



PROJECTS AND COMPETITION OF THE FUTURE

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The purpose of this publication is to make available to industry the results of research conducted by the Construction Industry Institute (CII). The publication does not necessarily represent the views of CII member companies, but is offered as a contribution to the industry.

CII was founded in 1983 to improve the cost effectiveness of the nation's largest industry. The members, who represent a broad cross-section of owners and contractors, believe that many of the problems that limit cost effectiveness are common ones, and that real improvements can be best accomplished in a cooperative environment with the benefits being shared by the construction industry at large.

CII uses the acronym TOPICS to describe the research effort. TOPICS signifies the six research thrust areas: Technology, Organization, People, Information, Controls, and Sigma (meaning others). The task forces for each area are listed below.

Technology

- Advanced Technological Systems
- Computer Integrated Design & Construction Design
- Electronic Data Management
- EPC Flexibility
- Environmental Remediation Technology
- Modularization Technology
- Technology Strategy
- Technology Survey

Organization

- Constructability
- Constructability Implementation
- Contracts
- Project Change Management
- Partnering
- Pre-Project Planning
- Project Organization
- Project Team Building
- Project Team Risk/Reward Allocation

People

- ADA Impacts
- Construction Work Force
- Continuing Supervisory Education
- Drug-Free Workplace
- Education and Training
- Employee Effectiveness
- Safety
- Zero Accidents

Information

- CICE Impact Evaluation
- Industry Data & Statistics
- International Construction
- Owner Engineering Organization

Controls

- Change Order Impacts
- Contracting, Phase II
- Cost/Schedule Controls
- Dispute Prevention and Resolution
- International Standards
- Materials Management
- Overtime
- Productivity Measurement
- Quality Management
- Quality Performance Measurement
- Schedule Reduction
- Total Quality Management

Sigma

- Barriers to Implementation
- Construction 2000
- Insurance
- Piping Function
- Retrofit Projects
- U.S. Navy Demonstration Project
- Workers Compensation

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Executive Summary

This report summarizes the research sponsored by the CII Construction 2000 Task Force to identify trends that will influence projects and competition of the future. This publication is intended for senior managers, strategic planners, managers responsible for facility engineering and construction, and operations managers in owners' and contractors' organizations.

Key differences in future project operations may include:

- Global markets for manufactured goods and for engineering and construction services
- New forms of project development such as build, own, transfer
- Continuous process improvement or total quality management
- Significant resource constraints, such as engineers, skilled craft, and perhaps critical permanent equipment and materials of construction
- Use of advanced information technology
- Increased offsite fabrication.

Differing technical attributes of future facilities may include:

- Decreased project size and greater emphasis on retrofit
- Increased concern for employee and public safety
- Further waste minimization and environmental protection
- Increased product quality and greater production flexibility
- Fully distributed control systems for process plants
- Increased scope of mechanical and electrical systems in buildings to conserve energy and improve indoor air quality.

To remain competitive in markets that are increasingly global, construction's customers may demand improved performance and increased cost effectiveness of future facilities. Owners, in turn, may place new demands on their organizations and their suppliers, including design and construction. These new demands pose major challenges for engineering and construction in the next decade. With anticipation and preparation, engineers and contractors can gain new competitive advantages. Even a single action can create a significant competitive advantage for an engineering or construction firm.

Introduction

What will be different about facilities and project operations in the industrial and building market segments in 2000? What technical and managerial capabilities will be required to design and construct these projects?

Objectives of the Research

The objectives for the investigation of projects of the future are listed below:

- Identify trends that will influence project operations and facilities
- Describe characteristics of future projects for specific types of industries
- Describe necessary engineering, construction, and management capabilities
- Recommend actions to prepare for projects of the future
- Identify necessary changes in relationships between owners, designers, and contractors and incentives to develop capabilities for projects of the future.

What Changed During the Last Decade?

Examining the dynamics of the 1980s provides a useful frame of reference for considering possible changes during the 1990s. Significant change occurred in many markets of construction's customers, and in each segment of engineering and construction.

The *process* segment began the last decade with a massive, government supported effort to develop synthetic fuels, endured a long period of low oil prices, and ended with increasing design and construction activity to provide facilities for international markets and to comply with increasing safety and environmental requirements. Several major owners in this segment downsized engineering and construction staffs and entered into partnership relationships with contractors to obtain consistent support.

U.S. *industrial* firms who offered many types of durable goods made serious efforts to obtain more components from suppliers, automate production operations, and increase product quality. Environmental and recycle considerations became strong influences on both product and

plant decisions. Several types of firms significantly increased production capacity and many relocated to regions of the country offering lower cost labor.

Energy conservation and deregulation greatly changed the *power* segment. Electric load growth, though still modest by historical standards, exceeded expectations in many parts of the country, emphasizing regional differences. Electric utilities completed or cancelled most of the central generating stations under construction at the start of the decade, and resisted ordering new plants. Independent power producers offered cogeneration facilities as attractive alternatives under the new regulatory requirements. Conservation became a big player in most utilities' operations.

Fueled by an expanding economy and availability of financing, *building* boomed in many metropolitan areas during the 1980s. New architecture and new requirements for life safety and energy conservation changed design. The intense building volume included commercial, institutional, and light industrial space.

Even this brief retrospective of major segments in engineering and construction markets reveals a startling degree of change in just one decade. Early signals indicate even greater change will occur during the 1990s.

Driving Forces, Needed Capabilities, Actions to Prepare

Six fundamental forces that may shape engineering and construction projects in the year 2000 include:

- *Political forces* may decrease military construction and require new facilities to support international operations by global industrial firms.
- *Social trends* may alter the quantity, location, and type of buildings needed, along with the infrastructure to support these facilities. Changes in demographics in the U.S. will decrease the availability of engineers and craftspersons.
- *Economic driving forces* may create new demands for international facilities, force performance of design at the most cost effective locations, and increase pressures on capital availability for new facilities.
- *Environmental and energy forces* may create major demands for remediation services, alter the design of facilities to

further limit pollution, and require new forms of environmentally acceptable energy supply.

- *Technical driving forces* may provide advanced information technologies to improve engineering and construction productivity and furnish new materials to improve structural performance.
- *Trends in organization, management, and project relationships* may result in more decentralized structures, increased integration of project teams that include additional capabilities, and greater use of partnering.

The changes expected from these driving forces indicate a pressing need to prepare for projects of the future. The following combinations of actions and capabilities apply to each of the major segments of engineering and construction:

- *Monitor opportunities and influences* to identify new technology, regulatory requirements, and other driving forces that will shape projects and facilities.
- *Develop human resources* including generalist managers, technical professionals, and skilled crafts.
- *Go after new technology* to include advanced information technology for design, new process and system components, new materials of construction, and increased applications of automation in fabrication, assembly, and installation.
- *Continuously improve processes* by analyzing current systems, improving the capabilities and effectiveness of the work force, and increasing the effective use of new technology.
- *Challenge and involve all employees* by using participative management style in matrix organizations to effectively coordinate project teams.
- *Build team relationships* that lead to continuous improvement in productivity and quality of products and services.

Developing and building a management team that takes the actions described will improve operations, create competitive advantages, and prepare for projects of the future. Organizations that include these capabilities are extremely difficult for competitors to copy and implement.

Driving Forces and Implications for the Future

Despite the magnitude of changes in engineering and construction during the 1980s, the prospect for the 1990s looks even more dynamic. Why? Several fundamental driving forces are present in the markets of construction's customers, each with the potential to change markets and operations for owners of facilities, the types of facilities they require, and the way they acquire them. This section discusses the following types of driving forces and their implications for construction: environmental, energy, and technical.

Environmental and Energy Forces on Facilities and Projects

Preventing pollution and cleaning up the environment to protect public health and preserve natural beauty are causes most Americans support. The next decade could bring national efforts for environmental clean-up to the forefront. The American people seem willing to pay for the preservation of the environment through responsible legislation.

Environmental protection and energy supply provide the strongest driving forces for facilities and projects in the next decade. Pressures to clean up dangerous sites, limit all forms of pollution, mitigate global warming, and improve the indoor environment will increase demand for specific types of facilities. Concerns regarding environmental protection and energy conservation already influence the design and construction of new projects. Increasingly stringent criteria related to each can cause greater impacts on future projects.

New facilities or major renovations could be needed in order to limit air emissions, discharges to water, and generation of solid waste. Remediation work will produce a large market to clean up existing waste sites. Requirements to maintain indoor air quality and simultaneously limit building energy use will result in more complex building systems.

Maintaining a reliable and environmentally acceptable supply of energy likely will produce needs such as additional gas pipelines, new types of electric generation stations, and perhaps energy storage facilities. Projections indicate a significant demand for new electric generating stations during the 1990s and after 2000. The quest for alternate energy sources could create demands for several new types of facilities.