Time performance improvement of hospital building structure construction project by M-PERT utilization

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ABSTRACT

Base on the ratio of total sick patients and availability of hospital, it is concluded that time frame to build hospital is very important to achieve a proper balance of medical service. An effective and efficient scheduling is required to support the objectives so that optimum timing is achievable and construction of hospital to be achieved at optimum time frame.This research conducts statistical analyse using Relative Important Index (RII) resulting the most influential factors on the M-PERT method on hospital structure by combining project activities, calculation of activities, the most important work to be completed (critical path), preparation strategy, project schedule, highest analogy of scheduled network, determination of network timing, determination of starting activities, contract document, cost handling. Quality and time. Results of research of case studies on hospital building structure using M-PERT application method by combining existing (actual) schedule, schedule using PERT and schedule using M-PERT concluded that it does optimize the schedule. On the PERT method, project schedule optimization is 40,26 week, or reduction of 2.99 %. Using M-PERT method, schedule optimization is 38,86 weeks or reduction of 6,37 % from original schedule of 41,5 weeks

Keywords: *M-PERT, PERT, Hospital Building structure, time schedule*

1. INTRODUCTION

Delay of schedule on a project will give domino effect on the project costs. It is therefore, it requires analyses to optimize construction project scheduling specifically on hospital building structure to achieve shorter schedule and less costs. Structural work plays a vital role in the construction process, since most of the most of the structural work component lies on the critical path during project plan. It is therefore, unless it is properly mitigated, any delay on one of the structural work located in the critical path resulted delay on the next work stage. One of the alternatives on the project scheduling is called Manual Project-Duration Estimation Techniques (M-PERT) which is the further development/version of The Program Evaluation and Review Technique (PERT). M-PERT is a similar scheduling method to PERT, but M-PERT uses activity-on-node (AON) which focus on finish-start relationship, and this method resulted an array of project scheduling showing total duration of construction work by combining and merging two or more activity proceses.

2. METHODS

2.1. Scheduling

Scheduling has two important tasks is deciding which process should run and decide when and how long the process is running. The main target is a performance optimization scheduling according to fair criteria, efficiency, response time (response time), Turn around time, Throughput (Prawirosentono, 2007)

2.2 PERT

PERT was developed in the 1950s by the US Navy's Polaris project. Critical Path Method (CPM) is another name for PERT diagram. PERT diagrams represent the sequence of activities or dependence between activities. The activity sequence is represented in the form of a network diagram (network diagram) or an arrow diagram (arrow diagram).

2.3 M-PERT

M-PERT method was first introduced by Ballesteros Pablo Perez, Ph.D. in June 2017. For examples of bridge work using PERT method, and do Manual Program Evaluation and Review technique (M-PERT). M-PERT allows the calculation manually through the incorporation procedure downsizes recursive network until the last one standing representative of the overall activity (or the rest of) the duration of the project. The aim is to update and propose new techniques PERT redefined named M-PERT,

2.4 Hospital Building Structure

Structures are designed and implemented to be strong, sturdy, and stable when the burden / load combinations, safety and serviceability over the life of the service is planned to consider the function of the hospital building, location, durability, and the possibility of the implementation of the construction.

2.4.1 Upper structure

Construction on the hospital building is made of concrete construction, steel construction, wood construction or construction material and special technology.

2.4.2 Sub structure

Sub structure of the hospital building can be the foundation directly or deep foundations, adapted to the soil conditions at the site of the hospital establishment.

3. RESULTS AND DISCUSSION

3.1 Statistical analysis methods Relative Importance Index (RII).

This analysis method is processed with statistical calculations with the results of the questionnaire as input that will be processed into influential factor. RII determine the most influential factors in a ranking system based on the weight of a given value of the respondent after filling out the questionnaire.

The results of the questionnaire have been summarized in the preceding stage, will do three tests which test the validity, reliability and hypothesis testing.

3.1.1Validity test

To test the validity of the measuring instrument first sought the correlation between the parts of the measuring instrument as a whole by means of correlating each item of measuring instruments with a total score which is the sum of each score point by the formula Pearson Product Moment and then calculated with Test-T.

1. Phase 1 calculates the correlation of each of the questions with the formula Pearson Product Moment

Number of Respondents (n) = 37

question 1

$$r = \frac{n.\sum(XY)-(\sum X).(\sum Y)}{\sqrt{(n.\Sigma X^2-(\sum X)^2).(n.\Sigma Y^2-(\sum Y)^2)}}$$

$$\frac{4348}{12.292} = 0.3537$$

….. until……..

question 41

$$r = \frac{n.\sum(XY)-(\sum X).(\sum Y)}{\sqrt{(n.\Sigma X^2-(\sum X)^2).(n.\Sigma Y^2-(\sum Y)^2)}}$$

$$\frac{3648}{9460.1} = 0.38562$$

Phase 1 is complete and rhitung values obtained from each of the questions as input analysis at a later stage.

1. Phase 2 calculates the value of t

$$t = \frac{r.\sqrt{n-2}}{\sqrt{1-r^2}}$$

Phase 2 was completed and obtained tcount.

2. Phase 3 finding ttabel if known the significance of α = 0.05 and df = 10-2, with the two sides of the obtained test table = 2,024

3. Stage 4 Making decisions by comparing tcount with ttabel:

Valid Results = If $t_{arithmetic}$ > ttabel

Results Invalid = If $t_{arithmetic}$ > ttabel

Table 1 Validity

Sub Factor		r Hitung	r Tabel	t Hitung	t Tabel	Validitas
X 1	Pendistribusian durasi aktifitas	0.386	0.320	2.513	2.024	Valid
X 2	Efek dari durasi aktifitas pembagian yang berbeda	0.561	0.320	4.064	2.024	Valid
X 3	Menentukan kegiatan yang dimulai	0.441	0.320	2.952	2.024	Valid
X 4	Pekerjaan harus selesai cepat (jalur kritis)	0.340	0.320	2.171	2.024	Valid
X 5	Kemungkinan dari pembagian durasi aktifitas	0.412	0.320	2.710	2.024	Valid
X 6	Diagram Network yang dibuat pada tahap perencanaan	0.327	0.320	2.078	2.024	Valid
X 7	Tujuan Akhir dari tahap penjadwalan dalam proyek	0.329	0.320	2.087	2.024	Valid
X 8	Penjadwalan kontrak yang tepat waktu	0.631	0.320	4.885	2.024	Valid
X 9	Memecah atau mengurai proyek menjadi kegiatan	0.480	0.320	3.279	2.024	Valid
X 10	Menentukan perkiraan waktu network	0.548	0.320	3.936	2.024	Valid
X 11	Gambaran kegiatan jaringan proyek	0.371	0.320	2.400	2.024	Valid
X 12	Menggabungkan kegiatan proyek	0.465	0.320	3.147	2.024	Valid
X 13	Perhitungan kegiatan	0.457	0.320	3.083	2.024	Valid
X 14	kemiripan yang lebih tinggi dalam jaringan terjadwal	0.453	0.320	3.048	2.024	Valid
X 15	Alat yang dihasilkan masih akurat tetapi tidak rumit	0.510	0.320	3.559	2.024	Valid
X 16	Memahami kegiatan	0.570	0.320	4.158	2.024	Valid
X 17	Strategi Persiapan Pelaksanaan	0.485	0.320	3.326	2.024	Valid
X 18	Standart Penilaian	0.379	0.320	2.457	2.024	Valid
X 19	Definisi aktifitas kegiatan	0.338	0.320	2.153	2.024	Valid
X 20	Proses seleksi tim	0.438	0.320	2.924	2.024	Valid
X 21	Komunikasi antar jaringan	0.523	0.320	3.678	2.024	Valid
X 22	Tim budgeting	0.375	0.320	2.424	2.024	Valid
X 23	Fasilitas Kegiatan	0.361	0.320	2.324	2.024	Valid
X 24	Pengendalian biaya, mutu, waktu	0.628	0.320	4.838	2.024	Valid
X 25	Kepuasan klien dan stakeholder	0.434	0.320	2.888	2.024	Valid
X 26	Proses manajemen proyek	0.459	0.320	3.097	2.024	Valid
X 27	Keselamatan	0.338	0.320	2.155	2.024	Valid
X 28	Kerjasama	0.491	0.320	3.386	2.024	Valid
X 29	Tujuan organisasi	0.322	0.320	2.040	2.024	Valid
X 30	Gambar Rencana	0.534	0.320	3.792	2.024	Valid
X 31	Kontrol biaya dan sumber daya	0.476	0.320	3.250	2.024	Valid
X 32	Tujuan yang konsisten	0.387	0.320	2.518	2.024	Valid
X 33	Ketersediaan pekerja yang terampil	0.524	0.320	3.687	2.024	Valid
X 34	Kualitas jangka panjang	0.653	0.320	5.178	2.024	Valid
X 35	Schedule Proyek	0.480	0.320	3.286	2.024	Valid
X 36	Lingkup pekerjaan	0.520	0.320	3.650	2.024	Valid
X 37	Alur pekerjaan	0.363	0.320	2.335	2.024	Valid
X 38	Dokumen kontrak	0.354	0.320	2.273	2.024	Valid
X 39	Survey lapangan	0.484	0.320	3.315	2.024	Valid
X 40	Pengukuran	0.356	0.320	2.287	2.024	Valid
X 41	Pengujian	0.386	0.320	2.508	2.024	Valid

Source: personal preparations

3.1.2 Test Reliability

A consistency test of the instrument when measured repeatedly. Reliability test can use the formula Spearman Brown in equation. Questionnaire instrument can be said to be reliable if it meets the following requirements:

Reliable Results = If the value of r_{11} > rtable
Results Not Reliable = If the value of r_{11} > rtable

Looking rtabel if known the significance of α = 0.05 and df = 10-2, with the two sides of the obtained test rtabel = 0.2746

The next stage of calculating the value r11. The results of the analysis are presented in tables that can be seen in Table 2 below

Table 2 Reliability

Sub Factor		r Hitung	r Tabel	t Hitung	t Tabel	r11	Reliabilitas
X 1	Pendistribusian durasi aktifitas	0.386	0.320	2.513	2.024	0.557	Reliabel
X 2	Efek dari durasi aktifitas pembagian yang berbeda	0.561	0.320	4.064	2.024	0.719	Reliabel
X 3	Menentukan kegiatan yang dimulai	0.441	0.320	2.952	2.024	0.613	Reliabel
X 4	Pekerjaan harus selesai cepat (jalur kritis)	0.340	0.320	2.171	2.024	0.508	Reliabel
X 5	Kemungkinan dari pembagian durasi aktifitas	0.412	0.320	2.710	2.024	0.583	Reliabel
X 6	Diagram Network yang dibuat pada tahap perencanaan	0.327	0.320	2.078	2.024	0.493	Reliabel
X 7	Tujuan Akhir dari tahap penjadwalan dalam proyek	0.329	0.320	2.087	2.024	0.495	Reliabel
X 8	Penjadwalan kontrak yang tepat waktu	0.631	0.320	4.885	2.024	0.774	Reliabel
X 9	Memecah atau mengurai proyek menjadi kegiatan	0.480	0.320	3.279	2.024	0.648	Reliabel
X 10	Menentukan perkiraan waktu network	0.548	0.320	3.936	2.024	0.708	Reliabel
X 11	Gambaran kegiatan jaringan proyek	0.371	0.320	2.400	2.024	0.542	Reliabel
X 12	Menggabungkan kegiatan proyek	0.465	0.320	3.147	2.024	0.634	Reliabel
X 13	Perhitungan kegiatan	0.457	0.320	3.083	2.024	0.627	Reliabel
X 14	kemiripan yang lebih tinggi dalam jaringan terjadwal	0.453	0.320	3.048	2.024	0.623	Reliabel
X 15	Alat yang dihasilkan masih akurat tetapi tidak rumit	0.510	0.320	3.559	2.024	0.676	Reliabel
X 16	Memahami kegiatan	0.570	0.320	4.158	2.024	0.726	Reliabel
X 17	Strategi Persiapan Pelaksanaan	0.485	0.320	3.326	2.024	0.653	Reliabel
X 18	Standart Penilaian	0.379	0.320	2.457	2.024	0.550	Reliabel
X 19	Definisi aktifitas kegiatan	0.338	0.320	2.153	2.024	0.505	Reliabel
X 20	Proses seleksi tim	0.438	0.320	2.924	2.024	0.609	Reliabel
X 21	Komunikasi antar jaringan	0.523	0.320	3.678	2.024	0.686	Reliabel
X 22	Tim budgeting	0.375	0.320	2.424	2.024	0.545	Reliabel
X 23	Fasilitas Kegiatan	0.361	0.320	2.324	2.024	0.531	Reliabel
X 24	Pengendalian biaya, mutu, waktu	0.628	0.320	4.838	2.024	0.771	Reliabel
X 25	Kepuasan klien dan stakeholder	0.434	0.320	2.888	2.024	0.605	Reliabel
X 26	Proses manajemen proyek	0.459	0.320	3.097	2.024	0.629	Reliabel
X 27	Keselamatan	0.338	0.320	2.155	2.024	0.505	Reliabel
X 28	Kerjasama	0.491	0.320	3.386	2.024	0.659	Reliabel
X 29	Tujuan organisasi	0.322	0.320	2.040	2.024	0.487	Reliabel
X 30	Gambar Rencana	0.534	0.320	3.792	2.024	0.696	Reliabel
X 31	Kontrol biaya dan sumber daya	0.476	0.320	3.250	2.024	0.645	Reliabel
X 32	Tujuan yang konsisten	0.387	0.320	2.518	2.024	0.558	Reliabel
X 33	Ketersediaan pekerja yang terampil	0.524	0.320	3.687	2.024	0.687	Reliabel
X 34	Kualitas jangka panjang	0.653	0.320	5.178	2.024	0.790	Reliabel
X 35	Schedule Proyek	0.480	0.320	3.286	2.024	0.649	Reliabel
X 36	Lingkup pekerjaan	0.520	0.320	3.650	2.024	0.684	Reliabel
X 37	Alur pekerjaan	0.363	0.320	2.335	2.024	0.532	Reliabel
X 38	Dokumen kontrak	0.354	0.320	2.273	2.024	0.523	Reliabel
X 39	Survey lapangan	0.484	0.320	3.315	2.024	0.652	Reliabel
X 40	Pengukuran	0.356	0.320	2.287	2.024	0.525	Reliabel
X 41	Pengujian	0.386	0.320	2.508	2.024	0.557	Reliabel

Source: personal preparations

3.1.3 Hypothesis testing

There are two tests of hypotheses in this research is the Multiple Correlation and Multiple Regeresi. The following analysis of each test the hypothesis:

3.1.3.1 Multiple Correlation

Multiple Correlation is used to find the relationship between two independent variable (X) or simultaneously to the dependent variable. There are steps in to test the research hypothesis. The following is a discussion of the steps in hypothesis testing:

Step 1. Make H1 and H0 in sentences.

1. Hypothesis 1 relationship between independent and dependent variables.
   H1 = There is a relationship between the method of M-PERT and PERT method to the scheduling of the work of the hospital structures
   H0 = There was no relationship between the method of M-PERT and PERT method to the scheduling of the work of the hospital structures

2. Hypothesis 2 influence between independent and dependent variables.

H1 = There is the influence of the method M-PERT and PERT method to the scheduling of the work of the hospital structures

H0 = There is no effect between the method M-PERT and PERT method to the scheduling of the work of the hospital structures

Step 2. Make H1 and H0 in statistical form

H1: $r \neq 0$

H0: $r = 0$

Step 3, Creating a helper table to calculate the correlation double

Preliminary data required in this study is the research data for the variables X1, X2 and Y where:

X1: Variable PERT method

X: Variable M-PERT method

Y: Variable Structural Work Buildings Hospitals

Table 3 Multiple Correlation

TABEL PENOLONG MENGHITUNG KORELASI BERGANDA									
Responden	X1	$(X1)^2$	X2	$(X2)^2$	Y	$(Y)^2$	X1.Y	X2.Y	X1.X2
1	54	2916	24	576	111	12321	5994	2664	1296
2	50	2500	23	529	115	13225	5750	2645	1150
3	49	2401	26	676	117	13689	5733	3042	1274
4	52	2704	25	625	109	11881	5668	2725	1300
5	50	2500	24	576	112	12544	5600	2688	1200
6	52	2704	26	676	113	12769	5876	2938	1352
7	51	2601	24	576	112	12544	5712	2688	1224
8	58	3364	25	625	117	13689	6786	2925	1450
9	47	2209	23	529	100	10000	4700	2300	1081
10	54	2916	26	676	117	13689	6318	3042	1404
11	48	2304	22	484	102	10404	4896	2244	1056
12	53	2809	25	625	120	14400	6360	3000	1325
13	58	3364	27	729	119	14161	6902	3213	1566
14	51	2601	24	576	107	11449	5457	2568	1224
15	57	3249	28	784	129	16641	7353	3612	1596
16	55	3025	24	576	114	12996	6270	2736	1320
17	53	2809	26	676	117	13689	6201	3042	1378
18	51	2601	24	576	108	11664	5508	2592	1224
19	48	2304	24	576	103	10609	4944	2472	1152
20	51	2601	24	576	109	11881	5559	2616	1224
21	54	2916	25	625	115	13225	6210	2875	1350
22	48	2304	23	529	105	11025	5040	2415	1104
23	50	2500	24	576	118	13924	5900	2832	1200
24	51	2601	26	676	101	10201	5151	2626	1326
25	45	2025	22	484	102	10404	4590	2244	990
26	45	2025	21	441	106	11236	4770	2226	945
27	51	2601	25	625	109	11881	5559	2725	1275
28	54	2916	27	729	121	14641	6534	3267	1458
29	50	2500	22	484	99	9801	4950	2178	1100
30	48	2304	26	676	112	12544	5376	2912	1248
31	49	2401	25	625	103	10609	5047	2575	1225
32	50	2500	23	529	105	11025	5250	2415	1150
33	56	3136	29	841	124	15376	6944	3596	1624
34	55	3025	25	625	118	13924	6490	2950	1375
35	50	2500	25	625	114	12996	5700	2850	1250
36	53	2809	27	729	119	14161	6307	3213	1431
37	57	3249	27	729	117	13689	6669	3159	1539
38	60	3600	28	784	131	17161	7860	3668	1680
JUMLAH	1968	102394	944	23574	4270	482068	221934	106478	49066

Source: personal preparations

From the calculation of the number of tables in the formula below 3

table 4
X_1Y

X_1Y	
symbols Statistics	
n	38
ΣX_1	1968
ΣY	4270
ΣX_1^2	102 394
ΣY^2	482 068
$\Sigma X_1 Y$	221 934
r (X_1Y)	**0.7684**

Source: personal preparations

From table 4 result of r (X_1Y) worth 0.7684

table 5
X_2Y

X_2y	
symbols Statistics	
n	38
ΣX_2	944
ΣY	4270
ΣX_2^2	23 574
ΣY^2	482 068
$\Sigma X_2 Y$	106 478
r (X_2Y)	**0.7636**

Source: personal preparations

From table 5 result r (X_2Y) worth 0.7636

table 6
r (X_1X_2)

X_1X_2	
symbols Statistics	
n	38
ΣX_1	1968
ΣX_2	944
ΣX_1^2	102 394
ΣX_2^2	23 574
ΣX_1X_2	49 066
r (X_1X_2)	**0733**

Source: personal preparations

From table 6 result of r (X_1X_2) Worth 0733

table 7
interval coefficient

interval Koef	level ties
0.8-1	Very strong
0.6-0.799	Strong
0.4-0.599	Strong enough
0.2-0.399	Low
0-1.99	Very low

Source: personal preparations

table 8
Results summary of the level of relationship

Summary		
Symbol	**Value**	**level ties**
r (X_1Y)	0.7684	Strong
r (X_2Y)	0.7636	Strong
r (X_1X_2)	0.7331	Very strong
r (X_1X_2Y)	0.8229	Very strong

Source: personal preparations

Significance test
R = 0.8229
K = 2
N = 38
F count = 36.6975297
F table = F [(1-α), (df = k), (df = nk-1)]
F table = F [(1-0.05), (df = 2), (df = 38-2-1)]
F table = F [(0.95), (2.41)
F table = 3.27
F count> F table
H1 accepted - H0 rejected
There is a significant relationship between the method of Pert and MPERT on Building Structural Work Up Hospital

3.1.3.2 MULTIPLE REGRESSION
number of Respondents N = 38
Number of Variables m = 1
Step 1 H0 and H1 in sentences
H0 = There is a significant difference between the F-PERT method with the structure of the hospital building
H1 = There is significant relationship between the F-PERT method to the structure of the hospital building
Step 2 H0 and H1 in Statistics
H0 = $r \neq 0$
H1 = $r = 0$

X = Variable 1 = Method M-PERT
Y = variabel2 = Structures Hospital

Table 9 Multiple Regression

TABEL REGRESI GANDA									
Responden	SKOR			$(X1)^2$	$(X2)^2$	Y^2	(X1).(Y)	(X2).(Y)	(X1).(X2)
	X1	X2	Y						
1	54	24	111	2916	576	12321	5994	2664	1296
2	50	23	115	2500	529	13225	5750	2645	1150
3	49	26	117	2401	676	13689	5733	3042	1274
4	52	25	109	2704	625	11881	5668	2725	1300
5	50	24	112	2500	576	12544	5600	2688	1200
6	52	26	113	2704	676	12769	5876	2938	1352
7	51	24	112	2601	576	12544	5712	2688	1224
8	58	25	117	3364	625	13689	6786	2925	1450
9	47	23	100	2209	529	10000	4700	2300	1081
10	54	26	117	2916	676	13689	6318	3042	1404
11	48	22	102	2304	484	10404	4896	2244	1056
12	53	25	120	2809	625	14400	6360	3000	1325
13	58	27	119	3364	729	14161	6902	3213	1566
14	51	24	107	2601	576	11449	5457	2568	1224
15	57	28	129	3249	784	16641	7353	3612	1596
16	55	24	114	3025	576	12996	6270	2736	1320
17	53	26	117	2809	676	13689	6201	3042	1378
18	51	24	108	2601	576	11664	5508	2592	1224
19	48	24	103	2304	576	10609	4944	2472	1152
20	51	24	109	2601	576	11881	5559	2616	1224
21	54	25	115	2916	625	13225	6210	2875	1350
22	48	23	105	2304	529	11025	5040	2415	1104
23	50	24	118	2500	576	13924	5900	2832	1200
24	51	26	101	2601	676	10201	5151	2626	1326
25	45	22	102	2025	484	10404	4590	2244	990
26	45	21	106	2025	441	11236	4770	2226	945
27	51	25	109	2601	625	11881	5559	2725	1275
28	54	27	121	2916	729	14641	6534	3267	1458
29	50	22	99	2500	484	9801	4950	2178	1100
30	48	26	112	2304	676	12544	5376	2912	1248
31	49	25	103	2401	625	10609	5047	2575	1225
32	50	23	105	2500	529	11025	5250	2415	1150
33	56	29	124	3136	841	15376	6944	3596	1624
34	55	25	118	3025	625	13924	6490	2950	1375
35	50	25	114	2500	625	12996	5700	2850	1250
36	53	27	119	2809	729	14161	6307	3213	1431
37	57	27	117	3249	729	13689	6669	3159	1539
38	60	28	131	3600	784	17161	7860	3668	1680
Jumlah	1968	944	4270	102394	23574	482068	221934	106478	49066

Source: personal preparations

Tot Respondenn = 38
Number of independent variables
m = 2 7182
a. $\Sigma (X1)^2$ = 472.3157895
b. $\Sigma (X2)^2$ = 123.0526316
c. ΣY^2 = 2254.842105
d. $\Sigma (X1), (Y)$ = 792.9473684
e. $\Sigma (X2), (Y)$ = 402.2105263
f. $\Sigma (X1), (X2)$ = 176.7368421
Enter the result of the sum of squares to the equation b1, b2 and A \
B =
b1 = 0.985309089
b2 = 1.853435449
a =
a = 15.29654341

Multiple regression equation

Y= a + b1X1 + b2 X2
Y = 0.985309089X1+1.853435449X15.29654341 + X2

Finding a Multiple Correlation
R (x1, X2, Y) = 0.82286515
Looking for a Multiple Correlation value contribution
KP = 68%
Significance Testing Rule
Rule significance testing:

F count> F table, then H0 rejected H1 accepted
Fhitung <F table, then H0 rejected H1 accepted

If F count ≥ F tables, then reject H0 means Significant

If F count ≤ F table, then accept H0 means Not Significant
With significance level α = 0.05, then the value of F table as follows

$$f\ table = F\left[(1-\alpha), (dk\ Reg\ \left(\frac{b}{a}\right))), (dk\ Res)\right]$$

$$f\ table = F\left[(1-0{,}05), (dk\ Reg\ \left(\frac{b}{a}\right) = 1)), (dk\ Res = 37 - 2)\right]$$

How to find the value of Ftabel:
Number 1 as the numerator = Score column 35 as the denominator = row
Retrieved Ftable value = 3.27
Where

The number of independent variables (m) = 3 = Numerator = Column
The number of respondents (n) = 27 = Denominator = Lines

obtainable
F table = 3:27
Turns Fcount> Ftable, reject H0 means Significant

Step 5 conclusion:
Because Fcount> Ftable reject H0 and accept H1

$$\frac{n.\Sigma XY - \Sigma X.\Sigma Y}{n.\ \Sigma X2 - (\Sigma X)\ 2}$$

Thus a significant difference between the F-PERT method to the structure of the hospital building calculates significance

$$\frac{\Sigma Y - b.\Sigma X}{n}$$

F table = F [(1-α), (df = m), (df = nm-1)]
F table = F [(1-0.05), (df = 2), (df = 38-2-1)]
F table = F [(0.95), (2.41)
F table = 3.27
F count = 36.6975297
F count> F table
H1 accepted - H0 rejected
A significant difference between the method of Pert and MPERT on Building Structural Work Up Hospital

Table 10 ranking RII

VARIABEL	MAIN FACTOR	SUB FACTOR		Sub Factor		Main Factor		Variable	
				RII	Rank	RII	Rank	RII	Rank
PERT	Batasan Durasi Kegiatan	X 1	Pendistribusian durasi aktifitas	0.724	26	0.742	7	0.794	2
		X 2	Efek dari durasi aktifitas pembagian yang berbeda	0.719	27				
		X 3	Menentukan kegiatan yang dimulai	0.864	7				
		X 4	Pekerjaan harus selesai cepat (jalur kritis)	0.741	23				
		X 5	Kemungkinan dari pembagian durasi aktifitas	0.662	36				
	Penjadwalan	X 6	Diagram Network yang dibuat pada tahap perencanaa	0.895	5	0.839	1		
		X 7	Tujuan Akhir dari tahap penjadwalan dalam proyek	0.816	14				
		X 8	Penjadwalan kontrak yang tepat waktu	0.807	16				
	Perencanaan (PERT)	X 9	Memecah atau mengurai proyek menjadi kegiatan	0.811	15	0.801	3		
		X 10	Menentukan perkiraan waktu network	0.649	39				
		X 11	Gambaran kegiatan jaringan proyek	0.943	1				
MPERT	Analisa Kegiatan	X 12	Menggabungkan kegiatan proyek	0.833	10	0.828	2	0.828	1
		X 13	Perhitungan kegiatan	0.732	25				
		X 14	kemiripan yang lebih tinggi dalam jaringan terjadwal	0.855	8				
		X 15	Alat yang dihasilkan masih akurat tetapi tidak rumit	0.899	4				
		X 16	Memahami kegiatan	0.820	13				
Struktur Bangunan Rumah Sakit	erencanaan (PERT	X 17	Strategi Persiapan Pelaksanaan	0.886	6	0.779	4	0.749	3
		X 18	Standart Penilaian	0.711	28				
		X 19	Definisi aktifitas kegiatan	0.697	30				
		X 20	Proses seleksi tim	0.912	2				
		X 21	Komunikasi antar jaringan	0.785	20				
		X 22	Tim budgeting	0.689	32				
		X 23	Fasilitas Kegiatan	0.776	21				
	Pelaksanaan Pekerjaan	X 24	Pengendalian biaya, mutu, waktu	0.654	38	0.721	8		
		X 25	Kepuasan klien dan stakeholder	0.636	40				
		X 26	Proses manajemen proyek	0.658	37				
		X 27	Keselamatan	0.667	35				
		X 28	Kerjasama	0.825	12				
		X 29	Tujuan organisasi	0.842	9				
		X 30	Gambar Rencana	0.768	22				
	Pengawasan	X 31	Kontrol biaya dan sumber daya	0.737	24	0.745	6		
		X 32	Tujuan yang konsisten	0.706	29				
		X 33	Ketersediaan pekerja yang terampil	0.803	17				
		X 34	Kualitas jangka panjang	0.684	33				
		X 35	Schedule Proyek	0.794	19				
	Pengumpulan Data	X 36	Lingkup pekerjaan	0.798	18	0.750	5		
		X 37	Alur pekerjaan	0.693	31				
		X 38	Dokumen kontrak	0.675	34				
		X 39	Survey lapangan	0.829	11				
		X 40	Pengukuran	0.904	3				
		X 41	Pengujian	0.601	41				

Source: personal preparations

In table 10 obtained rankings on RII sub-factor calculation, Main Factor and Variable. In the first rank ranking RII on M-PERT method and ranking second in the rankings PERT method to three hospital building structure

3.2 Validation Case Studies

3.2.1 Scheduling Data Processing Program Evaluation and Review Technique (PERT)

Step 1, In PERT "weigh" the third estimate this time to obtain the expected timing of activities (expected time) with the formula:

$$te = (to + (4 \times tm) + tp)$$

Where:
te = the expected time
to = time of upbeat
tm = time moderate
tp = pessimistic time

Step 2, Calculation variants of each activity

V = variant
tp = pessimistic time
to = time of upbeat
Step 3. Calculation looking for project variants
By aggregating all variants that are on the critical path with the following formula:
$\sigma p = \sqrt{\Sigma v}$
σp = standard variant of the project
Σvp = sum of all variants on the critical path
showed the following results:
1. The standard deviation of the project
Σvp = 1.5376
$\sigma p = \sqrt{1,5376}$
= 1, 24 week

So what conclusions can be drawn using PERT is derived scheduling time optimization of ± 40.26 weeks or 2.99% from the beginning of the plan period was 41.5 weeks.

Table 11 Calculation Results PERT

		Aktivitas	WAKTU OPTIMIS	WAKTU YG PLNG MUNGKIN	WAKTU PESIMIS	EXPECTED TIME	VARIANCE	VARIANCE JALUR KRITIS
			to	tm	tp	te		
			minggu	minggu	minggu	(ta+4tm+tb)/6		
		Struktur beton						
1	A	Pekerjaan pondasi tiang	4.5	6	7	5.92	0.17	0.17
2	B	Pekerjaan tanah	3.50	4.43	5.00	4.37	0.06	0.06
3	C	Pekerjaan /formwork	2	4	6.25	4.04	0.50	
4	D	Pekerjaan beton	2	5	7.5	4.92	0.84	
5	E	Pekerjaan pembesian	1.86	3.71	5.00	3.62	0.27	
6	F	Pekerjaan grouting	0.5	1	1.25	0.96	0.02	0.02
		Struktur Baja						
7	G	Rangka utama	6.5	8	9	7.92	0.17	0.17
8	H	Denah rangka atap dan kanopi	5	6	7	6.00	0.11	0.11
9	I	Pekerjaan dudukan pipa talang	3	4	5	4.00	0.11	0.11
10	J	Pekerjaan rangka	1.25	2	3	2.04	0.09	0.09
		Pekerjaan Arsitektur						
11	K	Pekerjaan pasangan	3.21	6.43	7.50	6.07	0.51	
12	L	Pekerjaan penyelesaian dinding	2	4	5.5	3.92	0.34	
13	M	Pekerjaan penyelesaian lantai	4.5	9	11	8.58	1.17	
14	N	Pekerjaan langit-langit	3	6	8.5	5.92	0.84	
15	O	Pekerjaan pengecatan	5	7	8	6.83	0.25	0.25
16	P	Pekerjaan pintu jendela	3	4	5	4.00	0.11	0.11
17	Q	Pekerjaan atap, dadding dan talang air	6.0	7.71	10.00	7.81	0.44	0.44

Source: personal preparations

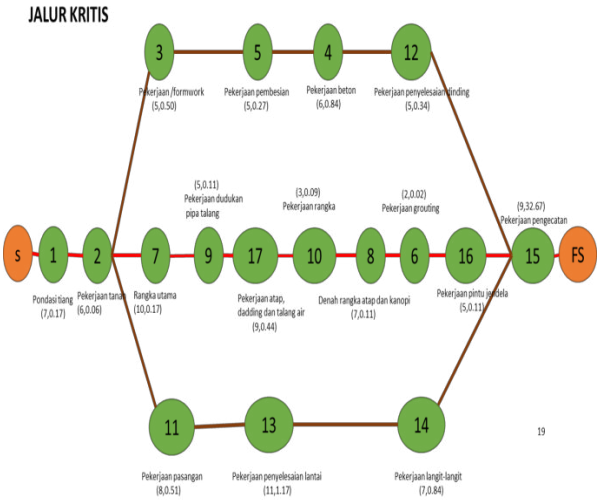

Figure 4 Network hospital building work

3.2.2 Using Manual Data Processing Program Evaluation and Review Technique (M-PERT)

The activities time optimization work using manual calculation with 4 merger that can be seen in figure 5

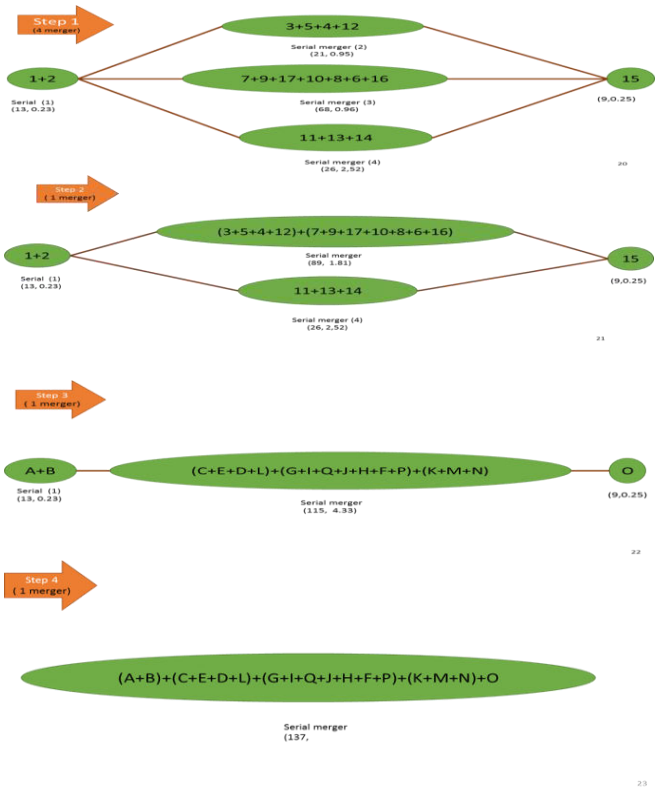

Figure 5 The results of merger activity with M-PERT method
Source: personal preparations

M-PERT method in a hospital building with 4 merger is done.
step 1 Using M-PERT formula is the number one (1) using the formula number 2. Results and merging images can be viewed in step 1
Taken combiner maximum parallel for all activities must finish everything before starting again.
The formula used for merging parallel maximum as follows: Serial merger

$$\mu_k = \mu_i \phi(\delta) + \mu_j \left(1 - \phi(\delta)\right)$$

$$\sigma_k^2 = (\sigma_i^2 + \mu_i^2)\phi(\delta) + (\sigma_j^2 + \mu_j^2)\left(1 - \phi(\delta)\right) + (\mu_i + \mu_j)\theta\phi(\delta) - \mu_k^2$$

Step 2 do 1 merger with
combining the parallel activities
Step 3 1 merger Merger conducted parallel 2
Step 4 in doing 1 merger by incorporation of the series beginning with the merger between parallel activities and weekend activities

Table 12 Comparison of the duration of the existing, PERT duration and duration M-PERT

NO	Aktivitas	DURASI EXISTING	DURASI PERT	DURASI M-PERT
	Struktur beton			
1	Pekerjaan pondasi tiang	6	5,92	5,54
2	Pekerjaan tanah	4,43	4,37	4,09
3	Pekerjaan /formwork	4	4,04	3,78
4	Pekerjaan beton	5	4,92	4,60
5	Pekerjaan pembesian	3,71	3,62	3,39
6	Pekerjaan grouting	1	0,96	0,90
	Struktur Baja			
7	Rangka utama	8	7,92	7,41
8	Denah rangka atap dan kanopi	6	6,00	5,62
9	Pekerjaan dudukan pipa talang	4	4,00	3,75
10	Pekerjaan rangka	2	2,04	1,91
	Pekerjaan Arsitektur			
11	Pekerjaan pasangan	6,43	6,07	5,68
12	Pekerjaan penyelesaian dinding	4	3,92	3,67
13	Pekerjaan penyelesaian lantai	9	8,58	8,04
14	Pekerjaan langit-langit	6	5,92	5,54
15	Pekerjaan pengecatan	7	6,83	6,40
16	Pekerjaan pintu jendela	4	4,00	3,75
17	Pekerjaan atap, dadding dan talang	7,71	7,81	7,31

Source: personal preparations

4 CONCLUSION

The conclusion of this study as follows:

1. Application of M-PERT hospital building structures can be expected to improve the performance of a corresponding image in the image flow chart Application 2
2. Factors - factors that most affect job scheduling structure of the hospital building includes: combining the activities of the project, perhitingan activities, the work must be completed quickly (critical path), preparation strategy implementation schedule of the project, the similarity in the network to determine the approximate time of the network, defining the activities initiated , contract documents, control the cost, quality and time.
3. The results of the case study on the work of building structures hospital adoption of M-PERT by comparing the duration of existing (Actual), duration of time with PERT method and duration of time with method M-PERT from case studies to optimize the time, with the method of Pert optimize time project be 40.26 weeks or a decrease of 2.99%, using the M-PERT method can optimize project time into 38.86 a week or a decrease of 6.37% over the initial plan was 41.5 weeks.

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