

Scheduling of Construction Projects

3.1 Introduction

Starting with the industrial revolution various tools and techniques were developed related to project management. The following historical summary may be useful :

- The Gantt Chart (or bar - chart) was developed in 1917 by Henry L. Gantt
- Flow-Line scheduling was developed in the 1930s
- The LOB (Line of Balance) technique was developed by the Goodyear Company in the early 1940s .
- Milestone Charts was developed in the 1940s.
- In 1957 the first paper discussing the critical path method (CPM) of scheduling was published.
- These developments were closely followed by the development of the PERT system[13].

Although there are many other techniques and types of schedules used in planning construction projects they can be categorized into two main types . These are : the time schedules and the resource schedules. A broad discussion will be made in this chapter to many techniques used in scheduling generally . The most common method in this field is CPM which will be explained in detail. First of all a brief overview of planning and scheduling will be introduced in the following articles .

3.2 Planning of Construction Projects

Planning is one of the four main functions of management : planning , organizing , control and leading .It forms the foundation of effective management . planning is a process of forecasting future

outcomes that may be uncertain or unknown . It means assessing the future and making provision for it by gathering facts and opinions in order to formulate appropriate actions. By planning a strategy can be made and objectives can be established before committing tasks . Once a planning strategy has been determined and objectives defined for a specific task, the manager will select and allocate necessary resources for carrying out the work. This is referred to as organizing which is the second of the four most important management functions mentioned above [7].

Since the plan is just a forecast it would be reasonable to expect some inaccuracy within . Managers usually accept some deviation and they look for it by monitoring the progress, evaluating deviations from the plan and replanning accordingly. This process is referred to as control. Planning, organizing and control functions are linked within the process. Scheduling of construction projects which is the main issue of this research is an important part of planning for construction projects as it is explained in the following articles . First of all the concept of scheduling will be explained .

3.3 Scheduling of construction projects

Scheduling includes assignment of each work in the project with its date of carrying out , the period that it will take and the resources that will be needed . It is a process of sequencing and timing. Since time is involved , it is also concerned with cost. Scheduling is performed using tools such as bar charts or the critical path method. It is a modeling task to obtain solution for a problem. Through modeling, a project is divided into a number of activities that are then scheduled.

The schedule is used to plan, organize and control construction of the project. This means checking time progress by tracking parts of the

work to determine if they are completed within the specified time limits. With analysis of the information it can be specified where the problems are. The most common schedule is a graphic chart like a bar chart format, while charts generated by the critical path method are more complex and commonly referred to as networks [8].

A process to develop a schedule model that meets the requirements of the project can be represented as in figure (3.1) .Activities must be identified , the resources required to complete each activity should be considered to determine the duration of each activity. When the schedule model is complete, a baseline must be established to permit comparison of progress with the original plan [9].

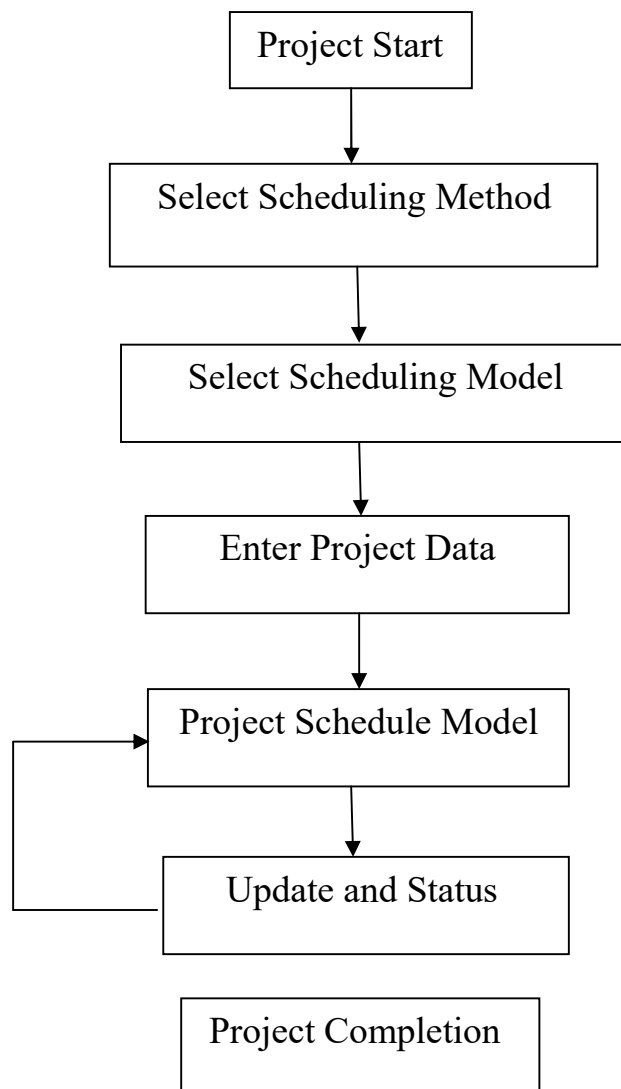


Figure (3.1) Schedule development process

3.4 Time schedule

Time schedule is prepared to give the logic of the activities and their durations. It is based on the assumption that the activities will be given the needed resources when needed. Hence it assumes that resources are unlimited and available when needed. This is an unrealistic assumption since resources may be unavailable when needed or available in limited manner and this often leads to inefficient allocation of resources and hence a higher cost. More realistic planning can be made using resource schedules [7].

3.5 Resource schedule

Resource schedule is prepared according to the available resources. If these resources are insufficient to carry out the work, the manager would need to either inject more resources or reschedule the work. Injecting resources adds extra cost while keeping to the same schedule. Rescheduling the work will extend the project period and its cost. In the planning stage, the manager has to find an optimum relationship between cost and time of the project. Time scheduling requires manager to vary resources to meet work demands. This means bringing new resources and removing them when they are no longer required. This results in extra cost with bringing resources and taking them away. It can be shown from the facts above that the control of time and cost are more likely to be achieved using resource-based scheduling [6].

3.6 Bar charts

A bar chart is a visual scheduling tool used to display planning information graphically in a compact form to a time scale [7]. It is divided into columns and rows. Columns represent time-scale expressed

in months, weeks, days etc. Activities are drawn as bars within horizontal rows. The first column lists activities that are to be scheduled in a logical order of executing . The executing process is then represented by horizontal bars which are drawn for each activity within the time frame of the bar chart. The length of an activity bar gives activity duration. Figure (3.2) is an example of a bar chart drawn for purpose of a construction project of infrastructure works .

The ends point of an activity bar shows the relationship between each activity and the following activities. If the end of a preceding activity is connected to the start of a following activity by a link line, the traditional bar chart format is converted into a linked format and will give more clear picture of relationships among scheduled activities. Figure (3.3) is a linked bar chart drawn for the first seven activities from the project in figure (3.2) .

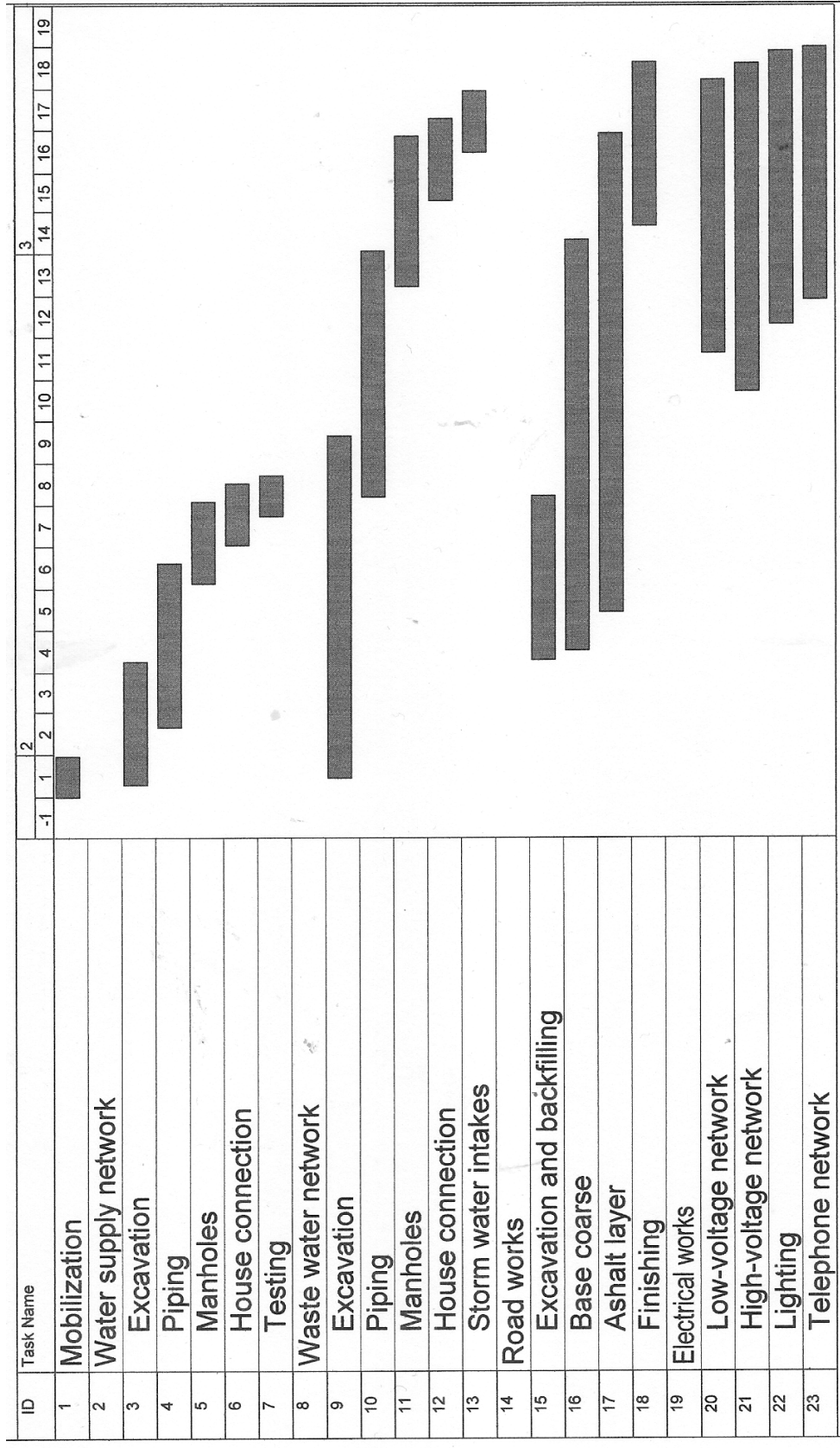


Figure (3.2) Example of bar charts