

CONSTRUCTION
INDUSTRY
INSTITUTE

SCHEDULE REDUCTION

The Construction Industry Institute
The University of Texas at Austin
3208 Red River
Suite 300
Austin, Texas 78705-2650
(512) 471-4319
FAX (512) 499-8101

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Schedule Reduction

**Prepared by
The Construction Industry Institute
Schedule Reduction Research Team**

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Executive Summary

Owners are demanding higher quality in their construction projects, and that the projects be delivered at lower costs and within shortened durations. Recent research by CII reveals that meeting such demands is possible, and that using specific schedule reduction techniques can assist in reducing project durations without escalating total installed cost.

The Construction Industry Institute established three broad industry goals for the Year 2000: reduce total project costs by 20 percent, reduce project schedules by 20 percent, and improve recordable accident rates by 25 percent. In pursuit of the second of these three goals, CII established the Schedule Reduction Research Team. The purpose of the team was to investigate the efforts by the engineering and construction industry and other industries in the use of techniques that can bring about reductions in project duration. This publication is a summary report on the research.

The team examined case studies of successful projects, which showed that the following five techniques are highly effective in reducing project durations:

- Freeze of project scope
- Constructability
- Concurrent engineering
- Cycle time analysis
- Use of electronic media

The team found that the use of techniques to reduce product delivery time is much more prevalent in industries where the work environment is much more controlled compared to the construction industry. No schedule reduction techniques, however, are unique to the other industries. Also, it was rare for a single technique to be used in isolation. What is important to note about schedule reduction techniques in the construction industry is that the working environment in which they are used is the most critical factor. Such an environment generally has management commitment and support for using the schedule reduction techniques, cross-functional teams with both technical and interpersonal skills, and good lines of communication among all project participants.

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Introduction

Background

Reducing project duration has been identified by CII as a significant means for improving U.S. competitiveness. Reducing the delivery time and cost of projects in the engineering and construction (E&C) industry by 20 percent is one of the broad industry goals set by CII for this decade.

Previous CII research (“Concepts and Methods of Schedule Compression,” CII Source Document 55) identified over 90 techniques that can be applied to reduce project duration. Some of these techniques, however, may result in higher direct project costs in order to achieve a shorter time-to-market delivery. The Schedule Reduction Research Team was formed to further evaluate selected techniques that would shorten the project duration *without* an increase in total direct project cost.

The mission of the research team, therefore, was to provide additional tools for meeting schedule reduction goals by considering proven practices both within construction and from other industries.

Research Methodology

The research team re-examined the techniques reported in CII Source Document 55, and then made the following distinction between schedule compression and schedule reduction:

Schedule compression: The use of techniques that shorten the project duration, but result in an increase in project cost.

Schedule reduction: The use of techniques that shorten the project duration and do not result in an increase in project cost.

In both definitions, “project duration” is defined as the entire project cycle from conceptual design (after business planning) through start-up.

The research team initially split into power, process, and commercial industry subteams to examine baseline schedules, identify proven techniques for reducing project durations, and compare the applicability of the identified techniques across industries. The team concluded that the identified techniques were in fact applicable across industry lines. It also determined that projects within different construction industry segments (process, power and commercial) generally have similar phases: conception/definition, design, procurement, construction and start-up.

From a long list of possible schedule reduction techniques (SRTs), the research team focused on five that were believed to have the highest potential for reducing project duration *without* increasing total project cost. These five techniques (not prioritized) are:

- Freeze of project scope
- Constructability
- Concurrent engineering
- Cycle time analysis
- Use of electronic media

Previous CII research in these areas concentrated on quality and cost effectiveness. The Schedule Reduction Research Team, however, evaluated these techniques for their effectiveness in reducing schedules. The objectives of the research team were to:

1. Assess/quantify the impact of the five selected SRTs on project duration.
2. Search for successful SRTs used in other industries that are applicable to the E&C industry.
3. Assess/quantify the impact of the additional SRTs on project duration.
4. Determine implementation cost and implementation problems of the selected SRTs.
5. Develop guidelines/recommendations for successful implementation of the selected SRTs.

Research Approach

The research was founded on a broad-based literature survey and personal interviews with representatives from companies that were actually involved in the application of selected SRTs. The objective was to document case studies that illustrate the results and payoffs, reasons for implementation, implementation processes, success factors (secondary issues contributing to successful implementation), implementation barriers, and lessons learned for each SRT. Company searches were conducted to determine the state-of-the-art and to identify the active users of each SRT. The research team targeted a variety of businesses outside the E&C industry, including the manufacturing, pulp and paper, utility, electronics, petrochemical and aerospace industries.

A total of 19 case studies were researched, representing total project expenditures of over \$1 billion.

Also, based on the research team's experience, a chart was developed showing the relative impact of a particular SRT during typical project life-cycle phases (Appendix A).

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Freeze of Project Scope

Freezing of project scope occurs at a point in the project cycle when the project participants, stakeholders, and management agree that changes will not be made to the defined project scope. Typically, certain deliverables produced by the project team are required prior to freezing project scope. These deliverables vary based on different project types.

Expected Results

Continuing changes to the scope of a project beyond the final authorization of project funds inevitably result in lengthened project duration and higher than budgeted costs. Freezing of

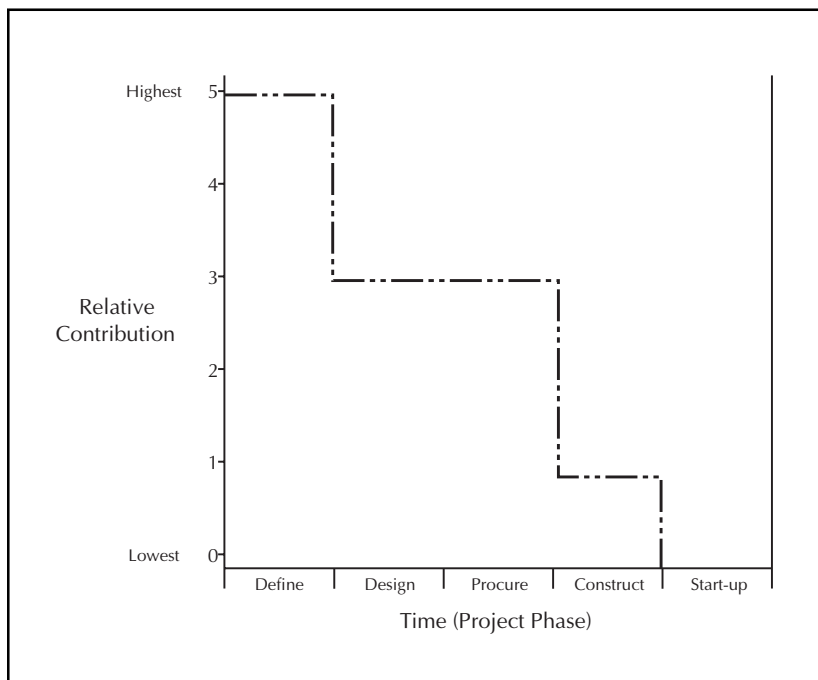


Figure 1. Impact of Project Scope Freeze over Project Life Cycle

scope at the proper time is essential to allow detailed design and material procurement to progress as rapidly as possible without rework and inefficiencies associated with project changes.

The research studied three cases, including installation of an R&D facility, new paper mill and utility industry improvements. Freezing of project scope contributed to reduction of project durations of approximately six to 20 percent of normally expected times. In addition, better accuracy in project budgeting and lower overall project costs have been realized on projects where a formal process for scope freezing has been utilized.

Practices

The objective of freezing the scope is to eliminate uncertainty associated with major items, which then frees the various disciplines to proceed with detailed design and material procurement as soon as funding approval is obtained. Concept development work needs to be completed prior to freezing of project scope. In addition, project definition should have progressed to the point that the authorization (definitive) cost estimate and project authorization request package can be developed before freezing the scope of work. Evaluation of alternatives (value engineering), constructability input and safety reviews should be completed before the scope is frozen. All concept and project definition documents required to solidify the scope of work should be reviewed and approved by representatives of the end-user prior to development of the authorization estimate and freezing of the scope.

Generally, significant items that have a major influence on project costs and duration should be included in the scope freeze. As an example from the process industry, a pump should be defined by performance specifications, materials of construction, operating parameters and type. On the other hand, the details of the pump foundation and connecting piping are not normally designed until later in the detailed engineering phase and therefore cannot be specified accurately enough to “freeze” at this time.

Appendix B lists the deliverables typically required to be completed prior to freezing of project scope. While these deliverables vary by industry and project type, they have been found to reflect the proper point for scope freeze. Capital processes within individual companies may not support completion of these

deliverables prior to development and approval of the funding authorization package. In such cases, the scope should not be frozen until the deliverables have been completed.

Each company must determine the specific steps and approvals required to define the project accurately and to freeze the scope of work. The owner must have a strong commitment to freezing the scope process. In addition, an effective scope change control process must be in place to handle any changes in the project that are necessary beyond the scope freeze point.

Success Factors

One of the key factors found on most successful projects is a project team with experienced people in the primary roles having a desire to work together for the good of the project. Some of the team-related factors which contribute to scope freezing include a high level of trust and respect among the owner, contractor, and other team personnel; inclusion of a representative of the end-user on the project team; and commitment by all team members to avoid scope growth, even if funds become available due to under-runs on planned expenditures.

The owners' insistence on a strong up-front planning effort and the early involvement of end-users and contractor personnel establish the right environment for the scope freeze process.

In case studies from the research, utilization of 3-D computer aided design and drafting (CADD) contributed to good communication of project plans with the end-user. The end-user was able to clearly see and understand project plans as conceived by the project team at an early stage in the project. Good visual communication of plans can eliminate misunderstandings and therefore contribute to earlier elimination of some project uncertainties.

Subdivision of the project into smaller components also contributes to a quicker and more concise definition of systems, resulting in shorter overall project durations. Adequate resources must be dedicated to each of the components to develop systems in parallel, and emphasis must be placed on properly managing the interfaces between the various components. Subdivision of the project should result in earlier definition of the critical deliverables required for freezing the scope.