COAA Benchmarking and Metrics Program

COAA Best Practices Conference XX
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Associate Director
CII History

- CII is an Organized Research Unit (ORU) of the Cockrell School of Engineering at the University of Texas at Austin
- Founded in 1983 by 29 companies; now 115+ members
- Purpose is to MEASURABLY improve the delivery of capital facilities
- First structured owner-contractor-academic research collaboration for the constructed project.
- The industry forum for the engineer-procure-construct process.
Owner CII Members

Abbott
Air Liquide
Air Products and Chemicals
Ameren Corporation
American Transmission Co.
Anheuser-Busch InBev
Aramco Services Company
Archer Daniels Midland Co.
Architect of the Capitol
Barrick Gold Corporation
BP America
Bristol-Myers Squibb Co.
Cargill, Inc.
Chevron
CITGO Petroleum
ConocoPhillips
The Dow Chemical Company
DuPont
Eastman Chemical Company

Ecopetrol S.A.
Eli Lilly and Company
Eskom Holdings Limited
ExxonMobil Corporation
GlaxoSmithKline
Hovensa, LLC
International Paper
Irving Oil Limited
Kaiser Permanente
Koch Industries
LyondellBasell
Marathon Oil Corporation
NASA
NOVA Chemicals Corp.
Occidental Petroleum Corp.
Ontario Power Generation
Petrobras
Praxair, Inc.
The Procter & Gamble Co.

SABIC
Sasol Technology
Shell Global Solutions US
Smithsonian Institution
Southern Company
Statoil ASA
Teck Resources Limited
Tennessee Valley Authority
TransCanada Corporation
U.S. Army Corps of Engineers
U.S. Dept. of Commerce/NIST/ Bldg. and Fire Research Lab
U.S. Dept. of Energy
U.S. Dept. of Health & Human Services
U.S. Dept. of State
U.S. General Service Administration
Contractor CII Members

Aker Solutions  
Alstom Power  
AMEC  
Apex Engineering  
AZCO INC.  
Baker Concrete Construction  
Bateman Engineering N.V.  
Bechtel Group  
Bentley Systems  
BIS Frucon Industrial Services  
Black & Veatch  
Burns & McDonnell  
CB&I  
CCC Group  
CDI Engineering Solutions  
CH2M HILL  
Coreworx  
CSA Group  
Day & Zimmermann  
Dresser-Rand Company  
Emerson Process Management  
eProject Management, LLC  
Faithful+Gould  
Flad & Associates  
Flint Energy Services  
Fluor Corporation  
Foster Wheeler USA Corporation  
Grinaker-LTA/E+PC  
Gross Mechanical Contractors  
GS Engineering & Construction  
Hargrove Engineers+ Constructors  
Hilti Corporation  
Industrial Contractors  
IDEA  
Jacobs  
JMJ Associates  
KBR  
Lauren Engineers & Constructors  
M. A. Mortenson Company  
McDermott International, Inc.  
Midwest Steel  
Mustang  
Oracle USA  
Parsons  
Pathfinder LLC  
Quality Execution  
S&B Engineers and Constructors  
The Shaw Group  
Siemens Energy  
SNC-Lavalin  
Technip  
URS Corporation  
Victaulic Company  
Walbridge  
Wanzek Construction  
WorleyParsons  
Zachry Holdings  
Zurich
CII Benchmarking & Metrics (BM&M)

- 2,049 projects entered since 1995, valued at over $133 billion
- Confidential
- Cost Effective
- Compelling, Focused Metrics
  - unique measures of CII Best Practices and productivity for engineering and construction
  - external performance benchmarks of safety, cost, schedule, change, and rework
- Unique Approach
- Experienced
  - Competent, Professional Staff
WHY BENCHMARKING?
Trim Capital Spending by 25%

- McKinsey & Company

“The management of capital investment has an enormous effect on profitability and competitiveness, yet few companies do it effectively. We believe that the use of evaluation tools, disciplined processes, and best practices can help companies trim capital spending by up to a quarter without reducing capacity or functionality - and improve their operating costs and revenues through better investment decisions.”
National Research Council (2009)

• Advancing the Competitiveness and Efficiency of the U.S. Construction Industry
  – Opportunities for Breakthrough Improvements:
    • Widespread Use of Interoperable Technology Applications (BIM)
    • Improved Jobsite Efficiency (Effective Interfacing of People, Processes, Materials, Equipment and Information)
    • Greater Use of Prefabrication, Preassembly, Modularization, and Offsite Fabrication (PPMOF) Techniques and Processes
    • Innovative, Widespread Use of Demonstration Installations
    • **Effective Performance Measurement to Drive Efficiency and Support Innovation**
HOW DOES COAA BENCHMARK CAPITAL PROJECTS?
COAA Benchmarking Process

Three-step Process

1. Online Questionnaire
2. Benchmarking Database
3. Data Mining and Reporting Engine
COAA Benchmarking Roles

- **Board of Advisor**: BOA
- **Benchmarking Manager**: BMMAN
- **Benchmarking Associate**: BMWASSOC
- **Project Manager**: BMPM, BMPM, BMPM
### General Benchmarking Questionnaire

#### Currently editing - BMMAN TESTs

<table>
<thead>
<tr>
<th>General Project Info</th>
<th>Performance</th>
<th>Practices</th>
<th>Engineering Productivity</th>
<th>Construction Productivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Description</td>
<td>Budgeted &amp; Actual Project Costs</td>
<td>Front End Planning</td>
<td>Instructions</td>
<td>Instructions</td>
</tr>
<tr>
<td>Project Information</td>
<td>Planned &amp; Actual Project Schedule</td>
<td>Alignment</td>
<td>Concrete</td>
<td>Concrete</td>
</tr>
<tr>
<td>Project Scope</td>
<td>Achieving Facility Capacity</td>
<td>Partnering</td>
<td>Structural Steel</td>
<td>Structural Steel</td>
</tr>
<tr>
<td>Project Management Team</td>
<td>Project Outcomes</td>
<td>Team Building</td>
<td>Electrical</td>
<td>Electrical</td>
</tr>
<tr>
<td>Union Site Construction Workforce</td>
<td>Work Hours &amp; Safety Data</td>
<td>Project Delivery</td>
<td>Piping</td>
<td>Piping</td>
</tr>
<tr>
<td>Engineering Deliverables</td>
<td>Project Environment impacts</td>
<td>Constructability</td>
<td>Instrumentation</td>
<td>Instrumentation</td>
</tr>
<tr>
<td>Contract Type &amp; Alliance</td>
<td>Risk Assessment</td>
<td>Change Management</td>
<td>Equipment - Part1</td>
<td>Equipment - Part1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Zero Accident Techniques</td>
<td>Equipment - Part2</td>
<td>Equipment - Part2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Benchmarking</td>
<td>Direct Hire/Contract/Off-Shore</td>
<td>Insulation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Planning For Start Up</td>
<td>Technology Use</td>
<td>Scaffolding</td>
</tr>
</tbody>
</table>

**Project Process Legend:** Not Started  In Progress
# Project Key Reports

## Test General Large - Contractor

### General Performance Key Report

**Report Date:** 19/05/2011

### Project General Information

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Testco</th>
<th>Respondent Type (RT)</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project ID</td>
<td>CII009219</td>
<td>Questionnaire Type (QT)</td>
<td>General Benchmarking (Large)</td>
</tr>
<tr>
<td>Location</td>
<td>United States</td>
<td>Location Category (LC)</td>
<td>Domestic</td>
</tr>
<tr>
<td>Project Cost</td>
<td>USD $ 91,846,000.00</td>
<td>Company Involvement (CI)</td>
<td>Design and Construct</td>
</tr>
<tr>
<td>Site Work Hours</td>
<td>4,000,000.00</td>
<td>Industry Group (IG)</td>
<td>Heavy Industrial</td>
</tr>
<tr>
<td>Overall Project Duration</td>
<td>988 Days</td>
<td>Project Type (PT)</td>
<td>Oil Sands SAGD</td>
</tr>
<tr>
<td>Design thru Startup Duration</td>
<td>988 Days</td>
<td>Project Nature (PN)</td>
<td>Grass Roots</td>
</tr>
<tr>
<td>Midpoint of Construction</td>
<td>04/15/2007</td>
<td>Cost Category (CC)</td>
<td>$50MM - $100MM</td>
</tr>
</tbody>
</table>

### Key Report Legend

- **Q1, Q2, Q3 and Q4 stands for the 1st, 2nd, 3rd and 4th quartile respectively. If the Quartile cell is colored, Q1 represents best performance and Q4 represents worst performance.**
- **If the quartile cell is not colored, Q1 represents the group with the highest metric value, while Q4 represents the group with the lowest metric value. (For these metrics, lower or higher scores are not necessary better.)**
- **UO indicates an upper outlier with an extremely high metric value, LO indicates a lower outlier with an extremely low metric value.**
- **C indicates that the benchmarking result is suppressed because the comparison dataset doesn’t meet minimum requirements to ensure confidentiality (i.e., 10 or more projects from 5 or more companies).**
- **✓ indicates the comparison criteria indicates that the comparison dataset has the same specific characteristic as your project.**
- **Asterisk (*) on the n value denotes a small sample of projects (between 10 & 20).**

### General Performance - Cost

<table>
<thead>
<tr>
<th>Metric</th>
<th>Project Score</th>
<th>CII Database Mean</th>
<th>Quartile</th>
<th>Comparison Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Cost Growth</td>
<td>0.031</td>
<td>0.010</td>
<td>Q3</td>
<td>✔️ ✔️ ✔️ ✔️ all ✔️ ✔️ 19 *</td>
</tr>
<tr>
<td>Delta Cost Growth</td>
<td>0.031</td>
<td>0.002</td>
<td>Q1</td>
<td>✔️ ✔️ ✔️ ✔️ all ✔️ ✔️ 19 *</td>
</tr>
<tr>
<td>Project Budget Factor</td>
<td>0.970</td>
<td>0.950</td>
<td>Q3</td>
<td>✔️ ✔️ ✔️ ✔️ all ✔️ ✔️ 18 *</td>
</tr>
<tr>
<td>Delta Budget Factor</td>
<td>0.030</td>
<td>0.010</td>
<td>Q2</td>
<td>✔️ ✔️ ✔️ ✔️ all ✔️ ✔️ 19 *</td>
</tr>
<tr>
<td>Detail Engineering Cost Growth</td>
<td>0.026</td>
<td>0.068</td>
<td>Q2</td>
<td>✔️ ✔️ ✔️ ✔️ all ✔️ ✔️ 15 *</td>
</tr>
<tr>
<td>Procurement Cost Growth</td>
<td>0.036</td>
<td>-0.040</td>
<td>Q3</td>
<td>✔️ ✔️ ✔️ ✔️ all ✔️ ✔️ 17 *</td>
</tr>
<tr>
<td>Construction Cost Growth</td>
<td>0.048</td>
<td>0.011</td>
<td>Q3</td>
<td>✔️ ✔️ ✔️ ✔️ all ✔️ ✔️ 15 *</td>
</tr>
<tr>
<td>Startup Cost Growth</td>
<td>c</td>
<td>c</td>
<td>c</td>
<td>✔️ ✔️ ✔️ ✔️ all ✔️ ✔️ c</td>
</tr>
</tbody>
</table>
PAS – Data Miner

The image shows a screenshot of the PAS Data Miner interface. The interface is designed to analyze data related to various project metrics such as performance, cost, and project cost growth. The user can select different variables and metrics to customize the analysis. The Quartile Chart on the right side displays project cost growth data, with quartiles representing different time periods. The chart includes options for selecting the type of analysis, such as comparing different project priorities and examining specific project characteristics like schedule, cost, and project nature.
PAS – Integration with Corporate Systems is Important

- Timberline [Estimating]
- Web Interface [GUI]
- Advisor [Benchmarking]
- P6 [scheduling]
- Unifier [cost control]
- SAP [accounting]
WHAT ARE THE RESULTS?
Owner “1”

- PDRI vs. Project Cost Growth
Contractor “1”

- BPIS vs. Project Budget Factor
Project-Level Engineering Productivity

- 11% Improvement (2\textsuperscript{nd} to 1\textsuperscript{st} Quartile)

- 26% Improvement (4\textsuperscript{th} to 1\textsuperscript{st} Quartile)
Actual / Estimated Peak Construction Workforce

![Graph showing the relationship between Actual/Estimated Peak Construction Workforce and Project Cost Growth. The graph includes a scatter plot with data points and a trend line.](image-url)
Construction Indirect Cost Growth

![Graph showing Construction Indirect Cost Growth vs. Adjusted Total Project Cost ($M CDN, in 2007)]
Best Practices

Percent of Projects with High Best Practice Use

<table>
<thead>
<tr>
<th>Practice</th>
<th>Owner</th>
<th>Contractor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change Management</td>
<td>85%</td>
<td>82%</td>
</tr>
<tr>
<td>Zero Accident Technique</td>
<td>59%</td>
<td>81%</td>
</tr>
<tr>
<td>Planning for Startup</td>
<td>60%</td>
<td>73%</td>
</tr>
<tr>
<td>Front End Planning</td>
<td>61%</td>
<td>63%</td>
</tr>
<tr>
<td>Alignment during FEP</td>
<td>44%</td>
<td>55%</td>
</tr>
<tr>
<td>Project Delivery &amp; Contract Strategy</td>
<td>35%</td>
<td>33%</td>
</tr>
<tr>
<td>Project Risk Assessment</td>
<td>32%</td>
<td>28%</td>
</tr>
<tr>
<td>Constructability</td>
<td>28%</td>
<td>29%</td>
</tr>
<tr>
<td>Team Building</td>
<td>28%</td>
<td>28%</td>
</tr>
<tr>
<td>Partnering</td>
<td>16%</td>
<td>11%</td>
</tr>
</tbody>
</table>
The Benchmarking Dilemma

Value of External Benchmarking

Projects’ Use of External Benchmarking
Benchmarking Lessons Learned

• Senior management buy-in is vital to success, and hard to achieve
• A company champion is essential, but often not enough
• No one wants to be at the bottom
• “My project is special”
WHAT ARE THE POTENTIAL PITFALLS?
Potential Pitfalls

• Benchmarking is NOT Estimating
  – Good PM Practice: Develop Ground-Up Estimate
  – Measure Project (Process), NOT Product

• Ignoring Tools / Proven Best Practices
  – PDRI, PHI, PFS
  – FEP, Partnering, Constructability, etc.

• Not Benchmarking
  – No Objective Measures of Performance
  – No Understanding of Where to Improve
DEMO:
COAA PERFORMANCE ASSESSMENT SYSTEM (PAS)