

Project Change Management
Construction Industry Institute

Special Publication 43-1

Project



Management

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

Not printed with state funds

Project Change Management

.....

*Prepared by the
Construction Industry Institute
Project Change Management Research Team*

Special Publication 43-1

November 1994

Reviewed by CII 23Jun04

© 1994 Construction Industry Institute™.

The University of Texas at Austin.

CII members may reproduce and distribute this work internally in any medium at no cost to internal recipients. CII members are permitted to revise and adapt this work for the internal use provided an informational copy is furnished to CII.

Available to non-members by purchase; however, no copies may be made or distributed and no modifications made without prior written permission from CII. Contact CII at <http://construction-institute.org/catalog.htm> to purchase copies. Volume discounts may be available.

All CII members, current students, and faculty at a college or university are eligible to purchase CII products at member prices. Faculty and students at a college or university may reproduce and distribute this work without modification for educational use.

Printed in the United States of America.

Table of Contents

.....

Executive Summary	v
1. Introduction	1
2. Phases of the Project Life Cycle	3
3. Dynamics of Change Management	7
4. Principles of Effective Change Management	11
5. Metrics	19
6. Recommended Practices	25
7. Conclusions	35
Bibliography	37
Appendix: Change Management System	39

Executive Summary

.....

Owners, designers, and construction contractors are all aware that introduction of changes into a project can lead to problems and hinder project success. Changes may interrupt the flow of work, create delays, cause schedules to slip and inflate costs, which in turn may generate claims and even costly litigation.

CII established the Project Change Management Research Team to find solutions to or, preferably, the means of avoiding such problems. The team guided an extensive research effort and is now ready to present its findings to the industry.

The team's research focused on determining the nature and origin of problems related to changes. The relationship to timing of changes throughout the project life cycle was established. The elements of a project that are subject to change were categorized. As a result of its investigation, the research team concluded that it would provide three primary deliverables to the industry: (1) a comprehensive view of agreements and changes; (2) a set of recommended best practices for the effective management of change; and (3) a prototype change management system, reflecting the means of implementing research team findings.

This publication provides these deliverables, beginning with a description of a typical project life cycle, followed by a discussion of the dynamics of change management. Next, the principles of effective change management that were identified by the research team are presented, followed by a discussion of how metrics may be employed as part of the management process. Recommended practices are then presented, and are organized on the basis of each of the project phases. Finally, the prototype change management system is included as an appendix.

Highlighting the principles of effective change management, they are: promote a balanced change culture, recognize change (when it occurs), evaluate change, implement change, and continuously improve from lessons learned.

The research team believes that significant savings in total installed costs of construction projects are achievable by improving management of changes. Owners and contractors can profit from increased efficiency. Schedules can be made more reliable, and end-user satisfaction can be enhanced. The industry can benefit immediately and significantly by implementing the recommendations presented here.

.....

The engineering and construction contracting environment is increasingly competitive and litigious, project schedules and financial parameters are aggressive, and project scopes are complex. Today's smaller, less experienced staffs and leaner budgets, however, often force owners and contractors to re-evaluate project execution plans. Nonetheless, those responsible for executing projects are expected to deliver high-quality and cost-effective results. Projects thus are more likely to require changes in order to meet business needs or objectives.

Changes-additions, deletions, or other revisions within the general scope of a contract that cause an adjustment to the contract price or contract time-present a variety of challenges for every party to a construction project. Frequently, events on a project lead to an amazing divergence of opinion about what constitutes a change and about its impact. Since a change may affect a variety of project outcomes in different ways for each party, this is understandable. Consequently, various terms for proposed changes-discretionary, non-discretionary, preferential, functional, normal design development, and regulatory-are often used in an attempt to establish or even shift responsibility. In change management, the absence of common terms and specific contract conditions can lead to dissatisfaction and litigation.

Project management teams must have the ability to respond to a change quickly and effectively. This ability to respond, however, is complicated by a variety of project organizations, project control systems, and work execution methods.

Effective Change Management

To overcome the problems associated with changes to a project, project teams must be able to effectively manage changes. Three steps must be taken to create a "balanced change culture." First, a commitment by all parties must be reached to recognize changes and to increase sensitivity to changes as the project progresses from concept to construction. Second, planning for potential changes should be initiated as early in the project as possible. Third, all parties to the project should agree that changes are to be evaluated and agreed upon as expeditiously as possible.

Taking this approach will require the project team to apply the research team's *principles of effective change management*:

1. Promote a balanced change culture.
2. Recognize change.
3. Evaluate change.
4. Implement change.
5. Continuously improve from lessons learned.

1: Introduction

.....

Each phase of a project should have established change management procedures consistent with these principles. As the project moves forward, the procedures will have to address increasingly detailed matters and must establish more finite control.

While most parties involved in projects have change management procedures, such procedures generally deal more with what to do after a change occurs instead of how to manage the change and its impacts. The CII Project Change Management Research Team has focused on improving this situation by:

1. Developing a better understanding of project change and its total impact on projects;
2. Identifying the principles that influence the effective management of change; and
3. Providing recommendations for best practices.

The research team, with this publication, provides tools-in the form of recommendations-that can help the industry save significantly on the total installed cost of a project and at the same time can help to increase earnings by improving overall management of project changes.

Readers should review CII Publication 6-10, *The Impact of Changes on Construction Cost and Schedule*. That publication focuses solely on the construction phase, although the conclusions and recommendations are consistent with those provided here. That is, since changes in the construction phase often have a major impact on project success, introducing change as early as possible in the project life cycle is a proven advantage.

To manage project change, the evolution of a project through the different phases of the project life cycle must be understood. The figure below indicates the flow-through of the various phases of the project life cycle. These phases often overlap and vary

in duration. Each phase is a work process, with specific input and output relationships with the other phases. This chapter describes each phase and concludes with a discussion of the interphase agreements.

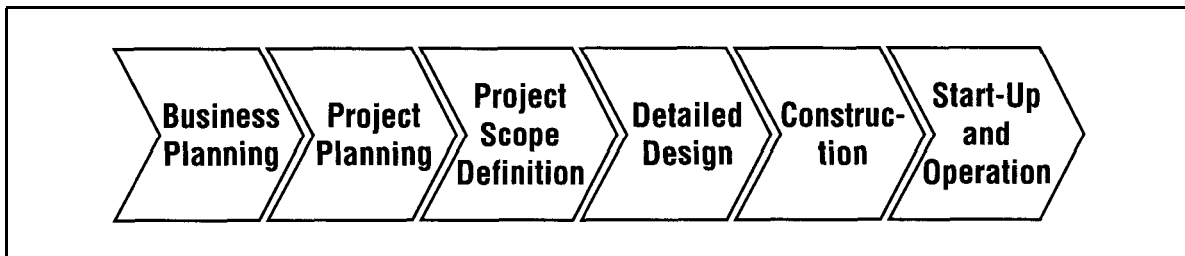
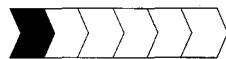


Figure 1. Project Life Cycle

Business Planning



The first phase of the project life cycle is business planning. The business planning phase of the project life cycle links the strategic business goals with initial project goals. The owner leads this process, producing the capital investment business objectives and the justification for the facility.

During this initial phase, the owner's marketing and other business functions define the need for the facility and estimate its financial return. Marketing, as part of the overall development team, normally supplies written business objectives for the facility. Engineering and operations provide early estimates of both initial and operating costs. Based on similar, previously executed projects, a rough economic model of the venture, including a preliminary scope definition, major risks and rewards, and

cost estimates can be completed. If the initial economic model indicates a favorable return on investment, the project will proceed to project planning.

Project Planning



In the project planning phase, the owner uses the basic business objectives to develop a scope of work for the project. The scope should be sufficiently developed to define acceptable project risks and funding requirements for the ensuing phases. Although not all of the design questions will have been settled at this point, the basic information such as facility size and capacity will be decided upon during project planning.

Different industries, and even different owners, will formulate their own guidelines of what constitutes "sufficient" scope definition and "acceptable" risk. Some

2: Phases of the Project Life Cycle

owners will only partially fund the project at this point, requiring the project team to reconfirm project cost and schedule after conceptual engineering has been completed.

In the project planning phase, a high level of experience in project estimating, planning, and design is required. Many owners maintain this expertise themselves to assure sound business decisions. Owner engineering and construction organizations usually lead the project planning phase, assisting the business organization in decisions concerning the project's basic scope and timing. Some owners, however, employ planning consultants.

During project planning, ideas and suggestions from those who will operate and maintain the facility can help to minimize changes as the project moves forward.

Project Scope Definition



During the project scope definition phase, all the basic design decisions are made, including adaptation of the facility to the selected site, incorporation of local codes and standards, and further detailing of the facility. The project scope is documented in drawings, sketches, item lists, and text. Project documentation produced in this phase is usually sufficient for estimating material quantities accurately enough for project control.

Even though the owner makes all the fundamental decisions in project scope, a designer may be hired to create scope documentation to quantify the detailed design of the facility.

Constructability analysis at this stage is invaluable in that it can help the project team minimize changes as the project moves closer to construction.

Detailed Design



During detailed design, the documents for fabrication of components and the construction of the facility are produced for the suppliers and constructors. Detailed design is typically performed by an architectural and/or an engineering design firm. Engineered materials and equipment are often procured in this phase or earlier.

Construction



The construction phase of the project life cycle involves the fabrication of permanent components and the construction of the facility. Construction may be managed by the owner, by a construction management firm, or by a general contractor. Regardless of the division of responsibility at the owner's level, much of the actual work in the construction phase may be performed by specialty subcontractors and suppliers, whose scope is defined by individual subcontracts.

2: Phases of the Project Life Cycle

Start-Up and Operation



During the start-up and operation phase of the project life cycle, the facility operator assumes the care, custody, and control of the completed facility. In the process industries, this phase would include commissioning activities and plant acceptance procedures. The facility only begins to achieve its business purpose once operations commence.

Agreements: The Inter-Phase Relationships

As the project moves from phase to phase and overall control and leadership move from one entity to another, various agreements are reached to assure orderly execution of work. An effective change

management process recognizes change as a *modification to an agreement between project participants*. Figure 2 shows the project life cycle and the ever-increasing complexity of these agreements.

These agreements consist of inputs (requirements) and feedback (how the requirements will be satisfied). The communication of inputs and feedback must be clear, complete and understood. If not, the agreement will be flawed and one or both parties to the agreement will be dissatisfied.

Another difficulty in an evolving project is that the “upstream” party to an agreement often defines the project in less specific terms than does the “downstream” party. That is, the upstream party defines *what* it

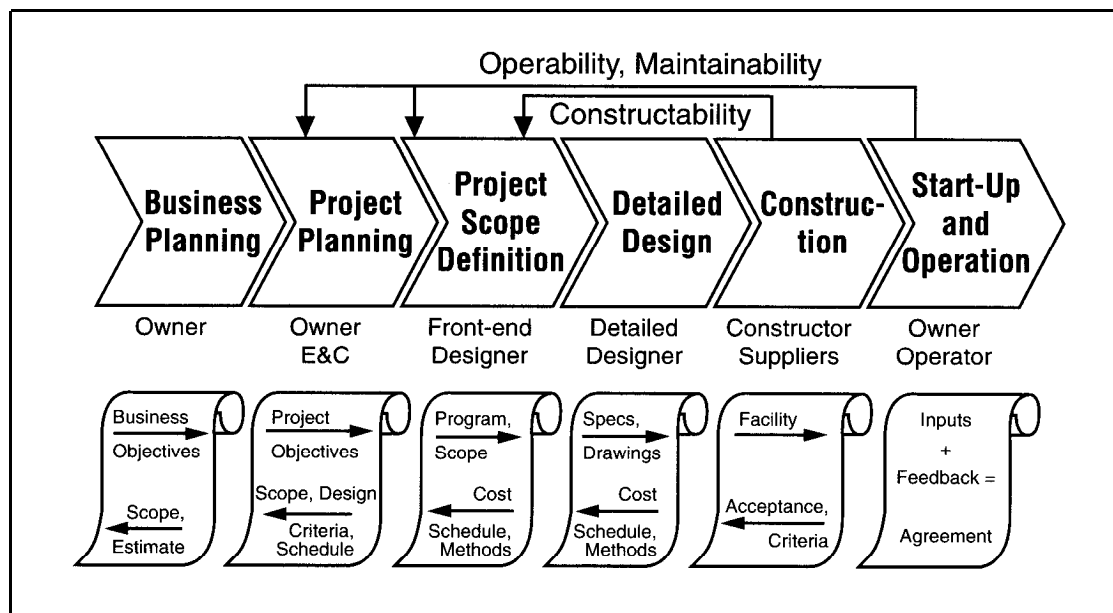


Figure 2. Project Life Cycle, with inter-phase relationships

2: Phases of the Project Life Cycle

wants, but is less involved in *how* the downstream party provides it. The downstream party responds with a solution to the problem of *how* it will accommodate the desires of the upstream party. The communication that occurs here is extremely complex and may be easily misunderstood.

For project agreements to be completely understood by all parties, obstacles to communication must be acknowledged and bridged. Just as the designer has a responsibility to the constructor to produce clear and complete drawings, the constructor has a responsibility to the designer to seek clarification when questions arise. Many problems in the engineering and construction industry occur because one party does not sufficiently understand what is required by another party, yet acts anyway. This situation can rapidly consume time and money in addition to producing detrimental end results.

Just as a variety of *agreements* is made on a project, a corresponding variety of *changes* is also made. Even when agreements are clear and well understood at one level, they continue to be made at varying levels of detail, thus making their meaning difficult to understand.

One example is project scope definition. For the owner, project scope is broader and is framed in different terms than that of, for

example, the scope of the painting contractor. If the painting specification for a building is changed, this is definitely a change to the painting contractor. The owner, however, would not consider this a change because the building size and nature have not been materially altered.

Because *change* can best be understood in the context of *agreements*, a critical skill for project managers is the ability to discern whether an agreement actually exists. By having a change management process in place, a project manager will be able to better understand the complexity of the project and to better communicate with all project participants.

Agreements and Organization

Agreements are made at many levels of a project, just as teams are organized at many levels. The agreements become more specific and detailed as the organization is filled out with all the work teams. Likewise, change can be introduced at any level, possibly requiring the restructuring of many related or collateral agreements. A key to effective change management is maintaining a broad view of all of the agreements on a project and constantly testing the completeness and quality of these agreements. (See CII Special Publication 12-2 for more discussion.)

Changes occur during the development and execution of projects for a variety of reasons. Regardless of the type and magnitude of a change, complex dynamics result. The complexity created by change increases as the project moves through the different project phases. To ensure that the expected project outcomes are achieved, it is necessary that project execution include a change management process that will deal with these complexities and minimize interference and disruption of the project execution plan.

The elements of a project that are subject to change and that will affect the change management process are:

- Project Scope
- Project Organization
- Work Execution Methods
- Control Methods
- Contracts and Risk Allocation

Changes to these elements will have different effects during various project phases. In addition, the interaction of these elements becomes significantly more complex as the project proceeds.

Change management should vary with the type of project, the project phase, project agreements and contracts, and project schedule. An effective change management process should allow for the complex dynamics that will likely develop, and should

provide a disciplined approach for recognizing, evaluating, and implementing changes in a timely and cost-effective manner.

Project Scope

As used here, project scope includes project content and parameters, schedules and milestones for execution, budgets, and expected project outcomes. Project scope is the major determinant of the cost of a project. Thus, scope changes will have both significant and direct impacts on project cost. Even the value of beneficial changes to project scope will be diminished because of the effects of the disruption that they create. The negative effects of scope change will increase rapidly as the project progresses from business planning to start-up. Even incremental change can have disproportionate impacts due to indirect and cumulative effects.

In terms of quantifying the cost of changes, the effects on productivity frequently are unrecognized by current change management practices. The research by the team clearly shows that projects with a high degree of change experience lower productivity (see Figure 3, next page). On projects with less than six percent of hours spent on changes, productivity was better than planned. This indicates a need to consider the total effect caused by an environment of excessive change.

3: Dynamics of Change Management

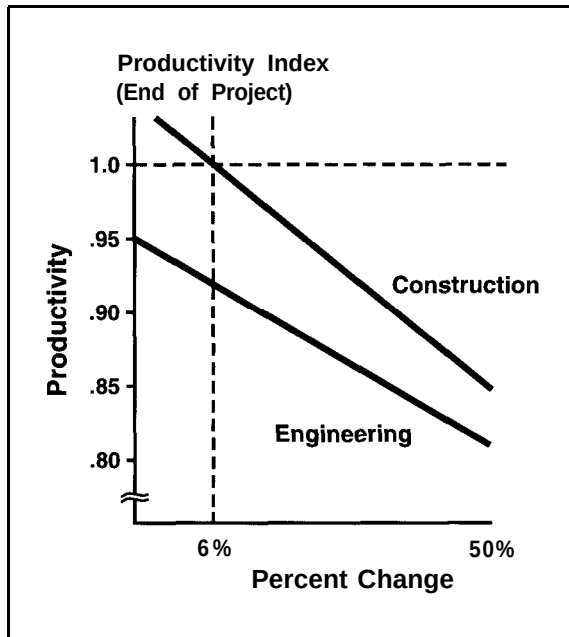


Figure 3. Effects of change within phases. Productivity declines in regard to changes within a phase. (Based on CII Project Change Management Research.)

Project Organization

The project organization involved in the execution of any project phase will affect the management of change. Additionally, organizational changes themselves represent a project change. Such changes can relate to structure, interfaces, hierarchy, personnel assigned to the project and their skill level, experience and behavioral characteristics.

To be effective, the project team must have the capability and disposition to manage change. This must be done in a manner that provides the desired results with minimum negative impacts on the project and on all involved with its

execution. The organization needs to include personnel who have experience and discipline in recognizing, evaluating and implementing change. The organizational structure and hierarchy must clearly identify the responsibility, accountability and empowerment for managing change. Most importantly, the team must make decisive and timely decisions concerning proposed changes and must effectively communicate the decisions to team members and others who have a stake in the project.

Project organizations should include a balance of innovators and implementors, should promote teamwork and collaboration, and have a disciplined approach to executing projects. Effective change management should be established as a project success factor for organizational, team and individual performance.

Changes in the project organization must be made in a calculated manner, and should consider the possible impacts on project execution.

Work Execution Methods

Work execution methods, as used here, are all the processes, methods, systems and procedures used by those involved in the execution of projects.

Effective management of change requires the use of work execution methods that include specific, integrated

3: Dynamics of Change Management

and systemic steps to recognize, evaluate and implement change. Work methods, including the management of change, should be standard, proven, known to those utilizing them, and understood and accepted by those who interface in the execution of the work. Importantly, work execution methods should allow for and accommodate change appropriate for the degree of definition and certainty that exists for any particular project phase.

A change in work execution methods from those planned or being applied can represent a project change. When such changes are being considered or are found to be necessary, the impact on the project must be evaluated, the same as any other change, including both direct and indirect impacts. Particular consideration should be given to the products, timing and quality produced by the work methods and what impact these will have on users, both internal to a project phase and between two or more phases.

Control Methods

Project control methods, as used here, are budget controls, schedule controls, trend analyses, status reports, progress reports and other methods used to monitor project performance against established benchmarks. Similar to work execution methods, the control methods used in managing changes should be standard,

known to those utilizing them and understood and accepted by those involved with the project.

Effective control methods allow for proactive management of change. Project controls, therefore, should be appropriate for the type of project and the project phase. Such controls should make specific provisions for identifying and quantifying project changes. In particular, project controls should be capable of reflecting the cumulative effect of changes, especially the cumulative effect of “minor” changes. Individually, such minor changes may be considered manageable, but may cause unexpected cost and schedule impacts because of the complex nature of projects.

Furthermore, the control baseline should be mentioned throughout the project in order to provide project management with consistent tracking of deviations and changes. Changing the project control baseline during the detailed engineering/construction phase can cause a lack of confidence in the control system and a loss of team discipline. Rebuilding should only be done, then, in extreme circumstances involving established overall changes in a project.

Control methods for project changes should be appropriate for the magnitude, nature, timing and assessed impact of the change. Disproportionate control of changes

3: Dynamics of Change Management

.....

can lead to delays and unnecessary additional work, which likely will have an adverse effect on project execution.

Contracts and Risk Allocation

The types of contracts and the allocation of risks in place during the execution of a project can have a significant impact on project change management and project success. These factors also may affect the attitudes and behavior of the people involved with project execution in ways that inhibit the proper recognition, evaluation and implementation of change.

Contracts, agreements, guidelines, and responsibilities, preferably in written form and mutually accepted by all parties involved, should always be in place. These may vary in form and content depending on the phase of the project, the number of organizations, groups or individuals involved, the nature of the work being performed, the level of definition available and the accuracy of the data serving as the baseline. The absence of such contracts and agreements frequently leads to problems in the effective execution of work, and will be particularly problematic in the management of change.

Verbal agreements, understandings or directions can be easily misinterpreted, miscommunicated, or even ignored. While appropriate in some circumstances, they should be avoided. As a minimum, the pertinent understandings from verbal agreements or directions should be confirmed and communicated in writing.

The allocation of risk has been the subject of earlier research by the CII Contracts Research Team. It concluded that inequity in allocation of risks affects owner-contractor working relationships, project performance and outcomes. The reader is referred to CII Publication 5-3, *Contract Risk Allocation and Cost Effectiveness*, for details and recommendations.

Summary

The project elements that affect change and change management are project scope, project organization, work execution methods, control methods, and contracts and risk allocation. Because the dynamics created by changes can be complex, effective management of change is needed during all phases of a project. The change management process utilized should be appropriate for the project phase, the degree of definition that exists, and the type of agreement and risk allocation in place.

This chapter presents the principles of effective change management that have been identified by the research team. Using and understanding these principles will facilitate the success of any project.

The principles of effective change management are:

- Promote a balanced change culture
- Recognize change

- Evaluate change
- Implement change
- Continuously improve from lessons learned

Ineffective change management is often similar to spinning a pinwheel (see Figure 4). The challenge is to straighten out the pinwheel so that the process flows forward instead of in an unending circle (see Figure 5).

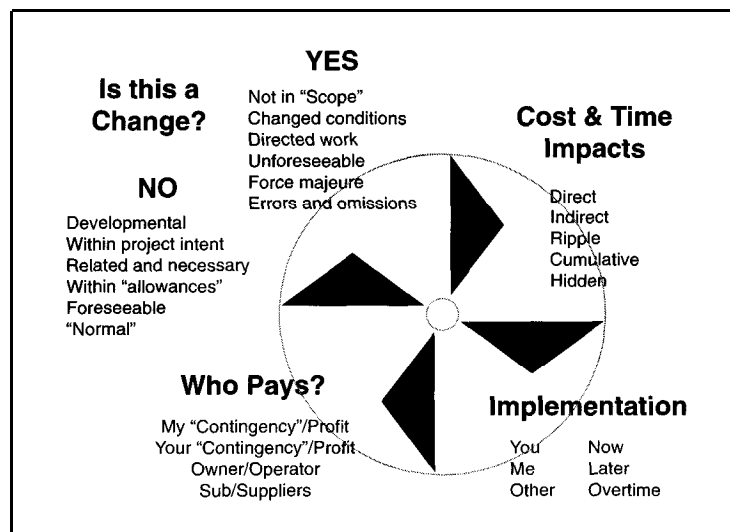


Figure 4. Ineffective Change Management

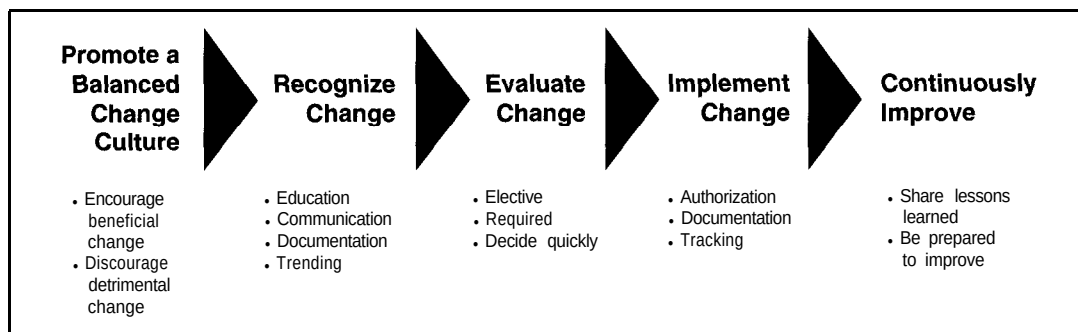


Figure 5. The Principles of Effective Change Management