THE BUSINESS ROUNDTABLE

Construction Cost Effectiveness Task Force

The Business Stake in Effective Project Systems

September 1997

The Business Roundtable
An Association of Chief Executive Officers Committed to Improving Public Policy

The Business Stake in Effective Project Systems

A White Paper from THE BUSINESS ROUNDTABLE
September 1997

Table of Contents

I. Background and Context

Over the past fifteen years, most American manufacturers have transformed their approach to the engineering and management of their capital projects. Virtually all major firms have reduced the size and scope of work performed by engineering organizations. Many companies are drifting because they are uncertain about the appropriate size and role of their in-house capital projects organization. Nearly every owner engineering and project management organization in the U.S. has been reorganized, sometimes repeatedly, without achieving a satisfactory result in many cases.

The difficulty for most capital project organizations is to find a mix of size and responsibilities that meets business needs in an optimal fashion. When an optimal mix has been achieved, they need to find a means of communicating to their business partners that this has been done.

This report first discusses what the bottomline stake is for a manufacturing business in having an effective capital project system. It then reviews the rapid changes that have occurred in the roles of owner engineering functions. The engineering function is then placed in the context of the business supply chain. The report concludes with the characteristics of excellent performers.

The data base utilized for analysis in this report has been developed by Independent Project Analysis (IPA), Reston, Virginia. It contains data from over 2,000 projects from a variety of industries which represents $300 billion dollars in investment. The Business Roundtable expresses its appreciation to IPA for its assistance and cooperation.

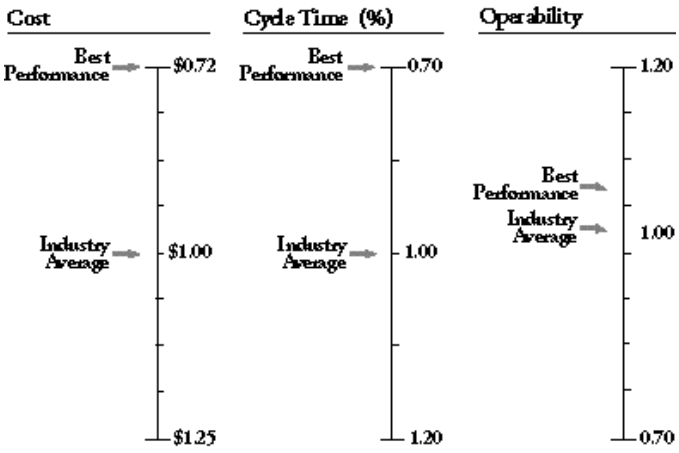
Stake in Project System Excellence

- Among benchmarked companies, project system performance ranges from adding 7.5 ROI points to an average project to subtracting 6 ROI points from that project.
- Each year for the past several years, the gap between the best companies and the rest has increased.
- Some companies are achieving significant comparative advantage through their approach to the development and execution of capital projects. Others are increasingly at a disadvantage.

This data base has benchmarked over 60 major companies' project systems and monitors the performance of over two dozen of these companies. When examining the relative performance of these project systems, some important trends appear. The best company transforms a 15 percent return on investment (ROI) project, based on average performance, into a 22.5 percent ROI project. In contrast, the poorest performers turn that same project into a 9 percent ROI.

Most important from a business perspective, the gap between the best and the worst has widened over the past several years. Some companies have learned how to acquire consistent and significant comparative advantages from their capital project systems, while others find themselves increasingly at a disadvantage.

Project System Improvements Can Increase ROI: The Current Leading Edge



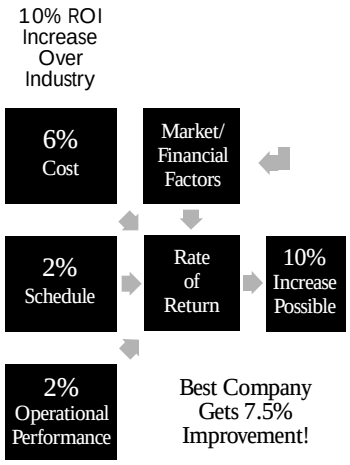
The chart above shows the current leading edge in state of the art project management. In relative cost performance, the best company is spending 72 cents of the

industry average dollar for the same functional scope. The fastest company takes only 70 percent as long as the industry average to bring a project from a business idea to a facility in production. The company with the best track record in starting up and getting on-spec product from new facilities achieves 6 percent more product from facilities than the industry average.

When these three performance factors are combined, an astounding 10 percent improvement in ROI can be achieved. This means that based on extraordinary project performance, a 15 percent ROI project can be transformed into a 25 percent ROI winner. Note: This ROI model is based on a nominal $50M project with an industry average return of 15% and all non-project variables held constant. If ROI exceeds 35-40%, schedule becomes much more significant than cost.

However, one company is actually achieving 75 percent of that possible gain. Several others are achieving substantial boosts in ROI just by the manner in which they organize and execute their project work. Conversely, some major U.S. manufacturers are doing projects so poorly they regularly transform an average 15 percent ROI project into a 9 percent project.

Improving Project System Performance Improves Capital Efficiency



Project System Contribution to Return on Investment

% IRR Differential

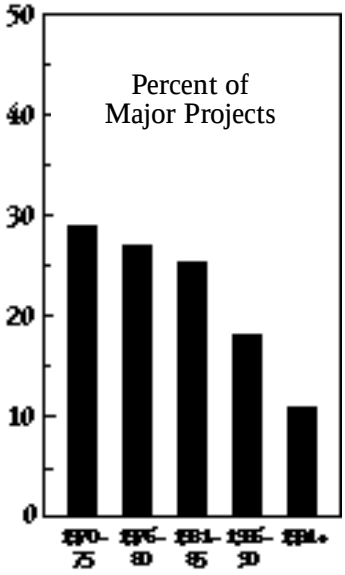
Differential IRR Values Based on Representative Project—Average 15%

II. The Changing Role for Owner Engineering

There is both good news and bad in the current state of project management. Many things have improved in the past 20 years. Cost overruns are significantly lower relative to the 1970s and early 1980s. Cycle times are 20 percent faster and projects are considerably safer in construction than 20 years ago.

Cost, however, remains rather unpredictable. Startup and operability of new assets has not improved in the past 20 years. Most distressing is the fact that more than two-thirds of major projects built by the process industries in the United States in the past five years have failed to meet one or more of the key objectives anticipated at authorization.

Owner Detailed Engineering Has Almost Disappeared



In the 1970s, it was quite common for detailed engineering work to be performed by in-house engineering organizations. Some major manufacturers even had their own construction forces. For major companies, engineering department staffs were numbered in the thousands.

Today, only a few companies in the process and allied industries in the United States maintain the ability to perform detailed engineering in-house. The trend toward engineering out-sourcing started in the U.S. and has spread to much of the European industry as well.

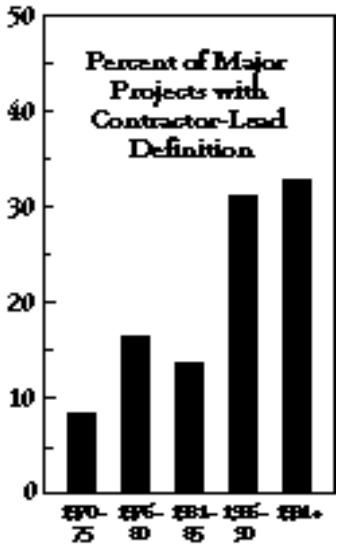
The out-sourcing of detailed engineering and construction work began a process of down-sizing in-house engineering staff that continues in many companies. Many of the companies that eliminated in-house detailed design capability originally intended to maintain the forces

required to do the definition work which is so critical to project success. As the chart shows, the contractor role in definition has grown as well. Today, almost half of all projects have substantial contractor involvement in project definition. The out-sourcing of engineering is appealing in many ways. The cyclical nature of capital programs at most process industry companies has meant that the large in-house forces carried substantial cost penalties in periods of minimal work. Engineering contractors with a large client base are more flexible in adapting to this changing workoad. Furthermore, the U.S. engineering contractors responded to an increased workload with a strengthening of their expertise and systems in many areas. Today, for example, engineering contractors, not owners, are the leading edge in the use of 3D CAD systems.

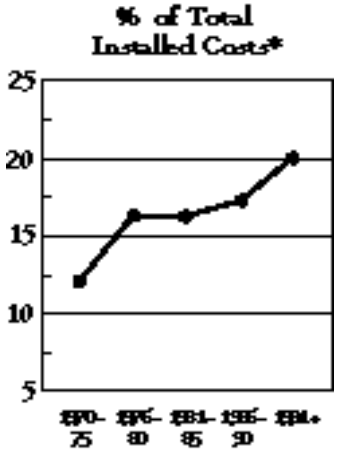
However, if the hope of out-sourcing was a decline in engineering costs, that hope has not been realized. The engineering costs for major projects has continued to grow just as the amount of work performed in-house has declined. There are many reasons for the growth in engineering costs which may have increased even more if in-house forces remained large. On a positive note, engineering costs, as a percentage of total installed costs, have often not been a good indicator of project execution efficiency. Funds expended in front-end planning, design, constructibility, etc., have often resulted in lower costs in field construction, startup, long-term maintenance and operation.

Some owners have turned to “alliances” with contractors as a solution to the loss of in-house forces. Alliances are long-term contractual relationships between owners and contractors intended to promote efficiency in capital projects.

Engineering Contractors Are More Involved In Definition



But Overall Engineering Costs Have Continued To Climb



*Includes owner’s process design, contractor’s detailed design, and both owner’s and contractor’s project management

But, when examined quantitatively, there appears to be no correlation between the use of alliances and project results. The most effective project system benchmarked uses alliances extensively. The second best has no alliances. One of the poorest project systems in the database is a pioneer in establishing alliances. One can only conclude that it is not alliances, but the substance of the work process that drives the result.

Weak owners perform poorly on projects in alliances as often as they do in non-alliance situations. Additionally, detailed engineering costs do not necessarily decline with the use of alliance contractors. Indeed, performing detailed engineering with alliance contractors is on average the most expensive alternative.

This is not intended to, and should not, discourage owners from developing alliances. It is, however, a caution. Owners must first learn how to do projects well and only then consider alliances. Expectations must be kept firmly in check. Alliances are not a silver bullet answer for down-sizing.

The rapid changes in owner engineering functions have resulted in the substantial loss of basic competence in some organizations. Of particular concern is the technical competence to assist the businesses in arriving at the most appropriate project to meet the business need has been lost along with the competence to execute the project effectively.

Unfortunately, while the long-term damage to a company's earnings from "doing the wrong projects wrong" is devastating, the effects are not apparent for a number of years. One of the basic dilemmas in business today is the lack of congruence between the business person's perfor-

mance horizon—usually measured in calendar quarters—and the effects of major capital decisions, which are always measured in years.

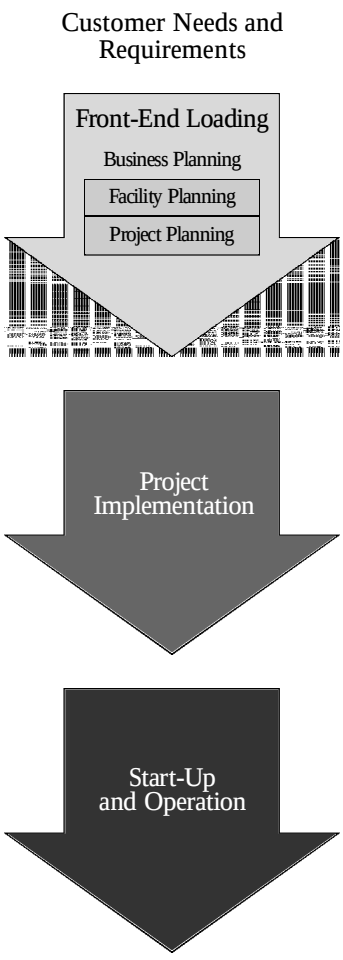
The key difference between successful and unsuccessful companies is not down-sizing. Successful companies have down-sized too. The winners have changed the substance and process of their engineering, not just the number of people on the company rolls.

Companies which have lost competence in capital projects have never done so all at once. But as more of their deeply experienced, critically skilled personnel retire, they lose the ability to define alternatives effectively. The selection of the wrong projects for business needs, however, will tend not to appear for several years.

More immediate, these companies find themselves quite dependent on contractors, placing them in an increasingly poor bargaining position. They will find that new technology projects go badly "off-the-rails," as the quality of internal processes declines. Globalization is also high risk because a strong owner work process is even more critical when executing off-shore. They will find that the goal of spending money more efficiently in small projects becomes more difficult when there is no core process for major projects.

Finally, the loss of owner engineering competence eventually puts the business person directly across the table from the contractor with no buffer or translator. The direct business-to-contractor interface can be very unstable because the parties do not have the mechanism to bridge gaps in communication. As a result, there are a growing number of wasteful lawsuits, arbitrations and claims.

The Project Supply Chain



III. THE SUPPLY CHAIN CONTEXT

The companies that have succeeded in this new environment have fundamentally changed their view on the role of capital project system in their business. Instead of viewing capital projects as the line responsibility of the Engineering Department, they view projects as the principal means by which the corporation's capital asset base is created. They view technology and engineering as elements in the supply chain that result in competitive products, not as non-integrated functions.

The supply chain of a capital project starts with the identification of a customer need that might be translatable into a business opportunity. The front-end loading process is made up of the critical planning phases of the project. It is called front-end loading because the effective commitment of time and resources at this point dictate the future success of the project. The business opportunity is explored in the first stage of the front-end loading process. Alternative methods of meeting the defined needs are explored, including non-capital options. Market forecasts and competitive studies are performed along with technology assessments and product development if needed.

The most successful companies are using their technical resources in this business development process. As the business planning to meet a particular need becomes focused on a capital project as the solution, a project manager skilled in capital project execution is named to work with the business lead in the development of the next stage—facility planning.

Facility planning hones the broad project objectives into a particular project at a particular site with a particular

technology configuration and schedule. Different formulations of the project are explored and a selection is made. The project planning stage fills in the details needed to bring the project to a point where detailed engineering can be mobilized to execute the project with little or no change.

It is hard to overstate the importance of the front-end loading process. While fewer than one project in three meets all of its authorization business objectives, analysis of the database shows 49 out of 50 projects that have achieved a best practical front-end loading index score meet all objectives.

It is because of the central role of front-end loading that project excellence cannot be bought in the market like a commodity. The project supply chain requires integrating business, technical and manufacturing functions into teams that can create a project which uniquely fills the business requirement. Except in isolated cases, capital projects are not standardized and repeatable items. Most attempts to force capital projects in that direction lead to poor results.

The companies that are failing to achieve effectiveness in capital projects are those which have lost the ability to shape unique assets on the front-end of the process. Those who cannot control the front-end loading process are destined to pay too much for capital assets that at best only approximately fill the business requirement.

Defining New Roles in Project Definition

- All Owner: Traditional project definition with little or no use of contractors
- All Contractor: Contractor has responsibility for definition with little or no owner input
- Contractor Lead: Focus of control is with contractor, but owner remains involved throughout
- Integrated: Owner brings contractor on board early, integrates team and lead being decided by comparative advantage

IV. ACHIEVING PROJECT SYSTEM EXCELLENCE

There are four common options. The "All Owner" option traditionally makes minimal use of contractors in the definition phases. In the "All Contractor" option front-end loading is turned over to contractors with minimal owner input. The "Contractor Lead" option has been used for many years, and is even viewed as the preferred option by a number of owners. About 10 years ago, a few companies started experimenting with functionally "Integrated Teams" as an alternative. The integrated teams consisted of owner functions such as engineering, business operations and maintenance, and outside engineering and construction contractors. Even vendors have been included in many of the most effective teams.

Defining New Effective Roles

The chart above shows project outcomes as a function of how front-end loading is organized and directed. There are several interesting differences. "All Contractor" projects are the worst on every performance metric. Turning poorly

defined projects over to contractors is an expensive and probably unaffordable luxury.

By contrast, "Integrated Team" projects generally dominated the best performance category in terms of cost and schedule and almost equaled "All Owner" projects in operability of plant. A major penalty of the "Contractor Lead" projects is the relatively poor operational performance of the facility. Projects front-end loaded by contractor organizations simply did not perform as well as those defined by owners. The lost production, which continued well into the second year of operation, overwhelmed any business benefits of faster cycle times. In addition, the benefits of faster schedules are best gained through Integrated Teams.

Integrated, empowered team project organization is not a fad. Some of the members of The Business Roundtable have been successfully applying the concept for a number of years and are gaining substantial competitive advantage as a result. The company that leads in performance metrics in terms of ROI is the leading practitioner of integrated team projects.

So what are the characteristics of the Best Capital Project Systems? In addition to using fully integrated cross-functional teams, they actively foster business understanding of the capital project process. Businesses always manage the project process whether they are aware of it or not. Whether they manage them poorly or well depends on knowledge of the process. The best project systems have business leaders on their major capital projects helping to make trade-offs between competing objectives for the overall benefit of the corporation.

In the best project systems, engineering and project management report to the businesses whose supply chain

Universal Characteristics of Best Capital Project System

- Cross functional teams to develop projects
- Active and project knowledgeable business leadership, especially on the front-end
- Engineering and project functions report to the businesses, not to plant management
- Continuous improvement systems
- Systematic performance measurement
- The in-house resources required to develop and shape projects until the projects are ready for detailed design

they serve and not to plant operations. Plant managers have pressing and immediate concerns that conflict on a daily basis with the needs of capital efficiency, but they should still be part of the team.

The best project systems have continuous improvement efforts which are subject to real and effective measurement. They have managers who can distinguish between effectiveness and predictability. This requires sophisticated measurement systems.

The best project systems all maintain the in-house resources necessary to develop and shape projects on the front-end and to bind the owner functions together to chose the right project and prepare for efficient execution.

The Best Maintain a Center of Excellence

All of the better-than-average project systems have some form of central organization that is responsible for:

- Providing excellence in project definition
- Maintaining disciplinary excellence in project management, including safety
- Integrating with manufacturing
- Integrating contractors effectively into their project process

The very best systems provide active integrated support to the businesses in the initial shaping of new capital assets.

There is one final characteristic of all companies that have managed to perform at least above average in capital efficiency. They have all maintained some form of central organization that is responsible for providing the organization of the work process for front-end loading, a skilled resource pool in a number of core competencies, and the organizational and inter-personal "glue" that binds operations, business engineering and outside resources into an effective project process. In the very best systems, those same skills help the businesses select the right capital assets to make, acquire or refurbish.

Do you know where your company fits into the spectrum on capital project execution excellence? As this report outlines, it pays to know and it pays to improve. All the way to the bottom line return on investment.

APPENDIX A

OWNER PROJECT DELIVERY SYSTEM ASSESSMENT QUESTIONNAIRE

This questionnaire attempts to permit business leaders to quickly assess their project delivery system, obtain a broad picture of their business' capabilities in this area and gauge how these capabilities relate to those of owner organizations which are considered best in class.

The questions are organized as Project Inputs, Project Outputs, Safety and a General Summary section. It is suggested the business leader empower a cross-functional team of business management, project management, safety, engineering and sourcing professionals to assist in obtaining the true picture of the business' capabilities including risk management. If more than two hours effort is required, it could be a signal of the business' weakness in this area. If your team answers no or has a level of uncertainty on several questions, there may be significant opportunity for improvement.

Project Inputs: (Assessed at the time of funding authorizations)

Project Development Status:

- Has all research and development work required for the design of the project been completed?
- Are all technology selection issues fully resolved?
- Have efforts been made to determine how your capital project/program costs compare to other businesses in your company and your competitors?
- Has the technical scope of the projects/programs been defined and understood, and an effort been made to

"freeze" the project/program scope (so that changes are minimized and project/program delivery is maximized)?

- Have engineering, environmental and construction firms been prequalified?
- Is there a clear link between this project and the business strategy?

Project Execution Planning:

- Does your organization use cross-functional teams of both owner and contractors when planning and subsequently executing a project/program?
- Has a definitive, fully integrated, resource-loaded project plan been prepared with the input of all project/program disciplines, including constructibility and maintainability reviews?
- Is a contracting strategy defined early in the planning phase of the project/program?
- Does your pre-project planning include provisions for turn-over commissioning and start-up?

Site-Specific Factors:

- Has a project plan been developed addressing the assessment and resolution of site-specific conditions—specifically site mapping, soils investigations, environmental investigation and regulatory permit/code compliance, health and safety reviews and fire suppression and MFL (Maximum Foreseeable Loss) reviews?

Project Outputs:

Project Costs/Schedule/Cycle Time:

- Does your capital project/program cost collection system provide timely information to permit analysis of alternative solutions when deviations occur?
- Has an analysis of capital project/program cost sensitivity to project profitability been performed?
- Are all team members aware of this relationship when making execution strategy decisions?
- Has a similar analysis on schedule sensitivity to project profitability been performed and communicated?
- Do you analyze results of past projects/programs in order to improve cost and cycle time performance on future projects/programs?

Operability:

- Have completed facilities achieved expected performance within targets?
- Do your operability results meet business requirements?
- Has a sensitivity analysis been performed on the relationship between operability and profitability?

Safety:

- Do you document the construction safety record on your major projects?
- Does your organization require its contractors to have an active substance abuse policy and assure all sub-tier contractors have a substance abuse policy? Is constractor adherence to this policy audited?
- Does your organization pre-qualify its prospective contractors in terms of safety?

- Have there been any safety performance audits performed in the past twelve months?
- Does your organization require contractors to prequalify their sub-tier contractors in the area of safety?

General:

- Will an improved capital project/program delivery system assist you in meeting your business objectives?

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