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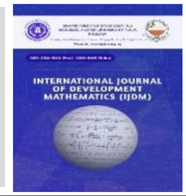

Family Planning Welfare Center Establishment

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ABSTRACT

The paper employed Critical Path Method and Project Evaluation Review Technique (CPM/PERT) on the Establishment of Family Welfare Planning Center project to plan, organize, and schedule the tasks required in order to meet the project deadline. CPM and PERT are tools that project managers use to schedule, plan, and arrange tasks for any project. The tactics help managers identify the resources required at various times and what additional resources are required, as well as evaluating the impact of certain activity delays. They also help define occupations and activities and their start and end periods. It also aids in estimating when the job should be finished. The purpose of the paper is employ and apply PERT in the Establishment of family planning welfare center. The results show that building a family welfare center would take 412 weeks, which is five weeks longer than expected. This project is the first of its type to build a family welfare center using CPM/PERT methodologies.

1. Introduction

Project management is the process of planning, organizing, directing, and controlling resources in each project activity to maximize activity duration and reduce total project time and expenses. Every project has controllable components, such as labour, supplies, money, and equipment; the project's completion time is the uncontrollable component in project analysis. Limited resources must be committed to the implementation and execution of the project. The project manager is responsible for managing the project cycles and integrating these resources into project sub-activities in order to deliver the project results effectively, efficiently, and on schedule. Project management includes planning, initiating, carrying out, supervising, and concluding projects for both individuals and businesses. It offers methods, concepts, tactics, and disciplines to assist individuals and organizations in completing projects within budgeted limitations and on time.

The paper's primary objectives are to efficiently, effectively, and promptly plan, organize, coordinate, and reschedule these family welfare center-related operations. To achieve our goals, we used CPM/PERT tools to execute these activities. The purpose of this study is to illustrate how CPM/PERT may be used

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practically in a family welfare center establishment project. Project managers will be encouraged to adopt the use of CPM/PERT in project management by doing this (Bagashaw, 2021; Iheonu & Achom, 2023).

In order to streamline the planning and scheduling of the U.S. Navy's Polaris nuclear submarine project, the PERT Methodology was created in 1957 (Winston, 2004; Taha, 2017). Simultaneously, Du Pont and Remington Rand Corporation USA independently developed CPM (Jain, 2013). PERT makes the assumption that every job time is independent and identically distributed. Thus, the central limit theorem (Bluman, 2009; Mood *et al*., 1974).

Jain (2013) uses the PERT technique in their health monitoring and control program. The study used CPM/PERT to administer the vaccination campaign in the Indian state of Jaipur. Participating experience workers gathered research data, and computers were used for computation. The findings indicate that the project will be finished in ninety days, with a standard deviation of 10.14 and a variance of 102.86. Nine of the twenty-two tasks are particularly important.

Another case study of great significance in the area of CPM/PERT methodology application is the research conducted by Oladimeji *et al*. (2023) In the Federal University of Technology Akure in Ondo State, Nigeria, the University Health Center building uses CPM/PERT. The goal of the study is to determine how long it will take to finish the health center construction. After conducting data analysis, every potential path for the project's activities was identified. The critical path's location was discovered. Each activity's anticipated duration was established. The likelihood of finishing the job in the allotted time was assessed. According to the findings, there is a 50% likelihood that the project will be finished in the allotted time.

The goal of the current study is to better understand the patient flow in an emergency department at a university hospital using the Fuzzy Critical Path Method (FCPM) and the Fuzzy Program Evaluation Review Technique (FPERT). Fuzzy numbers work better for high-uncertainty procedures, including those in emergency rooms, which is why fuzzy sets were included. The project network is created by identifying the activities that impact the flow of patients through the emergency department. The observed ED provides information on the times of each activity for 1500 patients. Results from the use of FCPM and FPERT are used to calculate the critical path, slack times, and the anticipated project completion time (Muhammet *et al*., 2017).

To learn more about the patient flow in the emergency department of a university hospital, a case study is conducted there. The project network is created by identifying the activities that impact the flow of patients through the emergency department. The analysis uses data from 1500 patients regarding the times of each activity. Results from the application case are used to calculate the critical route, slack times, and the anticipated project completion time (Muhammet *et al*., 2017).

The rest of the study is organized as follows: Section 2 presents the project management methods used in the healthcare industry. Section 3 presents the findings and comments. There is a conclusion at the end of Section 4.

2. Methodology

The project is represented in terms of events and activities using CPM/PERT methodologies. Events indicate when an action begins or ends, and the activities use up time and resources. In the context of health management, some instances of "activity" and events could be: Estimating the duration of the activities is the next step in project implementation, and in PERT, the average duration of each activity is calculated by summing together three time estimates for each activity. CPM/PERT demands the use of network diagrams which are the graphical or diagrammatic represent of the project. We may take an example of a building up welfare center programme which is made up of 19 activities.

1. The optimistic time estimate: This is an estimate of how long an activity can be finished in the shortest amount of time. This is predicated on perfect conditions and smooth operations. The symbol for this is a.
2. The most likely time estimate: This is the approximate amount of time needed to complete a task in typical circumstances. Typically, m is used to represent this.
3. The pessimistic time estimate: This is an estimate of the maximum amount of time needed to complete a specific task under unusual circumstances. Typically, b is used to indicate this.

Using the formula, the three time estimates are condensed into a single time estimate (anticipated time, represented by E(T).

$$\mu = \frac{a + 4m + b}{6}$$

The variance of the jobs time equals

$$\sigma^2 = \left[\frac{b - a}{6}\right]^2$$

a. Float Computation

Total float

is the amount of time that an activity's start time could be postponed past its earliest feasible start time without affecting the project's completion date. Algebraically:

$TF_{ij} = LC_j - ES_i - D_{ij} \quad = LC_j - EC_{ij} \quad = LS_{ij} - ES_i$

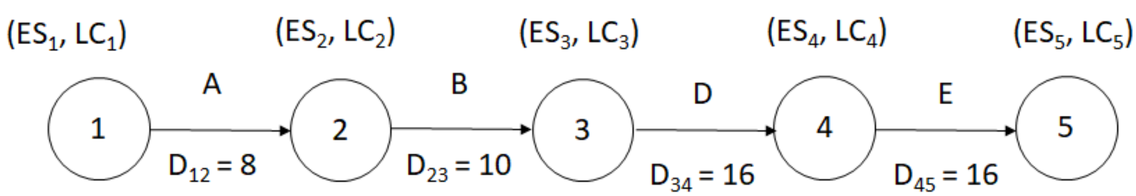
Free float

is the amount that an activity's start time can be postponed without causing any subsequent activities to begin later than their earliest permissible start time is known as the free float. Algebraically:

$FF_{ij} = ES_j - ES_i - D_{ij} \quad = LC_j - LC_i \quad = Di_j$

Prototype Network diagram is presented in figure 1.

Figure 1: Sketch diagram



b. Data collection

Three time estimates based on historical experience were estimated for a block in the Jimeta district when creating the welfare center project, and one average or expected time estimate was computed Using computer software called Management Scientist V7.0 (Anderson et al., 2013). This may be seen in Table 1, below: Three time estimates based on historical experience were estimated for a block in the Jimeta district when creating the welfare center project, and one average or expected time estimate was computed. This may be seen in Table 1.

i. Activity

1. Conduct needs assessment and demographic analysis
2. Identify target areas and priority locations

3. Stake-holder consultation workshops
4. Develop project design and work plan
5. Prepare and finalize budget
6. Secure funding and partnerships
7. Acquire land/space for centers
8. Construct or renovate facilities
9. Recruitment of health and administrative staff
10. Staff orientation and technical training
11. Develop service guidelines and SOPs
12. Procurement of equipment and supplies
13. Launch awareness campaigns
14. Begin service delivery at centers
15. Establish mobile outreach services
16. Develop and implement M and E framework
17. Regular data collection and reporting
18. Mid-term review and adjustments
19. Plan for expansion and sustain-ability

Table 1: Three time estimates based on historical experience for a block in the Jimeta district

ID	Activity description	Predecessors	a	m	b	E(T)
A	Conduct needs assessment and demographic analysis	—	4	8	12	8
B	Identify target areas and priority locations	A	4	6	8	6
C	Stake-holder consultation workshops	B	8	12	16	12
D	Develop project design and work plan	B	8	10	12	10
E	Prepare and finalize budget	D	12	16	20	16
F	Secure funding and partnerships	E	12	14	16	14
G	Acquire land/space for centers	F	12	14	16	14
H	Construct or renovate facilities	G	16	20	24	20
I	Recruitment of health and admin staff	E	20	22	24	22
J	Staff orientation and technical training	I	24	28	32	28
K	Develop service guidelines and SOPs	J	24	26	28	26
L	Procurement of equipment and supplies	F	28	30	32	30
M	Launch awareness campaigns	L	28	40	48	39
N	Begin service delivery at centers	M	32	36	40	36
O	Establish mobile outreach services	N	36	44	48	43
P	Develop and implement M&E framework	O	40	44	48	44
Q	Regular data collection and reporting	N	44	48	52	48
R	Mid-term review and adjustments	P	72	76	80	76
S	Plan for expansion and Sustainability	R	80	92	96	91

3. Results and Discussion

The total of all the work periods in the critical path is the project length T. Bold arrows, which indicate the critical path, are A-B-D-E-F-L-M-N-O-P-R-S. The project is projected to take 412 Weeks to complete. The network displays two time computations, namely the Earliest Start (ES) and Latest completion (LC). The last two, Float or Slack, Latest Start (LS) and Earliest Completion (EC), are calculated and displayed in the Table 2.

After then, the PERT analyst attempts to identify the predecessor and successor activities by logically sequencing the operations. Table 2 and Figure 2 display the sequential limitations and related network diagram for the welfare center program creation.

Table 2: Sequential limitations and related network diagram for the welfare center program creation

Activity Arc(ij)	Activity Duration (D_{ij})	Earliest Start (ES_i)	Earliest Completion (EC_{ij})	Latest Start (LS_{ij})	Latest Completion (LC_j)	Total Float (TF_{ij})	Free Float (FF_{ij})
A (1,2)	8	0	8	0	8	0	0
B (2,3)	6	0	8	0	8	0	0
C (3,16)	12	14	19	400	412	0	0
D (3,4)	10	14	24	14	24	393	393
E (4,5)	16	24	40	24	40	0	0
F (5,6)	14	40	54	40	54	0	0
G (6,7)	14	54	68	378	392	324	0
H (7,16)	20	68	88	392	412	324	324
I (5,8)	22	40	62	336	358	296	0
J (8,9)	28	62	90	358	386	296	322
K (9,16)	26	90	116	386	412	296	296
L (6,10)	30	54	84	54	84	0	0
M (10,11)	39	84	123	84	123	0	0
N (11,12)	36	123	159	123	159	0	0
O (12,13)	43	159	202	159	202	0	0
P (13,14)	44	202	246	202	246	0	0
Q (12,16)	48	159	207	364	412	205	205
R (14,15)	76	246	322	246	322	0	0
S (15,16)	90	322	412	322	412	0	0

*Non -critical activity

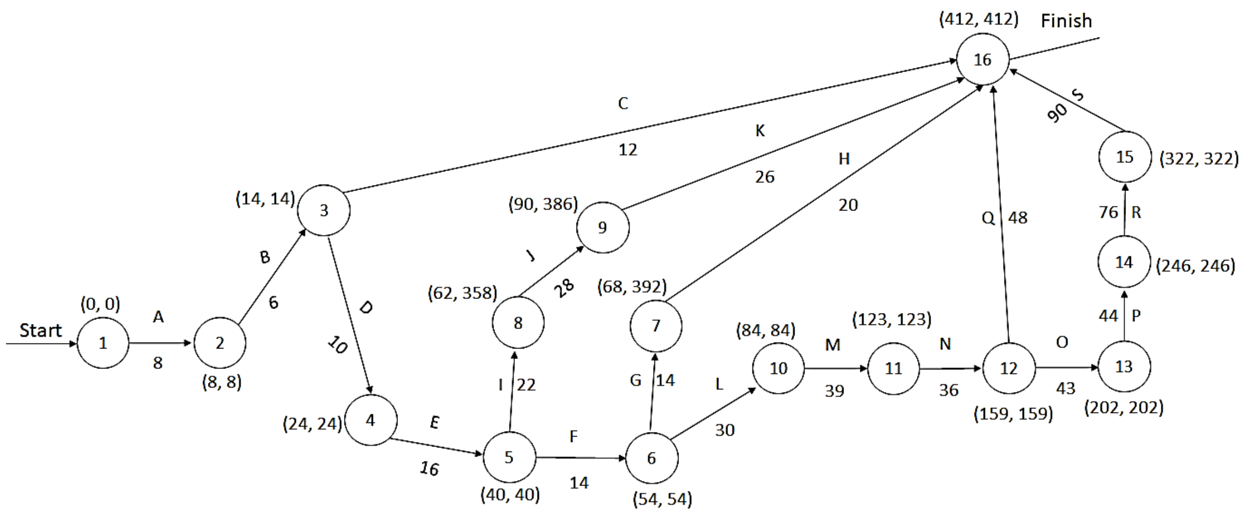


Figure 2: Sequential limitations and related network diagram for the welfare center program creation

The amount that an activity can be postponed without lengthening the project's duration is known as its float or slack. The float for all critical activities is 0, meaning they cannot be delayed. In computations, there are often two measures of float that are employed. They are total float and free float. In the instance of a portion of the welfare center program's network, let's examine the two float measures. The project length T is the sum of all the job times in the critical path. PERT assumes that all the job times are independent, and are identically distributed. Hence, the central limit Theorem (Mood et al., 1974). T has a normal distribution with mean μ and variance σ^2. Figure 3, exhibits a normal distribution with mean μ and variance σ^2

Additionally, we are able to compute the likelihood of completing the project by the deadline. For example, the client would like to know the likelihood that the project would be finished 12 weeks sooner than anticipated. The calculation looks like this:

Probability (T ≤ 400) = Probability $\left(Z \leq \frac{T - E(T)}{\sqrt{V(T)}}\right)$

Probability (T ≤ 400) = Probability $\left(Z \leq \frac{400 - 412}{5}\right)$

= Probability $(Z \leq -2.4)$

The shaded area to the left of z = – 2.4 has a value of 0.4918, which we obtained from the standard normal table. Subtracting this value from 0.5000 yields 0.0082. There is a 0.82% chance that the project will be finished 12 weeks sooner than anticipated.

With a mean of E(T) = 412 weeks and a standard deviation of STD = 5 weeks, the project completion time T is distributed normally. The likelihood that the random variable will fall within one standard deviation of the mean for any normal distribution is 0.68. The project time is therefore 68% likely to fall between 407 and 417 weeks. T has a 95% probability of falling between 402 and 422 weeks, which is two standard deviations from the mean. Additionally, there is a 99.7% chance that T will fall between 397 and 427 weeks, or within three standard deviations.

Let's say the client wants the project finished in 12 weeks sooner than expected, if at all possible. What information should the program manager give his customer regarding the center's chances of being established in 400 weeks? The client can select the one that best suits him by using PERT to estimate alternative Scheduled Completion Dates with 68 percent, 95 percent, and 99.7 percent assurance of completion. First, let's calculate the likelihood that the project will be finished in 400 weeks. PERT employs a frequency distribution curve called the beta-distribution and applies the method below to get the standard deviation based on the three time estimations tp, to, and tm.

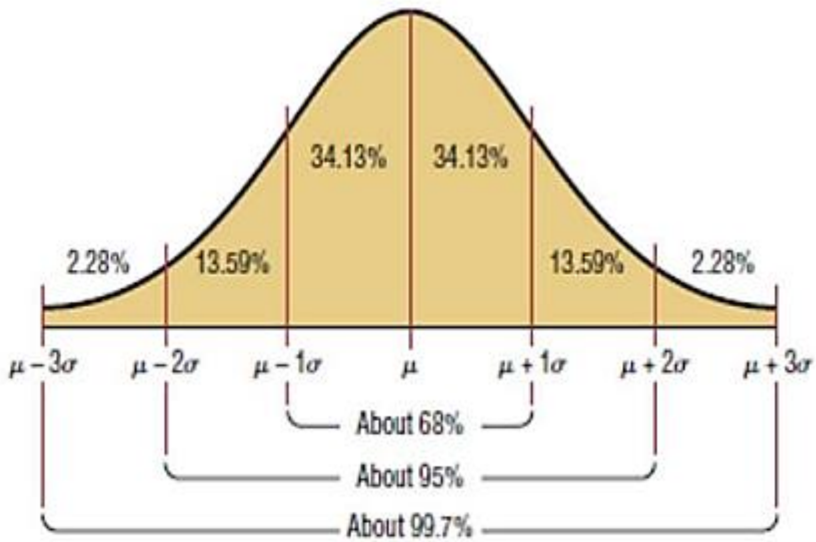
The total of all the task durations on the critical route equals the project length T. PERT makes the assumption that every activity's time is independent and identically distributed. Therefore, T has a normal distribution with mean E(T) and variance V(T), according to the central limit theorem (Mood et al., 1974).

$$Z = \frac{T - E(T)}{\sqrt{V(T)}}$$

Let T stand for the length of the project. Next, the project's anticipated duration is expected to be as

E(T) = Sum of the expected times of task
= E(A) + E(B) + E(D) + E(E) + E(F) + E(L) + E(M) + E(N)+ E(O) + E(P) + E(R) + E(S)
$= 8 + 6 + 10 + 16 + 14 + 30 + 39 + 36 + 43 + 44 + 76 + 90$
$= 412$

Figure 3:



The variance of the project duration is

V(T) = Sum of the variances of task

$$= \sigma_{12}^2 + \sigma_{23}^2 + \sigma_{34}^2 + \sigma_{45}^2 + \sigma_{56}^2 + \sigma_{6,10}^2 + \sigma_{10,11}^2 + \sigma_{11,12}^2 + \sigma_{12,13}^2 + \sigma_{13,14}^2 + \sigma_{14,15}^2 + \sigma_{15,16}^2$$

$$= 1.78 + 0.44 + 0.44 + 1.78 + 0.44 + 0.44 + 1.11 + 1.78 + 4.00 + 1.78 + 1.78 + 7.11 = 32.89$$

The standard deviation of the project duration is

$$\text{STD} = \sqrt{V(T)}$$

$$= \sqrt{32.89}$$

$$= 5.73$$

The methodology mentioned is totally based on time dimensions and the project completion time and the probability of its completion on time were calculated and criteria for differential control of activities based on Critical Path was investigated. Project cost analysis requires analyzing the usage of resources and their deployment in diverse activities. Determining the ideal project time at the lowest possible overall cost is the goal of project cost analysis, also known as crashing. This process, known as "crashing" or "reducing the project duration," takes into account the impact of the activities on the direct and indirect costs of the project.

4. Conclusion

The welfare center's construction will be finished in 412 weeks, with a 5.73-week standard error. This completion time is the result of a single key path that consists of twelve crucial tasks. Both total and free float are zero for each of these crucial activities. This outcome demonstrates that the first of its kind was carried out, even though it is restricted to the project activities of creating a welfare health center.

"Time" is the cornerstone of the methodology known as the Programme Evaluation and Review Technique (PERT). Any program or project is assumed to be a collection of many tasks or endeavors. These activities are related to and dependent upon one other on certain levels. Only after every activity has been finished will the project or program be considered complete. The basic concept of PERT/CPM is not new, and we are largely familiar with it. PERT/CPM provides a scientific basis for such project planning. It provides a solid and logical structure for completing activities and allocating the resources required to do them, allowing the project to be finished in the shortest amount of time with the fewest resources.

PERT is ultimately a scientific technique that helps projects be implemented within resource and schedule restrictions. It illustrates the various kinds of judgments that must be taken at various points during the project and compels the project manager to use reason in the face of uncertainty.

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