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Information System Design and Application of the Critical Path Method (CPM) Determining the Optimal Time for Implementing Activities

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Abstract

Information is the result of processing data from one or various sources, which is then processed so that it provides value, meaning and benefits. In the modern era, the use of technology plays a very important role as a means of information and promotion, especially in the field of websites in conveying information. The activity implementation plan carried out by the institution to determine the time period for completing activities still uses estimates as a guide. These estimates result in uncertain completion times. This is of course a problem in the implementation of activities, because late completion times result in time differences with the initial planned targets. Based on these conditions, the delivery of information is felt to be less than optimal because it does not yet have a website page, so the author feels that the West Sumatra Center for Public Policy Studies (PSKP) requires an information system that is able to support activities and provide information about the institution to be more effective and efficient. Then a schedule of the activity implementation process is needed from start to finish. One method that can be used for scheduling is the critical path method (CPM). This method is part of the work network method which is oriented towards determining schedules and estimating them which are deterministic (certain). With this CPM method, all activity processes are in accordance with the initial target.

Keywords : Information Systems , ***Critical*** *Path Method (CPM),* Deterministic, Initial Target.

1. Introduction

Information technology is a very effective supporting factor today and allows people to enjoy various conveniences produced by technology. Current technological developments, especially information technology, are developing very rapidly. Nowadays we often hear about internet technology, which is a development of information technology. This development is developing more towards user friendly, which means it makes it easier for users to understand and carry out the functions of the internet [1]

Currently, government and non-government organizations or institutions use websites as information media. The activity implementation plan carried out by the institution to determine the time period for completing activities still uses estimates as a guide. These estimates result in uncertain completion times. This is of course a problem in the implementation of activities, because late completion times result in time differences with the initial planned targets.

Based on these conditions, the delivery of information is felt to be less than optimal because it does not yet have a website page, so the author feels that the Center for Public Policy Studies needs an information system that is able to support activities and provide information about the institution to make it more effective and efficient. Then a schedule of the activity implementation process is needed from start to finish. One method that can be used for scheduling is the critical path method (CPM). This method is part of the work network method which is oriented towards determining the time schedule and its estimation which is deterministic (certain) [3][4]

A system is generally composed of a number of smaller systems. Small systems within a system are called subsystems. Subsystems are parts of a system that independently form a system that has a smaller role than the system.

Project scheduling always uses the work network analysis method. Scheduling methods include network-based methods that use linear time-cost balance. Each activity can be completed faster than the normal time by bypassing the activity for a certain cost. Thus, if the project completion time is not satisfactory, certain activities can be bypassed to complete the project in less time [5]

Critical Path Method (CPM) is a method that is often used in network analysis. This method classifies activities into 2 groups, namely critical activities and

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non-critical activities. Classification of these activities is carried out based on the longest path algorithm. If the activity is on the critical (longest) path then the activity is classified as a critical activity, which means that the implementation of this activity cannot be postponed[6]

Critical Path Method (CPM) is detailing each activity, activity predecessor, activity time or time normal, and cost [7]. Critical Path Method (CPM) is a method of project time management or project scheduling. This method is used in planning, scheduling, decision making and the control process of a project [8]

Because if critical activities are delayed it will result in increasing the completion time of the project or activity. If an activity is not on the critical path, it is classified as a non-critical activity. The implementation of these non-critical activities can be postponed without affecting the overall project completion time. The goal of getting the critical path is to get the fastest time to start activities in the network and the time to complete the project or activity.

2. Research methodology

The research will design a web-based information system and apply the Critical Path Method (CPM) method. The following is the research framework which can be seen in Figure 3.1.

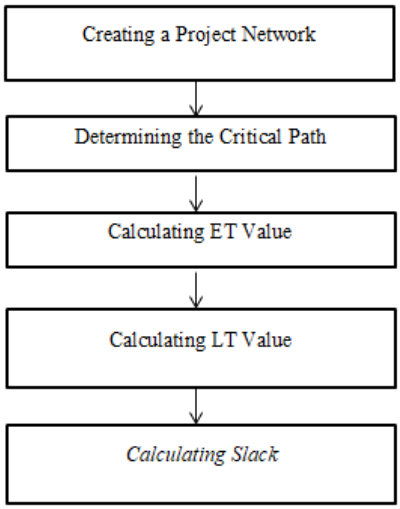

Figure 1. Research Framework

critical path method (CPM) algorithm is explained as follows.

1. Create a network of projects or activities.
2. Determine the critical path. The critical path is the path with the longest amount of time.
3. Calculate ET_i , the fastest time an event can be realized at each point (event) with the formula:

$$ET_j = maximum\ (ET_i = t_{ij})$$

Where i is the initial node of the activity that ends at j and t_{ij} is the time duration of the activity from i to j .

4. Calculate LT_i , the longest time of the event, namely the longest time an activity can take without delaying the completion of the entire project. Mathematically, LT_i is formulated as:

$$LT_i = minimum\ (LT_j = t_{ij})$$

Where j is the end node of all activities starting at i and t_{ij} is the duration of activity time from i to j .

5. Calculate the gap value (*slack*) for each event using the formula:

$$S_{ij} = LT_j - ET = -t_{ij}$$

Slack is the amount of time an activity can be delayed without affecting overall project completion and usually occurs in events that are not on the critical path

3. Results and Discussion

The institutional activity that will apply the Critical Path Method *(* CPM) is the Community Satisfaction Survey. The activities and time duration in the Community Satisfaction Survey process are presented in the table and the network image *for* the process can be seen in the following table.

Table 4. 1 General description of institutional activities

Activity	Information	Start	Finished
	Preparation phase		
A	Preparing methods for conducting surveys and reviewing survey materials	0	1
B	Preparation of location, questionnaire and survey equipment	1	4
C	Surveyor selection	4	5
D	Surveyor Training	5	10
E	Data Processing Training	6 or 7	8 or 9
F	Expanding Questionnaires	8 or 9	9 or 10
	Implementation Stage		
G	Field survey	10	23
H	Data entry	23	

			29
	Data Processing Stage		
I	Data processing	29	35
J	Preparation of reports	35	41
	Reporting and Presentation Stage		
K	Submission of Interim Report	41	47
L	Percentage of Reports with technical teams, service units and other SKPD	47	48
m	Refining the Final Report and Enlarging the Report	48	54

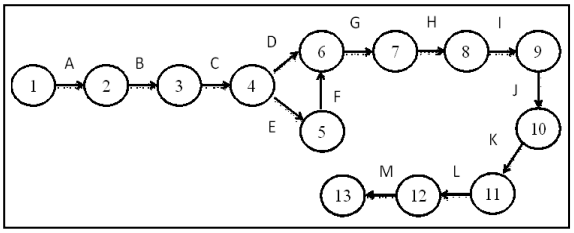

Figure 2 Network Diagram (*Network*)

To obtain the optimal time for implementing Community Satisfaction Survey activities, based on the Critical Path Method *(* CPM), it is described as follows.

Based on the network image, the process of implementing Community Satisfaction Survey activities has 2 paths , namely:

1. Path 1 : *1→ 2→ 3→ 4→ 6→ 7→ 8→ 9→ 10→ 11→ 12→ 13*
2. Path 2 : *1→ 2→ 3→ 4→5→ 6→ 7→ 8→ 9→ 10→ 11→ 12→ 13*

By amount of time:

1. Path 1 : *1→ 2→ 3→ 4→ 6→ 7→ 8→ 9→ 10→ 11→ 12→ 13 = 1 + 3 + 1 + 5 + 13 + 6 + 6 + 6 + 6 + 1 + 6 = 54* day
2. Path 2 : *1→ 2→ 3→ 4→5→ 6→ 7→ 8→ 9→ 10→ 11→ 12→ 13 = 1 + 3 + 1 + 2 + 2 + 13 + 6 + 6 + 6 + 6 + 1 + 6 = 53* days

So the critical path is path 1 because it has the largest amount of time. From the critical path, it was also found that the life of the project or activity was 53 days. Apart from that, information was also obtained that the critical activities were A, B, C, D, G, H, I, J, K, L, and M. Next, the scheduling of each activity is determined. First, get *the ET* of each event. The *ET* calculation is explained below.

1. Event 1: $ET_1 = 1$
2. Event 2: $ET_2 = maximum\ (ET_1 + t_{12}) = maximum\ (1 + 3) = 4$
3. Event 3: $ET_3 = maximum\ (ET_2 + t_{23}) = maximum\ (4 + 1) = 5$
4. Event 4: $ET_4 = maximum\ (ET_3 + t_{34}) = maximum\ (5 + 3) = 8$
5. Event 5: $ET_5 = maximum\ (ET_4 + t_{45}) = maximum\ (8 + 1) = 9$
6. Event 6: $ET_6 = maximum\ (ET_5 + t_{56}) = maximum\ (9 + 1) = 10$
7. Event 7 : $ET_7 = maximum\ (ET_6 + t_{67}) = maximum\ (10 + 13) = 23$
8. Event 8 : $ET_8 = maximum\ (ET_7 + t_{78}) = maximum\ (23 + 6) = 29$
9. Event 9 : $ET_9 = maximum\ (ET_8 + t_{89}) = maximum\ (29 + 6) = 35$
10. Event 10 : $ET_{10} = maximum\ (ET_9 + t_{10.11}) = maximum\ (35 + 6) = 41$
11. Event 11 : $ET_{11} = maximum\ (ET_{10} + t_{11.12}) = maximum\ (41 + 6) = 47$
12. Event 12 : $ET_{12} = maximum\ (ET_{11} + t_{12.13}) = maximum\ (47 + 1) = 48$
13. Event 13 : $ET_{13} = maximum\ (ET_{12} + t_{13.14}) = maximum\ (48 + 6) = 54$

Next, after obtaining *the ET* for each event, then look for *the LT* for each event. The calculation process to obtain *LT* will be explained as follows.

1. Event 13: $LT_{13} = ET_{13} = 54$
2. Event 12: $minimum\ (LT_{12} - t_{11.12}) = minimum\ (54-6)=48$
3. Event 11: $minimum\ (LT_{11} - t_{11.10}) = minimum\ (48-1)=47$
4. Event 10: $minimum\ (LT_1 - t_{10.9}) = minimum\ (47-6)=41$
5. Event 9: $minimum\ (LT_9 - t_{98}) = minimum\ (41-6)=35$
6. Event 8: $minimum\ (LT_8 - t_{87}) = minimum\ (35-6)=29$
7. Event 7: $minimum\ (LT_7 - t_{76}) = minimum\ (29-6)=23$
8. Event 6: $minimum\ (LT_6 - t_{65}) = minimum\ (23-13)=10$
9. Event 5: $minimum\ (LT_5 - t_{54}) = minimum\ (10-1)=9$
10. Event 4: $minimum\ (LT_4 - t_{43}) = minimum\ (9-1)=8$
11. Event 3: $minimum\ (LT_3 - t_{32}) = minimum\ (8-3)=5$
12. Event 2: $minimum\ (LT_2 - t_{21}) = minimum\ (5-1)=4$
13. Event 1: $minimum\ (LT_1 - t_1) = minimum\ (4-3)=1$

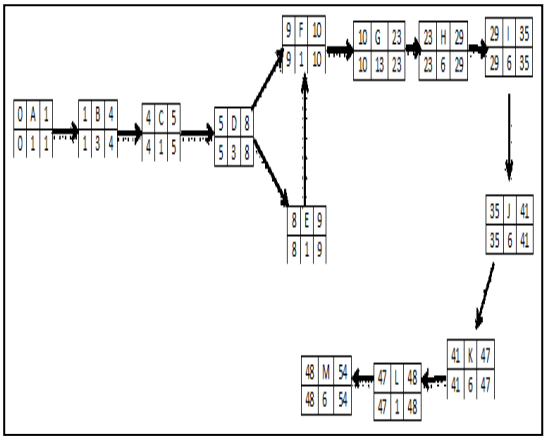

Figure 3 Calculation of *ET* and *LT times*

From the critical calculations, the results obtained were that activity **A** , preparing the survey implementation method and reviewing survey material must be completed in 1 day, activity **C** surveyor selection can be carried out after activity **B** preparing the location, list of questions and survey equipment has been completed on the 4th day. After activity **C** is completed, activity **D continues with** surveyor training and must be completed on the 10th day. Activity **E** starts on day 6. If activity **E** is postponed for 1 day so that it only starts on the 7th day it will not affect the completion of the Community Satisfaction Survey activity. This also applies to activity **F.** Activity **F** can be started on the 8th day but if it is postponed for 1 day so that it only starts on the 9th day it will not affect the completion time of the activity.

With the conclusion that the optimal time for Community Satisfaction Survey activities using the Critical Path Method *(* CPM) is 54 days with the activity schedule can be seen in the table following .

Table 4. 2 General Description of Institutional Activities

Activity	Information	Start	Finished
	Preparation phase		
A	Preparing methods for conducting surveys and reviewing survey materials	**0**	**1**
B	Preparation of location, questionnaire and survey equipment	**1**	**4**
C	Surveyor selection	**4**	**5**
D	Surveyor Training	**5**	**10**
E	Data Processing Training	**6 or 7**	**8 or 9**
F	Expanding Questionnaires	**8 or 9**	**9 or 10**
	Implementation Stage		
G	Field survey	**10**	**23**
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	Data Processing Stage		
I	Data processing	**29**	**35**
J	Preparation of reports	**35**	**41**
	Reporting and Presentation Stage		
K	Submission of Interim Report	**41**	**47**
L	Percentage of Reports with technical teams, service units and other SKPD	**47**	**48**
m	Refining the Final Report and Enlarging the Report	**48**	**54**

System Implementation

The system implementation stage is the stage where the system created is ready to be used. At this stage, several activities take place in stages, namely from planning the implementation of the system to implementing implementation activities and following up on system implementation.

1. System Main Page Display

The main page of the system is the initial display that appears first. On this page, menus will be displayed that can be accessed by visitors. The main page displays basic information from the West Sumatra Center for Public Policy Studies (PSKP), such as profile, gallery, contact and others.

Figure 4 Main page display

2. Organizational Structure Page View

The menu to go to this page is on the about us page, the organizational structure page contains information about the organizational structure of the Center for Public Policy Studies (PSKP) such as complete biodata of leaders and information on the names of other structures .

Figure 5 Organizational Structure Page Display

Figure 6 Organizational Structure Page Display

3. Program page display and activity results

On the activities page there are two menus, namely the program page that has been implemented and the activity results page. The program page contains information about what programs have been implemented by the Center for Public Policy Studies (PSKP). Then, on the activity results page there is information such as the value of each service unit using the institution's services. This page will always *be updated* if there is new activity results data. All this information is presented to visitors.

Figure 7 Program Pages That Have Been Implemented

Figure 8 Activity Results Page

4. Admin Login Page Display

On the *login page there is a login* form which functions as data validation for website admins who want to enter the system by inputting their *username* and *password* .

Figure 9 Admin Login Page

4. Conclusion

Designing a website-based information system can provide assistance and have a big impact on the delivery of information carried out by institutions. The aim of conveying information is to make the process of introducing institutions more effective and efficient in the cooperation process that will be carried out and to expand the area coverage for establishing cooperation with institutions. By implementing the critical path method (CPM). The implementation of activities carried out by the institution can run with targets determined at the beginning of planning and the time for completion of the activity is certain with details of the start to finish time for the stages of the activity so that there is no delay in completing the activity.

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