LECTURE FOUR: TIME PLANNING TECHNIQUE

Time Planning Technique

A project time plan depicts the sequence of accomplishment of the planning components plotted against project time scale. These components include activities and events. Time planning techniques are used to put these components on the time scale. The symbolic representation of these plan components varies with each planning technique.

Resource Planning Process:

Forecasting Input and Output

A forecast is a prediction of what is anticipated in future. It represents current thinking about the future outcome. It is based on various assumptions and judgements. The assumptions made at the time of forecasting are based on the currently available information which may or may not hold good in future.

The inputs and output forecast includes the data-wise requirement of project manpower, major materials, costly equipment, production casts, sales or earned value of work done and the xpected income. The basis of forecasting is the schedule of work.

Planning Construction Work Force

The project manpower planning primarily focuses on determining the size of the project work force, its structuring into functional groups and workers teams and scheduling the manpower recruitment/induction to match the task requirements.

Planning construction materials

Efficient materials management in project environments calls for an integrated approach covering numerous functions such as materials planning and programming , materials purchasing , inventory control, store-keeping and ware housing, materials transportation and handling at site, materials codification and standardization, and the disposal of surpluses.

Planning Construction Equipment

Production tasks needing equipment include excavating, handling, transporting, filling, compacting, grading, hoisting, concreting, pre-casting, plastering, finishing, trenching and laying of pipes and cables. The supporting equipment at project site consists of generators, transmission lines, pumping sets, treatment plants and other utility services equipment.

Planning Construction standard costs

The construction cost planning has its aim the integration of planning judgement, costing techniques and accounting discipline for developing standard costs, financial forecasts, project budget and cost control measures with the ultimate goal of achieving project profit or cost objectives.

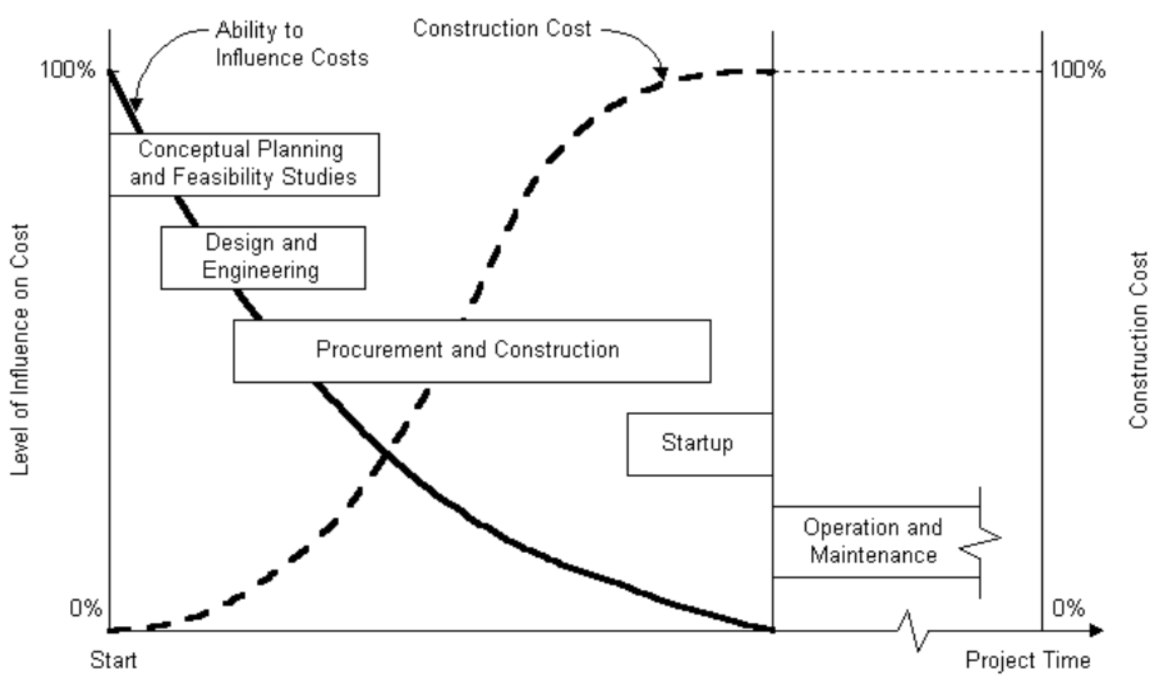
Strategic Planning and Project Programming:

The programming of capital projects is shaped by the strategic plan of an organization, which is influenced by market demands and resources constraints. The programming process associated with planning and feasibility studies sets the priorities and timing for initiating various projects to meet the overall objectives of the organizations. However, once this decision is made to initiate a project, market pressure may dictate early and timely completion of the facility.

Among various types of construction, the influence of market pressure on the timing of initiating a facility is most obvious in industrial construction. Demand for an industrial product may be short-lived, and if a company does not hit the market first, there may not be demand for its product later. With intensive competition for national and international markets, the trend of industrial construction moves toward shorter project life cycles, particularly in technology intensive industries.

In order to gain time, some owners are willing to forego thorough planning and feasibility study so as to proceed on a project with inadequate definition of the project scope. Invariably, subsequent changes in project scope will increase construction costs; however, profits derived from earlier facility operation often justify the increase in construction costs. Generally, if the owner can derive reasonable profits from the operation of a completed facility, the project is considered a success even if construction costs far exceed the estimate based on an inadequate scope definition. This attitude may be attributed in large part to the uncertainties inherent in construction projects. It is difficult to argue that profits might be even higher if construction costs could be reduced without increasing the project duration. However, some projects, notably some nuclear power plants, are clearly unsuccessful and abandoned before completion, and their demise must be attributed at least in part to inadequate planning and poor feasibility studies.

The owner or facility sponsor holds the key to influence the construction costs of a project because any decision made at the beginning stage of a project life cycle has far greater influence than those made at later stages, as shown schematically in Figure 2-3. Moreover, the design and construction decisions will influence the continuing operating costs and, in many cases, the revenues over the facility lifetime. Therefore, an owner should obtain the expertise of professionals to provide adequate planning and feasibility studies. Many owners do not maintain an in-house engineering and construction management capability, and they should consider the establishment of an ongoing relationship with outside consultants in order to respond quickly to requests. Even among those owners who maintain engineering and construction divisions, many treat these divisions as reimbursable, independent organizations. Such an arrangement should not discourage their legitimate use as false economies in reimbursable costs from such divisions can indeed be very costly to the overall organization.



Ability to Influence Construction Cost Over Time

Finally, the initiation and execution of capital projects places demands on the resources of the owner and the professionals and contractors to be engaged by the owner. For very large projects, it may bid up the price of engineering services as well as the costs of materials and equipment and the contract prices of all types. Consequently, such factors should be taken into consideration in determining the timing of a project.

Fundamental Scheduling Procedures:

Relevance of Construction Schedules

In addition to assigning dates to project activities, project scheduling is intended to match the resources of equipment, materials and labor with project work tasks over time. Good scheduling can eliminate problems due to production bottlenecks, facilitate the timely procurement of necessary materials, and otherwise insure the completion of a project as soon as possible. In contrast, poor scheduling can result in considerable waste as laborers and equipment wait for the availability of needed resources or the completion of preceding tasks. Delays in the completion of an entire project due to poor scheduling can also create havoc for owners who are eager to start using the constructed facilities.

Attitudes toward the formal scheduling of projects are often extreme. Many owners require detailed construction schedules to be submitted by contractors as a means of monitoring the work progress. The actual work performed is commonly compared to the schedule to determine if construction is proceeding satisfactorily. After the completion of construction, similar comparisons between the planned schedule and the actual accomplishments may be performed to allocate the liability for project delays due to changes requested by the owner, worker strikes or other unforeseen circumstances.

In contrast to these instances of reliance upon formal schedules, many field supervisors disdain and dislike formal scheduling procedures. In particular, the *critical path method* of scheduling is commonly required by owners and has been taught in universities for over two decades, but is often regarded in the field as irrelevant to actual operations and a time consuming distraction. The result is "seat-of-the-pants" scheduling that can be good or that can result in grossly inefficient schedules and poor productivity. Progressive construction firms use formal scheduling procedures whenever the complexity of work tasks is high and the coordination of different workers is required.

Formal scheduling procedures have become much more common with the advent of personal computers on construction sites and easy-to-use software programs. Sharing schedule information via the Internet has also provided a greater incentive to use formal scheduling methods. Savvy construction supervisors often carry schedule and budget information around with wearable or handheld computers. As a result, the continued development of easy to use computer programs and improved methods of presenting schedules have overcome the practical problems associated with formal scheduling mechanisms. But problems with the use of scheduling techniques will continue until managers understand their proper use and limitations.

A basic distinction exists between *resource oriented* and *time oriented* scheduling techniques. For resource oriented scheduling, the focus is on using and scheduling particular resources in an effective fashion. For example, the project manager's main concern on a high-rise building site might be to insure that cranes are used effectively for moving materials; without effective scheduling in this case, delivery trucks might queue on the ground and workers wait for deliveries on upper floors. For time oriented scheduling, the emphasis is on determining the completion time of the project given the necessary precedence relationships among activities. Hybrid techniques for resource leveling or resource constrained scheduling in the presence of precedence relationships also exist. Most scheduling software is time-oriented, although virtually all of the programs have the capability to introduce resource constaints.

The Critical Path Method

The most widely used scheduling technique is the critical path method (CPM) for scheduling, often referred to as *critical path scheduling*. This method calculates the minimum completion time for a project along with the possible start and finish times for the project activities. Indeed, many texts and managers regard critical path scheduling as the only usable and practical scheduling procedure. Computer programs and algorithms for critical path scheduling are widely available and can efficiently handle projects with thousands of activities.

The critical path itself represents the set or sequence of predecessor/successor activities which will take the longest time to complete. The duration of the critical path is the sum of the activities' durations along the path. Thus, the critical path can be defined as the longest possible path through the "network" of project activities. The duration of the critical path represents the minimum time required to complete a project. Any delays along the critical path would imply that additional time would be required to complete the project.

Use of Advanced Scheduling Techniques:

Construction project scheduling is a topic that has received extensive research over a number of decades. Apart from the fundamental scheduling techniques widely used and supported by numerous commercial scheduling systems, a variety of special techniques have also been developed to address specific circumstances or problems. With the availability of more powerful computers and software, the use of advanced scheduling techniques is becoming easier and of greater relevance to practice. The survey of some of the techniques that can be employed in this regard. These techniques address some important practical problems, such as:

- scheduling in the face of uncertain estimates on activity durations,
- integrated planning of scheduling and resource allocation,
- scheduling in unstructured or poorly formulated circumstances.

The most common formal approach to incorporate uncertainty in the scheduling process is to apply the critical path scheduling process and then analyze the results from a probabilistic perspective. This process is usually referred to as the PERT scheduling or evaluation method

ORGANIZATION OF PROJECT PARTICIPANTS:

In general, there are many ways to divide the project life cycle among organizations. The most typical ways are:

- Sequential processing whereby the project is divided into separate stages and each stage is carried out successively in sequence.
- Parallel processing whereby the project is divided into independent parts such that all stages are carried out simultaneously.
- Staggered processing whereby the stages may be overlapping, such as the use of phased design-construct procedures for fast track operation.

It should be pointed out that some decompositions may work out better than others, depending on the circumstances. The critical issues involved in organization for project management are:

- How many organizations are involved?
- What are the relationships among the organizations?
- When are the various organizations brought into the project?

There are two basic approaches to organize for project implementation, even though many variations may exist as a result of different contractual relationships adopted by the owner and builder. These basic approaches are divided along the following lines:

1. Separation of organizations. Numerous organizations serve as consultants or contractors to the owner, with different organizations handling design and construction functions. Typical examples which involve different degrees of separation are:

- Traditional sequence of design and construction
- Professional construction management

2. Integration of organizations. A single or joint venture consisting of a number of organizations with a single command undertakes both design and construction functions. Two extremes may be cited as examples:

1) Owner-builder operation in which all work will be handled in house by force account.

2) Turnkey operation in which all work is contracted to a vendor which is responsible for delivering the completed project

Since construction projects may be managed by a spectrum of participants in a variety of combinations, the organization for the management of such projects may vary from case to case. On one extreme, each project may be staffed by existing personnel in the functional divisions of the organization on an ad-hoc basis as shown in Figure-A, until the project is completed. This arrangement is referred to as the matrix organization as each project manager must negotiate all resources for the project from the existing organizational framework. On the other hand, the organization may consist of a small central functional staff for the exclusive purpose of supporting various projects, each of which has its functional divisions as shown in Figure-B. This decentralized set-up is referred to as the project oriented organization as each project manager has autonomy in managing the project. There are many variations of management style between these two extremes, depending on the objectives of the organization and the nature of the construction project. For example, a large chemical company with in-house staff for planning, design and construction of facilities for new product lines will naturally adopt the matrix organization. On the other hand, a construction company whose existence depends entirely on the management of certain types of construction projects may find the project-oriented organization particularly attractive. While organizations may differ, the same basic principles of management structure are applicable to most situations.

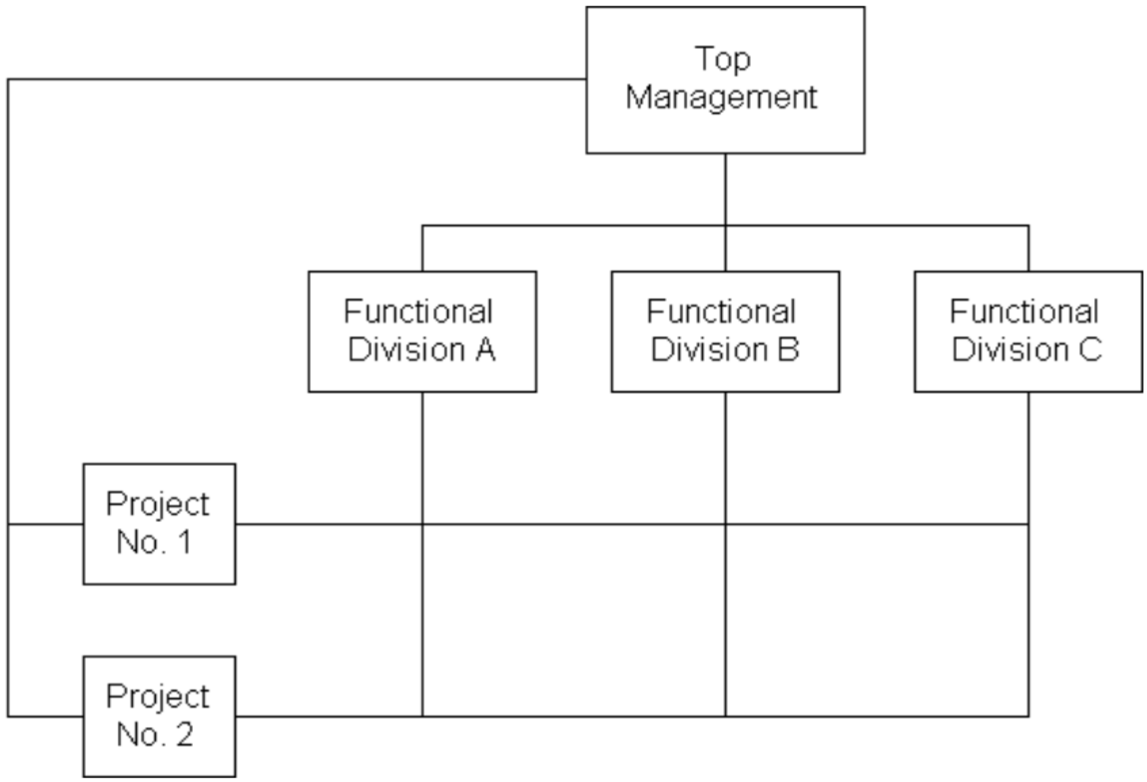


Fig. A. Matrix Organization

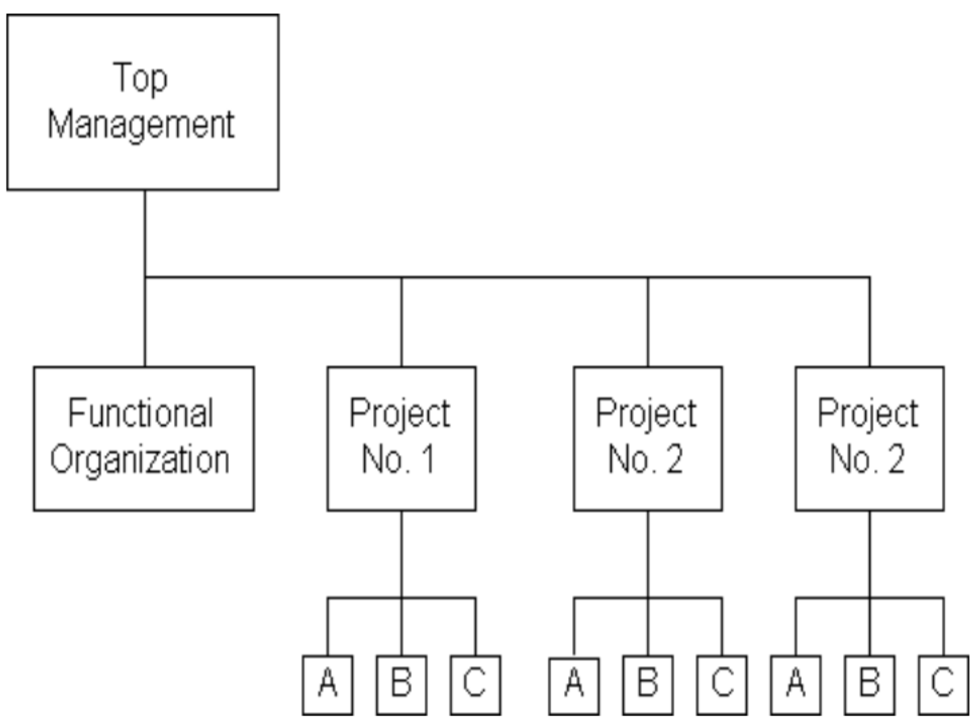


Fig. B. Project-Oriented Organization