity to be able to do crashing crashing (crashability), while the calculation Crash cost is to find crash slope on each work, the following calculation Crash Duration, Crash Cost and Cost Slope [1] [6].

a. Job volume = 314.99 kg
b. normal duration = 44 days
c. The normal cost = Rp. 414,573,631.76
d. The unit cost of wages = Rp.31877.00
e. The unit cost of materials = Rp. 1,085,600.00
f. The unit cost tools = Rp.27000.00
g. Normal daily productivity = 7:16 kg
h. Productivity acceleration = 7,961 kg
i. *crash duration* = a / h
= 314.99 / 7961
= 39.57 rounded up to 40 days
j. Normal wage / hour = (DXG)
= 31877.00x 7:16
= Rp. 228,310.92
k. Normal wage / day = (8 hours xj)
= 8 x 228,310.92
= Rp. 1,826,487.36
l. Overtime pay / day = (1.5 x 1) xj
= 1.5 x 228,310.92
=Rp. 342,466.38
m. Wage costs / day = (k + l)
= Rp. 1.826.487,36+ Rp. 342,466.38
= Rp.2.168.953,74
n. Total cost of wages = I xm
= 40 x 2,168,953.74
= Rp. 86,758,149.6
o. Total cost matrial = ax
= 314.99 x 1.0856 million, 00
= 341,953,144.00
p. The total cost of the tool = AXF
=314.99 x27,000, 00
= Rp. 8,504,730.00
q. *crash cost* = (N + o + p)
= 86.758.149,6 + 341.953.144,00 + 8.504.730,00
= Rp. 436,200,700.23

r. *crash Slope* = (Q - c) / (44-40)
= (436.214.548,31-414,573,631.76) / 4
= Rp. 491,484.74

From the above calculation, the results obtained from the values calculated by the crash duration, crashes cost and cost slope, from Concrete Work K-300, with the value of the event of delay in Concrete Work K-300, the duration of the acceleration (Crash duration) is 40 days from the normal duration 44 days. With the direct cost acceleration (Crash Cost) Rp. Rp. 436,200,700.23 And the added costs (Cost Slope) for K-300 Concrete work Rp. 491,484.74. in units of time.

3 CLOSING

3.1 Conclusion

Based upon the results of research and testing has been done on the Project Management System, it can be deduced as follows:

1. Project management system, can help SiteManager to plan projects that make such scheduling plan can determine the critical path of each job and address the relationship of the work with other jobs.
2. Project management system, can help SiteManager to identify risks and rate risk as well as informing the cost should be prepared of each risk.
3. Project management system, can help the head of field operators in doing the submission of reports and Site Manager can assist in monitoring and evaluating the project to comply with the plan.

3.2 Suggestion

Based on test results sisterm, there are suggestions for menambakan things - things that can complement future Project Management System, among others:

1. Adding a Human Resource Management in the system so that more human resources are managed optimally for.
2. Adding financial management in order to more easily provide information to the site manager and director.

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