

Project Planing and Scheduling Using Project Management Techniques: A Case Study on Janata Bank Building at KUET Campus, Bangladesh

M. R. HASAN¹, M. S. ISLAM²

¹Department of Building Engineering and Construction Management, KUET, Bangladesh
(rakibulhasanrana008@gmail.com)

²Department of Building Engineering and Construction Management, KUET, Bangladesh
(arlsaidulislam@gmail.com)

Abstract

Nowadays, efficient project management is one of the vital issues specially in construction industries worldwide and it is in severe condition in developing country like Bangladesh. The aim of this paper is to use of Critical Path Method (CPM) and Program Evaluation Review Technique (PERT) to analyze planing and scheduling of construction work of Janata bank building in KUET, Bangladesh. After collecting all primary information from the contractor and engineers, the most significant task like identification of the specific activities, proper sequencing of the activities, construction of network diagram and time scheduling of each activity was performed. Finally, the critical path and PERT were used to analyze the project plan and schedule. The possibility of project completion within the period was about 3.14% and that matched with practical scenery. The result of this study will be helpful for the practitioners to attain a successful project and make the project policy.

Keywords: *Janata Bank Building, Project Planning and Scheduling, Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Bangladesh.*

1 Introduction

In project management system, the success of a project largely depends on proper project planning and scheduling (Dvir, Raz et al. 2003). It has been a great challenge to complete a project within the stipulated period worldwide. As like other countries Bangladesh also facing a huge problem due to delay in construction work. There are many causes of schedule delay like political situation, improper site management, increasing of material cost etc. (Rahman, Lee et al. 2014). Delay in project completion creates plethora of problem. It produces cost overrun, time overrun, rejection of work, dispute, hampering in fame of a company etc. (Aibinu and Jagboro 2002). These problems occurred due to not identifying and lack of proper coordination of diverge activities in a project. Therefore, performing of project planning and scheduling efficiently has a great significance especially in construction industry. It will help to mitigate some problem that occur due to project delay. Proper coordination is possible if project planning and scheduling activities are assembled in a master plan (Kelley Jr and Walker 1959). There are some project management technique. These are helpful for proper project management. Program Evaluation Review Technique and Critical Path Method are most common. These techniques has been used for many years and these are significant in proper project planning and scheduling (Adebowale and Oluboyede 2011). Project managers get convenience to plan and schedule of a project of sequential activities using Program evaluation Review Technique and Critical Path Method. PERT and CPM charts involve the time duration that is required to complete each activity. PERT and CPM charts include sequence of activity that involve predecessor and successor. Each activity is attributed with earliest and latest start time and finish time. The path in the network diagram, which has no slack time for each activity on the path is called critical path. Slack or Float is defined as the total amount of time that an activity of a project can be delayed without hampering in total project delay (Christodoulou 2009). Activity duration in PERT analysis based on three time estimate approach like most likely estimate (m), optimistic estimate (o) and pessimistic estimate (p). PERT has a feature of probability. This property helps to calculate the probability of achieving the objective of project within the specified period (Davis 1963). In Bangladesh, project delay due to improper project planning and scheduling is not out of concern. The aim of this research is to analyze the project plan and

schedule using project management techniques. The study was performed on a project of construction of Janata Bank Building, at KUET campus in Bangladesh. It is expected that the outcomes from this study will be helpful for the project managers, consultants, contractors and students of engineering and construction management in decision-making, controlling and supervision of the project.

2 Methodology

At the initiation, a set of articles, journal paper, research paper, open discussion with the contractor, engineers who were responsible for the project of construction of Janata Bank Building and some website were selected to have knowledge of proper project planning and scheduling in construction sector. All the necessary information were collected from the respective contractor and the engineer. In this study two most common project management techniques were used as like Critical Path Method and Program Evaluation and Review Technique (PERT). Single time estimate for the activities were taken in Critical Path method. In practical, it is hardly possible to complete the project within specified period with activity time estimate. Hence, three time estimates were enrolled. Expected time duration is the mean of three time estimate like optimistic estimate (o), most likely estimate (m) and pessimistic estimate (p) (Sharma 2006). PERT analysis was used to determine variance and standard deviation which helped to find out the probability of project completion within stipulated period. Probability was find out from Z distribution chart called standard normal table. Critical path was determined by the activities which have zero slack time. Network diagram was prepared based on activity on node networking system where boxes were used to denote the activities.

$$\text{Expected time duration} = \frac{o+4m+p}{6}$$

Variance (σ^2) = $(p-o/6)^2$, Standard Deviation = σ

Janata Bank Building was located near TSC building of KUET at Khulna in Bangladesh. This building was picked as study area. Construction period was 1 year which started in November, 2016. It was 1 month delay to complete the work according to the contractor and the engineer. It was two storied building. The gross floor area of the house is 3,963 Square feet (sf). Exterior wall area is 2,219 sf. Each storey has an internal height of 10 feet and 6 inches.

3 Results and Discussions

In Table 1, description of all activities related to the construction of the selected building was exhibited. The activity was started with project initiation, which involve site clearance and end with finishing task. Table 1 also showed the project task that must be done before the task start. It is considered as predecessor.

Table 1. Description of all activities to complete the whole work of construction

Activity	Activity Description	Predecessors
A	Project Initiation	-
B	Earth Excavation	A
C	Sand Test	A
D	Sand Filling	B,C
E	Soling (Concrete Casting)	D
F	Footing	E
G	Short Column	F
H	Grade Beam	G
I	Sand Filling cum Earthwork	G
J	Column Cum Soling(Super Structure)	I
K	Ground Floor Slab cum beam	J
L	Ground Floor Wall Construction	K
M	First Floor Column	L
N	First Floor Slab	M
O	First Floor Wall Construction	N
P	Finishing	L,O

3.1 PERT and CPM Analysis

The following network diagram was prepared based on the information of the activities and their relationship. Network was performed based on activity on node networking system where boxes are selected to denote the activity.

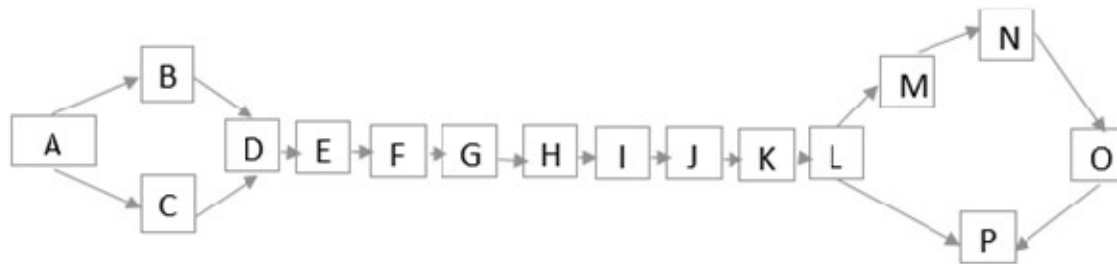


Figure 1. Network diagram of Janata Bank building construction

Table 2 showed the three time estimates like optimistic time estimate, most likely time estimate and pessimistic time estimate. It also executed the project activity and predecessors.

Table 2. Predecessors and three time estimates of construction of Janata Bank building

Activity	Predecessors	Optimistic Time (o) days	Most Likely Time(m) days	Pessimistic Time(p) days
A	-	10	12	18
B	A	5	6	13
C	A	1	2	3
D	B,C	12	15	26
E	D	4	6	10
F	E	22	25	38
G	F	7	10	15
H	G	17	20	24
I	G	12	15	21
J	I	43	45	50
K	J	56	60	66
L	K	6	7	11
M	L	20	22	26
N	M	42	45	50
O	N	6	8	13
P	L,O	68	70	90

Table 3 showed the expected time duration, variances and standard deviation of the project activities. Expected time duration is the weighted mean of three time estimates. Variance referred to the how much spread out the data was. Standard deviation referred to how much the activity was deviated from the mean value. Variance and standard deviation on the critical path was determined from [Table 3].

Various Path on the way to complete the project work.

Path 1 = A-B-D-E-F-G-H-I-J-K-L-M-N-O-P (377.5 days)

Path 2 = A-B-D-E-F-G-H-I-J-K-L-P (301.03 days)

Path 3 = A-C-D-E-F-G-H-I-J-K-L-M-N-O-P (372.5 days)

Path 4 = A-C-D-E-F-G-H-I-J-K-L-P (296.34 days)

For this project highest time of longest path, ABDEFGHIJKLMNOP was 377.5 days. Therefore, it would take approximately 377.5 days to complete the project. It is considered as critical path. There after it was necessary to unearth the probability of completion the project within specified period. In order to identify the probability a specified time 1 year was assumed to complete the project work.

Project variance on critical path was determined as follow:
 $1.78+1.78+5.44+1+7.11+1.78+1.36+2.25+1.36+2.78+.69+1+1.78+1.36+13.44=44.91$
 $Z = (\text{Due date} - \text{Expected date of completion})/\sqrt{(\text{Project variance on critical path})}$
 $Z = (365-377.5)/\sqrt{44.91} = -1.86$

Probability from Z distribution table was determined and it is = .0314= 3.14%. Hence, the probability of completion the project within specified period was not possible. In practical same thing happened. The project took extra around 1 month to complete the project.

Table 3. Mean variance and standard deviation of the project activities

Activity	Predecessors	Expected Duration(o+4m+p)/6	Variance(V) ((p-o)/6) ²	Standard Deviation ((p-o)/6)
A		12.67	1.78	1.33
B	A	7.00	1.78	1.33
C	A	2.00	0.11	0.33
D	B,C	16.33	5.44	2.33
E	D	6.33	1.00	1.00
F	E	26.67	7.11	2.67
G	F	10.33	1.78	1.33
H	G	20.17	1.36	1.17
I	G	15.50	2.25	1.50
J	I	45.50	1.36	1.17
K	J	60.33	2.78	1.67
L	K	7.50	0.69	0.83
M	L	22.33	1.00	1.00
N	M	45.33	1.78	1.33
O	N	8.50	1.36	1.17
P	L,O	73.00	13.44	3.67

Table 4 showed the earliest and latest starting and finishing time duration in days. In this case, total float was calculated using the following formula:

Latest finish (LF) – Earliest finish (EF) or
 Latest start (LS) – Earliest start (ES)

The path where the value of total float or slack time of the activities is zero indicate the critical path. The value of total float only existed in case of activity C. It is about 5 days. Therefore, there was only 5 days in contractor's hand who could 5 days in delay to start the activity C. It would not effect in the total project delay. The critical path showed in the following figure 2.

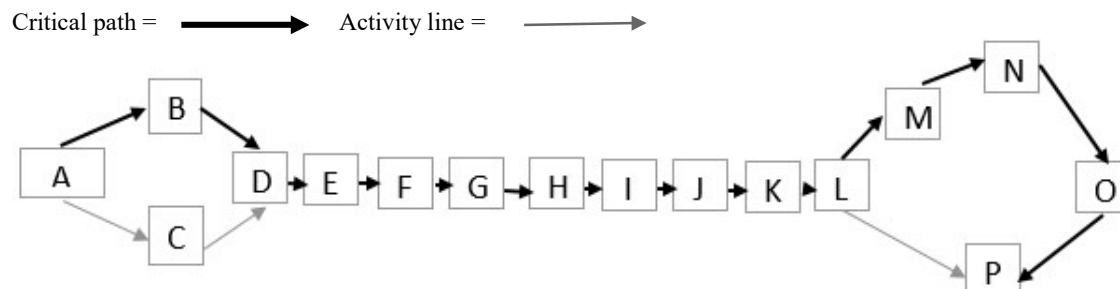


Figure 2. Network diagram with critical path of construction Janata Bank building

Table 4. Earliest and latest starting and finishing time and slack time of the activities of the project

Activity	Duration(days)	ES (days)	EF (days)	LS (Days)	LF (Days)	Slack Time (Days)
A	12.67	0.00	12.67	0.00	12.67	0.00
B	7.00	12.67	19.67	12.67	19.67	0.00
C	2.00	12.67	14.67	17.67	19.67	5.00
D	16.33	19.67	36.00	19.67	36.00	0.00
E	6.33	36.00	42.33	36.00	42.33	0.00
F	26.67	42.33	69.00	42.33	69.00	0.00
G	10.33	69.00	79.33	69.00	79.33	0.00
H	20.17	79.33	99.50	79.33	99.50	0.00
I	15.50	99.50	115.00	99.50	115.00	0.00
J	45.50	115.00	160.50	115.00	160.50	0.00
K	60.33	160.50	220.83	160.50	220.83	0.00
L	7.50	220.83	228.33	220.83	228.33	0.00
M	22.33	228.33	250.66	228.33	250.66	0.00
N	45.33	250.66	295.99	250.66	295.99	0.00
O	8.50	295.99	304.49	295.99	304.49	0.00
P	73.00	304.49	377.49	304.49	377.49	0.00

4 Conclusions

Delay of completion of project is phenomenon all over the world. Bangladesh is not out of this crisis. There are lots of reason behind this problem. Project gets more convoluted situation like rejection of work, rising of dispute, bad relationship among the stakeholder etc. Therefore, it is indispensable to take effective steps to analyse project. Especially at the initial stage project schedule analyse is important. The main purpose of the paper was to analyse the project plan and schedule that was performed by the respective person. Two project management techniques were used to analyse the project like PERT and CPM. According to contractor and engineer project completion period deadline was 1 years. Project schedule that was prepared based on estimate of time by the respective person. In accordance with schedule, it took around 380 days. From the analysis, it was found that probability of project completion within the period of 1 year was about 3.14 %. In practical, the project took extra around 1 month to complete the project. The analysis was matched up with the real fact. Therefore, such kind of analysis is helpful for the practitioners. This analysis should be performed before the project start because it will help the practitioners to take proper decision, planning and coordination among the project activities.

5 Acknowledgement

The authors acknowledge the collaboration of Md. Ikramul Hoque, Assistant professor, Dept. of Building Engineering and Construction management, KUET. The authors also acknowledge the help of engineer and contractor of the project. They provided sufficient information related to Janata Bank building construction.

References

- Adebowale, S. and E. Oluboyede (2011). "Network analysis and building construction: Implications for timing and costing of activities." *Journal of Civil Engineering and Construction Technology* 2(5): 90-100.
- Aibinu, A. and G. Jagboro (2002). "The effects of construction delays on project delivery in Nigerian construction industry." *International Journal of Project Management* 20(8): 593-599.
- Christodoulou, S. (2009). "Scheduling resource-constrained projects with ant colony optimization artificial agents." *Journal of computing in civil engineering* 24(1): 45-55.
- Davis, G. B. (1963). "The application of network techniques (PERT/CPM) to the planning and control of an audit." *Journal of Accounting Research*: 96-101.
- Dvir, D., et al. (2003). "An empirical analysis of the relationship between project planning and project success." *International Journal of Project Management* 21(2): 89-95.

- Kelley Jr, J. E. and M. R. Walker (1959). Critical-path planning and scheduling. Papers presented at the December 1-3, 1959, eastern joint IRE-AIEE-ACM computer conference, ACM.
- Rahman, M., et al. (2014). "Investigating main causes for schedule delay in construction projects in Bangladesh." Journal of Construction Engineering and Project Management 4(3): 33-46.
- Sharma, S. (2006). Operation research: Pert, Cpm & cost analysis, Discovery Publishing House.