Overview of the Global Project Landscape

Advanced Work Packaging Conference 2014

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- Lecturer, Researcher, and Consultant in the benchmarking of capital projects
- Program Management Expert
- Former employee of Fluor (Constructability Coordinator and Field Engineer), Phillips Petroleum, Bechtel, ePM, and Texas State University
Construction Productivity Decline

Productivity Index (1964-1999)
(Constant $ of contracts / workhours of hourly workers)

All Non-Farm Industries
+1.71%

Construction Industry
-.48%

Source: Journal of Construction Engineering and Management (Sept./Oct. 2001)
Actual / Estimated Peak Construction Workforce

![Graph showing the relationship between actual/estimated peak construction workforce and project cost growth](image-url)
PROJECT PERFORMANCE PREDICTABILITY RESEARCH (IMPACT ON FINANCIAL RETURNS)
CII Owners’ Capital Efficiency
(Ratio of Cash Flow (CFfOA) to Construction In Progress (CIP))

- Early 1990s Recession: 3.68 (1999)
- Early 2000s Recession: 3.68 (1999)
- Late 2000s Recession: 2.53 (2012)

N=64
Correlation between Construction In Progress (CIP) and Cash Flow (CFfOA) for CII Owners

- Correlation Coefficient (between CIP and CFfOA): N=64
- Year: 1990-2011
- R² = 0.88
  - 95.2% (1991)
  - 20.2% (2008)
CII Owners’ Weighted Average Cost of Capital (WACC)

- **Avg. WACC = 8.2%**
- **R² = 0.7079**
- **N=64**
Capital Project Performance - CII Owners

Owner (N_{total}=975)

N=310 (31.8%)
Avg. Cost Growth = -10.2%
Avg. Schedule Growth = 29.1%

N=239 (24.5%)
Avg. Cost Growth = 16.2%
Avg. Schedule Growth = 32.0%

N=53 (5.4%)
Avg. Cost Growth = -0.47%
Avg. Schedule Growth = 0.24%

N=271 (27.8%)
Avg. Cost Growth = -12.7%
Avg. Schedule Growth = -8.2%

N=102 (10.5%)
Avg. Cost Growth = 12.3%
Avg. Schedule Growth = -9.8%

69.7% Projects Not Shown
Cash Flow for an “Average” CII Owner Project

Slope of Revenue = 2.7% per year
(Incremental Rate of Corporate CFFOA)

“Average” CII Owner Projected Cash Flow

IRR = 14.1%
(Morningstar Estimated Hurdle Rate for Oil and Gas Companies = 14.7%)
Cash Flow Diagram for an “Average” CII Owner
(Includes Forecast 2012 - 2016)

Predicted CIP
Predicted CFfOA
UCL_CIP
LCL_CIP
LCL_CFfOA
UCL_CFfOA

-$4,000
-$3,000
-$2,000
-$1,000
$0
$1,000
$2,000
$3,000
$4,000
$5,000
$6,000
$7,000


Year
Cash Flow ($ Million)

$4.107 Billion (2012)

-$2.165 Billion (2012)

Source: Capital IQ Courtesy of McCombs School of Business, UT Austin
Scenario 1: High Cost and Schedule Growth

**As-Is Cash Flow**
- Cost Growth = 16.2%
- Schedule Growth = 32.0%

**To-Be Cash Flow**
- NPV\textsubscript{Target} = $7.6 Billion
- NPV\textsubscript{Scenario 1} = $5.7 Billion

25.3% Loss of NPV
Scenario 2: Low Cost and Schedule Growth

Cost Growth = -12.7%
Schedule Growth = -8.2%

NPV\textsubscript{Target} = $7.6 Billion
NPV\textsubscript{Scenario 2} = $6.8 Billion
11.1\% Loss of NPV
Net Present Value (Forecast for 2012-2016)

Owner (N_{Total}=975)

- NPV = $6.4 Billion
- NPV = $5.7 Billion
- NPV = $6.6 Billion
- NPV = $6.8 Billion
- NPV = $7.7 Billion

Expected NPV = $6.5 Billion
## NPV Impact of Suggested P.M. Practices

<table>
<thead>
<tr>
<th>Practices</th>
<th>Expected NPV</th>
<th>Gain/Loss</th>
<th>Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>CII Owners’ Average</td>
<td>$6.45 Billion</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Contract Method</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lump Sum</td>
<td>$6.81 Billion</td>
<td>$360 Million</td>
<td>5.5%</td>
</tr>
<tr>
<td>Cost Reimbursable</td>
<td>$5.50 Billion</td>
<td>-$950 Million</td>
<td>-14.8%</td>
</tr>
<tr>
<td>Working Relationship</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Work w/ CII Contractor</td>
<td>$6.80 Billion</td>
<td>$350 Million</td>
<td>5.3%</td>
</tr>
<tr>
<td>Work w/ Non-CII Contractor</td>
<td>$4.61 Billion</td>
<td>-$1,840 Million</td>
<td>-28.5%</td>
</tr>
<tr>
<td>PDRI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;=200</td>
<td>$6.48 Billion</td>
<td>$30 Million</td>
<td>0.5%</td>
</tr>
<tr>
<td>&gt;200</td>
<td>$6.10 Billion</td>
<td>-$360 Million</td>
<td>-5.6%</td>
</tr>
<tr>
<td>Planning for Startup</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High Use</td>
<td>$6.45 Billion</td>
<td>$0 Million</td>
<td>0.0%</td>
</tr>
<tr>
<td>Low Use</td>
<td>$6.23 Billion</td>
<td>-$220 Million</td>
<td>-3.4%</td>
</tr>
</tbody>
</table>

### Best Strategy to Maximize Expected NPV

- Lump Sum Contract, Working with CII Contractor, PDRI<=200, and High Use of Planning for Startup

\[ \sqrt{($360)^2 + ($350)^2 + ($30)^2 + (0)^2} = $496 \text{ Million} \]

- Expected NPV can increase $496 Million
- Expected NPV can decrease $2,113 Million
Opportunity Exists To Improve

- Target NPV: $7.65 B
- Expected NPV: $6.45 B
- B.P. Enhanced NPV: $6.95 B
- Optimal NPV: $8.00 B

KNOWN

UNKNOWN (RESEARCH)
PROJECT PHASE PERFORMANCE RESEARCH (IMPACT ON SCHEDULE)
CII Phase Duration Research (2011-Present)

- Normalized $250 MM Projects
- C/R (Blue) vs. L/S (Red) Contracting

<table>
<thead>
<tr>
<th>Normalized Project Execution Duration for $250 Million Project Between Cost Reimbursable and Lump Sum</th>
<th>Duratio n (weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering - Cost Reimbursable; Construction - Cost Reimbursable</td>
<td>68</td>
</tr>
<tr>
<td>Procurement</td>
<td>77</td>
</tr>
<tr>
<td>Construction</td>
<td>77</td>
</tr>
<tr>
<td>Engineering - Lump Sum; Construction - Lump Sum</td>
<td>71</td>
</tr>
<tr>
<td>Procurement</td>
<td>77</td>
</tr>
<tr>
<td>Construction</td>
<td>100</td>
</tr>
</tbody>
</table>

Notes: the project cost ranges from $25 Million to $500 Million (in 2009 dollars)
## Procurement Involvement in FEP

**Construction Industry Institute**

### Analyzed by: BMM Team
*Each project's cost was normalized to $250 MM*

#### 100% FEP complete prior to Procurement start (n=37 projects)

<table>
<thead>
<tr>
<th>Weeks</th>
<th>FEP</th>
<th>Design</th>
<th>Procurement</th>
<th>Construction</th>
<th>Startup</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>75 weeks</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>10</td>
<td></td>
<td>85 weeks</td>
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<tr>
<td>15</td>
<td></td>
<td></td>
<td>102 weeks</td>
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<td>20</td>
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<td>78 weeks</td>
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<td>25</td>
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<td></td>
<td>22 weeks</td>
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<tr>
<td>30</td>
<td></td>
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<tr>
<td>35</td>
<td></td>
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</tr>
</tbody>
</table>

#### 100% FEP complete prior to Procurement start (n=97 projects)

<table>
<thead>
<tr>
<th>Weeks</th>
<th>FEP</th>
<th>Design</th>
<th>Procurement</th>
<th>Construction</th>
<th>Startup</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>62 weeks</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>10</td>
<td></td>
<td>91 weeks</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>15</td>
<td></td>
<td></td>
<td>92 weeks</td>
<td></td>
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<tr>
<td>20</td>
<td></td>
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<td></td>
<td>93 weeks</td>
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<tr>
<td>25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25 weeks</td>
</tr>
</tbody>
</table>

### Weeks to Complete

- **35 Weeks**
- **40 Weeks**
Arrangement of Phases

LEGEND

Duration in %

Richard

Mean

Phases

Front-End Planning
Design/Engineering
Procurement
Construction
Start-UP

Overall Duration

Heavy (D=0.32%)
Light (D=0.24%)

Heavy (D=0.41%)
Light (D=0.34%)

Heavy (D=0.45%)
Light (D=0.46%)

Heavy (D=0.41%)
Light (D=0.52%)

Heavy (D=0.07%)
Light (D=0.21%)
Engineering Phase

- Impact of Design Efficiency

- 74% impact of design efficiency with p=0.063
5 Principles of Project Integration

- Work and Work Process
- Organizational Engineering
- Leadership and Governance
- Communications and Information Flow
- Business Environment and Culture
Communication and Information Flow

- Communicate Too Much or Not Enough?
- Lines of Communication = \( \frac{n(n-1)}{2} \)

<table>
<thead>
<tr>
<th># Project Team Members</th>
<th># Lines of Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>21</td>
</tr>
<tr>
<td>15</td>
<td>105</td>
</tr>
<tr>
<td>50</td>
<td>1225</td>
</tr>
<tr>
<td>100</td>
<td>4950</td>
</tr>
<tr>
<td>500</td>
<td>124750</td>
</tr>
</tbody>
</table>
Interface Mgmt. vs. Project Cost Growth

- Formal IM projects had lower mean of cost growth and less standard deviation.
Advanced Work Packaging?
Advanced Work Packaging?
Program(me) Management

- The coordinated management of a portfolio of projects to achieve a set of business objectives (CCTA 1995)
Programmatic Change Management

- Change Management System
  - Wal-Mart makes 170 changes per month to Supercenter prototype
Questions?

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