MANUFACTURING PROJECT MANAGEMENT CV. SUMBER ALAM MARMER

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ABSTRACT

CV. Sumber Alam Marmer is a company engaged in manufacturing manufacturing of marble material into new products, but there is a problem in scheduling the production of the project (project) which delayed the workmanship because the work done simultaneously in one time with the production per day resulting in the production of orders (project) Become less than maximum. Lack of risk analysis at the time of execution of which one of the examples of marble damaged matter it affects the cost where the budgeted budget is not in accordance with the planned. The lack of experience of project managers in handling the production of orders (projects) has its own problems faced when there are problems with work delays making it difficult to control production orders (projects).

Based on the presentation of the problems faced by CV. Sumber Alam Marmer need a project management of manufacturing that can help in making of planning scheduling, risk management and control using the Program Evaluation and Review Technique (PERT), probablity Impact Matrx (PIM), Expected Monetary Value (EMV) and Earned Value Management (EVM).

From the results of research and testing can be drawn conclusion that the system the management of this manufacturing project can make scheduling, identify risks and assess risks both qualitatively and quantitatively as well as controlling and estimating the timing and costs incurred on order production (projects).

***Keywords**: Manufacturing Project Management, Program Evaluation and Review Technique, Probabilitty Impact Matrix, Monetary Earned Value, Earned Value Management*

1. INTRODUCTION

CV. Sumber Alam Marmer is a manufacturing company engaged in the manufacture of marble materials into new products such as kitchen tables, inscriptions, crafts, marble and granite floors. CV. Sumber Alam Marmer is located on Jl. Raya Ciburuy Kp. Andir No.783 Kec. Padalarang Kab. West Java Province West Java-Indonesia.

Based on the interview with Mr. Hamzah Saifulloh as the project manager, explained that the company CV. Sumber Alam Marmer there are two types of production, namely daily production and order production (project). But there is a problem with scheduling the production of the order (project) that is delayed because the process is done simultaneously in one time and four different products so the working time becomes uncertain. This has a negative impact on the production of orders (projects) when problems occur, because it will make the production of orders (projects) to be less than the maximum.

Lack of risk analysis on the order (project), one of which is the destruction of marble raw materials it affects the cost, where the budgeted budget is not in accordance with the planned it will have a negative impact on the company because the longer the risk is ignored, the greater the expenses incurred by the company .

His worker sends the progress report of the work done by the operational team to the project manager as an evaluation material, it becomes his own problem faced by him in controlling the production of orders (projects). So he can not estimate the time spent and the costs incurred on the production of orders (projects) that are being done, and harm the company due to loss of client trust in the company.

Based on the presentation of the problems faced by CV company. Marble Natural Resources then required a project management that can assist managers in scheduling planning, to find out the fastest time, perhaps and the longest time and

estimate the percentage of possible completion of work. Assisting project managers in identifying and providing risk management on order production (project) then determining the large portion of risk, which is nominated in the form of risk costs. Assist project managers in controlling the production of other orders (projects) in the event of job delays and help estimate the time and cost of production pennowning (project) spelling.

2. CONTENT OF RESEARCH

2.1 Scheduling analysis

Analisis penjadwalan produksi pesanan (Analysis of order production scheduling (project) is information about schedule plan and production progress. In this case the planning of scheduling for production orders (projects) Adi Simple methods Program Evaluation and Review Technique..

2.1.1 Estimated time of work

At the stage of the method Program Evaluation and Review Technique begins with estimating the time of each job into three types, namely time optimistic time (to), most likely (m), and the time pesimistic (tp).

Table 1. *Details and Estimation jobs*

No	Work	Code	Predecessor	to	m	tp
1	Cut the size of the patern	I.1	-	4 days	5 days	8 days
2	Chisel feet and table mats	I.2	I.1	7 days	10 days	12 days
3	Cut the floor	I.3	I.2	3 days	6 days	8 days
4	Calibration of table legs and table mats	II.1	I.2	3 days	4 days	6days
5	Calibrate pieces of floor	II.2	I.3	2 days	4 days	6 days
6	Putty floors and tables	III.1	II.1,II.2	3 days	6 days	8 days
7	Polish floors and tables	IV.1	III.1	3 days	6 days	8 days
8	Packing	V.1	IV.1	2 days	4 days	7 days

2.1.2 Calculation of expeceted time, standart deviasi variance.

At this stage is to find the value of the expected time (te), standard deviation (S) and variance S^2 (), So we need a formula to find the value of the expected time (te), standard deviation (S) and variance (S^2)

$$te = \frac{(to + 4m + tp)}{6} \text{.....(2.1)}$$

$$se = \frac{(tp - to)}{6} \text{.....(2.2)}$$

$$S^2 = \left(\frac{(tp - to)}{6}\right)^2 \text{.....(2.3)}$$

Here are the full results of the calculation of the expected time (te), standard deviation (S) and variance (S^2)) on each job.

Table 2. *expected time, standart deviasi dan variance*

Code	to	m	tp	Expected time	Standart Deviasi	Variance
I.1	4	5	8	5,33 ~ 5 days	0,67	0,44
I.2	7	10	12	9,83 ~ 10 days	0,83	0,69
I.3	3	6	8	5,83 ~ 6 days	0,83	0,69
II.1	3	4	6	4,17 ~ 4 days	0,50	0,25
II.2	2	4	6	4,00 ~ 4 days	0,67	0,44
III.1	3	6	8	5,83 ~ 6 days	0,83	0,69
IV.1	3	6	8	5,83 ~ 6 days	0,83	0,69
V.1	2	4	7	4,17 ~ days	0,83	0,69
TOTAL				**45,00 ~ 45 days**	**6,00**	**4,61**

2.1.3 Foward Computation

To perform foward cmputation required value earliest finish (EF), the following is the formula to determine the value earliest finish (EF):

EF = ES + t, with t = te *.....(2.5)*

Here's the complete results of back and forth calculations:

Table 3. *Foward Computation*

Job Code	Earliest Start (ES)	Expected time (te)	Earlisest Finish (EF)
I.1	0	5	5
I.2	5	10	15
I.3	15	6	21
II.1	15	4	19
II.2	21	4	25
III.1	25	6	31
IV.1	31	6	37
V.1	41	4	41

Of recapitulation then be drawn into the network of Program Evaluation and Review Technique.

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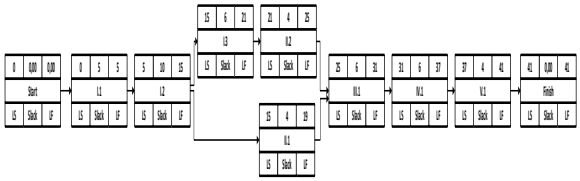


Image 1. *Diagram Network PERT*

2.1.4 Backward computation

In doing the Backward computation takes a formula to get the lastest value Start (LS), the following formula for the Backward computation

LS = LF – t, with t=te*.....(2.6)*

Here is the complete result of the calculation of retrograde.

Table 4. *Backward Computation*

Job Code	*Latest Finish (LF)*	*Expected Time (te)*	*Latest Start (LS)*
I.1	*5*	*5*	*0*
I.2	*15*	*10*	*5*
I.3	*21*	*6*	*15*
II.1	*25*	*4*	*21*
II.2	*25*	*4*	*21*
III.1	*31*	*6*	*25*
IV.1	*37*	*6*	*31*
V.1	*41*	*4*	*37*

Of the recapitulation in the countdown then be described a network of Program Evaluation and Review Technique.

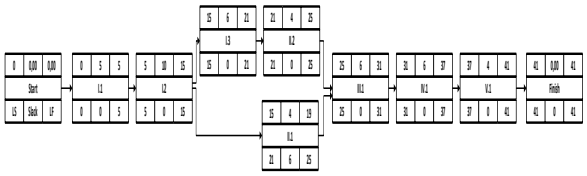


Image 2. *Diagram Network PERT*

2.1.5 Slack

. At the non-critical path (including sub-critical) there are time for delay or time can be delayed in exercising their activities without affecting a production order completion time (the project), this is called Slack, or Float. Here is the formula to find Sack or Float.

Slack = LS-ES or LF-EF *.....(2.7)*

Here are the results legkap perhiungan slack on each job.

Table 5. *The results of calculations*

Job Code	*Late Start*	*Eearly Start*	*Slack*
I.1	*0*	*0*	*0*
I.2	*5*	*5*	*0*
I.3	*15*	*15*	*0*
II.1	*21*	*15*	*6*
II.2	*2*	*21*	*0*
III	*25*	*25*	*0*
IV	*31*	*31*	*0*
V	*37*	*37*	*0*

From the analysis results in the above recapitulation table can be known critical path and others. Here is a picture jarigan work of Program Evaluation and Review Technique based on the value of the slack.

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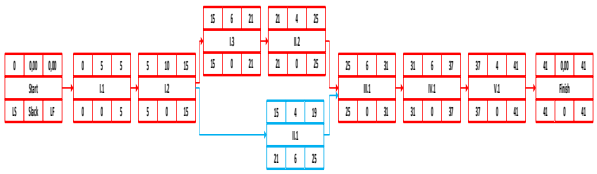


Image 3. *Diagram Network PERT*

2.16 Probability (project)

In the method of Program Evaluation and Review Technique final stage is to find the probability. Known total duration or (Ts) is 45 days, then it takes the value of the total duration of the critical path (Te) and Variance () on the critical path, following the critical path and variance values can be seen below:

Te *= I.1+ I.2 +I.3+ II.2 + III.1 + IV.1 + V.1*
= 5 + 10 + 6 + 4 + 6 + 6 +4
= 41 day
(S^2) *= I.1, I.2, I.3, II.2,III.1,IV.1 dan V.1*
= 0,44+ ,69 + 0,69 + 0,44 + 0,69+ 0,69+0,69
= 4,33

From these results can be determined probability value, by using the formula as follows:

$$Probability\ (Z) = \frac{Ts\ -\ Te}{\sqrt{\sum(S^2)}} \dots\dots\dots\dots\dots (2.4)$$

Then the probability or likelihood of completion of production of this project is completed

$$Z\ =\ \frac{45\ -\ 41}{\sqrt{4{,}33}}\ =\ \frac{4}{2{,}08}\ =\ 1{,}92 = 0{,}9713$$

So the conclusion is scheduling using the Program Evaluation and Review Technique can be used, because the processing time for 41 days the possibility of completion is 97.13% with the critical work is I.1, I.2, I, 3, II.2, III. 1, IV.1 and V.1dan V.1

2.2 Risk management analysis

The risk management process has several stages of identifying risks, determining the probable value and impact of risks and handling those risks.

2.2.1 Identification risk

Risk management process, firstly a risk identification aimed at making a risk list either happen or may occur Here is a risk identification table based on the responder..

Table 6. *Identification risk*

Risk Code	Risiko
R1	The grinding machine is broken
R2	Marble material is not finished
R3	Marble material crash
R4	Less support material
R5	Sick employee

2.2.2 Possilble values and impact

This stage is to determine the likelihood and impact of risks on each - each risk has been identified risk based on the table Boston Square Matrix.

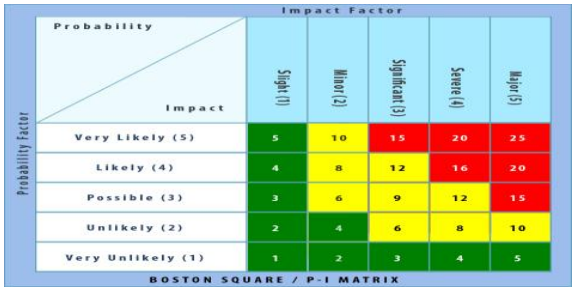


Image 4. Boston Square Matrix

From the picture boston matrix then made into a risk scale to make it easier in conducting qualitative assessment. Here is a scale peilaian based boston matrix

Table 7. *Scale risk assessment*

No	Scale	Level Of Risk
1	1 – 5	Low
2	6 – 14	Medium
3	15 – 25	High

Criteria penialai impact (impact factor) and measurement opportunities (probability) in accordance with the Australian or New Zealand Risk Management, as terlihar in the table below

Table 8. *Assessment of the impact*

No	Assessment	Value	Impact
1	Slight	1	The impact is not significantly felt, financial loss is meaningless
2	MInor	2	Need direct handling in place, the financial losses into the overhead costs (over head)
3	Significant	3	Need to be handled by the executor, financial loss is quite meaningful
4	Severe	4	There is a delay in the planned schedule
5	Mayor	5	Need handling by the leadership, big losses, need special handling

Tabel 9. *Assessment of probability*

No	Assessment	Value	Possibilitty
1	Very unlikely	1	Rarely occurs, only under certain conditions
2	Unlikely	2	Sometimes it happens in certain conditions
3	Possible	3	May occur under certain conditions
4	Likely	4	Occurs under certain conditions
5	Verry Likely	5	Often occurs in certain conditions

2.2.3 Level of risk performance

To determine the degree of importance of risk required analysis of possible values As well as the impact if the risk occurs. To know the level of importance and level of each risk for easy handling. The probable value of this impact is based on a questionnaire or response responeen

Table 10. *Risk assessment*

Code	Risk	Possibility	Impact
R1	The grinding machine is broken	3	4
R2	Marble material is not finished	2	1
R3	Marble material crash	4	4
R4	Less support material	2	2
R5	Sick employee	4	4

After analyzing the value of probability and risk impact, then do the calculations to obtain the value of the benefit of using the risk matrix method Impact Probability. Here is a formula used to find the value of risk interests.

Risk Exposure = probablity x loss*.....(2.8)*

The following is the full assessment of each risk

Table 11. *Assessment of risk*

Code	Risk	Interets	Level risk
R1	The grinding machine is broken	12	Medium
R2	Marble material is not finished	2	Low
R3	Marble material crash	16	High
R4	Less support material	4	Low
R5	Sick employee	16	High

From the result of determining the risk assessment, it is known that there is one medium level that is R1,

two low level that is R2, R4 and two high risk level that is R3 and R5

2.2.4 Risk handling

From the results of a series of risk analyzes that have been done then take action handling of each identified risk by looking at the level of importance and level of risk

Table 12. *Risk handling*

Risk Code	Level risk	Handling action
R1	Medium	Request a spare grind and repair the damaged machine at the warehouse
R2	Low	Return of marble material immediately
R3	High	Buy more raw materials and replace raw materials with the required volume
R4	Low	Buy again at an affordable price
R5	High	Maximize skilled workers or find workers with the same skills

From the results of a series of risk analysis and handling that have been done, it can be concluded with the existence of this risk management can help the Project Manager in taking action on each risk so that the risk that occurs will not affect the production of orders (projects)

2.2.5 Risk assessment

The risk assessment is conducted by means of discussion to get respondents from Mr. Hamzah Saifulloh as Project Manager at CV Sumber Alam Marmer to know the expected risk cost by calculating the probability value and the budgeted consequence cost of each identified risk. Strengthening is the probability value based on discussion approach with the project manager.

Table 13. *Probability of rissk*

Probability	Information
1-10%	Rarely occurs, only under certain conditions
11-20%	Sometimes it happens in certain conditions
21-30%	May occur under certain conditions
31-40%	Occurs under certain conditions
41-50%	Often occurs in certain conditions

For the probability and consequences for each risk based on the respondents from Mr. Hamzah Saifulloh is given a budget of Rp 800,000 and a probability of 30% for grinding wheels, Rp 700,000 for unsuitable marble materials and 20% probability, Rp 3,000,000 for broken marble and probability 40%, Rp 300,000 for support equipment and 20% probability, and budget of Rp 2,000,000 for sick employees and 40% probability. The probability value can only be determined by damage (physical) or other circumstances. Having obtained the value of probability and consequence percentage then calculated the expected cost when the risk occurs by using the formula:

EMV = Probabilitas x Konsekuensi.....(2.6)

The following is the complete result of the expected value / cost for each of these risks

Table 14. *Cost of risk*

Code	Risk	Probability	Consequences	EMV
R1	The grinding machine is broken	30 %	Rp. 800.000,-	Rp. 240.000,-
R2	Marble material is not finished	20 %	Rp. 700.000,-	Rp. 140.000,-
R3	Marble material crash	40 %	Rp. 3.000.000,-	Rp. 1.200.000,-
R4	Less support material	20 %	Rp. 300.000,-	Rp. 60.000,-
R5	Sick employee	40 %	Rp. 2.000.000,-	Rp. 600.000,-

So from the results of the analysis it can be concluded that at least in the presence of cost analysis or risk assessment can help project managers know the project manager to know the expected cost of each risk must not cost consequences..

2.3 Analsis of project control

The analysis of the project's drivers contains the estimated time and cost of production of the Adi Simple Hotel (project) project undertaken by CV. Alam Marmer. In pengendalain production order (project) using the method of Earned Value Management.

2.3.1 Calulation of percentageof work weight

The calculation of the weight of work is used to determine each percentage of the weight of each job, here is a formula used to find the percentage of work weight

For the weight percentage of ptotong work the measuring pattern is:

$$\boldsymbol{Bobot} = \left(\frac{\boldsymbol{Biaya\ pekerjaan}}{\boldsymbol{Nilai\ proyek}}\right)\boldsymbol{x}\ \mathbf{100}\ \ldots(2.10)$$

For the weight percentage of ptotong work the measuring pattern is:

Projet value = Rp 75.720.00,-
*Weight = (Rp 9.957.180/ Rp75.720.000) *100*
= 13,150 %

Here is the complete calculation of the percentage of the weight of the spelling on each job.

Table 15. *Percentage of the weight of the job*

Code	Work	Duration	Cost	Weight (%)
I.1	Cut the size pattern	5	Rp 9.957.180	13,150
I.2	Chisel feet and table mat	10	Rp 16.833.313	22,231
I.3	Cut the floor	6	Rp 15.303.012	20,210
II.1	Calibration of foot and table mat	4	Rp 6.733.022	8,892
II.2	Calibrate the floor	4	Rp 6.733.022	8,89
III.1	Putty floors and tables	6	Rp 7.478.107	9,876
IV.1	Polish floors and tables	6	Rp 7.478.107	9,876
V.1	Packing	4	Rp 5.204.236	6,873
Amount		**45**	**Rp 75.720.000**	**100 %**

In this order (project) control weigh the percentage of work using daily. To find the weight percentage of work per day iu own using the formula

Working weight / Duration of work

2.3.2 Analysis Planned Value

Planned analysis are costs dianggarakan value. Planned Value for menganalisan value takes a formula, the following formula is used to find the value of Planned Value

PV = (%progres rencana) x BAC.....(2.11)

It is known that the results of the analysis on the work cut the pattern of measuring on the first day is

Weight% of work = 2,630%
Project cost = Rp 75.720.000,-
*PV = 2,630% * Rp 75.720.000,-*
= Rp1.991.436

2.3.3 Earned Value Analysis

The analysis Earned Value is the total cost incurred yag accordance with the work completed. To find the value of Earned Value itself takes a formula, namely:

EV = (%progres rencana) x BAC.....(2.12)

Here is the analysis of the progress of the work on the first day can be seen as follows:

Weight% of work = 2,630%
Project cost = Rp 75.720.000,-
*PV = 2,630% * Rp 75.720.000,-*
= Rp1.991.436

2.3.4 Actual Cost Analysis

Analysis of Actual Cost is the amount of the actual cost of the work that has been carried out. Cost Actual value obtained based on the expenses of the work already carried out by the respondents from Mr. Hamzah Saifulloh as project manager in the company's CV. Natural Resources Marble. Here is the Actual Cost of construction on the first day

Actual Cost = Rp 1.991.436

2.3.5 Analysis Scheduling Variance (SV)

Analisis Scheduling Variance (SV) menunjukan waktu pekerjaan yang dilaksanakan terhadap waktu pekerjaan yang direncanakan. Untuk mencari nilai penympangan pada jadwal itu sendiri dibutuhkan sebuah rumus yaitu:

Scheduling Variance = EV – PV.....(2.13)

SV > 0 Actual progres > Plan acceleration of project to plan
SV < 0 Actual Progres < Plan there is a delayin the project agains the plan

Here is the result of the deviation analysis schedule on the first day, that is

Scheduling Variance = Rp1.991.436 - Rp1.991.436
= Rp 0

It is known that the results obtained on the first day Scheduling Variance value is 0 where it shows the progress of the work in accordance with the schedule direncankan.

2.3.6 Analysis Cost Variance

An Cost Variance analysis showed a difference in the cost obtained and when it is complete pekrjaan or orders (projects). Cost Variance for mencaei value itself it takes a formula. The formula is:

Cost Variance (CV) = EV – AC.....(2.15)

CV > 0, the cost of the actual volume > Actual Cost (Cost underrun)
CV < 0, the cost of the actual volume < Actual Cost (Cost overrun)

Here are the results of the analysis Schudle Performaced Index on the first day:

Earned Value = Rp1.991.436
Actual Cost = Rp1.991.436
Cost Variance = Rp1.991.436 - Rp1.991.436
= Rp 0

Based on the results of the first day of Cost Variance is Rp 0, which means it shows that the cost ikeluarkan in accordance with the planned costs.

2.3.7 Analysis Schudle performanced Index (SPI)

Index Performaced Schudle analysis is to determine the value of the performance index of the time / duration. To dance the value of Schudle Performaced Index itself takes on a formula. The formula, namely:

SPI = EV / PV.....(2.14)

SPI > 1, Actual Progress > plan: acceleration of the project to the plan.
SPI < 1, Actual Progress < plan: there is a delay in the project against the plan

Here are the results of the analysis Schudle Performaced Index on the first day

Earned Value = Rp1.991.436
Planned Value = Rp1.991.436
SPI = Rp1.991.436/ Rp1.991.436
= 1,00

Based on the analysis results obtained in the first day Schudle Performaced Index value is 1.00 that shows the progress of occupations resolved planned.

2.3.8 Analysis Cost Performace Index

Cost Analysis performanced Index which is to determine the value of cost performance index. To find the value Cost Index Performaced itself diutuhkan formula. The rusmus, namely:

CPI = EV / AC.....(2.16)

CPI > 1, The cost of the actual volume > Actual Cost (Cost under run)
CPI < 1, The cost of the actual volume < Actual Cost (Cost over run)

Here are the results of analysis performanced Cost Index on the first day:.

CPI = Rp1.991.436/ Rp1.991.436
= 1

Based on the results of Cost Variance in the first day is 1, which means it shows the cost of the work completed in accordance with the actual costs incurred.

2.3.9 Analysis of estimated time and cost

Based on SV, CV, SPI and CPI calculations that have been done before it can be seen that the project completion time will be late or faster and the cost incurred will be more or less than budgeted. In addition to the project's progress for the future, it is necessary to estimate the time and cost of completion. The following calculations Estimate Time Completion (ETC) and the Estimate at Completion (EAC)

2.3.9.1 Estimate Time Completion

To determine the approximate settling time can be taken by using the formula..

ETC = OD / SPI.....(2.17)

Where is the value of
OD = 41
SP =1
ETC = 41/1

2.3.1.9 Estimate At Completion

To determine the final cost estimate, it can be calculated using the formula;

EAC = BAC / CPI.....(2.18)

Here are the results of the analysis Estimate Completion on the first day, where the value of:

Total budget (BAC) = Rp 75.720.000
CPI = 1

2.3.10 Recapitulation EVM

Tabel 16. *Summary of Earned*

Day	Variant Analysis		Work Analysis		Estimation Analysis	
	(SV)	(CV)	(SPI)	(CPI)	(ETC)	(EAC)
1	Rp0	Rp0	1	1	41	Rp75.720.000
2	Rp0	Rp0	1	1	41	Rp75.720.000
3	Rp0	Rp0	1	1	41	Rp75.720.000
4	Rp0	Rp0	1	1	41	Rp75.720.000
5	Rp0	Rp0	1	1	41	Rp75.720.000
6	Rp0	Rp0	1	1	41	Rp75.720.000
7	Rp0	Rp0	1	1	41	Rp75.720.000
8	Rp0	Rp0	1	1	41	Rp75.720.000
9	(Rp841.249)	Rp0	0,95	1	43	Rp75.720.000
10	Rp0	Rp0	1	1	41	Rp75.720.000
11	Rp0	Rp0	1	1	41	Rp75.720.000
12	Rp0	Rp0	1	1	41	Rp75.720.000
13	Rp0	Rp0	1	1	41	Rp75.720.000
14	Rp0	Rp0	1	1	41	Rp75.720.000
15	Rp0	Rp0	1	1	41	Rp75.720.000

From the analysis in Table recapitulation of the workability of production orders (projects) menggnakan methods Earnd Value Management dikethaui that delays pengerjaaan on day 9 wherein the processing time does not correspond to the planned time tetai costs incurred in accordance with the planned cost, it can be concluded the results

analysis for 15 days spellings are still in good condition because of the costs incurred in accordance with the planned, despite the work has been delayed and with the control performed using this Mangement alue Earned assist project managers in estimating the time and cost

2.3.11 Analysis Kurva S

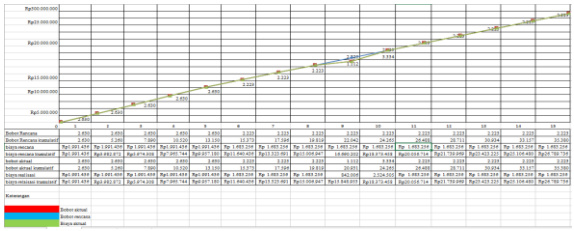


Image 5. *Kurva S*

3. CLOSING

3.1 Clonclusion

Based on the results of research and testing that has been done on Manufacturing Project Management System, can be drawn the following conclusions:

1. *Manufacturing project management systems can assist project managers in scheduling planning such as estimating scheduled work time, making the network work out the percentage of project completion and knowing critical work..*
2. *Manufacturing project management systems, can assist Project managers in performing risk management from identifying and assessing risk either qualitatively or quantitatively.*
3. *Manufacturing project management systems can assist project managers in controlling such as making job costing plans, weighting work plans and being able to estimate time and costs when there are delays or accelerations and evaluate the progress of the work.*

3.2 Suggestion.

Based on the results of sisterm testing, there are suggestions for menambakan things - things that can complement the Manufacturing Project Management System going forward, among others:

1. *Adding HR management information system for better company in managing workers, both for daily production and order production (project).*
2. *Adding a health and safety management information system to better manage the safety and health of workers.*
3. *Adding a financial information system for the administration easier to give information to the leadership*

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