Improving Construction Project Outcomes and Project Returns

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Northwest Construction Consumer Council
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Outline

• Capital Effectiveness
• Industry Trends
• Best Practices
  – Selecting the right capital project
  – Doing the capital project right
• Organizing to Consistently Implement Best Practices
Outline

- **Capital Effectiveness**
  - Industry Trends
  - Best Practices
    - Selecting the right capital project
    - Doing the capital project right
  - Organizing to Consistently Implement Best Practices
Defining Capital Effectiveness

- The effective capital project system contributes to the success of the business it serves by:
  - assisting in the selection of the best scope for the opportunity the business defines
  - delivering a cost competitive facility
  - in a timely fashion
  - that is fully operable
  - without causing serious injury
- The best project systems add about 3 to 5 points to project returns
Elements of Capital Effectiveness

Key Performance Indicators

- Low Cost
- Fast Cycle Time
- Excellent Operability

SAFETY

BETTER IRR
Basis of the Results Presented

- IPA’s Project Databases
- Data collected during face-to-face project team interviews
  - Consistency of definitions
  - Credibility
- Carefully normalized
  - Constant dollars
  - Common currency
  - Consistent scope
  - Overtime / multiple shifts
  - Locations
  - Operational performance: market / raw material availability
IPA Proprietary Databases

- **Manufacturing Plants PES® Database**
  - Detailed histories of process plant projects > $5MM
  - Number of projects=5500+

- **HAZRISK® Database**
  - Environmental assessments/Cleanups
  - Number of projects=400+

- **Upstream PES® Database**
  - Petroleum production platform worldwide
  - Number of projects=1000+

- **PES® Small Projects Database**
  - Projects of less than $5MM from process industries
  - Number of projects=1000+

- **Retail Facilities Database**
  - Service stations, c-stores
  - Number of projects=100+

- **Instrumentation & Control Projects**
  - Automation, DCS, SCADA, etc.
  - Number of projects=70+

- **Information Technology**
  - Applications development, telecommunication, implementation
  - Number of projects=150+

- **Megaprojects**
  - $Billion class projects of all types
  - Number of projects=100+

- **Pipelines Database**
  - Pipelines, terminals, booster stations, etc.
  - Number of projects=270+
Independent Project Analysis

IPA’s Manufacturing Plants Projects Database

- Project sizes range from $0.07MM to $36.0 + billion
- The database is current with 1995 as median year of authorization
- Global: 69% North America, 17% Europe, 6% Latin America, 7% Asia and 1% Africa
- Technology level ranges from off-the-shelf to truly novel
- 120 owners companies are represented
- Data are very detailed: ~1500 variables collected on each project
- >600 new projects added each year

Legend:
- Revamp
- Expansion
- Add-on
- Greenfield/Colocated

Independent Project Analysis
Outline

- Capital Effectiveness

- *Industry Trends*

- Best Practices
  - Selecting the right capital project
  - Doing the capital project right

- Organizing to Consistently Implement Best Practices
Some Definitions

- **Lost Workday Cases** = Cases resulting in days the employees would have worked or had to engage in restricted work but could not because of the job-related injury or illness per 200,000 field hours
- **Cost Index** = Project Engineering & Construction Cost / Industry Average Cost for Same Scope of Work
- **Schedule Index** = Project Execution (Start of Detailed Engineering through Mechanical Completion) Duration / Industry Average Execution Duration for Same Scope of Work
- **Operability Index** = Project Achieved Capacity Relative to Nameplate during Second Six Months of Operation / Industry Average Capacity Achieved Relative to Nameplate
- **For current Indices: Industry Average = 1.0**
Independent Project Analysis

Safety Performance

Trend is primarily driven by improvement in Europe

Year of Authorization

Percentage of Projects With One or More Lost Workday Cases

0% 10% 20% 30% 40% 50% 60%
Cost Improvement Over Time

Authorization Year

Cost Index

Industry

Independent Project Analysis
Cost Predictability has Stagnated
Execution Schedule Improvement has Leveled Off

![Chart showing Execution Schedule Improvement trends from 1995 to 2000. The index shows a steady increase until 1998, after which it levels off.](chart.png)
Operability Is Degrading

Operability Index

Authorization Year


Industry
Industry Trends

Over the past 15 years, a great many things have changed in the way that projects are delivered

- detailed engineering has been almost completely outsourced
- contractor involvement in front-end work has increased
- increased reliance on contractors for cost estimating and project control
- engineering has been progressively globalized
- automated tools have come of age
- competitive pressures have intensified
Industry Challenges

• Mergers, spin-offs, restructurings, and attempts to enter new product markets are changing the business personnel rapidly in many companies
  – The instability is causing:
    • use of projects for corporate cash flow and quarterly results control
    • increase in the number of business people who do not understand the project implications of their decisions

• Downsizing has left owner organizations anemic
  – Lacking ability to define cost-effective projects
  – Little ability to control projects
  – Aging expertise
  – Limited ability to assess ultimate project operational performance
Future Trends

- Some recognition that downsizing may have gone to far
  - one firm selecting a few projects to engineer in-house
- More firms working to strengthen gated processes
- More concern about retaining the right asset development competencies
Issues

Best performing companies are getting better faster than industry

What accounts for the project successes and failures?
Outline

• Capital Effectiveness
• Industry Trends
• **Best Practices**
  – *Selecting the right capital project*
  – Doing the capital project right
• Organizing to Consistently Implement Best Practices
Supply Chain for Projects

Customer Needs and Requirements

Front-End Loading

Business Planning  Facility Planning  Project Planning

Project Implementation

Startup and Operation

Products That Continuously Meet Global Customer Needs Better Than All Competitive Products

Independent Project Analysis
What Is Front-End Loading?

Front-End Loading (FEL) is the process by which a company develops a detailed definition of the scope of a capital project meeting business objectives.

--Why

--What

--When

--How

--Who

Independent Project Analysis
Supply Chain for Projects

Customer Needs and Requirements

Front-End Loading
- FEL 1 Business Planning
- FEL 2 Facility Planning
- FEL 3 Project Planning

Project Implementation

Startup and Operation

Products That Continuously Meet Global Customer Needs Better Than All Competitive Products

Selecting the Right Capital Project

Independent Project Analysis
Supply Chain for Projects

Customer Needs and Requirements

Front-End Loading

FEL 1 Business Planning
FEL 2 Facility Planning
FEL 3 Project Planning

Project Implementation

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Products That Continuously Meet Global Customer Needs Better Than All Competitive Products

What Practices Lead to Selecting the Right Project?

Independent Project Analysis
Can Project Business Success be Predicted?

- In 1995 with support from 23 CPI companies, IPA began an empirical study of the factors that govern the business success of a capital project.
- In 1997, we started to implement a new tool to help forecast the business success of ventures.
- Business success is measured as:

\[
\text{NPV (Actual)} - \frac{\text{NPV (Forecast)}}{\text{NPV (Forecast)}}
\]

- This tool is the *Business Front-end Loading Index*.
Business Front-end Loading Index

• Relates venture success (in terms of achieving NPV goals) to the quality and thoroughness of early...
  – analysis of the venture
  – scope development
  – teamwork between Business and Engineering functions

• The Index is *quantitatively* derived and validated through five years of use
Business FEL Index

Business Case + Team Dynamics + Scoping Quality → Business FEL Index

Independent Project Analysis
BFEL Index Explains Most NPV Variation

Actual Delta NPV

Predicted Delta NPV

R-Squared = .85
Observations

- Business Case development is the single most important aspect of venture success
- Effective communication between business and engineering is the second most; team integration is vitally important
- The engineering work in FEL-2 contributes, but does not dominate
- The reason to run a better project system from FEL-3 through startup is capital conservation more than basic venture success
Importance of Business Front-end Loading

• Changing the success rate with capital projects--even slightly--will make your company more successful
• Significantly reducing-- or eliminating-- very bad projects is possible
• Blaming bad project selection on “the market” is neither necessary nor productive
Let’s Kill Bad Projects Early!

“Nothing is so wasteful as perfecting that which should not have been done at all”

Peter Drucker
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Independent Project Analysis

Customer Needs and Requirements

Front-End Loading
- FEL 1 Business Planning
- FEL 2 Facility Planning
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Doing the Selected Capital Project Right
Elements of Capital Effectiveness

Business Strategy

Technology Strategy

Teams

Leading Technology

Use of Value Improving Practices

Front-End Loading

Optimal Scope for Business Needs

Executed With Minimum Change

Discipline

Timely Involvement of Contractors/Vendors

Cost

Schedule

Operability

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Key Leading Indicators

Key Performance Indicators

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Front-End Loading Drives Better Project Outcomes
FEL Drives Absolute Cost Performance

Relative Capital Cost
(Project Cost / Industry Avg. Cost)

1.2
1.1
1.0
0.9
0.8

Best Practical Good Fair Poor Screening

Industry Average Cost

Independent Project Analysis
Independent Project Analysis

Good FEL Improves Predictability

Percentage Cost Deviation

-20% 0% 20% 40% 60%

FEL Index
Best Good Fair Screening

+ 1 std. Mean - 1 std.
Better Definition Shortens Project Schedule Durations

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Better FEL Results in Fewer Changes

Percent of Projects Experiencing Major Changes

- Best
- Good
- Fair
- Poor
- Screening

- No Changes
- Change in 1 Project Phase
- Change in More Than 1 Project Phase

Independent Project Analysis
Use of a Few Value Improving Practices Combined with Good / Best Definition Further Drives Better Cost Performance

Relative Capital Cost (Industry Average = 1.0)

- **FEL Improvement Only**
- **FEL Improvement Plus Value Improving Practices**

FEL Rating:
- **Best Practical**
- **Good**
- **Fair**
- **Poor**
- **Screening**

Independent Project Analysis
Elements of Best Practical Level of Definition at the Time of Project Authorization

Site Factors

- Finalized equipment location / plot plan
- Environmental permits applied for
- Health and safety reviews (e.g., HAZOP) completed
- Soil and site conditions understood

Engineering

- Key engineering deliverables completed (e.g., PFDs, P&IDs, Equipment specifications)

Project Execution Plans

- Execution plan developed (e.g., contracting strategy, schedule, startup plans)
Elements of Capital Effectiveness

Key Leading Indicators
Independent Project Analysis

Key Performance Indicators

- Business Strategy
- Technology Strategy
- Teams
- Leading Technology
- Use of Value Improving Practices
- Front-End Loading
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Cost
Schedule
Operability

SAFETY
BETTER IRR
Defining Value Improving Practices

VIPs are out-of-the-ordinary practices used to improve cost, schedule, and/or reliability of capital construction projects

- Used primarily during Front-End Loading
- Formal, documented practices involving a repeatable work process
- Almost always facilitated by specialists from outside the project team
Value Improving Practices

- Technology Selection
- Process Simplification
- Classes of Facility Quality
- Waste Minimization
- Constructability Review (1)
- Process Reliability Modeling
- Minimum Standards and Specifications
- Predictive Maintenance
- Design-to-Capacity
- Energy Optimization
- 3D CAD (through execute)
- Value Engineering (2)
- Constructability Review (2)
- Constructability Review (3)

Authorization

Project Phase
- Business Planning
- Facility Planning
- Project Planning
- Execute
- Operate

Independent Project Analysis
How Does a Practice Become a VIP?

• There are dozens of special practices used in the industry that are possible VIPs:
  – Decision Risk Analysis
  – Team-building, etc.

• Only practices with a demonstrated, statistically reliable connection between use and better outcomes are deemed VIPs
Elements of Capital Effectiveness

- Business Strategy
- Technology Strategy

- Teams
- Leading Technology
- Use of Value Improving Practices
- Front-End Loading

- Optimal Scope for Business Needs
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Key Leading Indicators

Key Performance Indicators

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Cost
Schedule
Operability
New Technology

• New process technology continues to be essential to success in the process industries
  – Innovation yields lower costs for commodities
  – Innovation is the key to margins in specialties and pharmaceuticals
  – Innovation is sometimes forced by regulators
The Business Stake -- Does New Technology Pay Off?*

- An investment of $1.00 in chemical R&D yields, on average, $2.60 in operating profits in later years.
- The bulk of the investment is realized 3-5 years after the investment and continues for 8 years.
- Large firms are getting a bigger payoff than smaller firms ($2.86 vs. $1.79 for each R&D $1.00).

* Based on the work of Lev and Aboody as described in Chemical and Engineering News, September 2000.
Rate of Innovation in Process Industries

Independent Project Analysis
New Technology Projects Contain Risks Different Than Off-the-Shelf Technology Projects

- Cost Deviation
- Contingency Use
- Startup Duration Slip
- Early Performance (Second 6 months of operation)

New Technology Projects Contain Risks Different Than Off-the-Shelf Technology Projects

Independent Project Analysis
New Technology Drives Cost Down

Independent Project Analysis

Cost Index

Percent Capital Investment in New Technology
(Controlling for other factors)
Implementing New Technology

- New technology projects are much riskier enterprises
  - More cost growth
  - Longer cycle times (but not longer execution)
  - Much poorer startups
  - More frequent long-term operability problems
- All of the risks can be managed down to acceptable levels
Key Practices for Successful Implementation of New Technology Projects

- Recognize an innovative project -- business and technical difficulty
- Schedule by Accomplishment (Good engineering cannot substitute for basic engineering data)
- Thoroughly define the project
- Ensure an effective team
Elements of Capital Effectiveness

Key Leading Indicators
Independent Project Analysis

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