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CONCEPTS AND METHODS OF SCHEDULE COMPRESSION

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Concepts and Methods of Schedule Compression

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INTRODUCTION

It is control of project time, along with cost and quality, that comprise the basic goals for project management. How important is time? The phrase, "time is of the essence," is often found in the contract documents of owners, and is intended as a strong reminder to the engineer and/or constructor that the time milestones in the project have economic significance for the owner and that control of time is expected. Time control is important for the contractor as well, however, since time savings can improve profits and loss of time is costly.

Both proactive and reactive aspects to time management can be found. The proactive aspects are part of planning-how should the project stakeholders organize their efforts to reduce the time required to achieve the engineering and construction objectives? Every planner must constantly challenge historical schedule performance on similar work with the objective of reducing time without sacrificing other project objectives. These proactive efforts will yield the greatest return.

The reactive aspects of time management occur during the execution stage, when negative time variances threaten or begin to appear and actions must be taken to overcome those variances. How do the stakeholders best assure that time will not be lost needlessly? In both the proactive and reactive modes, the managers are seeking ways to achieve schedule compression. Thus, a knowledge of schedule compression techniques should be part of the skills and knowledge base of the professional project manager.

In 1986, the CII Cost/Schedule Task Force, through Colorado State University, undertook a study of schedule compression. The objectives of the study were to identify and evaluate schedule compression techniques that can be considered in one or more of the engineering, procurement, and construction phases of a project. Following many interviews with experienced engineering and construction personnel, a catalog of schedule compression techniques was compiled. During subsequent discussions within the Cost/Schedule Task Force, the original list was refined and a number of additional techniques added. This publication summarizes the results of those efforts. Readers are encouraged to obtain the source document (Reference 1) for further details.

As will be obvious from reviewing the techniques provided, some could be classified as techniques of constructability, productivity improvement, materials management, or some other management function. This should not be unexpected. As one studies the individual components of effective project management, it becomes apparent that the many functions included within the total are overlapping and interdependent. Thus, it really is not important which function claims credit for an idea or technique for improving cost, time, or quality management; it is only important that this idea be made known to those who can find

value in its application. And, there is advantage to repetition-an idea, if seen and heard often enough, soon becomes ingrained as accepted practice.

As used in this publication, "schedule compression" refers to the shortening of the required time for accomplishing one or more engineering, procurement, construction, or startup tasks (or a total project), to serve one of three purposes: (1) reducing total design-construct time from that considered normal; (2) accelerating a schedule for owner convenience; and (3) recovering lost time after falling behind schedule. As will be seen in the subsequent discussion, some schedule compression is forced, but much is achieved simply by preventing needless loss of time.

CATALOG OF SCHEDULE COMPRESSION TECHNIQUES

Overview

In this chapter, more than 90 different techniques for schedule compression are defined. As stated in Chapter 1, some of the techniques will force shorter schedule time and others will simply prevent needless loss of time. It must be emphasized at the outset that the various techniques will not necessarily reduce costs while saving time - in some instances it will be a time-cost trade-off. It must be emphasized also that the applicability of each depends on the situation. All are presented as possibilities for consideration by an open-minded project manager.

The methods are listed in alphabetical order under each major heading -- **they are not in order of potential usefulness.** The Appendix provides some guidance on relative value. For some of the techniques a Construction Industry Institute reference is noted where further information may be obtained on the subject. These references are fully identified in the References. The numbering system used in the following listing and discussion of techniques is only for the purpose of cross-referencing to listings used in the Appendix.

1.0 Ideas Applicable to All Phases of a Project

1.01 Avoidance of Interruptions. Any interruption of worker concentration will reduce productivity. Typical interruptions are employees stopping to visit with other employees, giving of revised or additional instructions, delivery of supplies, or noisy activity in adjacent areas. Meticulously plan work so that all instructions, supply deliveries foreexample, occur before work begins, and organize to avoid other distractions. In the field, training of apprentices is a continuing requirement, but must be accomplished in a manner that minimizes the effects of interruptions.

1.02 Efficient Staffing. Avoid excessive layers of line management. Excessive layering will tend to produce conflicting instructions, excessive filtering of information, and reviews. For example, use of a task force approach during detailed engineering will streamline work accomplishment. During construction, question the need for both superintendents and general foremen.

1.03 Incentives. A variety of incentives can be incorporated into a total project. Some incentives are targeted on the individual employees and run the gamut from token awards, such as certificates or belt buckles, to bonuses determined through a point or report card system. Some of these are briefly discussed in paragraph 7.02 for craft workers, but the ideas there can be expanded to any employee group. Contractual incentives are discussed in paragraph 3.06. Experience has shown that the most successful incentive programs are those

that ultimately benefit the individual employee. A bonus/award program designed to benefit only management actually serves as a demotivator for the individual employees responsible for production and quality.

1.04 Modern Management Systems. Utilize modern cost, schedule, materials, and quality management systems to facilitate the planning and controlling of work. (References 3,5,6 and 7)

1.05 Pareto's Law Management. Concentrate management attention on those activities which have the greatest potential to adversely affect project schedule, cost, and quality. The project should utilize a full family of indices and other indicators in its management reporting system, which can serve as early warning of problems.

1.06 Participative Management. Utilize techniques such as delay surveys, quality circles, problem solving teams, suggestion programs, and worker discussions (Management by Walking Around) to obtain employee/worker ideas for reducing inefficiencies and increasing production.

1.07 Partnering and Team Building. Throughout the life of the project the concept of "partnering" and "teamwork" should be emphasized. The team includes the owner, engineer, contractor, subcontractors, and key vendors. Partnering is achieved through fair sharing of responsibilities and risks among these project stakeholders. Its groundwork is laid through the utilization of non-adversarial contract methods which promote openness and trust-the idea is to create a common sharing of project goals. Teamwork is achieved through mutual support and cooperation among those stakeholders during project execution. Formal team building sessions during organization of an engineering team and during construction mobilization will assure mutual understanding of goals and procedures and establish the mechanism for problem solving. Subsequent team building sessions will reinforce the process and deal with new situations. Team building eliminates many of the barriers to progress on a project.

1.08 Personnel Management Practices--General. Utilize a progressive personnel management system which incorporates use of job descriptions, selective recruiting, periodic performance appraisals, performance incentives, orientations, and training. These practices will best assure presence of personnel who are the most capable for managing and performing the work.

1.09 Planning. One common ingredient in all successful projects is complete planning; thus ensure that all work has the benefit of planning. This includes long-range planning, short-range planning, and individual work package planning (References 5,6 and 8). Contingency planning is also extremely important (Reference 9). The objective is proactive planning, not concurrent planning (planning as you go). Special attention must be given to environmental, permitting, and community interest matters. Lack of attention in these areas can cause serious delays and cost overruns.

1.10 Reduction of Task Scope. Break complex work assignments into smaller, discrete, well defined, short-duration tasks for which milestones can be established for control. This will make it easier for engineers or work crews to understand the scope of work and will avoid the frustration, confusion, and delays associated with a work assignment not being clearly understood. This is applicable to both engineering and construction activities. This approach will eliminate time often lost in trying to analyze a complex task as a prelude to accomplishing the task. It will also provide a more positive structure for control.

1.11 Safety/Loss Control Program. A strong safety/loss control program will minimize the delays and costs associated with accidents and other losses.

1.12 Well-Defined Organizational Structure. Maintain an organizational structure that clearly establishes all reporting and control lines. Also maintain narrative position descriptions which delineate the authority, responsibility, and accountability of each position. This will reduce the potential for delays caused by lack of understanding of who is responsible for what. Also clearly establish document control and distribution procedures.

2.0 Engineering Phase

2.01 Change Management System During Engineering. Impose a strict change management procedure which requires review and approval of all proposed changes by affected managers (both owner and contractor). This procedure includes an analysis of the potential impact of each change on cost and schedule. This will reduce any tendency for individuals to introduce changes for convenience or personal desire. (Reference 2)

2.02 Computer-Aided Design and Drafting (CADD). Computer drawings may be developed in two or three dimensions depending on the system. The computer drawings assist in all engineering-procurement-construction (EPC) activities. The ability to color code, highlight, rotate, separate, and zoom provides the opportunity to visualize the tasks and pre-plan activities for engineering, procurement, and construction for most efficient use of time. This is a computerized version of physical modeling. Some CADD software is capable of providing quantity surveys and work packages. For this to be an effective technique, proven systems and experienced personnel must be using those systems. CADD is a fast-moving technology and considerable time is required to develop operator proficiency; it is not something to adopt at the last minute. (Reference 3)

2.03 Consolidation of Permanent Components or Functions. It may be possible to reduce project building volume and square footage requirements by consolidating functions otherwise placed in multiple structures in a single general support structure. For example, an industrial plant control room can be placed within a process building rather than in a separate building. Of course, this philosophy must be balanced against the need for redundancy of systems.

2.04 Constructability Analysis During Engineering. Analysis of engineering design concepts, prior to initiation of detailed design, by experienced construction personnel will best insure design approaches which promote the most expeditious and cost-effective methods of construction. Such analyses examine construction options such as prefabrication and modularization as well as traditional methods. They also influencedesign decisions, such as facility layout and materials utilized. (Reference 4)

2.05 Dual-Purpose Design. Designs can be selected that allow components to serve both a construction function and a function in the completed structure. For example, steel may be used as both a form and structural component on some concrete structures (pipe columns, piers formed with sheet-piling). As another example, for tilt-wall work a permanent slab may serve as a form for the wall that is to be tilted up.

2.06 Efficient Packaging for Transportation. Consider dimensional limitations of common transportation modes (length, width, height, volume, weight) when designing and specifying components so as to minimize the need for special transportation and handling. The handling of oversize components can be expected to add to both cost and delivery time.

2.07 Engineering Approvals. Impose strict procedures for controlling engineering submittalsand approvals. Include required completion dates for submittal/ approval activities in the project schedule. Establish approval cutoff dates and specify that any exceptions require special justification and authorization. Anyone approving such exceptions should acknowledge in writing anticipated schedule or cost implications associated with approval of the exception.

2.08 Freezing of Project Scope. Prior to commencement of detailed engineering, the owner/architect/engineer team should have defined the project scope. The owner waives the right to make scope changes after this approval unless attendant cost and schedule impacts are acknowledged. As a control procedure, it is advisable that the date for freezing of project scope become a milestone date on the overall project control schedule. This forces activity planning to target on this date. (Reference 2)

2.09 Inter-Stitial Design. In building designs, additional height can be designed into each floor to permit good vertical working space for workers installing utilities and other systems. Further, this space can be zoned so that each zone will be used for only a single system. This promotes ease of installation, prevents interferences, saves time, and facilitates incorporation of changes if they occur at a later date. It involves higher materials cost, but this will be offset by lower installation and subsequent revamp costs.

2.10 Materials, Equipment and Systems Standards. Select and specify standards for materials, equipment, and systems early in thedetailed engineering phase to promote consistency and to reduce the potential for later confusion and change.