Resources Management for Foundation and Backfilling of Telenor Tower

KYAW MYAT MOE [1], KYI KYI SWE [2], ZAR CHI THAUNG [3]
[1] *Mechanical Engineering Department, Yangon Technological University, Myanmar*
[2] *Mechanical Engineering Department, Technological University (Thanlyin), Myanmar*
[3] *Mechanical Engineering Department, Technological University (Maubin), Myanmar*

Abstract- Telecommunication towers are very much essential due to rapid growth of the Telecommunication Technology. In this study, the resources management performed a vital role. Towers consist of steel super structure and reinforced foundation. Resource management implies simultaneous management of all available resources to achieve maximal efficiency. First and foremost, the important of resource management is the modern complex organization. Secondly, a brief discussion of how the resources management system is significant in developing economy is explained. Moreover, some information about network planning system in project management and resources are able to effect the project duration and cost introduced. Thirdly, the complete information about Network model in resources management is well explained. In the later sections, the two most powerful network techniques in planning and controlling resources management are studied and some calculations about them are presented.

Indexed Terms - Telecommunication towers, resources management, maximal efficiency, Network model.

I. INTRODUCTION

Many of the most difficult engineering challenges of recent decades have been to design, develop, and implement new systems of a type and complexity never before attempted. Examples include the construction of vast petroleum production facilities in the North Sea off the coast of Great Britain, the development of the manned space program in both the United States and the former Soviet Union, and the worldwide installation of fiber opticlines for broadband telecommunications. The creation of these systems with performance capabilities not previously available, and within acceptable schedules and budgets, has required the development of new methods of planning, organizing, and controlling events. This is the essence of project management. Succinctly, a project is an organized endeavor aimed at accomplishing a specific non-routine or low-volume task. Although projects are not repetitive, they may take significant amounts of time and, for our purposes, are sufficiently large or complex to be recognized and managed as separate undertakings. Consequently, teams have emerged as the way of supplying the needed talents. But the use of teams complicates the flow of information and places additional burdens on management to communication with, and coordinates the activities of, the participants.

Management of a project differs in several ways from management of a typical enterprise. The objective of a project team is to accomplish its prescribed mission and disband. Few firms are in business to perform just one job and then disappear. Since a project is intended to have a finite life, employees are seldom hired with the intent of building a career with the project. Instead, a team is pulled together on an ad hoc basis from among people who normally have assignments in other parts of the organization. They may be asked to work full time on the project until its completion; or they may be asked to work only part time, such as two days a week, on the project and spend the rest of the time at their usual assignments. A project may involve a short-term task that lasts only a matter of days, or it may run for years. After completion, the team normally disperses and its members return to their original jobs.

Operations and production management contains three major classes of systems: (1) those designed for mass production, (2) those designed for batch production, and (3) those designed for undertaking non repetitive projects common to construction and new product development. Each of these classes may be found in both the manufacturing and service sectors.

Mass production systems are typically designed around the specific processes used to assemble a product or perform a service. Their orientation is fixed and their applications are limited. Resources and facilities are composed of special-purpose equipment designed to perform the operations required by the product or the service in an efficient way. By laying out the equipment to parallel the natural routings, material handling is automated and the use of conveyors and monorails is extensive. The resulting system is capital-intensive, very efficient in the processing of large quantities of specific products or services for which relatively little management and control are necessary. However, these systems are very difficult to alter should a need arise to produce new or modified products, or to provide new services. As a result, they are most appropriate for operations that experience a high rate of demand as well as high aggregate demand.

Batch-oriented systems are used when several products or services are processed in the same facility. When the demand rate is not high enough or when long-run expectations do not justify the investment in special-purpose equipment, an effort is made to design a more flexible system on which a variety of products or services can be processed. Because the resources used in such systems have to be adjusted (set up) when production switches from one product to another, jobs are typically scheduled in batches to save setup time. Flexibility is achieved by using general-purpose resources that can be adjusted to handle different processes. The complexity of operations planning, scheduling, and control is greater than in mass production systems, as each product has its own routing (sequence of operations). To simplify planning, resources are frequently grouped together based on the type of processes that they perform. Thus batch-oriented systems contain organizational units that specialize in a function or a process, as opposed to product lines that are found in mass production systems.

II. SIGNIFICANCE OF PROJECTS IN PLANNING DEVELOPING ECONOMIES

It is often necessary to make decisions which will affect a significant proportion of an organization's money-flow for many years ahead and to make those decisions at a time when there is a paucity of sound information upon which to base them. Previous experience is often used as a basis of forward planning but, as technology advances, new projects become more complex and previous experience has less relevance. Simultaneously, competition becomes fiercer and it is increasingly necessary to evaluate alternative plans accurately so that adequate, but not uncompetitive, profit margins can be maintained.

After technical specifications have been formulated, commercial success becomes dependent upon completing a project by a certain date and within a certain cost. Decisions have to be taken on the amount of resources (men, equipment, materials, and money) which are to be allocated to the project. Inevitably, the efficiency with which these are used greatly influences the profit margin.

Two developments have recently appeared upon the commercial and industrial scene in answer to the demand for more accurate financial evaluation of projects. They are the perfection of planning networks, or arrowed diagrams, as a basis for project planning, and the widespread use of electronic computers capable of rapidly analyzing these networks. The logical nature of the planning network and the speed of computer processing enable management to test alternative plans, and different degrees of planning detail, before embarking on major forward planning decisions.

A. The Planning Network

The planning network is a graphical method of specifying the work that is to be carried out in order that the project can be completed. The individual activities or jobs in a planning network are shown as arrows and these terminate in circles or squares which are known as events. An event is usually numbered for analytical and reference purposes, and represents a point in time, as opposed to an activity which takes place over duration of time.

A planning network may be simple, with only twenty or thirty arrows, or may be complicated, with 10000-20000 arrows, according to the depth of planning required. In either case, however, it gives rather more information than traditional planning methods as it shows not only the order of precedence of the work to be done, but also the interrelationships between different specialist responsibilities.

B. Planning Resource Requirements

In planning resource requirements, therefore, the following key facts have to be taken into account.

(i) The total resource requirements for a project over its duration.
(ii) The minimum delay to the completion of the project when insufficient resources are available.
(iii) The most efficient utilization of resources to carry out the project in a fixed time.

(i) Resource Aggregation

The resources for activities on the critical path are accumulated in the time period allocated to each critical activity. For other activities having float time available, however, there is a choice between aggregating resources at the earliest time or the last time.

In Figure 1(a) the resource required for the simple network shown have been aggregated at the earliest time which can be allocated to each activity and in Figure 1(b) resources requirements have been aggregated at the latest time each activity can be scheduled. A resource availability level is also shown and it is seen that in both cases this has been exceeded.

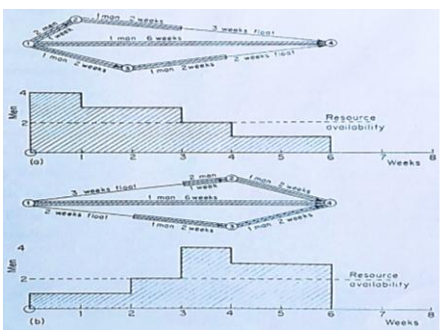


Fig. 1 Resource aggregation: (a) scheduled at earliest dates (b) scheduled at latest dates

(ii) Resource Allocation

Resource allocation is the scheduling of activities and the resources required by those activities while taking into consideration both the resource availability and the project time. In economics, resource allocation is the assignment of available resources to various uses. In the context of an entire economy, resources can be allocated by various means, such as markets or central planning.

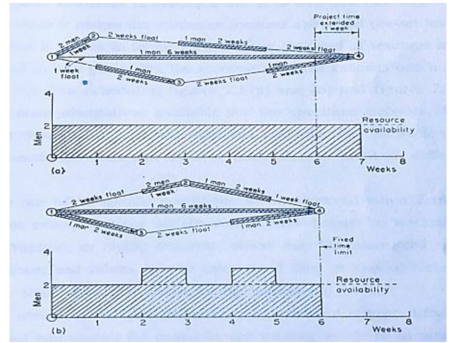


Fig. 2 Resource allocation:(a) within resource limit
(b) within time limit

In Figure 2 (a), here the network has been allocated on a resource-limited basis and in consequence the completion date has to be extended by I unit (from 6 to 7). It shows the minimum delay to the completion of the project when insufficient resources are available. The effect of the operation is shown in Figure 2 (b), where the level of resource availability has been exceeded in two places but the increase nowhere exceeds one unit.

C. Planning project communication

To understand the requirements of a project communication plan, two needs should be known: the need to understand what the project would require from its communication system and the need to know what communication methods and communication styles might be used to effectively address these requirements. Greenleaf states that the ways to promote communication are to ensure that reports reach members in time; to make use of planned times when members gather and speak; and to ensure that communication records are available for team members. Poor communication during projects affects the schedule, the cost, the safety of workers and the project quality.

D. Experiences of Developing Countries in Project Management

Developing countries encounter similar problems and shortcomings in the course of industrial development projects in general and introducing and applying network analysis techniques in project management in particular.

Network analysis techniques have a rather limited application in developing countries. As a very useful project management tool one would think that it is widely accepted and applied. But there are a number of factors which discredit these techniques and hinder their further application in developing in developing countries.

E. Lack of Well Prepared Feasibility Study of Projects

Rapid rates of industrial growth are frequently not backed by well-studied and prepared projects to achieve the targets for which network techniques are to be used to programme, coordinate and control their implementation. Even with well-conceived projects and well prepared feasibility studies, time may have elapsed for some reason or another, such as in seeking financiers, between the completion of a study and the commencement of the execution of the project, during which many relevant circumstances are likely to have changed. Since the work required in implementing the project should be based primarily on the feasibility study, in many developing countries, project implementation is based on unrealistic technical parameters and estimates and hence entails interruption of work, alterations and increase in costs.

F. Evolvement of Industrial Projects, within National Economic Plans

In appraising the project from an economic point of view, the following factors are considered.

(i) Whether the development of the project in a sector of the economy is likely to contribute significantly towards the development of whole economy.
(ii) Whether the project is likely to contribute effectively towards the development of other sectors.
(iii) Whether that contribution is likely to be large enough to justify the use of the quantity of scarce resources that will be needed- invested capital domestic and foreign, management talent, skilled labour and the like.

The evolvement of projects in economic plans is in such a way that the projects which are formulated must be in line with the short and long term plans to achieve balanced growth. Success or failure of plans depend upon the projects meeting of due dates. Hence require projects.

G. Project organizational structure

Organizations are structured in such a way as to achieve the goals and objectives. There are two basic structures. Firstly, the bureaucratic structure that is arranged in a pyramidal hierarchy, with authority increasing from one level to the other, as one moves up in the organization. The authority lies in the position rather than in the people who occupy it. Secondly, the matrix structure that breaks the unity of command where every employee has one person to report to. This structure allows flexibility and involvement, which leads to greater motivation and teamwork.

III. NETWORK

Many managerial problems in areas such as transportation systems design, information systems design, and project scheduling have been successfully solved with the aid of network models and network analysis techniques.

A. Network Analysis Techniques

Network analysis is useful tools that produce models for planning scheduling and controlling projects. In network analysis a model is represented by an arrow diagram.

Some representatives of the forms of network analysis techniques are

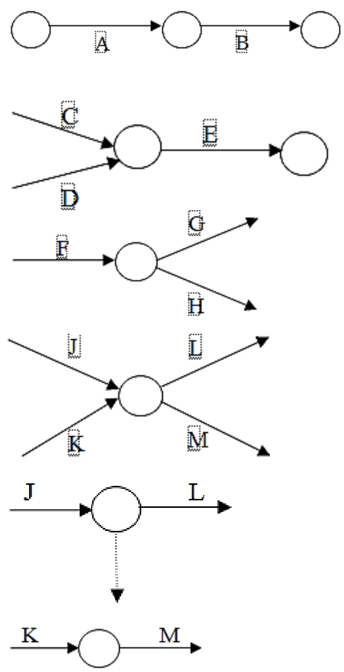
(i) PERT (Program Evaluation and Review Technique).
(ii) CPM (Critical Path Method).
(iii) LESS (Least Cost Estimating and Scheduling System).
(iv) RAMPS (Resource Allocation and Multi-project Scheduling).
(v) SCANS (Scheduling and Control by Automated Network Systems).
(vi) PACT (Production Analysis Control Techniques)
(vii) TRACE (Task Reporting and Current Evaluation).
(viii) CPPS (Critical Path Planning and Scheduling).
(ix) TOES (The Trade-off Evaluation System).

(x) MPACS (Management Planning and Control System).

B. Network Elements

A listing of diagrams, which appear again and again in arrow networks is given in figure 3.4, together with their interpretation.

Network Representation — Interpretation



Job B cannot start until job A is completed.

E is cannot start until both C and D are completed.

F must be completed before either G or H can start.

Both J and K must be completed Before either L or M can start.

Both J and K must be completed Before M can start.

L depends only on J not on K.

Fig. 3: Network Element

(i) Network Construction

A network may be drawn in two ways. One can start all the beginning of a project and draw the activities which can follow immediately after the first activity has been completed, and so on until the final activity is reached.

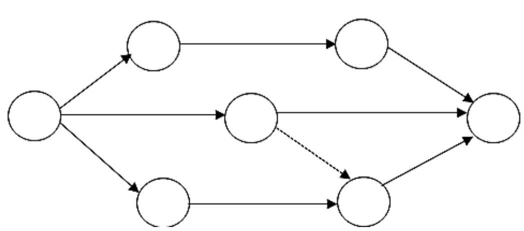


Fig. 4 A Network Diagram

(ii) Numbering the Network

To number a network sequentially in ascending order, all of the network start events are located the lowest numbers in the range then events are numbered progressively from the network start events to the network end events.

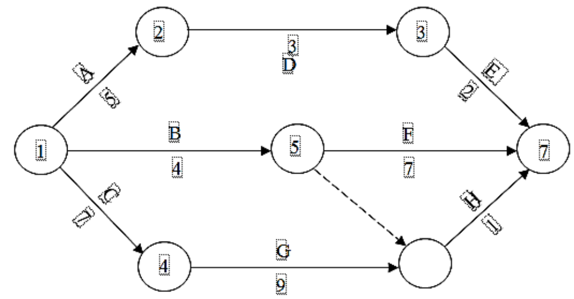


Fig. 5 A Network Diagram with Time Duration

To obtain a number sequence in descending order this procedure be reversed by starting at the network and events and working back to the start events. However, networks of ten need alternation and it is tedious to renumber the whole network whenever additional event is added.

IV.CONTROL AND PLANNING

A. Project Scheduling by use of CPM

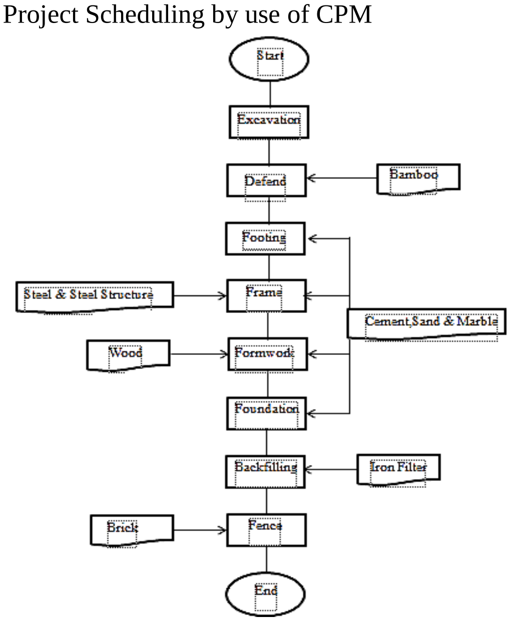


Fig. 6 Work Flow Diagram

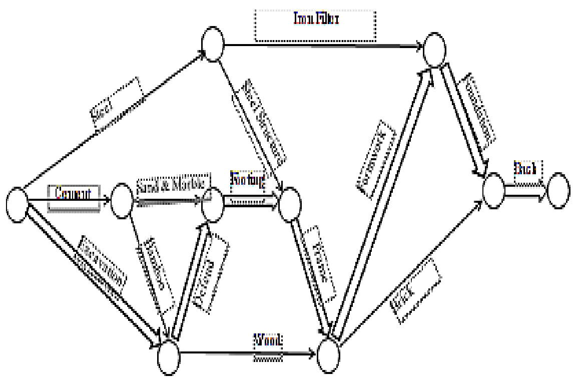


Fig. 7 Arrow Network Diagram

B. Boundary Time Calculation

(i) Critical Path

(a) Excavation

Earliest Start (ES) = 0

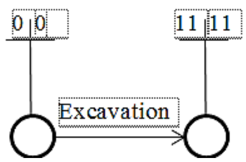
Earliest Finish (EF) = 11

Latest Start (LS) = 0

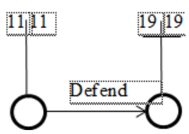
Latest Finish (LF) = 11

Float or Slack = (EF-ES)

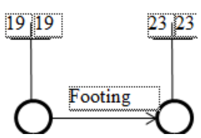
= (LF-LS)= 0



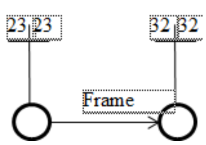
(b) Defend



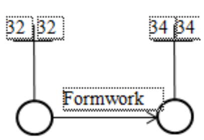
(c)Footing (Slab)



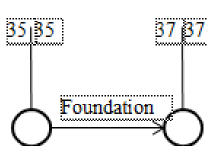
(d) Frame



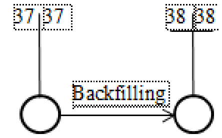
(e) Formwork



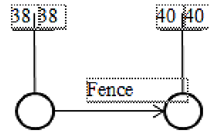
(f) Foundation



(g) Backfilling



(h) Fence



(ii) Non Critical Path

(a) Bamboo

Earliest Start (ES) = 0

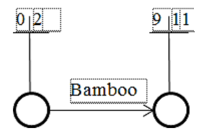
Earliest Finish (EF) = 9

Latest Start (LS) = 2

Latest Finish (LF) = 11

Float or Slack = (9-0)=9 days

=(11-2)=9 days



And then, Steel, Steel Structure, Sand and Marble, Cement, Wood, Brick and Iron Filter are calculated.

Table I. Result of Boundary Time Table for Activity Schedule (days)

Activity	Earliest Start (ES)	Latest Start (LS)	Earliest Finish (EF)	Latest Finish (LF)	Slack (LS-ES)	Critical Path
Excavation	0	11	0	11	0	Yes
Cement	0	16	3	19	3	
Steel	0	3	10	13	10	
Steel Structure	3	13	13	23	10	
Sand & Marble	0	4	15	19	15	
Defend	11	19	11	19	0	Yes
Footing	19	23	19	23	0	Yes
Wood	19	24	27	32	8	
Frame	23	32	23	32	0	Yes
Formwork	32	34	32	34	0	Yes
Foundation	35	37	35	37	0	Yes
Brick	34	37	35	38	1	
Backfilling	37	38	37	38	0	Yes
Iron Filter	32	33	33	34	1	
Fence	38	40	38	40	0	Yes

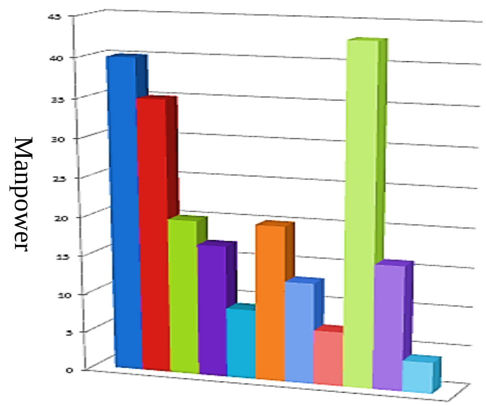


Fig. 8 Loading Diagram

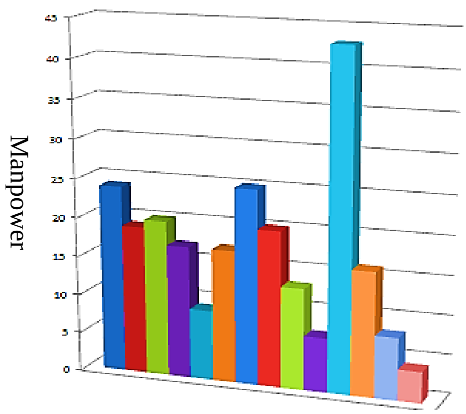


Fig. 9 Loading Diagram Modify

C. Project Scheduling by use of PERT

Table II. Data of Optimistic, Most Probable, and Pessimistic Activity Time Estimates (in days)

Activity	Optimistic (a)	Most Probable (m)	Pessimistic (b)
Excavation	8	9	11
Defend	6	7	8
Bamboo	2	3	4
Footing	3	4	5
Cement	2	3	4
Sand & Marble	3	4	5
Steel	1	2	3
Steel Structure	8	9	10
Frame	7	8	9
Wood	2	3	4
Formwork	2	3	4
Foundation	1	2	3
Backfilling	2	3	4
Iron Filter	1	2	3

Brick	2	3	4
Fence	2	3	4

(i) Calculation of Expected Time and Variance

(a)Expected Time

$$t_e = \frac{a + 4m + b}{6} \quad \text{where,} \quad a \le m \le b$$

(b) Variance

$$\sigma_{ij}^2 = \left(\frac{b - a}{6}\right)^2$$

D. Probability of Meeting Scheduled Date Calculation

***(a)** The number of standard deviation*

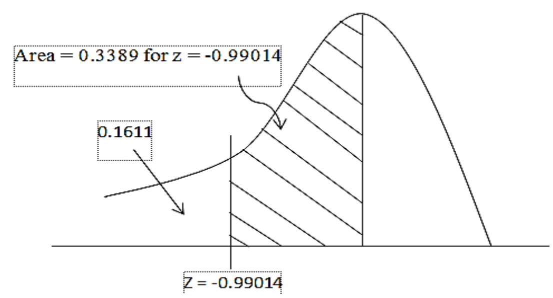
$$Z = \frac{T_S - T_E}{\sqrt{\sum \sigma^2 T_E}}$$

Where, T_E= expected project duration

T_S= schedule completion time

The sum of the individual variance = $\sum \sigma_{T_E}^2$

The probability that the project duration with be less than 16.11%.



The probability that the project duration with be more than 2.39%.

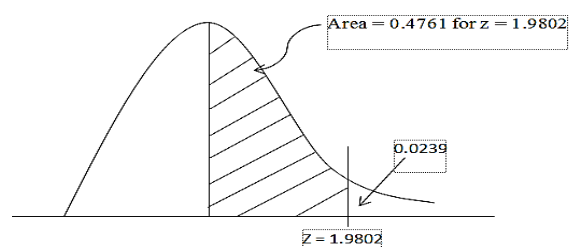


Fig. 10 Illustration of Normal Distribution of the Project Completion Time

Table III. Result of Expected Time and Variance

Activity	Expected Time (days)	Variances
Excavation	9	0.25
Defend	7	0.11
Bamboo	3	0.11

Footing	4	0.11
Cement	3	0.11
Sand & Marble	4	0.11
Steel	2	0.11
Steel Structure	9	0.11
Frame	8	0.11
Wood	3	0.11
Formwork	3	0.11
Foundation	2	0.11
Backfilling	3	0.11
Iron Filter	2	0.11
Brick	3	0.11
Fence	3	0.11

E. Cost Optimization

Carpenter	10000
General Worker	8000 ks
Labour Head	15000 ks
Skill worker	10000 ks
Skill worker Head	18000 ks

Table IV. The Project can be completed to meet a deadline of 40 days at normal cost

Activity	Duration	Cost (Ks)	Resource
Excavation	11	1133000	12
Defend	8	632000	9
Bamboo	2	94000	5
Footing	4	508000	15
Cement	3	213000	8
Sand & Marble	4	284000	8
Steel	3	189000	7
Steel Structure	10	880000	8
Frame	9	1242000	13
Wood	4	188000	5
Formwork	2	80000	4
Foundation	1	287000	35
Backfilling	3	213000	8
Iron Filer	1	31000	3
Brick	3	213000	8
Fence	2	78000	4
		6265000	

Table V. The Project can be completed to meet a deadline of crash time at crash cost

Activity	Duration	Cost (Ks)	Resource
Excavation	8	1336000	20
Defend	6	666000	13
Steel	8	1024000	12
Structure	7	1316000	18
Frame	3	237000	9
Wood			
		245667	

(i) Slope

$$\text{Slope} = \frac{\text{Crash Cost} - \text{Normal Cost}}{\text{Normal Time} - \text{Crash Time}}$$

Table VI. Result Data of Slope for Activity

Activity	Slope
Excavation	67667
Defend	17000
Steel Structure	72000
Frame	37000
Wood	49000
	242667

The project can be completed to meet deadline of 30 days at minimum cost by crashing activity of excavation 3 days, defend 2 days, steel structure 2 days, frame 2 days and wood 1 days.

The new project will occur = Normal Cost + Slope
= 6265000 + 242667
= 6507667 kyats

V. CONCLUSION

Top management must be well acquainted with CPM/PERT technique and its capabilities in saving time, resources and costs. Top management must also have a sense of systematic scheduling and must be interested in the efficiency of the organization. Without the eager response and appreciation of the top management, the implementation of a planning system through CPM/PERT could never be successful. The projects which are to be controlled and monitored by CPM/PERT technique must be a one-time effort, and where more uncertainties are encountered.

In applying CPM/PERT the detailed information about the project must also be made available. Historical information should also be gathered and documented. Information regarding preparation and planning of the project are, specification of machinery and equipment, raw materials preparation of tenders, project activities according to selected levels of detail, activity sequential relationships, methods of performing the project, durations, time schedules and the like. By using this information, the logic of strategy already adopted can be reviewed and adjusted, and project implementation network can be updated for further use as a control tool.

ACKNOWLEDGMENT

The author wishes to acknowledge his deepest gratitude to his family, relatives and friends to carry out this paper.

REFERENCES

[1] U Lin, "Industrial Engineering and Management", 2014.

[2] Avraham Shtub Jonathan F.Bard Shlomo Globerson, "Project Management", 1994.

[3] Jack Gido and James P. Clements, " Successful Project Management", Thomson South-Western, 2nd Edition

[4] William R. Duncan, Director of Standards, PMI Standards Committee, "A Guide to the Project Management Body of Knowledge", Newton Square, Project Management Institute, 2000.

[5] Spittler, J. R., & McCracken, C. J., "Effective Project Management in bureaucracies", Int. Trans Annual Meeting, Vancouver, Canada, 1996.

[6] Rashid, A. A. A., "Global strategies of construction firms, Dept. of Construction Management & Engineering", University of Reading, UK, 1991.

[7] Newton Square, "A guide to the project management body of knowledge", PMI, Standard Committee, 2004.

[8] Jack R. Meredith and Samuel J. Mantel, "Project Management", Seventh Edition, 2010.