Construction Performance Committee Workshop

‘From Lagging to Leading’
Benchmarking Phase 3: 10-10 Program

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Associate Director – Capital Project Analytics

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Goals

- 10-10 Program concept
- Correlating Performance – Leading/Lagging
- Applied Research with Best Practices
Brief Background of CII

- Founded in 1983 by 28 organizations; now ~130
- An Organized Research Unit of the Cockrell School of Engineering at the University of Texas at Austin
- First structured Owner-Contractor-Academic research collaboration for the constructed project
- Focused on improving capital projects’ execution (safety, productivity, cost and schedule effectiveness)
- Focused on using capital projects to drive business results
CII Structure
CII Performance Assessment

TimeLine

1980s

1990s

2000s

2010s

General Program

1999 Safety Survey

Pharma Program

2011 Productivity Benchmarking Report

COAA Phase 3

Health Care Benchmarking

COAA

Construction Owners Association of Alberta

COAA

Construction Owners Association of Alberta
Phased Based Measurement

‘Old School’ Project Management

Phase-Gate Based Project Management

The “Hidden” Projects
Phased Based Measurement

General Benchmarking
Process, Practice

10-10 Benchmarking
People, Practice

Benchmark (CII PAS)

CII 10-10 Phase Questionnaires

CII 10-10 Phase Questionnaire
CII 10-10 Program

- Performance Assessment System with simple and important indicators
  - 10 Leading Indicators
  - 10 Lagging Indicators

- Assesses project performance and team performance
- Provides **actionable** information
- Based on CII research
Leading Indicators

- Assessing Practices and Working Relationships
- Capturing the opinion of multiple team members, anonymously
- Tests the Implementation, Adoption, Culture and Maturity of practices
Leading Indicators

1. Planning
2. Organizing
3. Leading
4. Controlling
5. Human Resources
6. Quality
7. Sustainability
8. Supply Chain
9. Safety/EHS
10. Design Efficiency
Planning:
• To predetermine a course of action
• Forecasting, Objective Setting, Program Development, Scheduling, Budgeting, and Policies and Procedures Development.

Organizing:
• To arrange and relate the work to be done so people can perform it most effectively
• Development of Organization Structure, Delegation of Responsibility and Authority, and Establishment of Relationships.
10 Leading Indicators

**Leading:**
- To cause people to take effective action
- Decision-Making, Communications, Motivation, Selection of People, and Development of People

**Controlling:**
- To assess and regulate work in progress and completed
10 Leading Indicators

**Design Efficiency:**
- Exploiting techniques to optimize the design
- Use of material quantities
- Maximum capacity at minimum cost

**Human Resources:**
- Appropriately staffed
- Minimum turnover
- Appropriate training
- Capability maturity

**Quality:**
- Direct conformance to project requirements
- Assure the delivery of material goods as intended
10 Leading Indicators

Sustainability:
  • Environmental impact of the project during construction and operation

Supply Chain Management:
  • Promote enhanced working relationships amongst all project stakeholders including those in the project supply chain

Safety:
  • Eliminate any possibility of personal injury or property damage on the project.
Leading Indicator Survey

Questions are:
- Yes/No
- 5-point scales (strongly agree - strongly disagree)
- Multiple choice questions

The interfaces between project stakeholders were well-managed.
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree

The availability and competency of craft labor was adequate
A. Strongly Agree
B. Agree
C. Neutral
D. Disagree
E. Strongly Disagree
## Leading Indicators

### Assessing Practices and Working Relationships

<table>
<thead>
<tr>
<th>Question</th>
<th>Mean (SD)</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>22 The project team was well aligned in terms of the owner's objectives, needs and expectations.</td>
<td>2.67 (1.17)</td>
<td>6</td>
<td>17%</td>
<td>33%</td>
<td>17%</td>
<td>17%</td>
</tr>
<tr>
<td>36 All of the necessary, relevant project team members were involved in the risk assessment process.</td>
<td>2.67 (1.03)</td>
<td>6</td>
<td>33%</td>
<td>67%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38 Leadership effectively communicated business objectives, priorities, and project goals.</td>
<td>2.50 (1.51)</td>
<td>6</td>
<td>50%</td>
<td>17%</td>
<td>17%</td>
<td>33%</td>
</tr>
<tr>
<td>45 The project's work processes and systems (e.g., document management, project controls, business and financial systems) supported project success.</td>
<td>2.50 (1.51)</td>
<td>6</td>
<td>17%</td>
<td>17%</td>
<td>17%</td>
<td>60%</td>
</tr>
<tr>
<td>18 The Front End Planning process included sufficient resources necessary to adequately define the scope.</td>
<td>2.50 (1.17)</td>
<td>6</td>
<td>17%</td>
<td>59%</td>
<td>17%</td>
<td>35%</td>
</tr>
<tr>
<td>20 The project team members were familiar with the project execution plan (PEP) and they used it to manage their work.</td>
<td>2.50 (1.26)</td>
<td>6</td>
<td>50%</td>
<td>17%</td>
<td>17%</td>
<td>17%</td>
</tr>
<tr>
<td>21 The Procurement strategy and plan were developed and communicated to the project team during Front End Planning.</td>
<td>2.50 (1.22)</td>
<td>6</td>
<td>25%</td>
<td>60%</td>
<td>17%</td>
<td></td>
</tr>
</tbody>
</table>
Leading Indicators

Relevance of multiple responses

Formal classroom safety training was attended:

- 11%
- 67%
- 11%
- 11%

Was there a formal new hire safety orientation process?

- 87%
- 11%
- 11%
- 11%

Did an owner representative participate in the orientation?

- 22%
- 22%
- 33%
- 22%

Was safety performance a criterion for contractor and subcontractor selection?

- 44%
- 56%

Were safety toolbox meetings held daily?

- 44%
- 44%
- 11%

3.44
3.00
2.89
2.89
2.78

3.00
Project Average Score
Leading Indicators
Assessing Practices and Working Relationships

<table>
<thead>
<tr>
<th></th>
<th>Individual Input Measures - 1 Surveys</th>
<th>Mean</th>
<th>SD</th>
<th></th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>The Front End Planning process included sufficient resources necessary to adequately define the scope.</td>
<td>5.00</td>
<td>1</td>
<td>100%</td>
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</tr>
<tr>
<td>23</td>
<td>The project execution plan supported the objectives of this project.</td>
<td>5.00</td>
<td>1</td>
<td>100%</td>
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<tr>
<td>24</td>
<td>The Front End Planning process adapted to changes in project objectives or market conditions.</td>
<td>5.00</td>
<td>1</td>
<td>100%</td>
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<tr>
<td>26</td>
<td>The project had an effective risk identification and management process.</td>
<td>5.00</td>
<td>1</td>
<td>100%</td>
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<tr>
<td>27</td>
<td>Preassembly, prefabrication, modularization, and offsite fabrication were thoroughly evaluated during Front End Planning.</td>
<td>5.00</td>
<td>1</td>
<td>100%</td>
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<tr>
<td>32</td>
<td>People on this project worked effectively as a team.</td>
<td>5.00</td>
<td>1</td>
<td>100%</td>
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<tr>
<td>36</td>
<td>All of the necessary, relevant project team members were involved in the risk assessment process.</td>
<td>5.00</td>
<td>1</td>
<td>100%</td>
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</tr>
<tr>
<td>37</td>
<td>Project leaders recognized and rewarded outstanding personnel and results.</td>
<td>5.00</td>
<td>1</td>
<td>100%</td>
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</tbody>
</table>
Questions are mapped to Leading indicators

<table>
<thead>
<tr>
<th>Industrial Projects – Construction Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Question</strong></td>
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<td>17</td>
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<tr>
<td>18</td>
</tr>
</tbody>
</table>
• Understanding Quartiles
• Suppose a group of 40 “similar” projects and how they perform for the planning indicator

N=40
Finding CII resources for specific indicators
# Measurement of Practices

<table>
<thead>
<tr>
<th>Best Practice</th>
<th>FEP</th>
<th>Engineering</th>
<th>Procurement</th>
<th>Construction</th>
<th>Startup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Front End Planning</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Constructability</td>
<td>√</td>
<td></td>
<td>√</td>
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<tr>
<td>Project Risk Assessment</td>
<td>√</td>
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<td>√</td>
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<tr>
<td>Planning for Startup</td>
<td>√</td>
<td>√</td>
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<td>√</td>
<td>√</td>
</tr>
<tr>
<td>Alignment</td>
<td>√</td>
<td></td>
<td></td>
<td>√</td>
<td>√</td>
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<tr>
<td>Team Building</td>
<td>√</td>
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<td>√</td>
<td>√</td>
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<tr>
<td>Change Management</td>
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<td>√</td>
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<tr>
<td>Quality Management</td>
<td></td>
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<td></td>
<td>√</td>
<td></td>
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<tr>
<td>Materials Management</td>
<td></td>
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<tr>
<td>Zero Accident Techniques</td>
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</tbody>
</table>
### Lagging Indicators (Metrics) by Phase

**Table 6: List Output Metrics by Phase**

<table>
<thead>
<tr>
<th>Metrics Type</th>
<th>FEP/PROG</th>
<th>ENGDES</th>
<th>PRO</th>
<th>CON</th>
<th>STA/COM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity-based Metrics</td>
<td></td>
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</tr>
<tr>
<td>Lagging Indicators</td>
<td>(Building) Forecasted Project Cost Efficiency</td>
<td>(Building) Forecasted Project Cost Efficiency</td>
<td>(Building) Forecasted Project Cost Efficiency</td>
<td>(Building) Actual Project Cost Efficiency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Building) FEP (Programming) Cost Efficiency</td>
<td>(Building) Engineering (Design) Cost Efficiency</td>
<td>(Building) Forecasted Total Equipment Cost/Capacity</td>
<td>(Building) Startup (Commissioning) Cost Efficiency</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Building) Forecasted Project Schedule Efficiency</td>
<td>(Building) Engineering (Design) Schedule Efficiency</td>
<td>(Building) Forecasted Project Schedule Efficiency</td>
<td>(Building) Actual Project Schedule Efficiency</td>
<td></td>
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<tr>
<td></td>
<td>(Building) FEP (Programming) Schedule Efficiency</td>
<td>(Building) Engineering (Design) Schedule Efficiency</td>
<td>(Building) Forecasted Project Schedule Efficiency</td>
<td>(Building) Startup (Commissioning) Schedule Efficiency</td>
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<td></td>
<td>(Building) Forecasted Project Schedule Efficiency</td>
<td>(Building) Construction Schedule Efficiency</td>
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<td>(Building) Construction Schedule Efficiency</td>
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<td>(Building) Construction Schedule Efficiency</td>
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<tr>
<td>Phase Burn Metric</td>
<td>7. FEP (Programming) Burn Rate</td>
<td>8. Engineering (Design) Phase Burn Rate</td>
<td>7. Procurement Phase Burn Rate</td>
<td>8. Construction Phase Burn Rate</td>
<td>7. Startup (Commissioning) Phase Burn Rate</td>
</tr>
<tr>
<td>Procurement Metrics</td>
<td></td>
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<td></td>
<td>8. Total Cost of Equipment/Total Number of Major Equipment</td>
<td>9. Total Project Cost/Number of Vendors</td>
<td>10. Total Project Cost/Number of Purchase Orders</td>
<td>8. Startup (Commissioning) Management Team Size/Total Project Cost</td>
<td></td>
</tr>
<tr>
<td>Safety Metrics</td>
<td></td>
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<td>11. TRIR</td>
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<td>12. DART</td>
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</tbody>
</table>
Assessing Project Outcomes

**Construction Cost growth:**

- Actual Cost - Estimated Cost
- Estimated Cost
Assessing Project Outcomes

Matching similar projects:
Start with all Projects: 1,800
- Phase [Construction]: 1,200
  - Respondent [Owner]: 1,000
  - Type [Refining]: 400
  - Capacity Unit [BPD]: 60
CII 10-10 Model

Coordinator

Reports

Lagging/Outcome data

CII Server

Leading Indicators’ Data

SURVEY LINK

Project Team

SURVEY RESULTS
10-10 PERFORMANCE ASSESSMENT FINDINGS
Leading Impact on Lagging

Effect of Leadership

Impact of Safety

Effect of Organizing
CII Best Practice
• A process or method that, when executed effectively, leads to enhanced project performance.
• Proven, through extensive industry use and impact validation

Value of Best Practices
• Project benchmarking is used to understand extent of implementation & impacts
• Value of Best Practices Report is updated/reissued periodically
Assessing the Impact of Practices

What is the impact of practices on phase outcomes?

For 1 unit increase in the Alignment score, Construction Cost Growth decreased, on average, by 7.6%.

We look at the coefficient of x in the regression equation:

\[ y = 0.0762x + 0.4181 \]
To what extent are practices *implemented* across phases?

What’s **HIGH**? … What’s **LOW**?
The Good News

7.4% better cost growth (Owner projects)
7.9% better schedule growth (Owner projects)

7% better schedule growth (Owner projects)
6.1% worse cost growth for Contractor projects with low use of Constructability (2010 VBP)

Opportunities for Improvement
Improvement in PDRI score for one unit increase in practice score

\[ y = -102.49x + 633.63 \]
Improvement in score for one unit increase in practice score

Associations During Engineering Phase

Bar chart showing percent improvement in engineering phase outcomes for Team Building and Materials Management.

- Team Building: 7.1% improvement in engineering cost growth and 7.5% improvement in engineering schedule growth.
- Materials Management: 6.5% improvement in both engineering cost growth and engineering schedule growth.

Legend:
- Engineering Cost Growth
- Engineering Schedule Growth
Construction Phase Associations

Improvement in score for one unit increase in practice score

<table>
<thead>
<tr>
<th>Practice</th>
<th>Percent Improvement in Construction Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment</td>
<td>7.6%</td>
</tr>
<tr>
<td>Team Building</td>
<td>6.7%</td>
</tr>
<tr>
<td>Materials Management</td>
<td>5.9%</td>
</tr>
</tbody>
</table>

Cost Growth

Schedule Growth
Summary of the Findings

1. Several practices had substantial impact on Scope Definition
   • Alignment, Team Building, Risk Management and Constructability

2. High potential for improvement for Materials and Quality Management
   • Especially in the Construction Phase

3. Overall, Alignment and Team Building are significantly correlated with project phase outcomes
   • These BPs still very relevant
Call to Action

Benchmarking Phase 3:
- Targeting 30+ projects in Phase 3
- Launch Leading Indicator ‘10-10’ across project phases
  - Watch for Training schedule from the University of Calgary
  - Benchmarking Support offered directly through the University of Calgary
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For more information, please visit www.10-10program.org.