PLANNING, SCHEDULING & PROJECT CONTROL

THE AIM OF PLANNING, SCHEDULING AND CONTROL
The completion date of a project is known. It is the market driven date conveyed to the Project Manager and Task force by the Owner. Planning, scheduling, and control is the art of preparing a plan that meets the completion date, scheduling the individual tasks to support the plan, and reporting progress against schedule.

The aim of planning, scheduling and control is to show the Project Manager at all times:

1. Precisely where the work stands, and where it should stand.
2. When delays occur, what must be done to offset them.
3. The cost of correcting delays, compared to the cost of drag-out that will otherwise accrue.
4. The impact of delays and difficulties which occur on project completion, start-up, production and the Owner's return on investment.
5. The earliest practicable time that project completion and start-up can be expected, if all goes well.

The terms "planning", "scheduling" will be encountered frequently. As applied to Engineering and Construction projects:

1. "Planning" means determining what work must be done to achieve the project objective and the relationships between the various activities.
2. "Scheduling" means deciding when the various activities will be carried out.
3. "Control" means making full use of the tools provided by the scheduling and monitoring operations and refers to the process of analyzing data, investigating causes of backlog, determining solutions, comparing the cost of these drag-out costs, and preparing specific recommendations to the Project Manager.

Practical results of project control range from detecting errors in planning to achieving better control over revisions in the engineer's shop, re-allocating manpower from low priority to high priority tasks, pinpointing inadequate supervision, inefficient labor, and approval bottlenecks, and eliminating effects of delays on project completion. Control is the principle function of the Project
Controller, his planning, scheduling and measurement of progress being the means by which he creates data necessary for the control function.

The presence of a Project Controller on a project does not in any way relieve any individual Task Force member from the responsibility for planning day-to-day work. This includes the assignment of tasks, the preparation of documents, the detail preparations leading to efficient execution, inspection and review, all directed towards the goals defined for his unit in the project schedule.

CONTINGENCIES
Under our method of project management, the Owner holds both the schedule contingency and budget contingency in reserve. If problems are encountered, the Project Manager informs the Owner of the problem, requests the use of contingency, and justifies use of contingency over any other alternative.

PRELIMINARY PLAN AND SCHEDULE
It is assumed that a preliminary plan and schedule was prepared in the course of defining the project for appropriation and are available as reference for detailed project planning and control.

PROJECT DEFINITION
Usually the first planning task that confronts the Task force when starting a newly funded project is to prepare a Project Definition. The purpose of the Project Definition is:

1. To create common understanding and agreement among all concerned regarding:
   a. The project objective.
   b. The principal tasks, operations and activities, which together must be accomplished by the Task Force, by the Owner, and by others, to achieve the objective.
   c. The relationships between these activities and their effect on each other and on the whole project.
   d. The urgency of completion for the whole project and for each of its components.
   e. The division of responsibility for execution of various portions of the project between the Task Force, the user Owner, and others.
2. To act as reference as to scope of work for that portion of the project assigned to the Task Force and to control escalation (scope creep).
3. To establish in general terms the magnitude of the Task force’s portion of the work by describing the nature and extent of the engineering, procurement, and construction work involved, and by pinpointing unusual
problems, limitations, major unresolved questions, and decisions outstanding.

4. To act as the basis for the preliminary timetables, planning plan, detailed planning, and reporting

To facilitate control, the project is divided into areas or portions based on functional significance. Each portion or area is planned, scheduled and controlled as a complete functional entity; each area must include the utilities, access routes and other facilities needed to make it operable or useful as a functional entity.

PLANNING PLAN, SCHEDULE AND BUDGET

On larger projects based on the number of areas to receive detailed attention and the broad timings reflected in the Owner’s schedule, the Project Controller prepares a Planning Plan and Timetable showing when detailed planning for each area will take place and what additional assistance he will need for this. A simple planning budget follows, based on salaries, expenses, data processing and drafting assistance needed, supplies, etc. called for by the Planning Plan.

SOFTWARE AND PLANNING

The use of software to facilitate this function is strongly encouraged. At the time of this writing, Primavera, Timberline, and MS Project Manager are known to be comprehensive and easy to use software. Software is used to eliminate some of the drudgery in planning operations. We recommend the software be used generally as follows:

1. The project is broken down into functional areas and team agreement obtained.
   a. A network diagram is produced to describe the detailed steps required to complete each functional area and team agreement obtained.
   b. Estimated work effort, estimated task duration, and resources assigned to every step in every functional area and team agreement obtained.
   c. The network diagrams are then linked together at the most logical points to form the project diagram.
   d. The project network diagram is converted to a project Gantt chart.
   e. Resource leveling is applied and the completion date generated.

   The completion date will probably be unacceptable.

2. At this point the Task Force has to decide how to manipulate the plan to:
a. Those areas that can generate an early revenue stream for the Owner are scheduled early to take full benefit of any early revenue stream.
b. Those areas that provide no benefit until the entire project is complete are scheduled late, to avoid premature commitment of funds.
c. Review for over design, gold plating, or padding that can be eliminated.
d. Add or change resources to reduce the project completion date to an acceptable time.

Once this work has been completed, reviewed, agreed, and approved, the results should be printed and published, and the software turned off. We recommend against using the reporting features of the software. We do not believe in the value added system of reporting progress. The temptation to change the schedule to reduce schedule pressure is very great and must not be allowed.

ENGINEERING, PURCHASING; CONSTRUCTION AND PLANNING PRIORITIES

Engineering, Purchasing, and Construction Priorities
Where several areas are scheduled for concurrent execution, every effort should be made to pursue them with equal vigor. However, if at any time the available resources are insufficient to pursue all areas concurrently, the available resources are concentrated on the higher priority areas at the expense of the lower priority areas. Priorities are worked out from the Project Schedule by comparing the relative value to the Owner of each of the various areas if completed. In the case of those areas scheduled late due to negative return, they are compared on the basis of the cost of premature commitment of funds, and the impact on the whole project should any of the various areas run over the scheduled completion time.

Planning Priorities
Planning priorities on the other hand are determined on the basis of the relative value to the Owner in controlling project and area execution, of applying detailed planning and monitoring measures to the various areas. In other words, detailed planning measures are applied where it appears they will do the most good. Where it is clear that they will exert little influence on control of the project, only very broad planning and scheduling measures are applied.

ENGINEERING TIMETABLES
It should be recognized that the preparation of design transmittals and drawing lists might be occurring at the same time as the detailed project planning.
Engineering will be one of the first collections of area tasks to be scheduled. Engineering Timetables are generated from the software on an area-by-area basis, starting with the highest priority area. It is important to prepare these timetables as quickly as possible so as to have engineering under measurement at the earliest possible moment. It is important that the Project Manager participate directly in seeing that the Engineering Timetable is prepared properly and without delay. In particular, he must ensure that the Architect-Engineer's job captains or equivalent are used to prepare the lists of design transmittals, specifications and drawings, and that they are not side-tracked elsewhere until this work has been completed. He must ensure that all concerned face the problem of defining the engineering work head on, and that whatever time is needed to think out each list thoroughly and in detail, is devoted to this task. The aim is to create the final, complete drawing list at the outset, with the final drawing titles, so that no further revision will be necessary throughout the project.

As soon as the Engineering Timetable has been prepared for a given area, measurement of progress should start and weekly progress reports should be distributed to all concerned, including the Architect-Engineer. It is important that the Architect-Engineer and the Engineering Coordinator execute their work in accordance with the established priorities.

ENGINEERING MANPOWER ESTIMATES

Engineering manpower estimates required for the engineering budget are prepared in two portions as follows:

1. Manpower required for scheduled engineering. This is derived directly from the Engineering Timetable by converting the tasks shown thereon to men in the various disciplines and categories and by converting results to man-hours.
2. Non-scheduled engineering. This is accounted for separately by discipline and category by estimating the man-hours for voided work and revised work plus delays in engineering and engineering assistance that has been requested by the Task Force.

PURCHASING TIMETABLES

Purchasing timetables are usually prepared in conjunction with engineering timetables on an area-by-area basis. They reflect inquiries, quotations, bid evaluations, and preparation of purchase orders and contracts. Purchasing timetables give valuable advance information as to the purchasing manpower that will be needed during peak periods.

SCHEDULING VENDOR WORK

While there are many cases in which the vendor's delivery promises are acceptable, for key items where a delivery delay will jeopardize the project
schedule it is mandatory for the Project controller to go into the vendor’s shop and schedule his work using the concepts outlined above. Where this is the case, the Task Force’s intention to provide schedule assistance must be clearly stated in the inquiry and the vendor’s quotation must be evaluated in light of his willingness to cooperate. As soon as a vendor selection has been made the Project controller should prepare a detailed timetable for the vendor’s engineering, procurement, fabrication, assembly, test, and preparation for shipment and should set up a system of measuring the vendor’s progress.

CONSTRUCTION TIMETABLES
These are prepared on an area-by-area basis immediately following the engineering timetables. The degree of detail will depend on the degree of urgency for the particular area or portion in question; for high priority areas the construction timetable should be in considerable detail. Construction timetables are prepared following the usual sequence of identifying the work and establishing the relationship between the various tasks, and estimating the time required for each task (this usually originates with the Construction Manager but the Project Control Engineer and the Project Manager must satisfy themselves that they are realistic and contain no padding). Following this the construction network is melded with the corresponding engineering network and a network calculation is made. The resultant network is then "massaged" by examining each critical and near-critical task and shortening its planned duration wherever practicable. The resultant network is then incompressible in that it is either impossible or impracticable to complete the work involved in less time, even under ideal conditions.

Following the massaging step and establishment of the final network length, the Project Control Engineer recalculates the entire network to determine individual task boundaries. He then carries out scheduling and leveling adjustments within these boundaries and follows this with a detailed feasibility study of the congestion, interference, manpower and equipment availability, weather, etc. problems. Some further adjustment may be necessary.

On completion of feasibility checks a final Construction Timetable is prepared showing the construction logic on a time-scale basis. This is reviewed by the Construction Manager, by the Project Manager, and by the Owner. Upon approval, it is distributed to those concerned.

The Construction Timetable is never changed throughout the project unless the scope of the project changes.

SCHEDULING START-UP OPERATIONS
Where the task force has responsibility for managing start-up operations, these operations are scheduled in the normal manner.
PROGRESS REPORTS
Progress reports are prepared each week showing work completed against work units scheduled and, where this shows a backlog, the reasons for the backlog, what is being done to offset it, whether the project length is affected, and the assistance, if any, being requested from headquarters. We suggest that weekly reports be prepared Friday mornings and reflect work completed up to the end of Thursday. Reports should be submitted to the Project Manager before noon Friday. Reports are prepared by the Project Controller as a service to the Project Manager. The Project Manager is responsible for ensuring that they are factual, meaningful, clearly understandable, and withhold no important information.

Measurement of Progress
Work progress is measured, not on the basis of hours spent or work accomplished, but on the basis of the estimated time remaining to complete each task. Should this estimate equal or exceed the original estimate, no credit for physical progress is given. The Architect-Engineer, vendor or contractor providing he is properly instructed in this method of measurement can carry out actual measurement. The Project Controller is responsible for frequent spot-checks to satisfy himself that the progress reported is valid. Physical progress is compared with scheduled progress and actual manpower with scheduled manpower. Any inconsistency is the subject of careful investigation by the Project Controller.

Work Sampling
From time to time, particularly as each new phase of work commences, the Project Controller must carry out detailed work sampling, to test the validity of original duration estimates and of the progress reported. Where this shows a definite pattern of incompatibility with the original estimates, major adjustments may be required which will necessitate recalculation of earliest practicable completion date.

Follow-up Action
The Project Manager must realize that the end result of the planning, scheduling and control is recommendations based on analysis. These are pointless without corresponding follow-up action, and the latter is the responsibility of the Project Manager.

PROJECTIONS
From time to time it may be necessary to carry out projections of the project schedule, based on the work remaining to be done, when it is obvious that the completion date originally calculated will not be met. It is important to understand that these projections are merely recalculation based on updated information in
the light of what has passed. They are not predictions of actual completion, but are statements of the earliest practicable completion date based on the current situations.