



SCOPE DEFINITION AND CONTROL

Bureau of Engineering Research
The University of Texas at Austin

Publication 6-2
July 1986

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Scope Definition and Control

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**Publication 6-2
July 1986**

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Printed in the United States of America.

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INTRODUCTION

There has been considerable alarm in the business community over industrial project cost overruns in recent years. What are the causes? The Business Roundtable Construction Industry Cost Effectiveness (CICE) Project Report A-6¹ states that "Poor scope definition at the estimate (budget) stage and loss of control of project scope rank as the most frequent contributing factors to cost overruns." A recent report² found that some construction industry officials consider lack of scope definition to be the most serious problem on construction projects.

While inadequate definition may be attributable to poor planning and management of projects, it must be assumed that there can be circumstances which either preclude full scoping of projects or force managers to proceed at a level of scope definition less than desirable. Regardless of the reasons, when there is poor scope definition, final project costs can be expected to be higher because of the inevitable changes which disrupt project rhythm, cause rework, increase project time, and lower the productivity and morale of the work force.

Cost overruns on industrial projects can be both apparent and real. Most overruns are calculated by comparing final costs with budgeted costs. If the budgeted costs are not based on a well-defined scope, they are probably low and not a valid base for comparison. Real overruns occur as a consequence of unjustified scope growth during engineering, other engineering changes, and a variety of engineering, procurement, and construction inefficiencies. However, the inescapable conclusion is that scope definition and control is a key factor in both apparent and real cost overruns.

This publication will explore this subject and attempt to answer these questions:

- Why is scope definition a problem?
- Why is scope growth a problem?
- What can industry do to control these problems?

WHY INADEQUATE SCOPE DEFINITION?

Industry Opinion

Most of the information contained in this publication has been condensed from the research report identified as Reference 3. In that research, a number of owners and contractors were interviewed. These individuals recognized that lack of scope definition contributes to higher project costs. Thus, the first question addressed must be, "Why are owners willing to proceed on the basis of inadequate project definition?" Interviews provided explanations along these lines:

- Owner does not have engineering expertise to provide complete conceptual definition.
- If the initial order-of-magnitude (feasibility) estimate looks favorable, there is no reason to spend additional funds in scope definition.
- As a matter of economy, owners want to limit amount spent in feasibility and project authorization/budget studies.
- The shorter the time spent on preliminaries, the quicker the job can be completed and the lower the overhead.
- High interest rates make project duration critical.
- Market pressures make project duration critical.

Further investigation found that both owners and contractors consider *market pressure* to be the single most important reason for underdeveloped scope. The following explanations were offered:

- Demand for a product, while intense, may be short-lived. Many marketing analysts have noted a trend toward short project life cycles, particularly in technology-intensive industries.
- Competition in product development has increased. A representative from a company in a particularly competitive industry noted, "If we don't hit the market first, there may not be a market at all."
- In many cases, profits to be derived from plant operation seem to greatly outweigh changes in construction costs. An example cited was the Alaska pipeline, in which poor scope definition plus regulatory and environmental problems caused the project cost to rise from an estimated \$900 million to more than \$7 billion. In spite of

this, the project is considered a success and profits have overshadowed all cost overruns.

In support of the market pressure argument, most industry representatives contend that further definition of scope would add to project duration (up to 25 percent).

Of the other possible reasons for inadequate scope definition previously noted, only two more were given much endorsement and neither ranked in significance with market pressure. The first is the lack of or less than full use of engineering capability within the owner organization to define conceptually a project. While it was commonplace in past years for large owners to maintain an in-house engineering and construction management capability, there is now a trend away from this as a matter of cost effectiveness. Among those owners who still maintain engineering and/or construction divisions, many operate these divisions as reimbursable, independent organizations and are inclined to economize in their use because they are reimbursable.

The second reason relates to the euphoria that can accompany early cost estimates and revenue projections that are extremely favorable. In their haste to realize these revenues as quickly as possible, owners compromise good planning and scope definition.

Making the Best of the Situation

Ideally, owners should insist on full scope definition before proceeding with a project. For one or more reasons, however, owners can be expected to proceed on some projects with underdeveloped definition. One approach which may permit earlier and more complete development of definition is to have greater and continuous marketing-construction interface and coordination to permit earlier identification of potential market needs and their consequences in terms of construction. Of course, this is subject to the ready and continuous availability of engineering expertise. If such expertise is not maintained in-house, an owner could consider establishment of an *ongoing* relationship with an engineering firm with experience in the owner's type of work. Over time, this firm would become familiar with the owner's philosophy and processes and be able to respond quickly to owner requests for conceptual engineering and budget estimates.

If time does not permit full scope definition, the risks of cost/schedule overruns should be part of the feasibility analysis of the project. If the decision is still to proceed, efforts must then be focused on scope control. Better procedures for developing realistic budget estimates, better procedures for quantifying bulk materials requirements, and better systems for controlling changes are the areas which can contribute most to scope control. Remaining chapters of this publication concentrate on these areas.

SCOPE DEFINITION AND CONTROL vs. BUDGET ESTIMATING

The Problem

During the course of a project, a number of cost estimates are normally prepared. Although terminology is not standardized, the first estimate can be called *order-of-magnitude*, and is usually part of a feasibility study. It utilizes cost/capacity curves or other scale of operations approaches related to output, and can vary by as much as ± 50 percent. The next level of estimate is the *factored* estimate. For this estimate to be prepared, flow diagrams are required so that major items of process equipment can be identified. It is then assumed that cost, quantity, and dimensional relationships exist between this equipment and other project cost components. Costs are factored using these relationships. This estimate will vary in the range of ± 30 percent. The order-of-magnitude and factored estimates are *conceptual* estimates. The next level of estimate, the *control* estimate, is prepared once the piping and instrumentation diagrams (P&IDs) as well as civil control drawings are available. Quantities can be approximated from these items; where definition is lacking, allowances are added. Accuracy should be ± 15 percent. The highest level of estimate is *detailed* or *definitive* and is made once detailed drawings are available. The accuracy of this estimate should be within ± 10 percent.

Good scope definition is not considered possible until the P&IDs are available. Thus, budget estimates should be of the *control* estimate category. Unfortunately, most budget estimates apparently are prepared before these drawings are available and are of the factored estimate category. Consequently, the budget estimate is subject to the high variability previously noted. Much of the variability problem is associated with *offsites* (access, utilities, and other area-sensitive costs). These are more a function of geographic location, plot plan, and arrangement than of equipment. As stated in a 1979 Rand study, "Most of the variation found in cost estimation error can be explained by . . . the degree of definition of the project's site and related characteristics."