The Knowledge Leader for Project Success

Owners • Contractors • Academics

COAA Major Projects Benchmarking Program

Phase II (2009 – 2012)

Stephen P. Mulva, Ph.D.
Associate Director
May 19, 2010

Agenda

- Introduction
  - Construction Industry Institute (CII)
  - COAA Alberta Major Projects Benchmarking Program
- Building a Performance Culture
- Best Practices
- Phase II
  - NextGen Benchmarking System
  - University of Calgary
    - Performance Assessment Lab (PAL)
    - Sector-Specific Research
- Questions

CII History

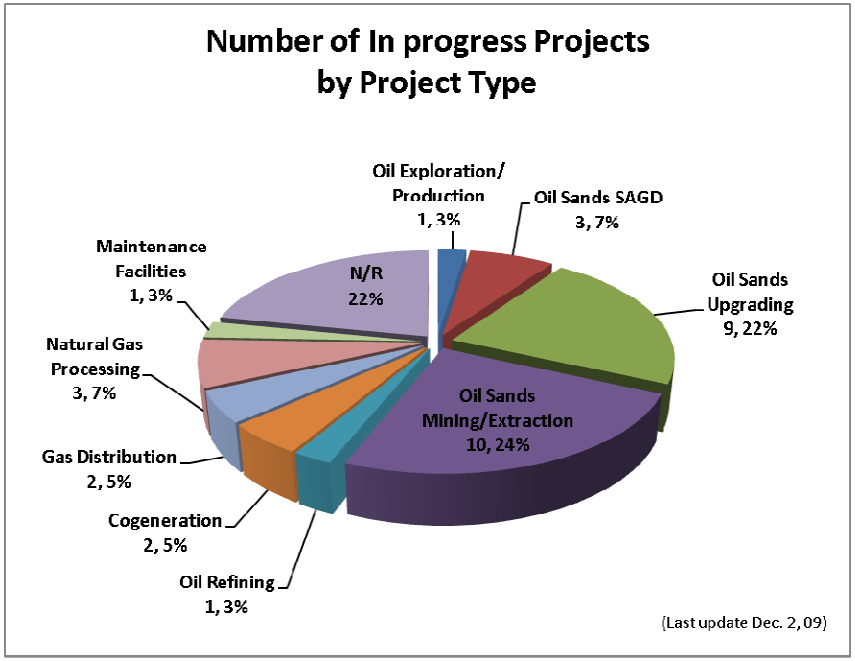
- Established as a recommendation from The Business Roundtable Construction Industry Cost Effectiveness (CICE) Project to address:
  - construction research
  - fragmentation of the industry
- Founded in 1983 by 29 companies; now 110 members
- First to bring research to the engineering-construction world
- First owner-contractor-academic research collaboration for the constructed project
- The principal industry forum for the engineer-procure-construct (EPC) process.

COAA Alberta Major Projects Benchmarking Program

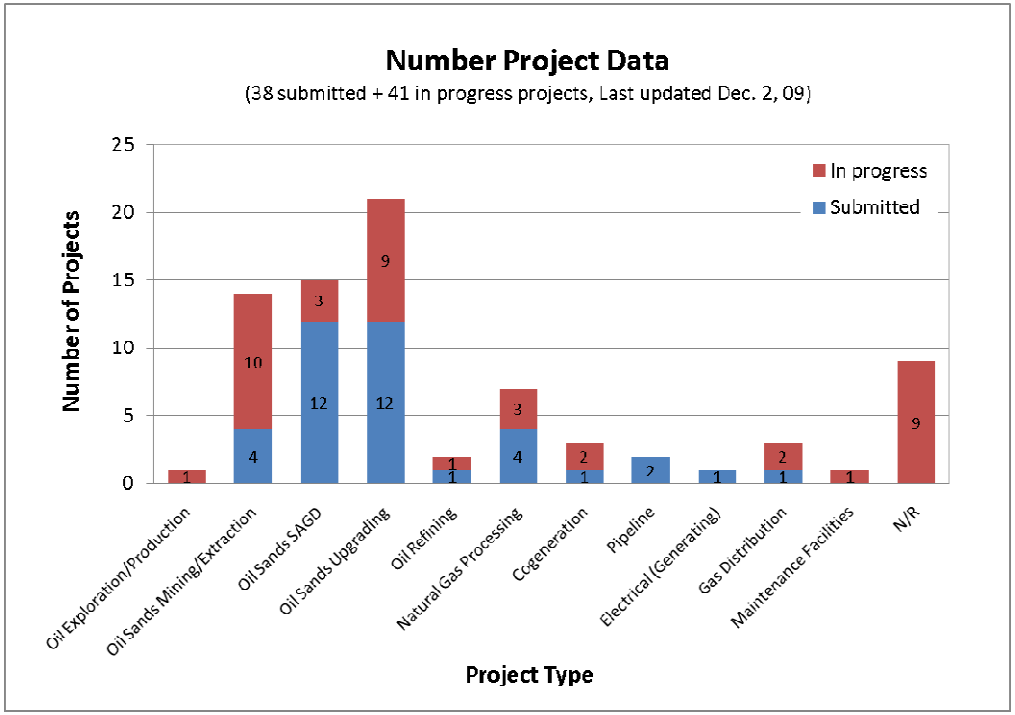
- Completed Phase I May 2009
  - Benchmarked 37 Projects
  - Published “Alberta Report”
- Sponsored by:
  - COAA
  - Government of Alberta, Finance & Enterprise Division
  - COAA Member Companies
- Began Phase II December 2009
  - Additional Development (Metrics / Pipelines)
  - University of Calgary
  - “Alberta Report #2”

Current Status (79 Projects)

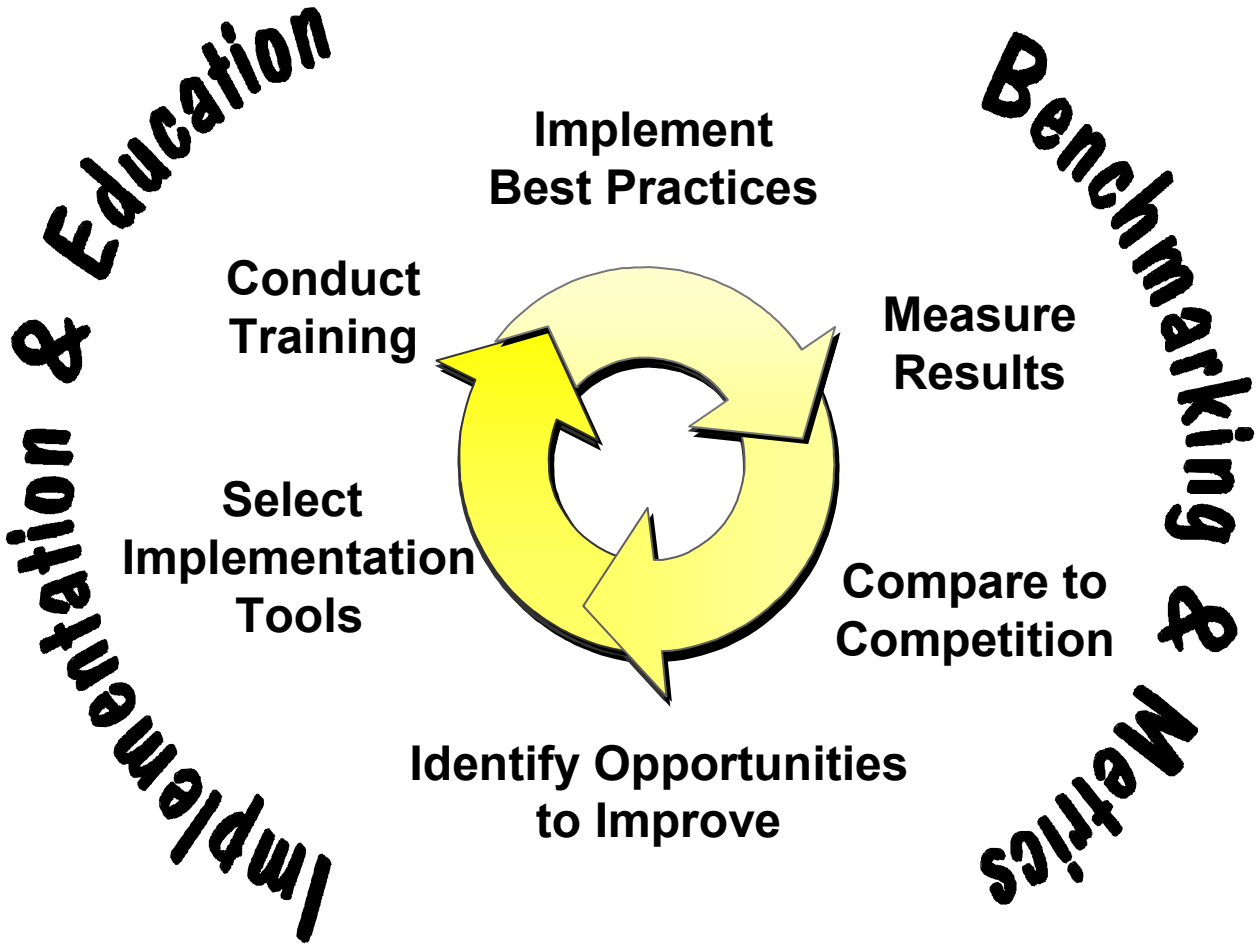
- 41 In-progress projects



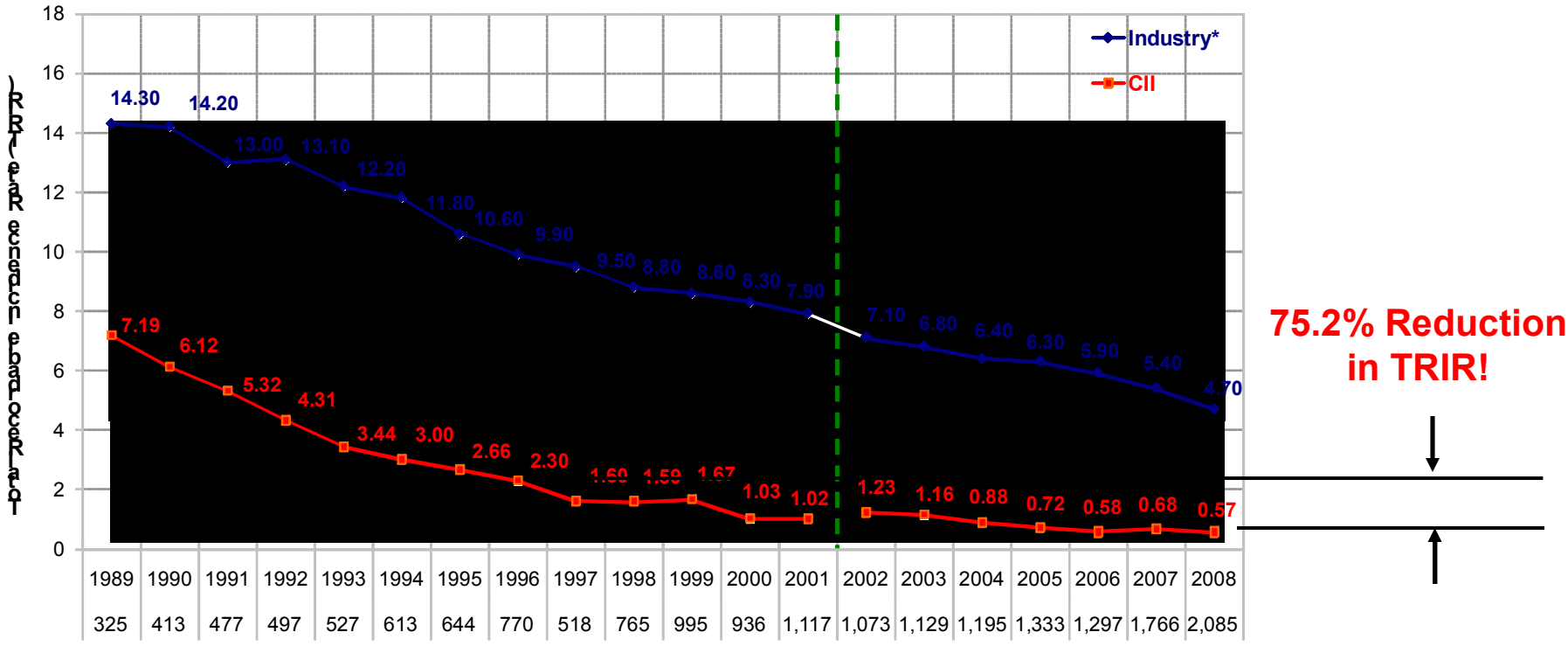
- 38 submitted from phase 1 + 41 in-progress projects



The Improvement Process



Industry Safety Culture

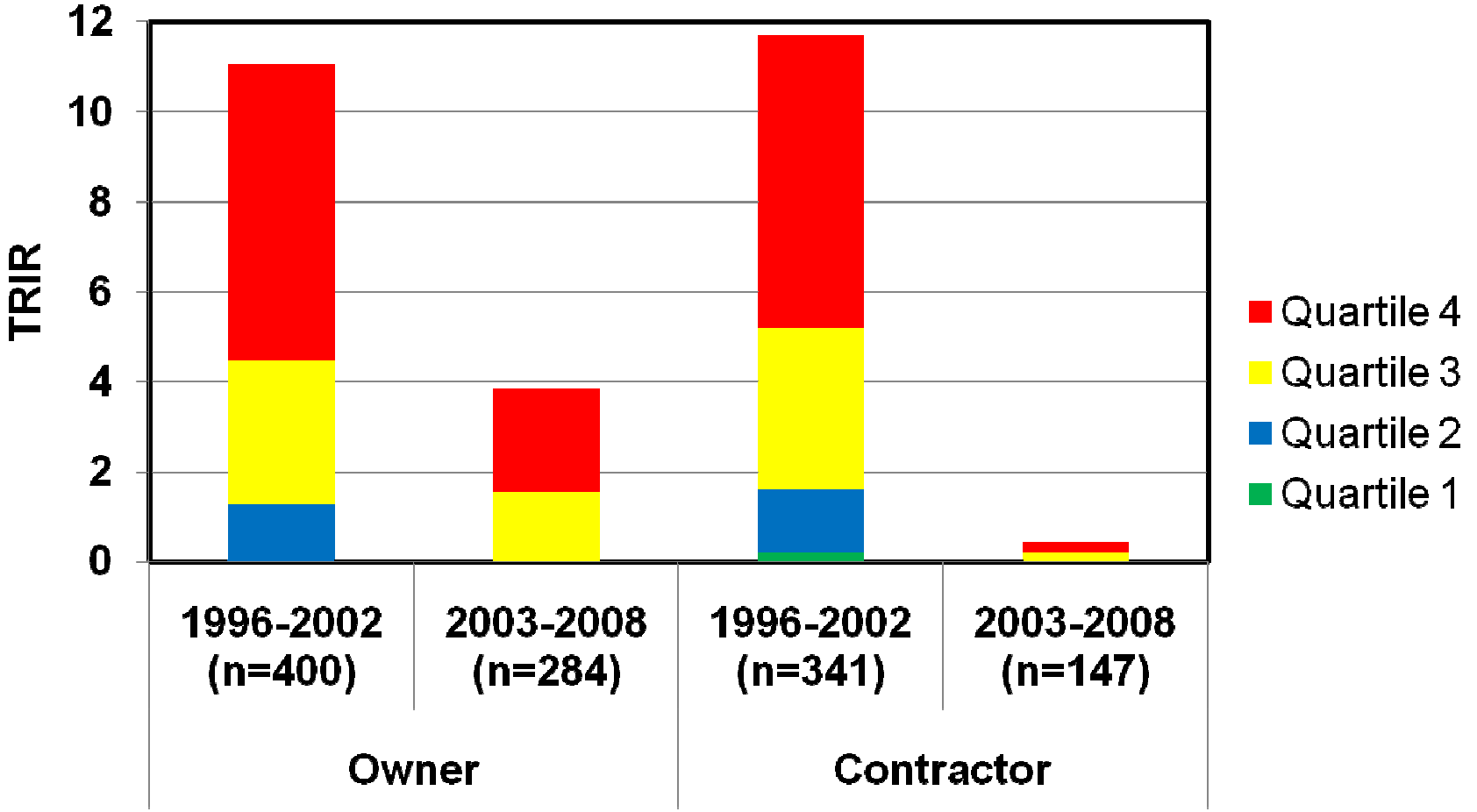


75.2% Reduction in TRIR!

*OSHA Construction Division, NAICS 236-238, SIC 15-17

Reflects OSHA Reporting Change

CII Benchmarking Safety Results



What If…

We Developed a **Performance Culture**

That…

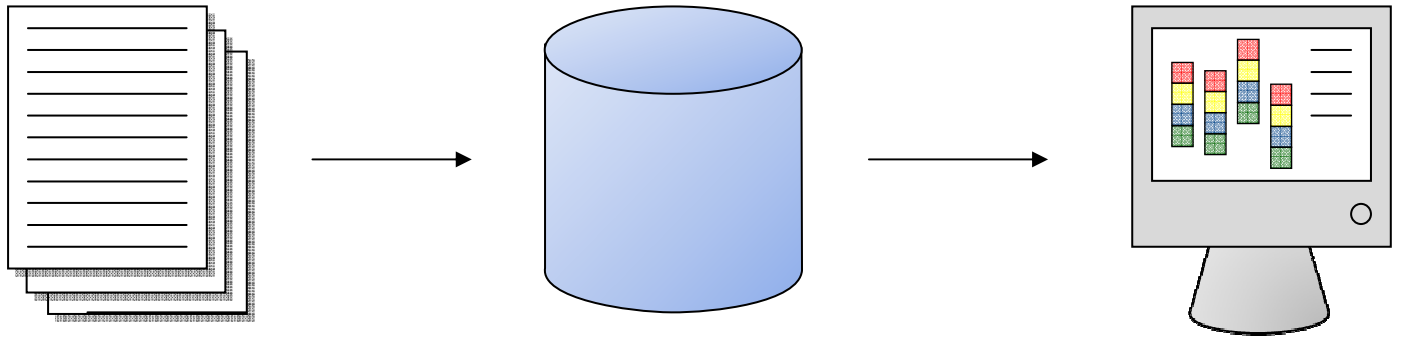
Rivaled Our Industry's **Safety Culture**?

Point of Departure

- 5 Principles of Project Integration
  - Work and Work Process
  - Organizational Engineering
  - Leadership and Governance
  - Communication and Information Flow
  - Culture and Environment
- Best Practices
- Benchmarking

COAA / CII Benchmarking Process

Three-step Process



Online Questionnaire

COAA Benchmarking Database

Data Mining and Reporting Engine

COAA Standard Metrics

Performance

- Cost Performance
- Schedule Performance
- Safety Performance
- Change Performance
- Rework Performance
- Construction Productivity
- Engineering Productivity

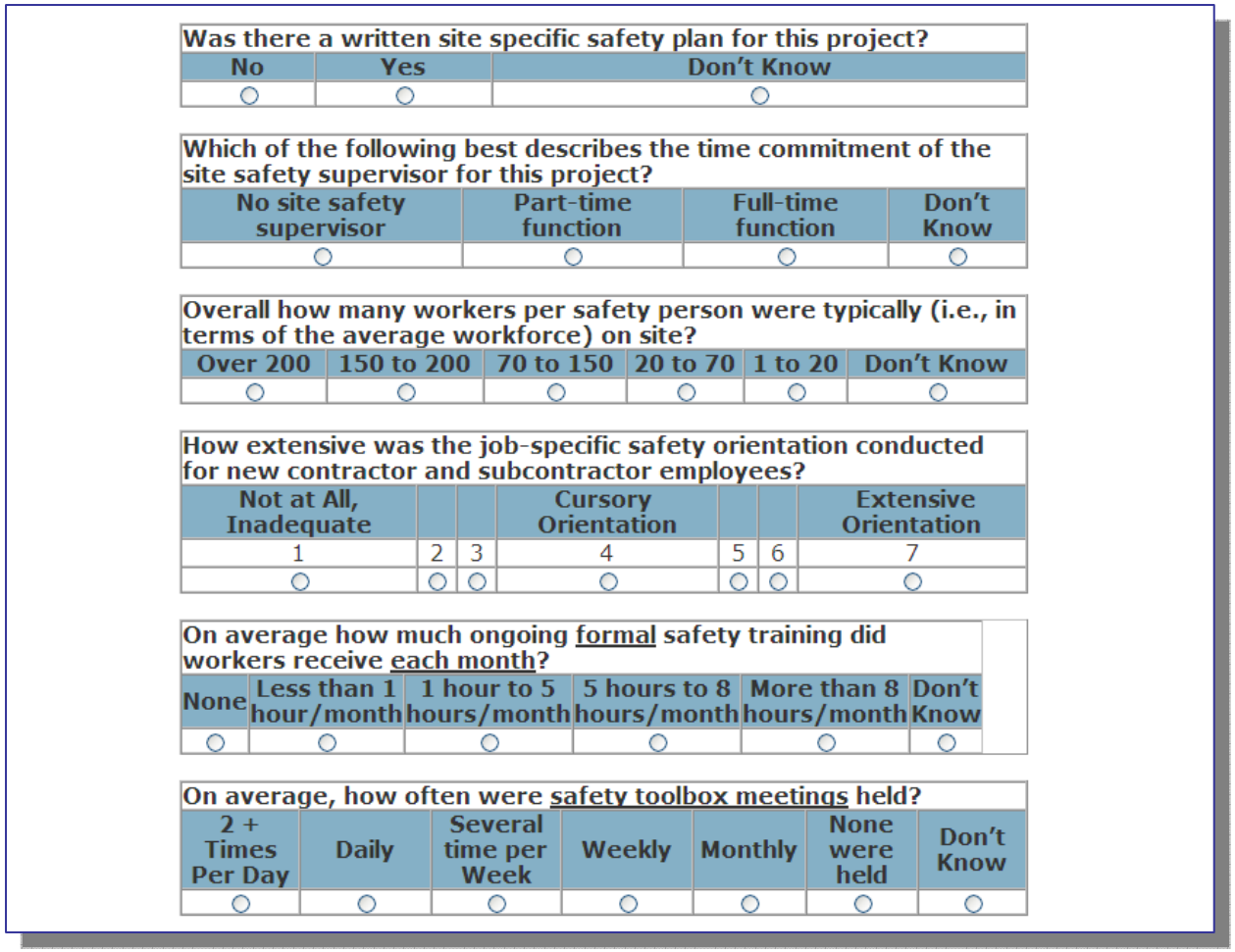
Practice Use

- Front-End Planning
- Alignment
- Team Building
- Partnering
- Project Risk Management
- Change Management
- Constructability
- Zero Accident Techniques
- Planning for Startup
- Proj. Delivery & Contract Systems
- Benchmarking
- Workface Planning

Reporting Best Practice Use Data

Zero Accidents Techniques

Safety techniques include site specific safety programs and implementation, and auditing and incentive efforts to create a project environment and a level of training that embraces the mind set that all accidents are preventable, and that zero accidents are an obtainable goal.



Was there a written site specific safety plan for this project?

No	Yes	Don't Know
○	○	○

Which of the following best describes the time commitment of the site safety supervisor for this project?

No site safety supervisor	Part-time function	Full-time function	Don't Know
○	○	○	○

Overall how many workers per safety person were typically (i.e., in terms of the average workforce) on site?

Over 200	150 to 200	70 to 150	20 to 70	1 to 20	Don't Know
○	○	○	○	○	○

How extensive was the job-specific safety orientation conducted for new contractor and subcontractor employees?

Not at All, Inadequate			Cursory Orientation			Extensive Orientation
1	2	3	4	5	6	7
○	○	○	○	○	○	○

On average how much ongoing formal safety training did workers receive each month?

None	Less than 1 hour/month	1 hour to 5 hours/month	5 hours to 8 hours/month	More than 8 hours/month	Don't Know
○	○	○	○	○	○

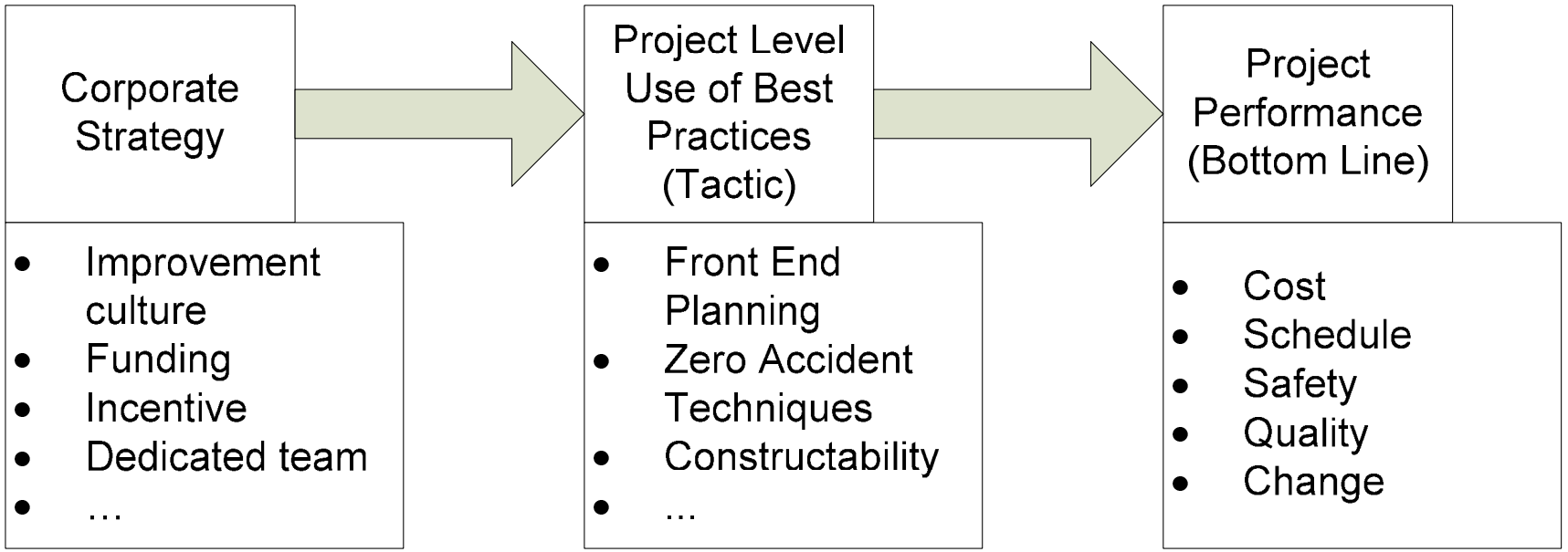
On average, how often were safety toolbox meetings held?

2 + Times Per Day	Daily	Several time per Week	Weekly	Monthly	None were held	Don't Know
○	○	○	○	○	○	○

Use of Best Practices

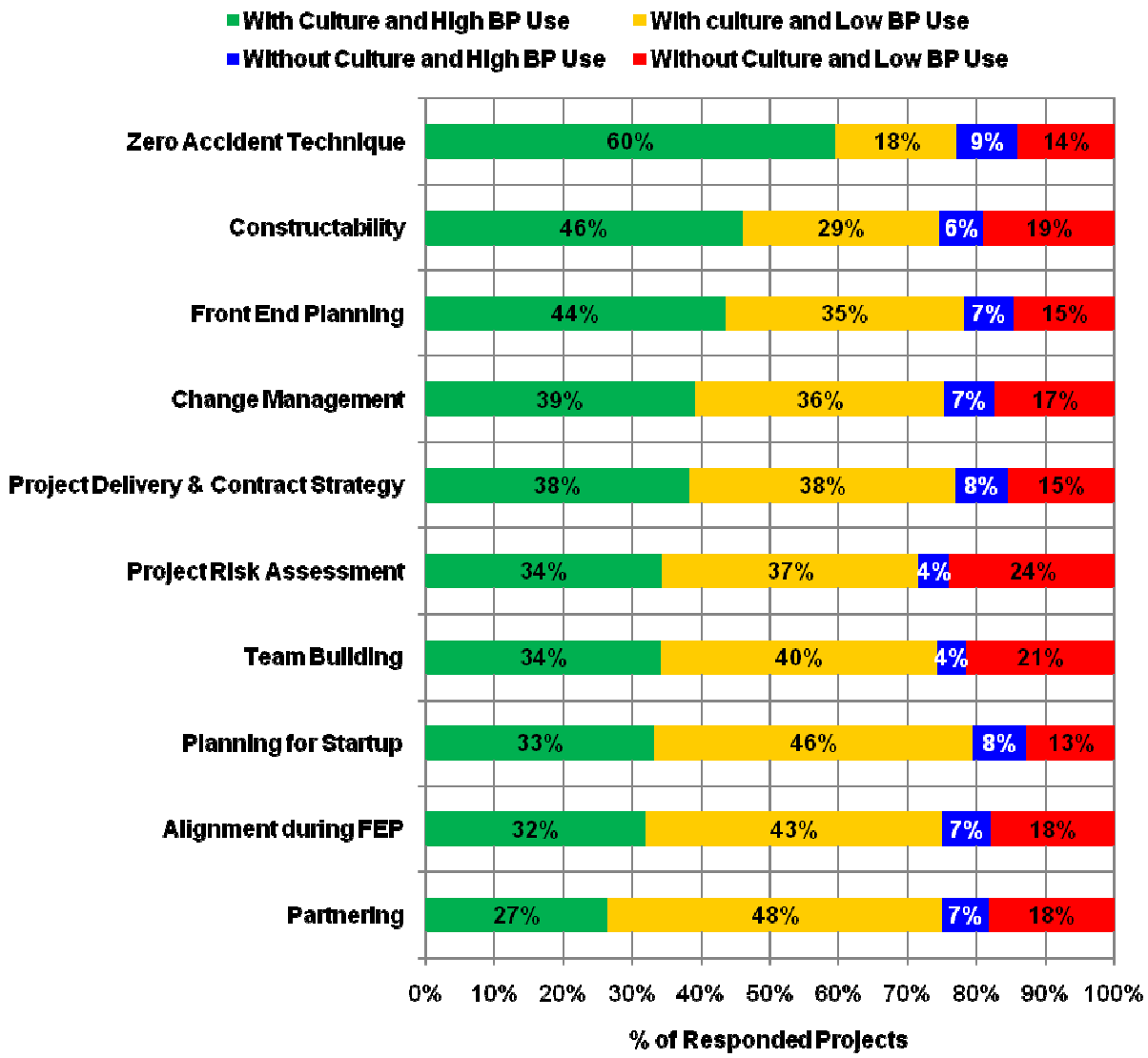
Begins with the 5 PI's (Culture, Leadership)

Ends with Improved Performance

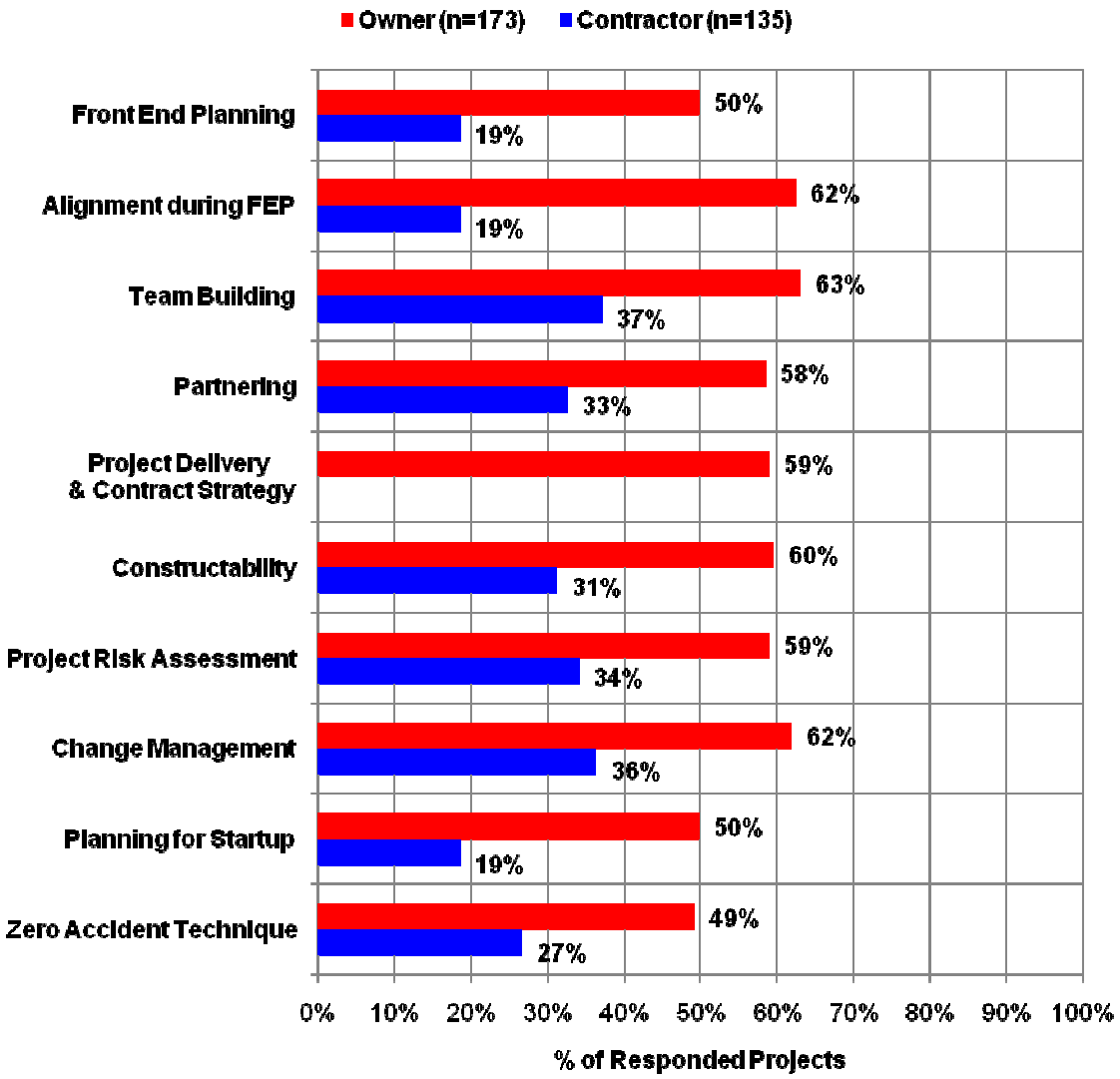


Culture

A relationship exists between culture and best practice use

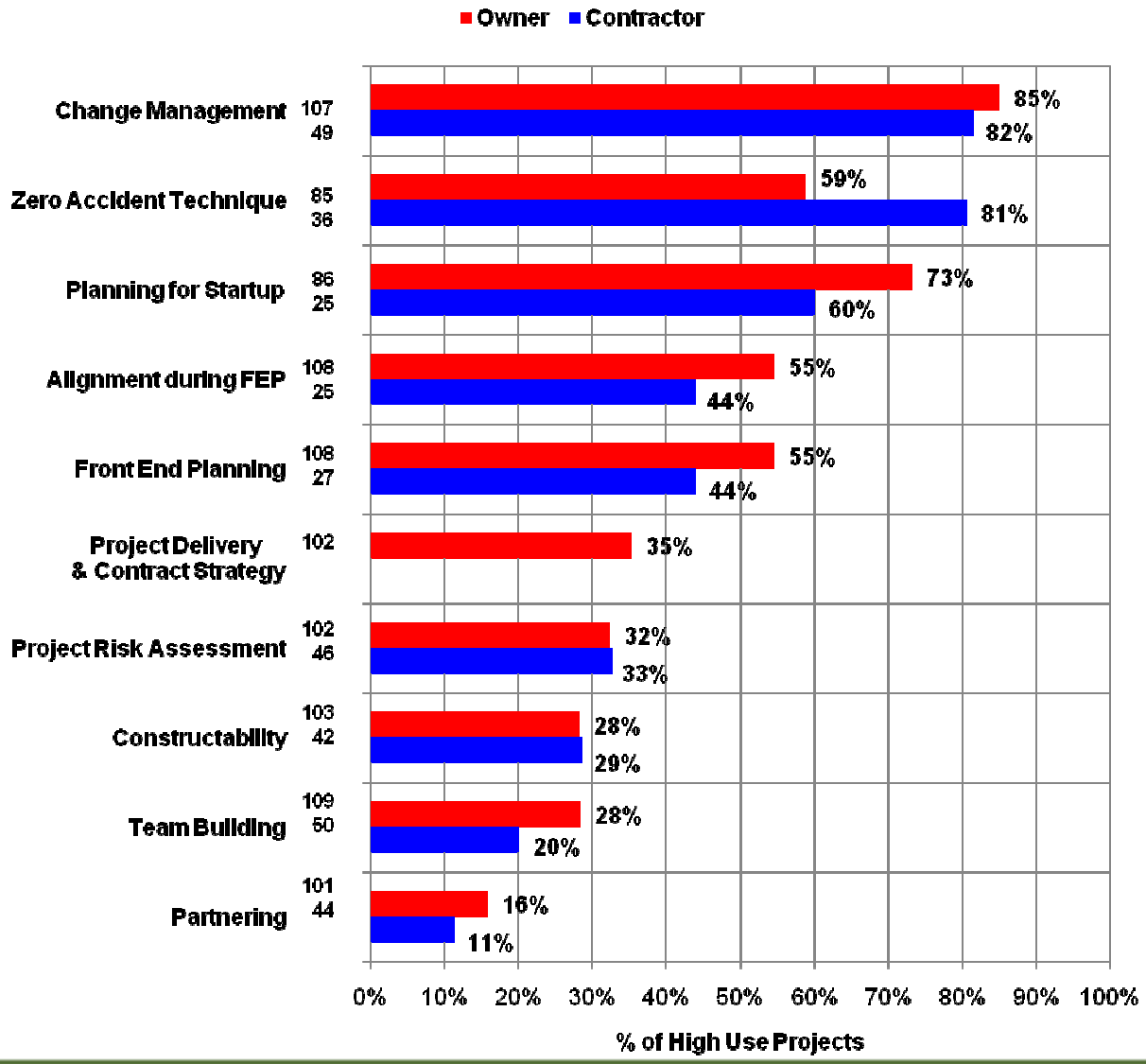


Project Response Rate

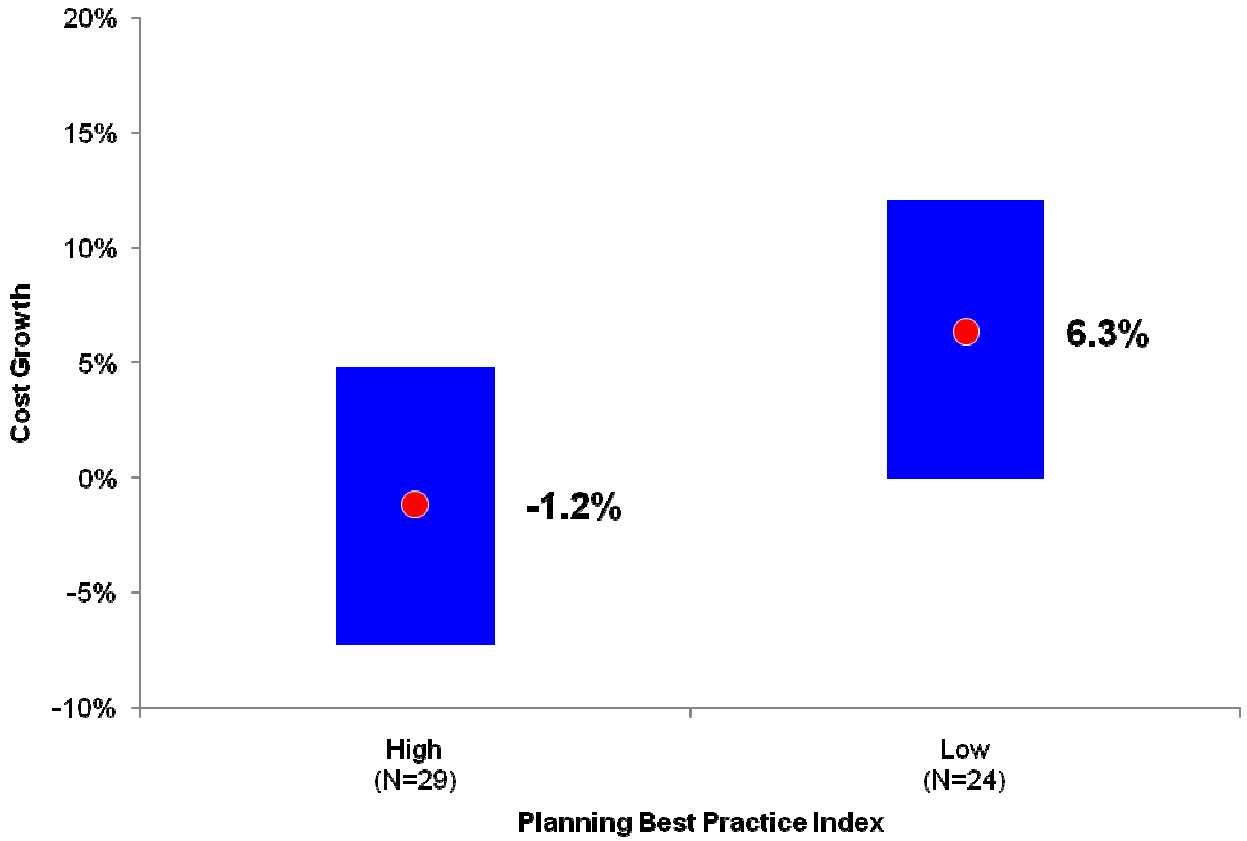


Project Response Rate

Percent of Projects with High Best Practice Use

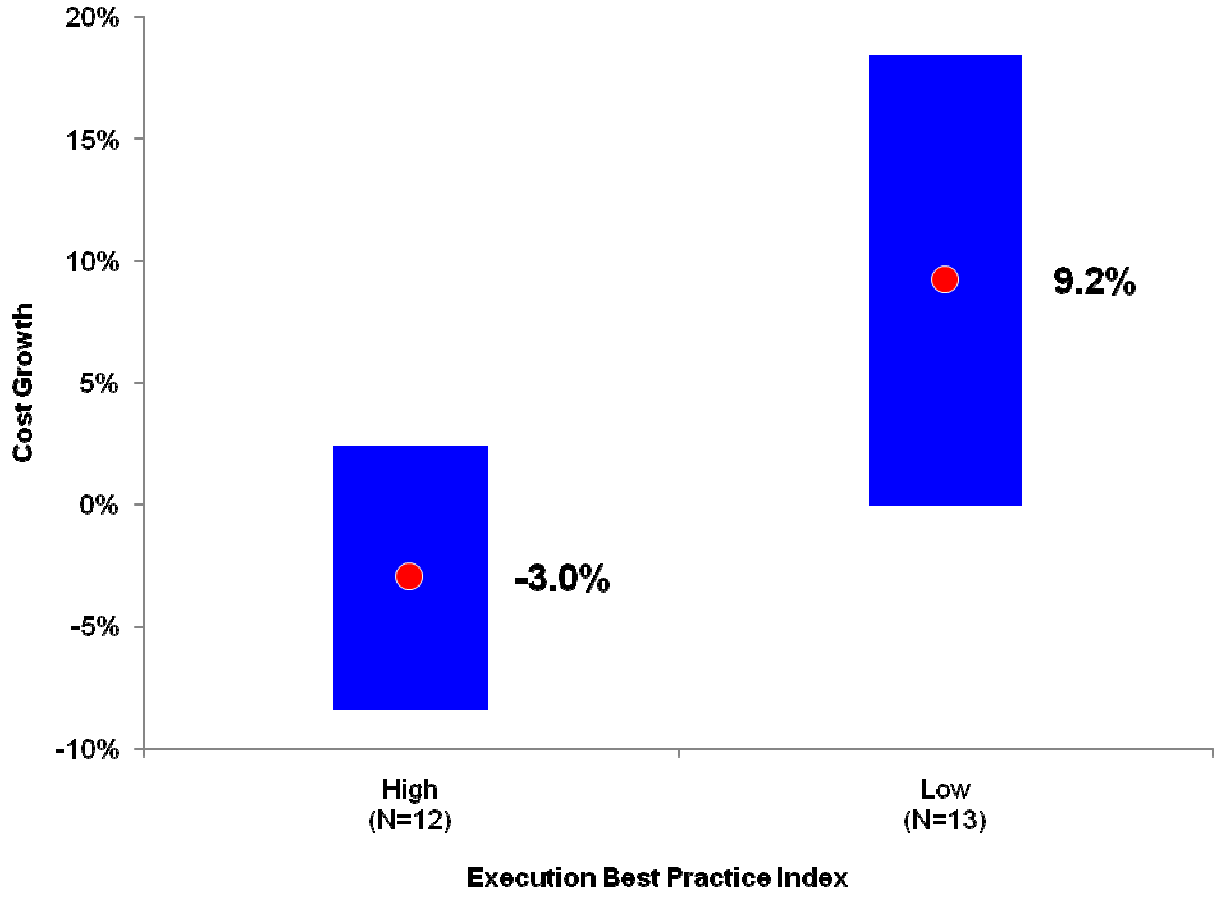


Owners Plan*



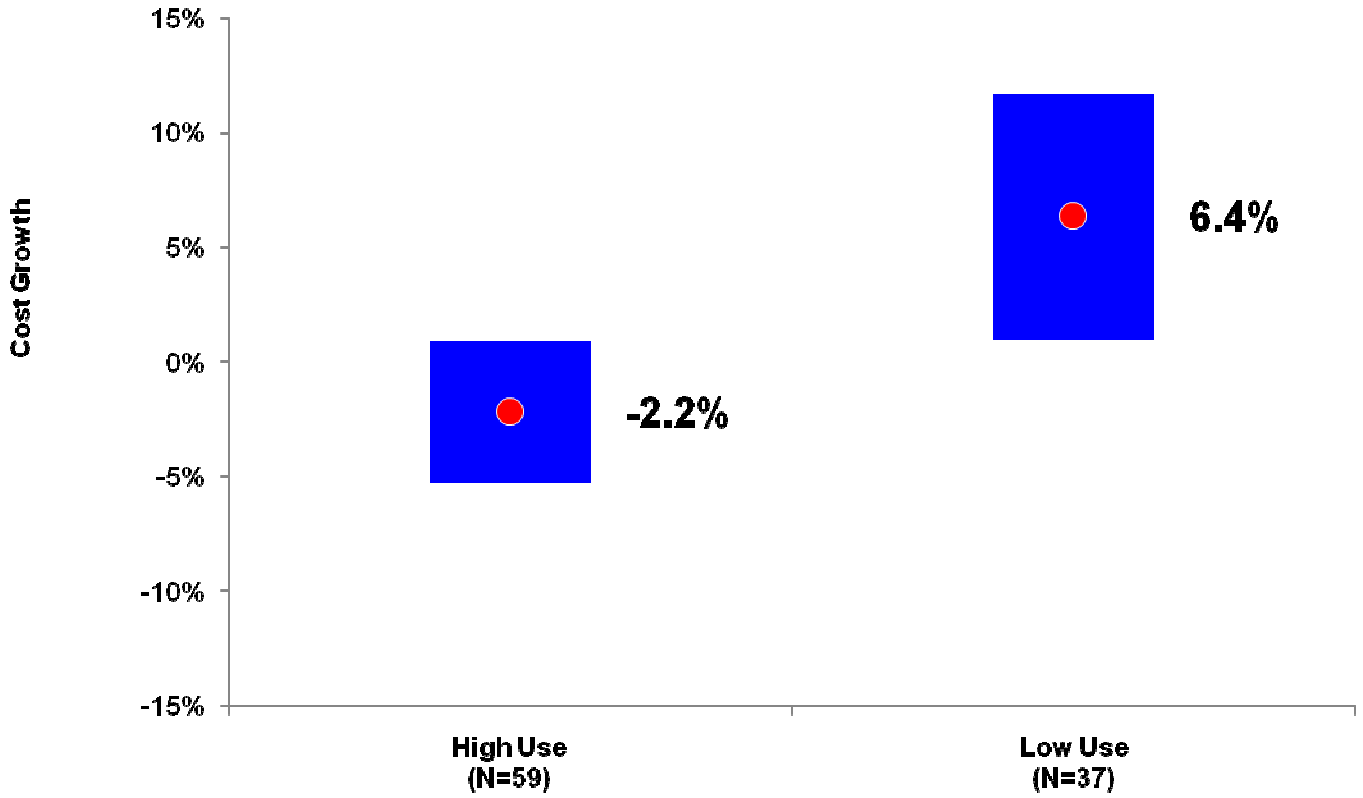
*FEP, Alignment During FEP, Planning for Startup

Contractors Execute*

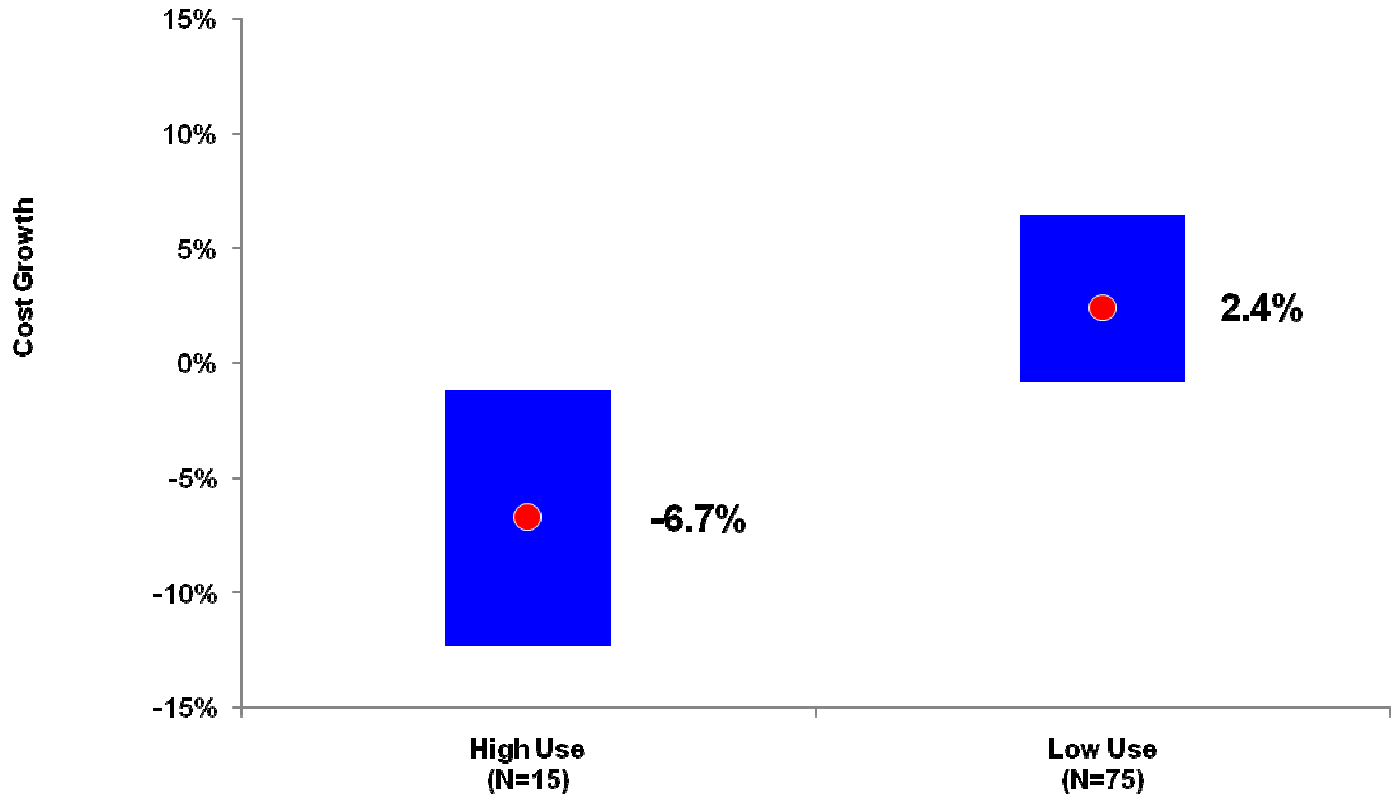


*Constructability, PRA, Change Management

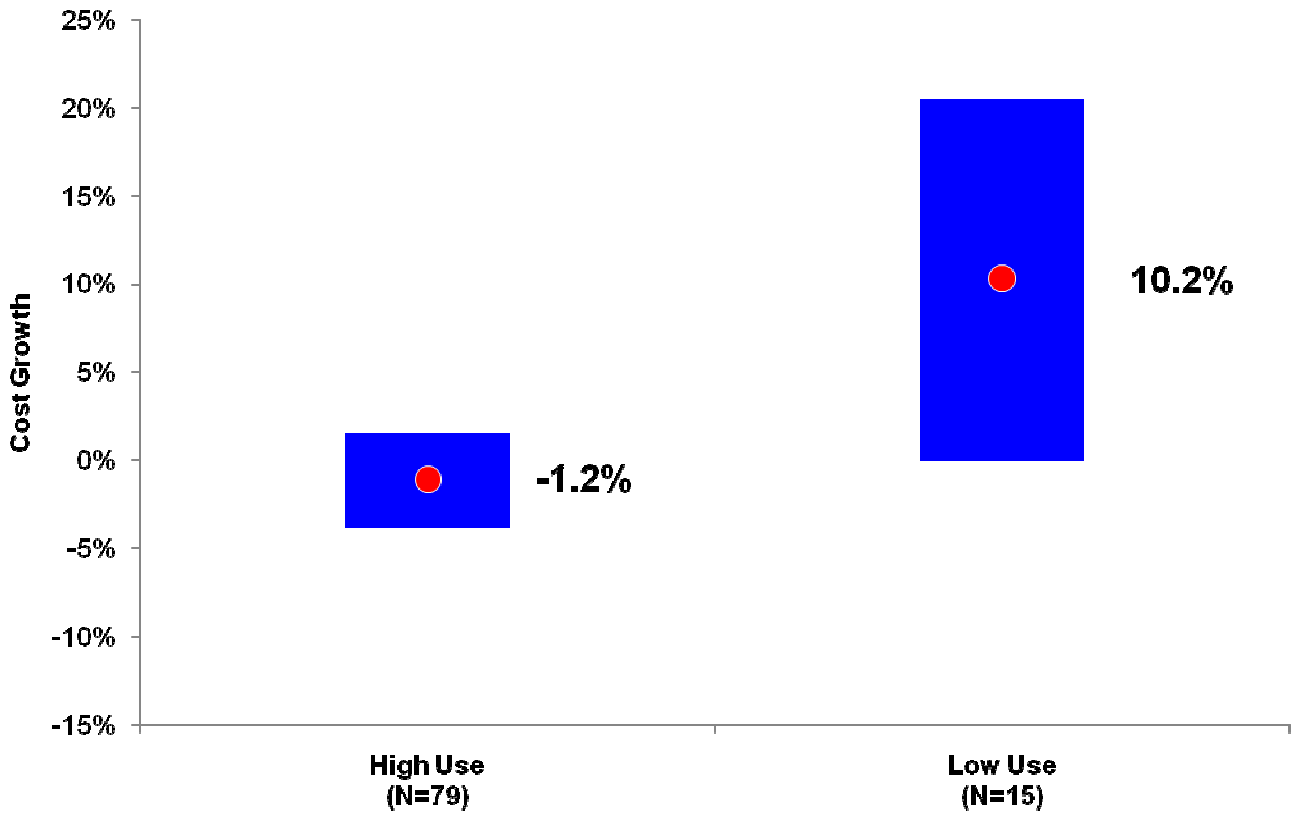
Owners Use of Front End Planning



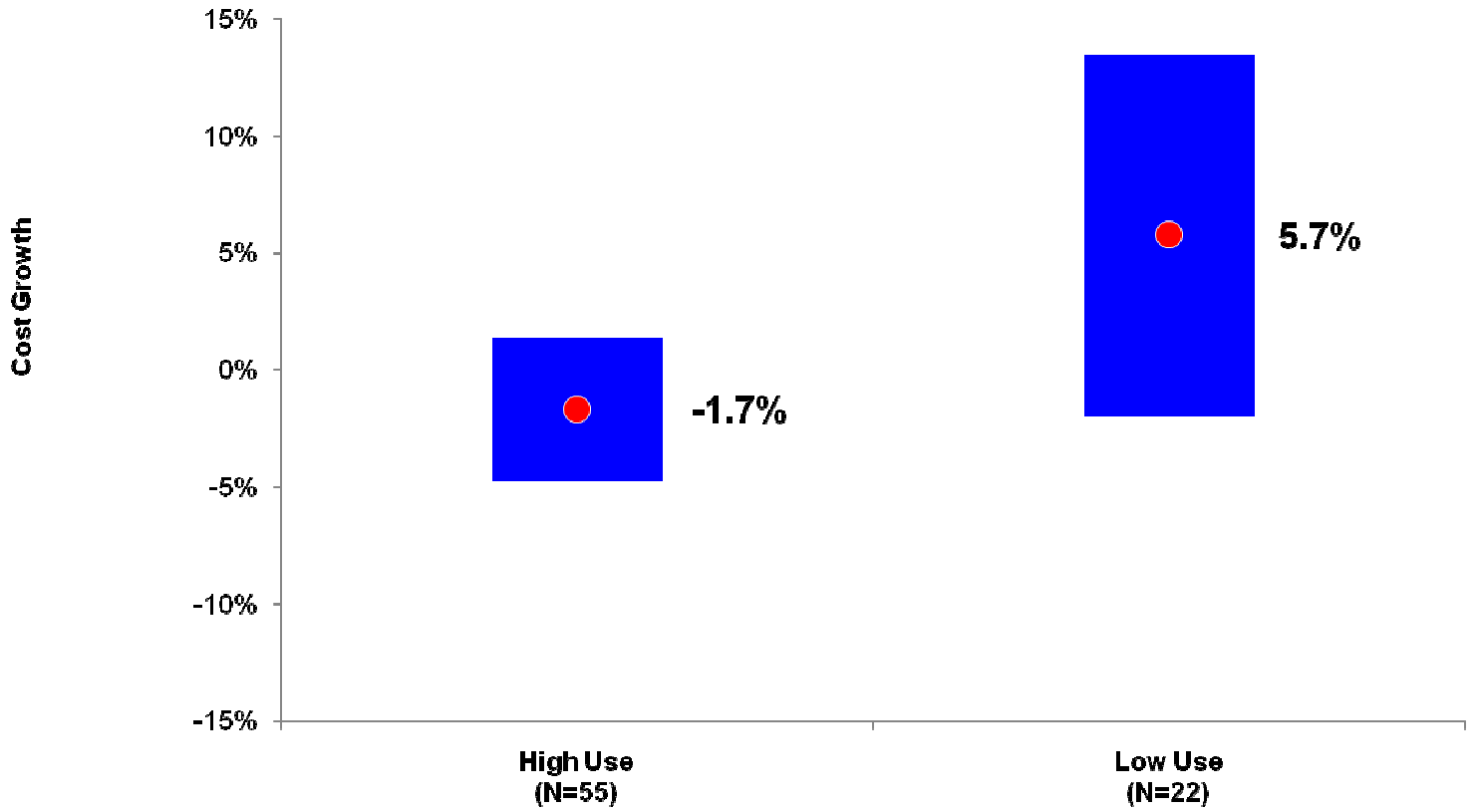
Owners Use of Partnering



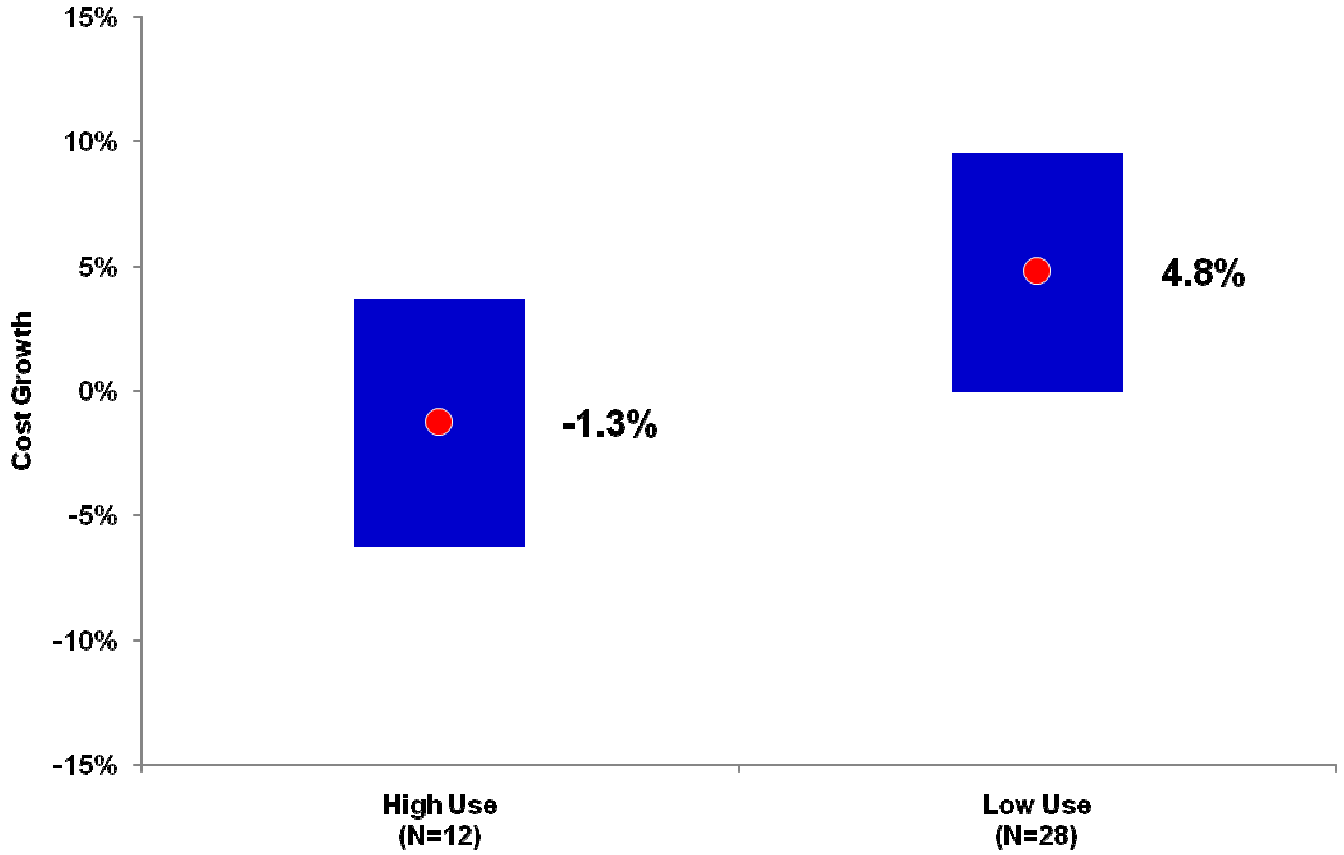
Owners Use of Change Management



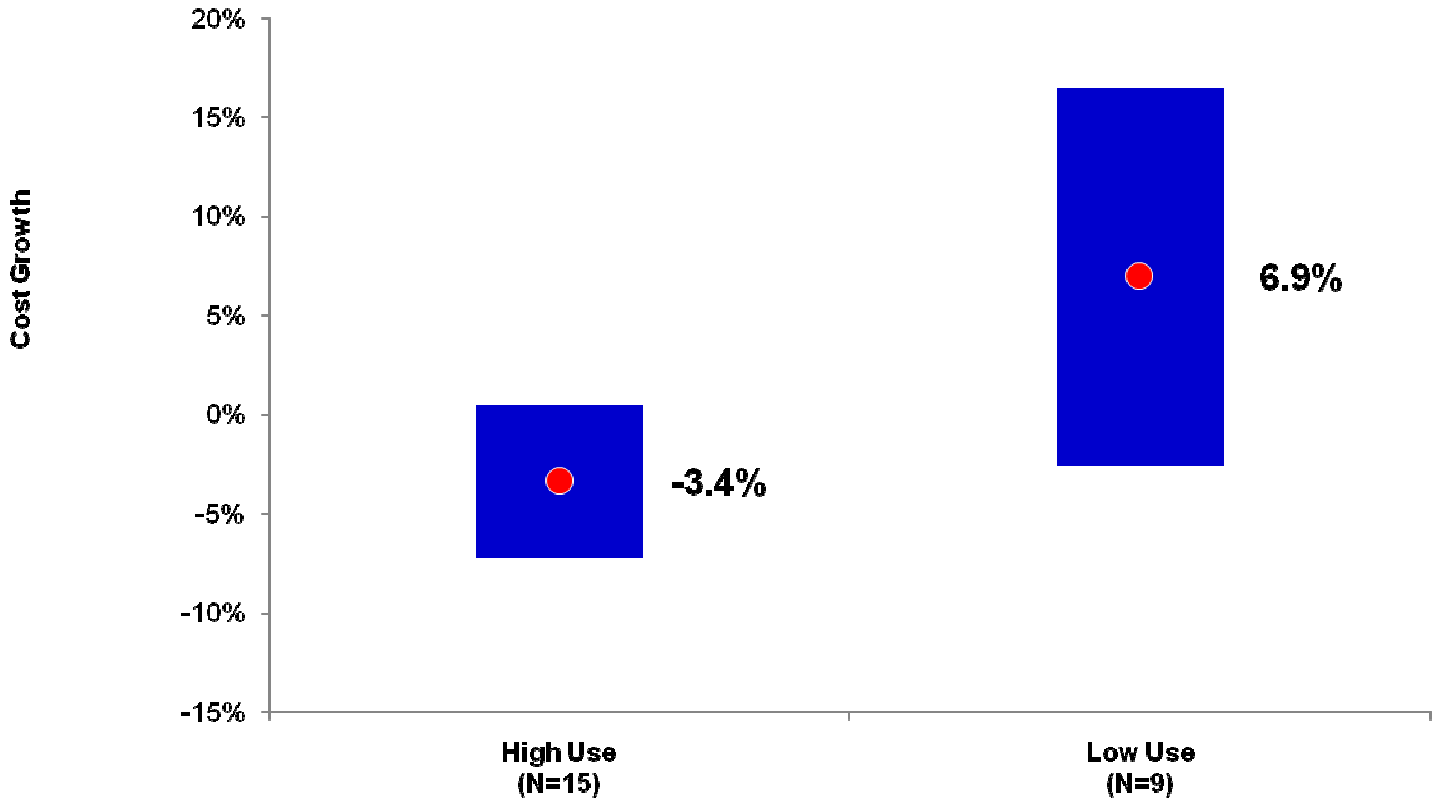
Owners Use of Planning for Startup



Contractors Use of Constructability



Contractors Use of Planning for Startup



Main Findings

- Implementation of Practices is Differential Between Owners and Contractors
  - All 14 Should Not be Applied Universally
  - Change to CII Implementation Philosophy
- Partnering is Biggest Surprise
- On Average, Owners Have 20.4% Unrealized Cost Performance (Contractors, not as much)
- CII Best Practices Show Little Schedule Advantage (same as previous studies / research opportunity)
- Other (TBD)

NextGen Benchmarking System

- 24/7 Data Mining (Entire Questionnaire)
- Expanded Key Report
- Level 1 Engineering and Construction Productivity
- Internal (Business Unit, Product Line) Benchmarks
- Instant Feedback with Quarterly Quartile Updates
- Performance Assessment Lab (University of Calgary)

NextGen System – Key Report

- Key Report Format
  - Progress Key (with Quarterly Updates)
  - Eliminate Percentile Bar and Chart (Confusing)
  - Proposed
    - Score (ex. 0.069)
    - Quartile (ex. 2Q)
    - Percentile (ex. 60%)
    - Comparison Criteria Listed (Not in Appendix)

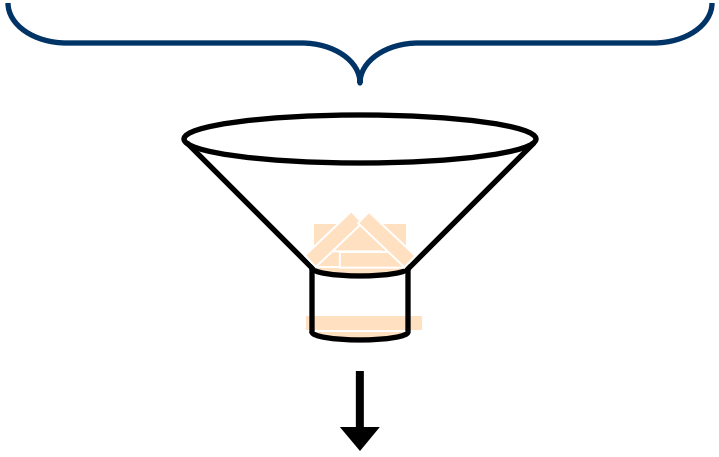
Cost Performance

Metric	Project Score	Database Mean	Quartile	Percentile	Comparison criteria				n
					Industry Group	Project Type	Project Nature	Cost	
Project Cost Growth	0.069	-0.022	4Q	20%	Infrastructure	All	Grass Roots	15-50MM	24
Delta Cost Growth	0.069	0.083	2Q	60%	Infrastructure	All	Grass Roots	15-50MM	24

Project-Level Productivity

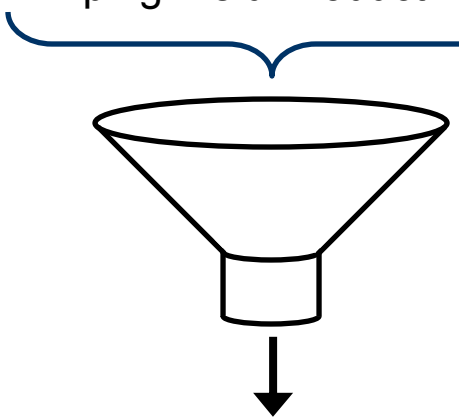
DISCIPLINE-LEVEL PRODUCTIVITY

Electrical Engineering Productivity
Instrumentation Engr. Productivity
Concrete Engineering Productivity
Structural Steel Engr. Productivity
Piping Engineering Productivity
Equipment Engr. Productivity



ENGINEERING PRODUCTIVITY

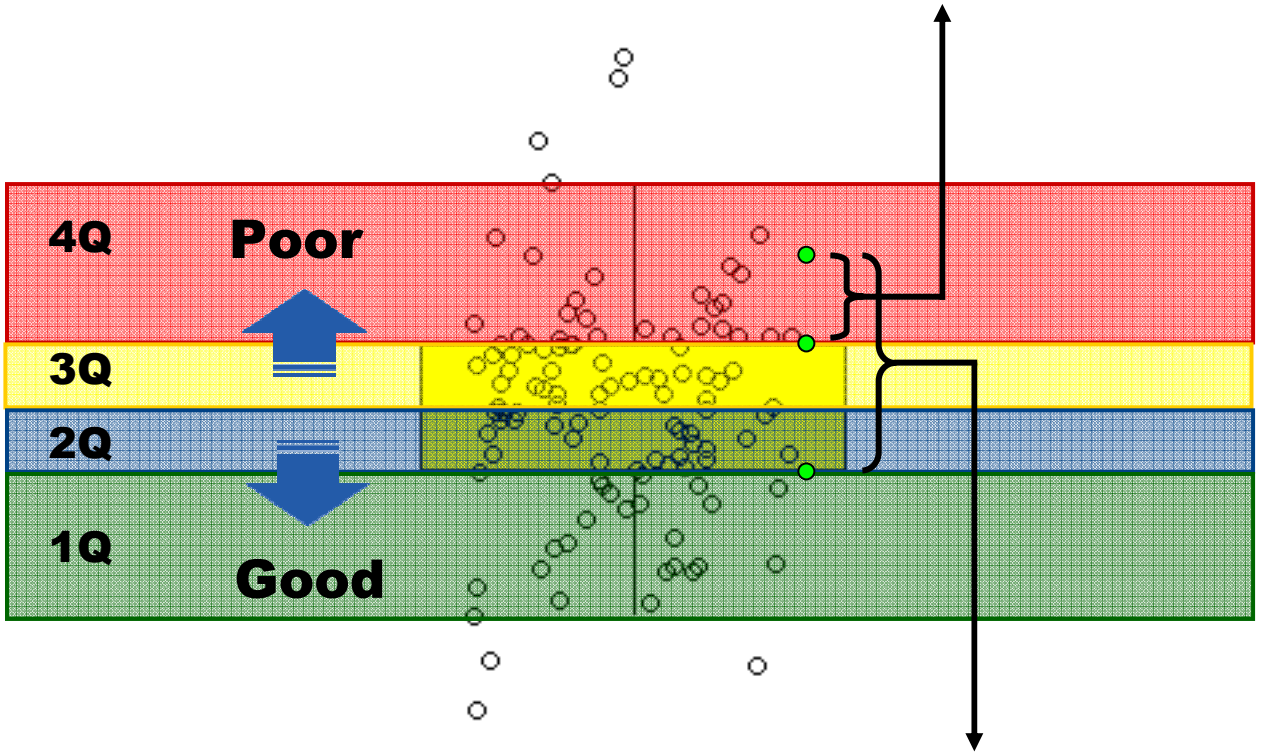
Instrumentation Field Productivity
Structural Steel Field Productivity
Scaffolding Field Productivity
Equipment Field Productivity
Insulation Field Productivity
Electrical Field Productivity
Concrete Field Productivity
Piping Field Productivity



CONSTRUCTION PRODUCTIVITY

Project-Level Productivity Example

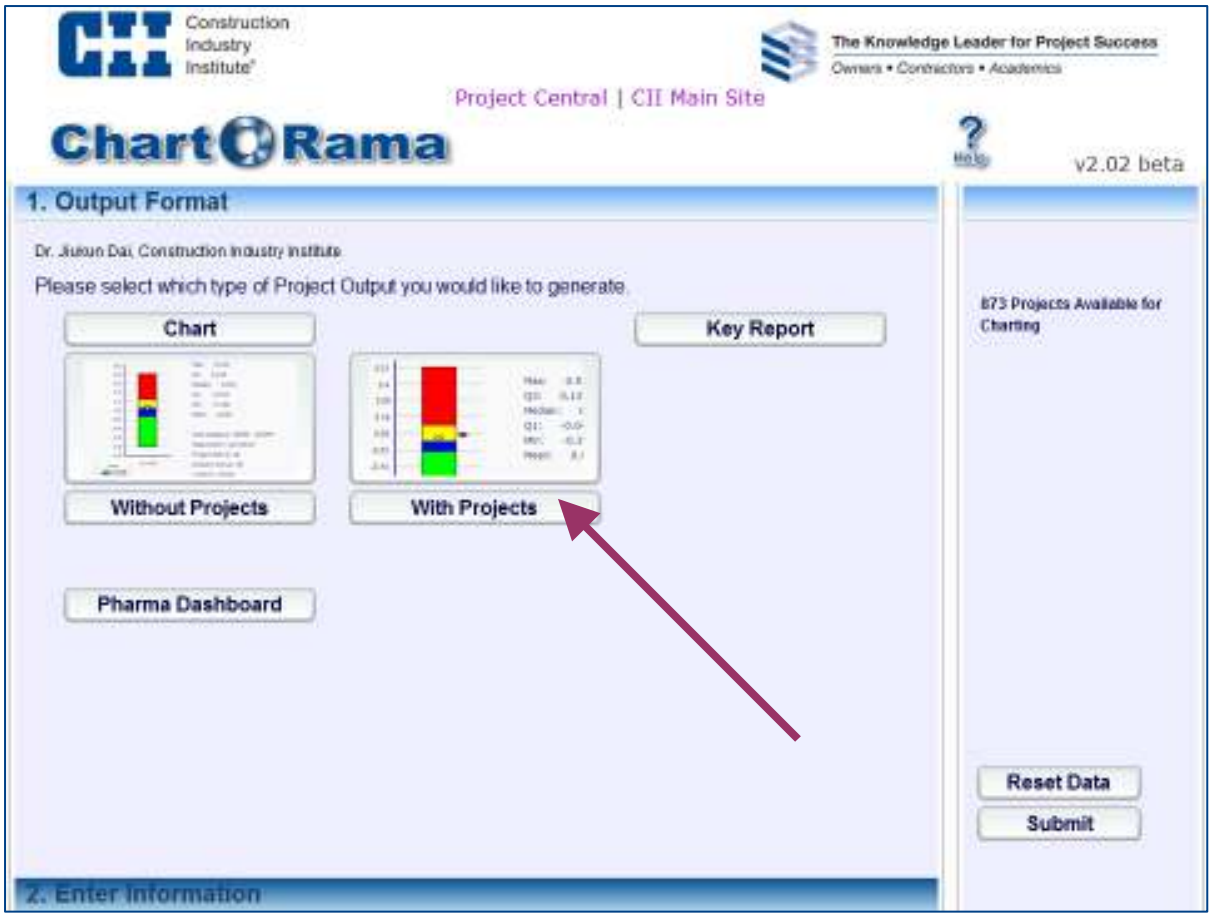
- 11% Improvement (4th to 3rd Quartile)



- 26% Improvement (4th to 1st Quartile)

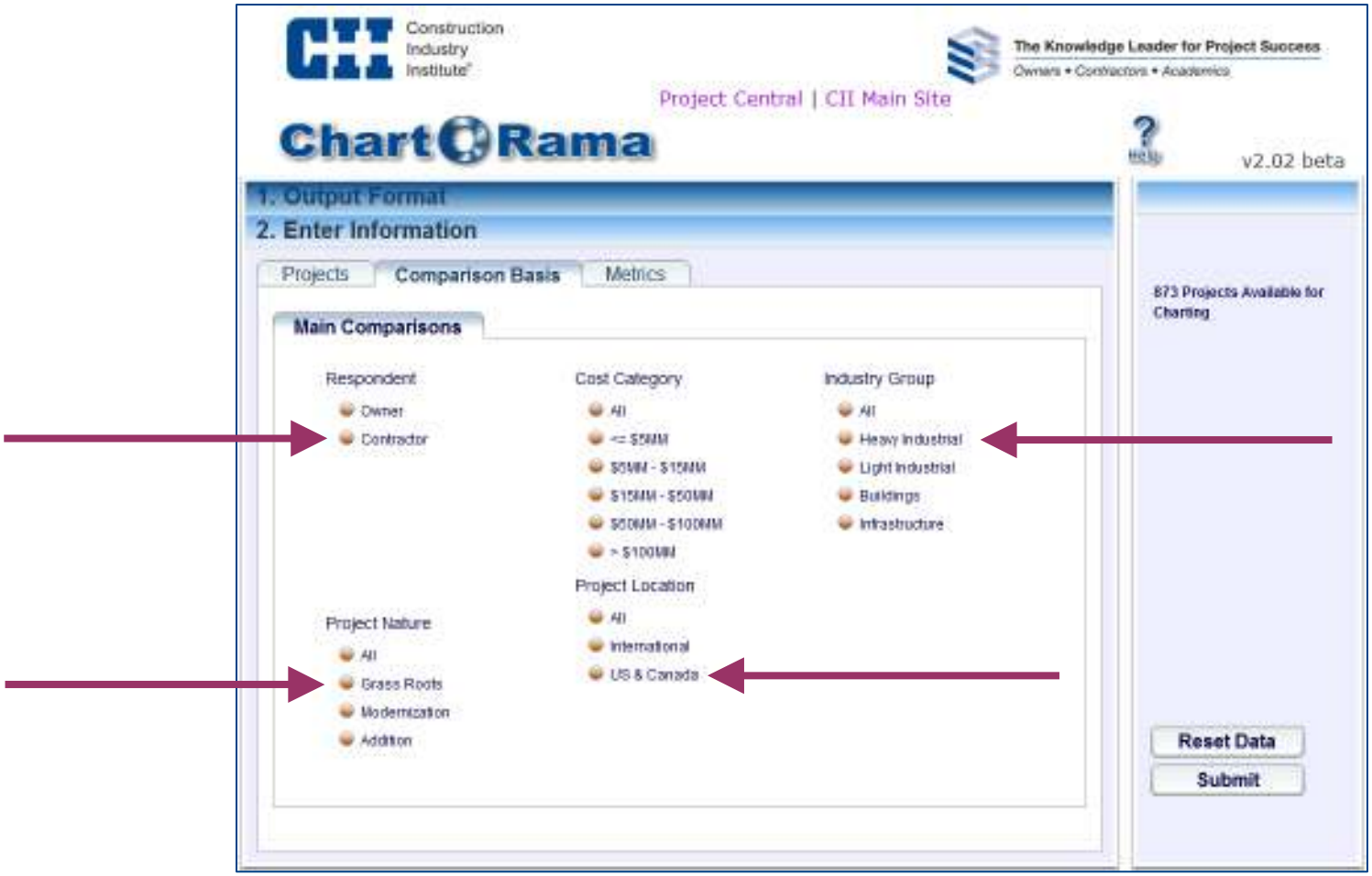
24/7 Data Mining

- Chart-o-Rama (Step 1)



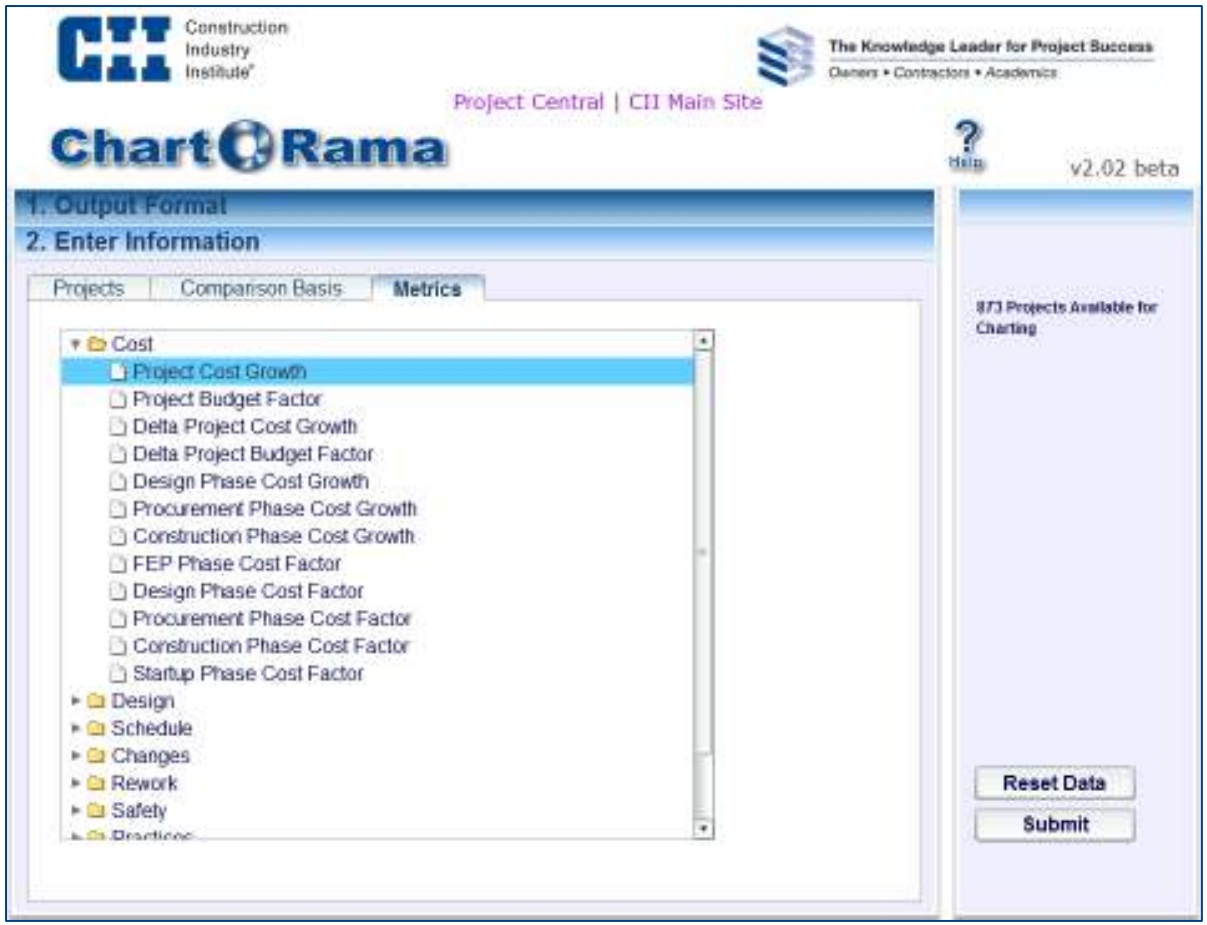
24/7 Data Mining

- Chart-o-Rama (Step 2)



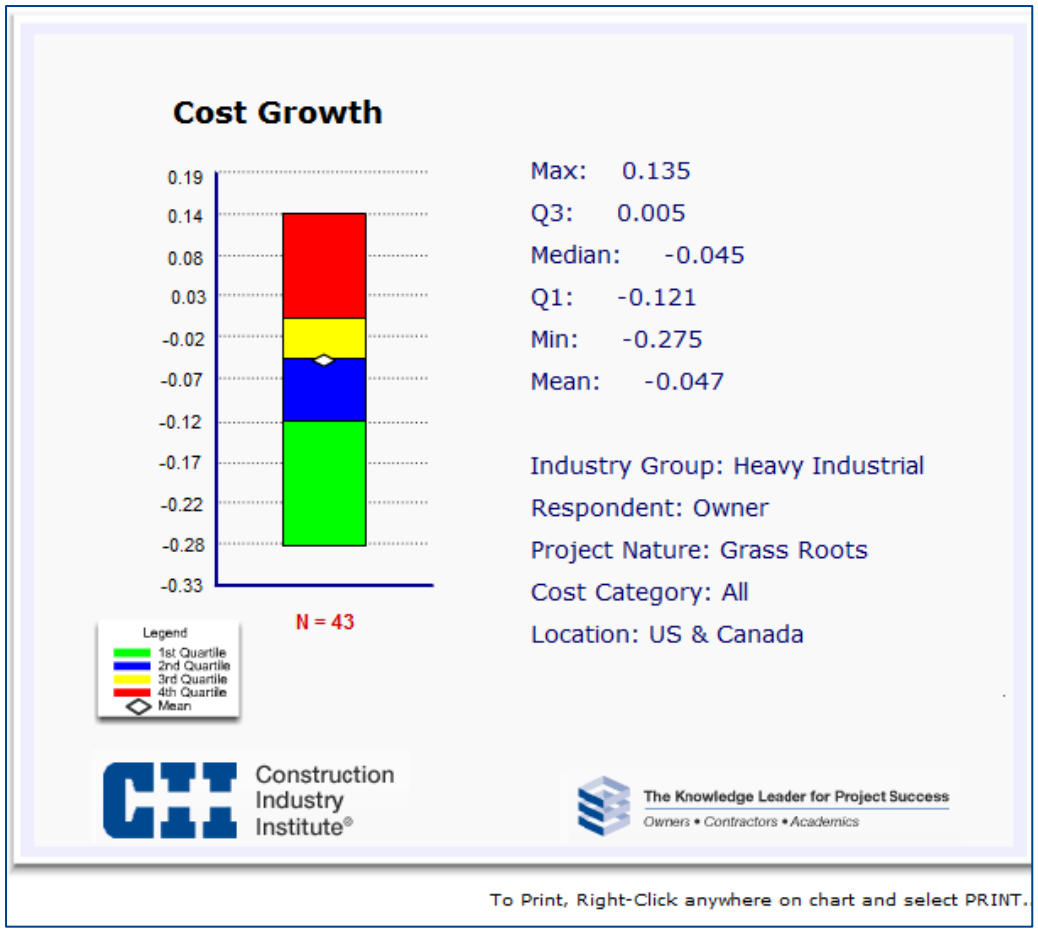
24/7 Data Mining

- Chart-o-Rama (Step 3)



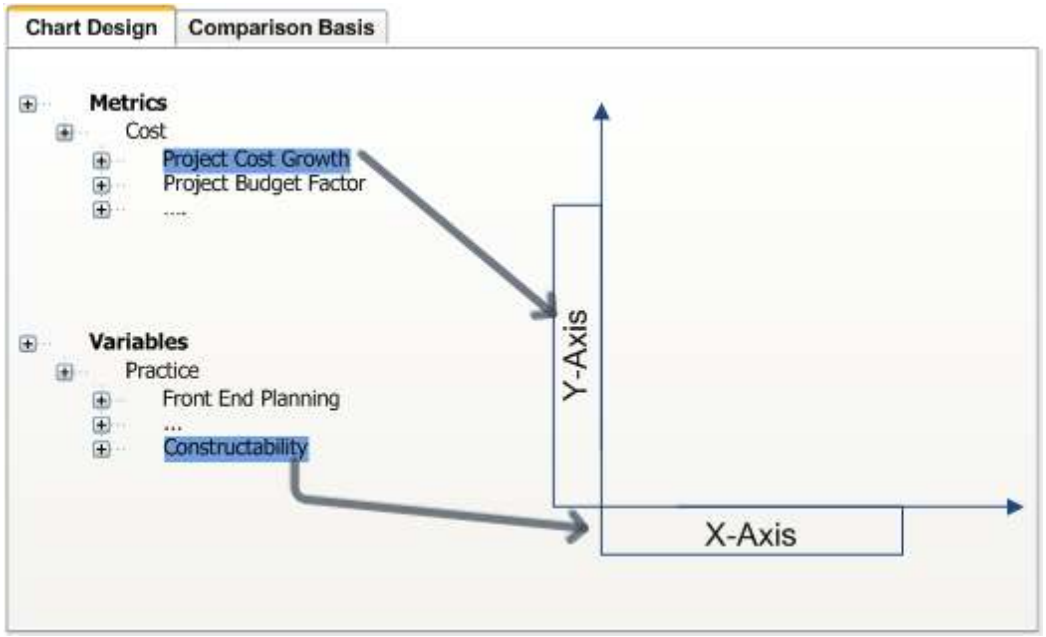
24/7 Data Mining

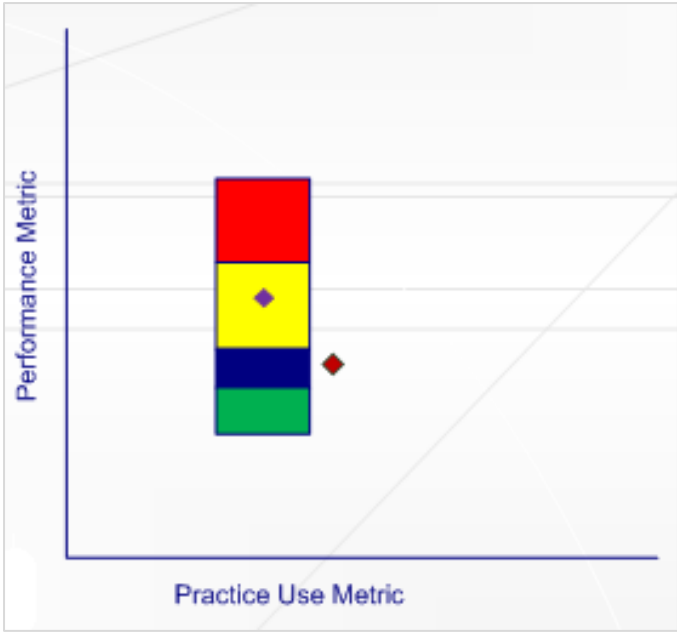
- Chart-o-Rama (Step 4)



24/7 Data Mining

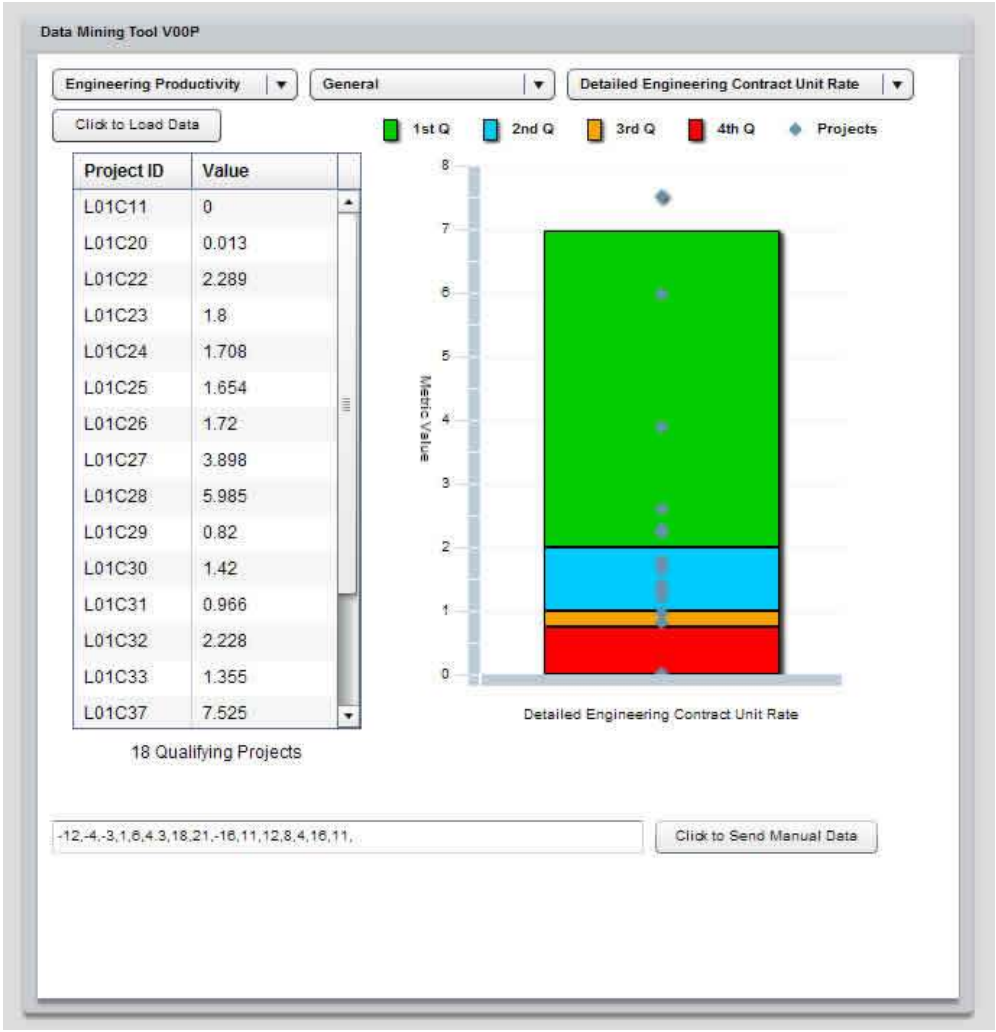
- Construct **ANY** Comparison (by Sector / PAL)
  - Metric vs. Metric, Variable, or Criteria
  - **1st of its Kind**
  - **Informs Research**



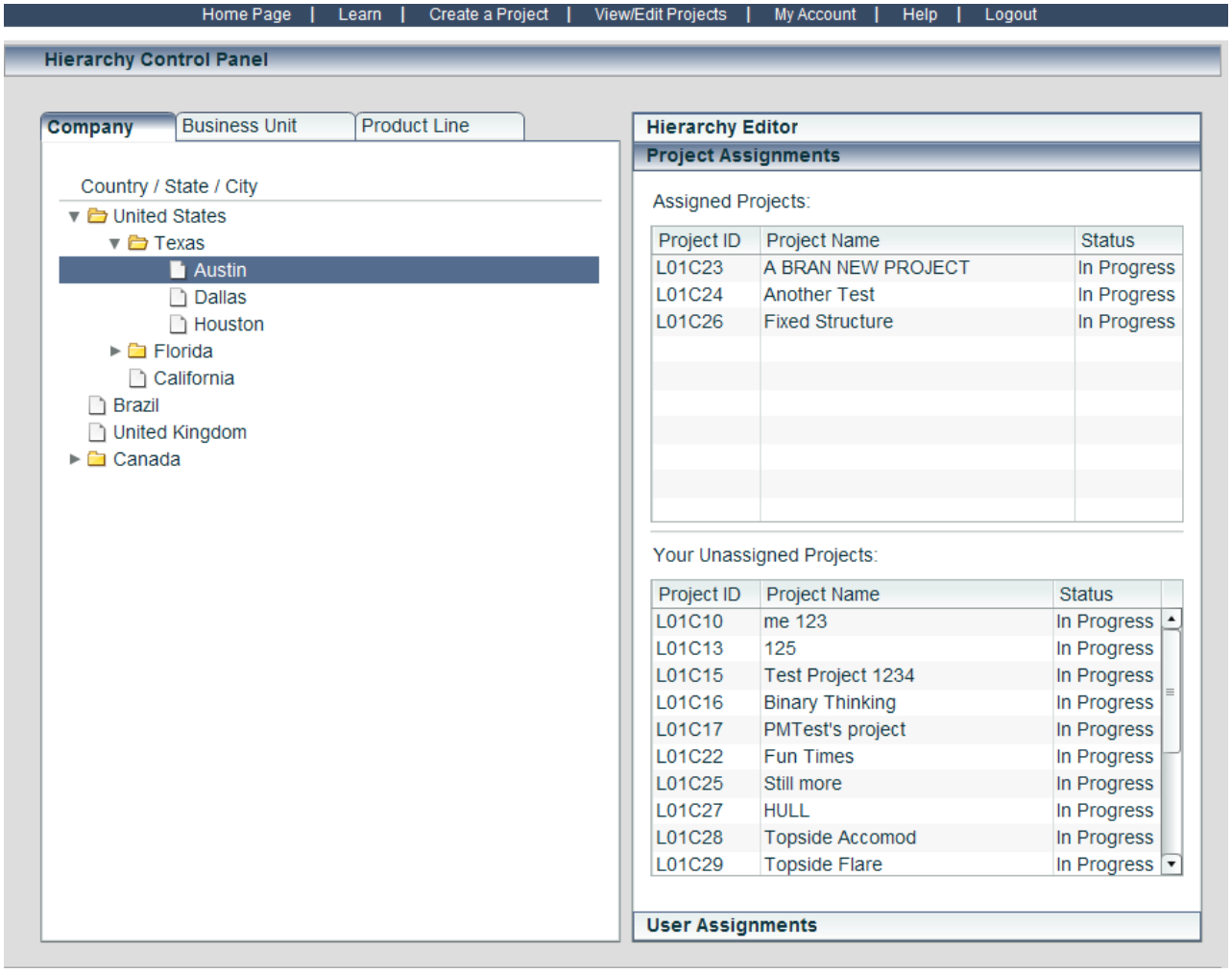


24/7 Data Mining

- Programming in Progress



NextGen System (Company Hierarchy)



- Single Page Setup
- Easily Updated
- Benchmarking Manager
  - Authorized to Setup
  - Authorized to Maintain
- Optional (Only if Company wants Internal Benchmarks)

COAA Phase II Development Summary

- Benchmarking at Sanction & Completion
- Normalization (Cost Index) of Absolute Metrics
- Modularization Metrics for Const. Productivity ($/m^3)
- Construction Indirect Cost and Workhours
  - $ / Construction Indirect WH
  - $ / Construction Equipment
- Field Rework
- Closeout (Product List) / Production Capacity
- Best Practices, PDRI, Delivery System (EPCM)
- **Pipeline Metrics**
- Other

COAA Phase II Development Summary

- Pipeline Metrics
  - Metrics Classifications
    - Project Performance & Delivery Strategies
    - Pipeline Construction
    - Productivity
    - Labour
  - Analysis Categories/ Project Considerations
    - Contract Type and $ (road ditch, weights/anchors, concrete coating, crossings)
    - Workday/Equipment Type
    - Labour Pool (union/merit, CLAC)
    - Shift Schedule (WH/day, days/week)
    - Worker Accommodations (camp, travel allowance)

COAA Phase II Development Summary

- Pipeline Metrics (Project Performance & Delivery Strategy)
  - $Pipe/TIC, $Pipe/Km
  - $TIC/Dia.(inch)/ mile
  - $Construction Cost/dia. (inch)/mile
  - Capacity (m^3/day)
  - $Owner PM/TIC
  - $Owner PM/Construction Cost
  - $Engineering Cost/km and $Engineering Cost/TIC
  - $Permit Fee/TIC
  - $Land Cost/km
  - $Environmental Studies & Monitoring/TIC
  - $Environmental Studies & Monitoring/km

COAA Phase II Development Summary

- Pipeline Metrics (Productivity)
  - Weld cm^3/Wh or Weld/Day (segmented by pipe diameter)
  - Wh/km
  - Km/day
  - Indirect Wh/Direct WH
  - Peak Indirect Wh/Direct Wh
  - Other?

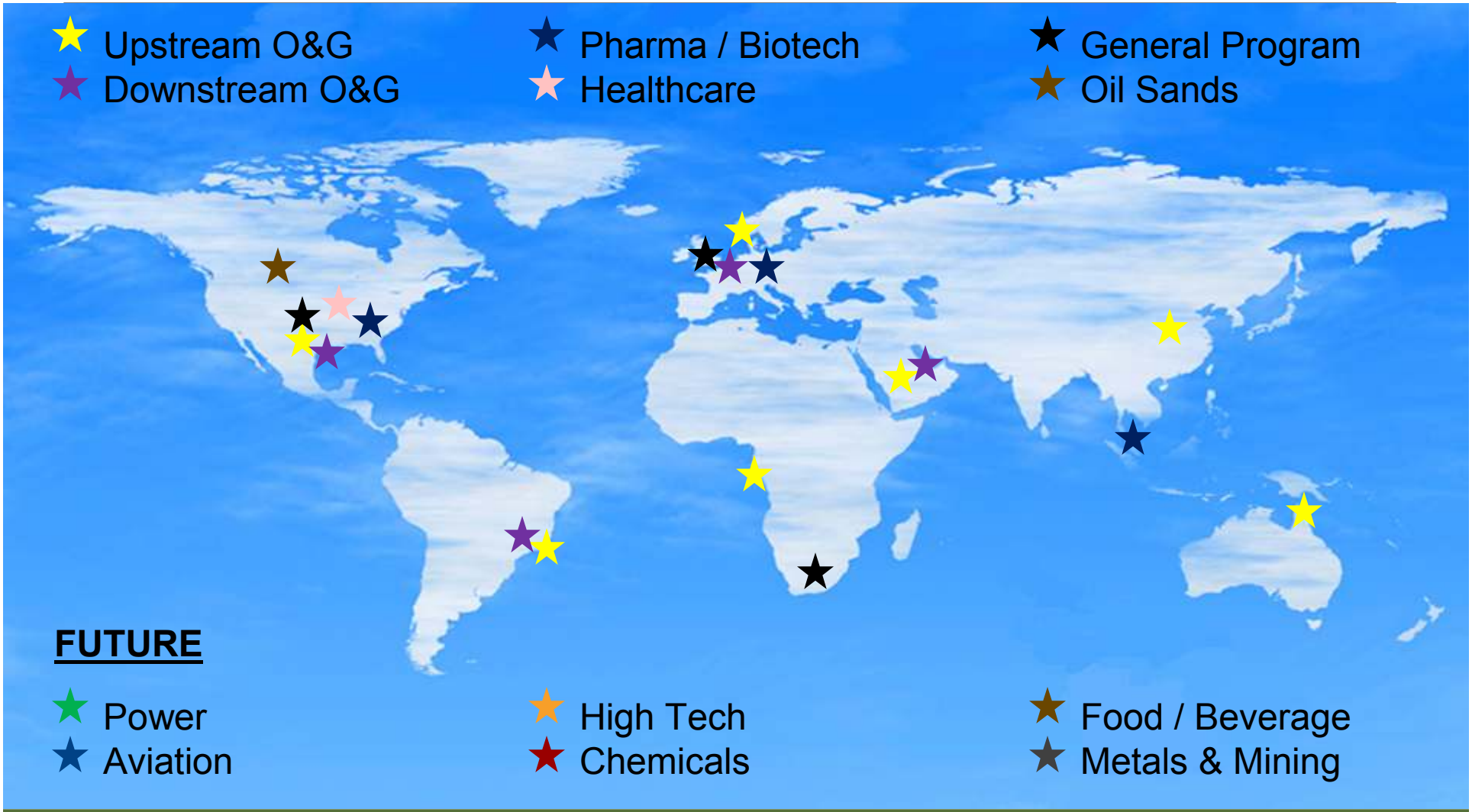
University of Calgary (PAL)

- COAA Phase II
- Dedicated Server at Univ. of Calgary
- Faculty Involved:
  - Dr. George Jergeas
  - Dr. Janaka Ruwanpura
  - Dr. Jim Lozon (Postdoc)
- Research (2 Graduate Students)
  - COAA Metrics / Additional Development
  - Pipeline Projects
  - Other?
- Here to Help You

CII Sector-Specific Research

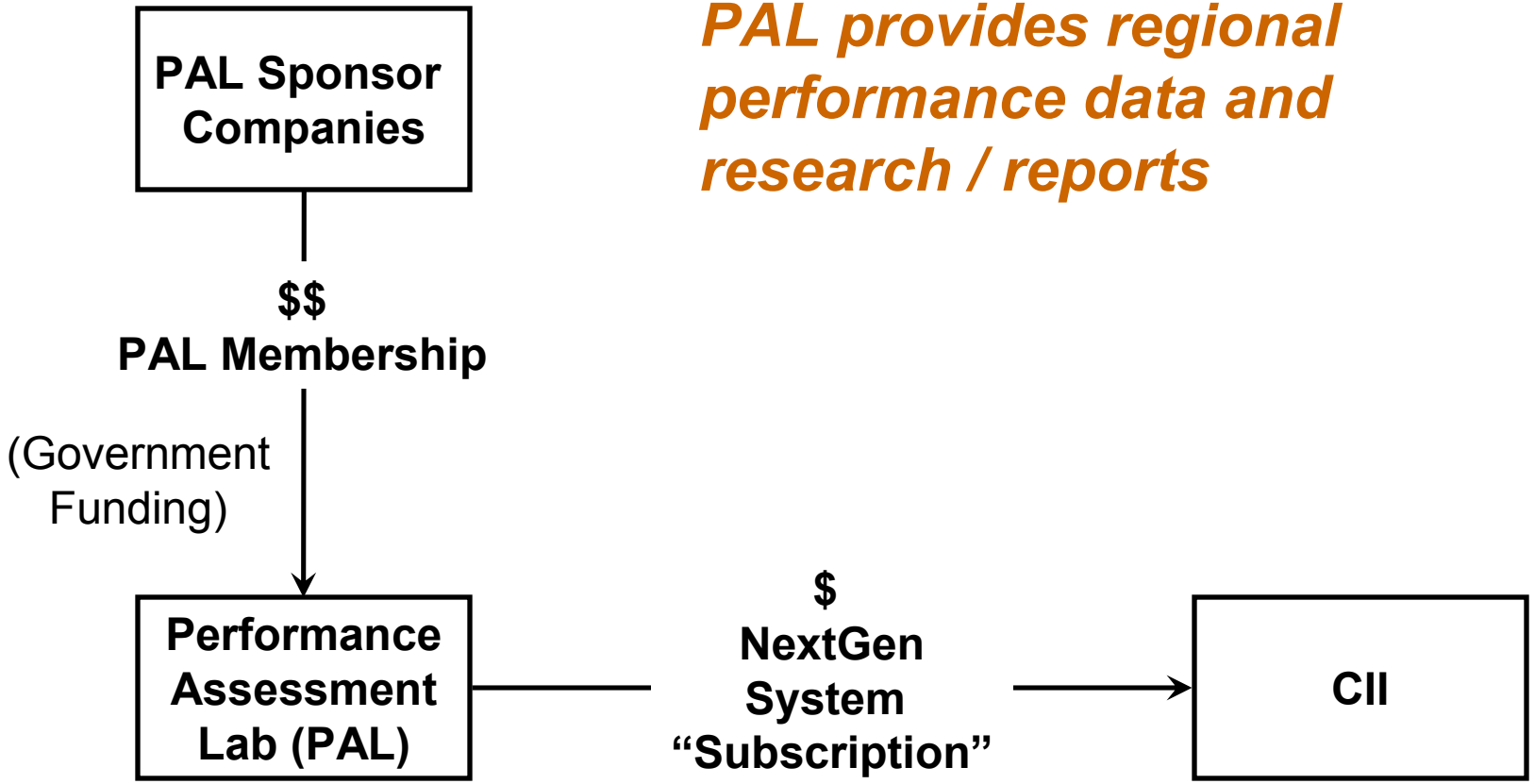
- Current
  - Pharmaceutical
  - D/S Oil & Gas
  - Oil Sands (COAA)
  - U/S Oil & Gas
  - Healthcare Facilities
- Future
  - (Nuclear) Power
  - Aviation Facilities
  - Others

CII PAL Global Network



The Knowledge Leader for Project Success
Owners • Contractors • Academics

PAL Financial Model



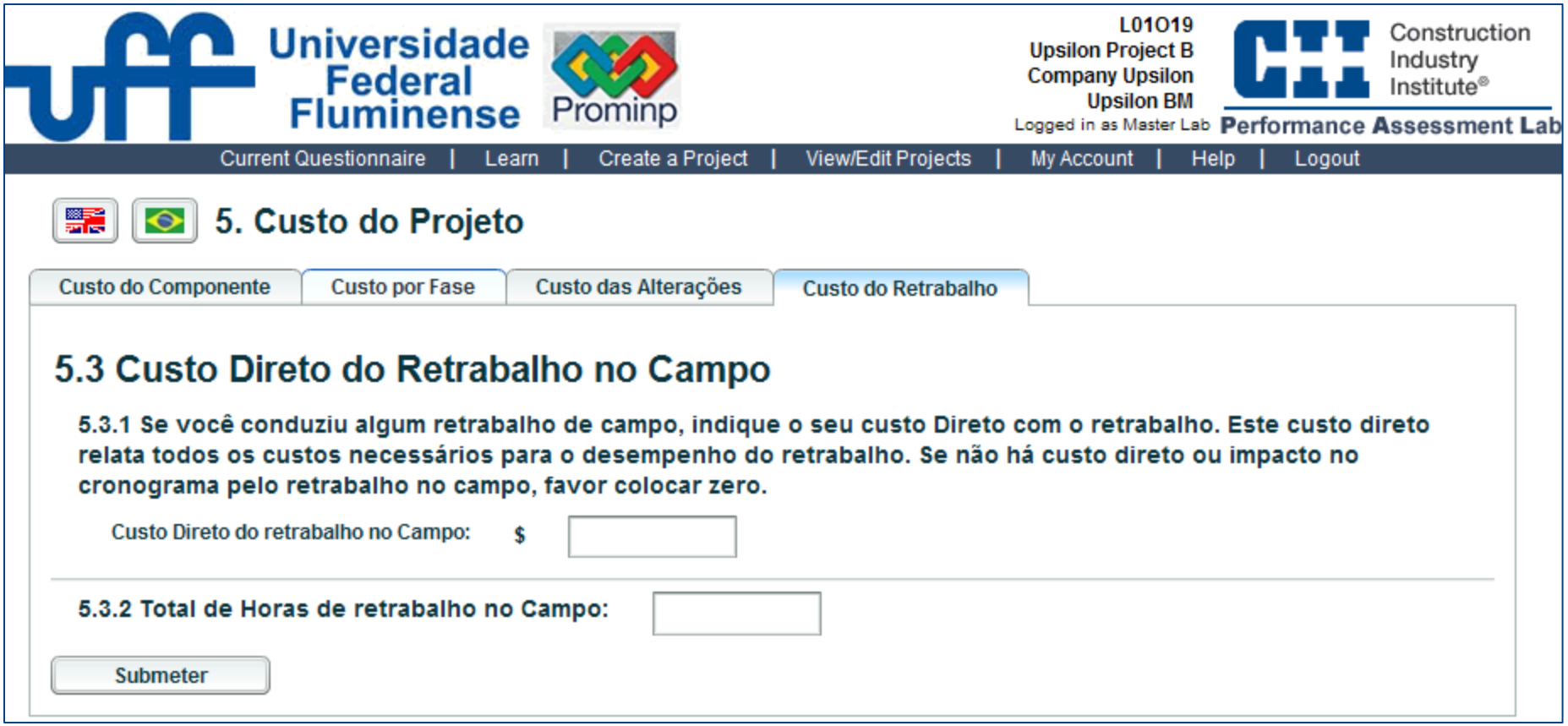
PAL provides regional performance data and research / reports

CII NextGen System

(Performance Assessment Lab (PAL))

CII NextGen System

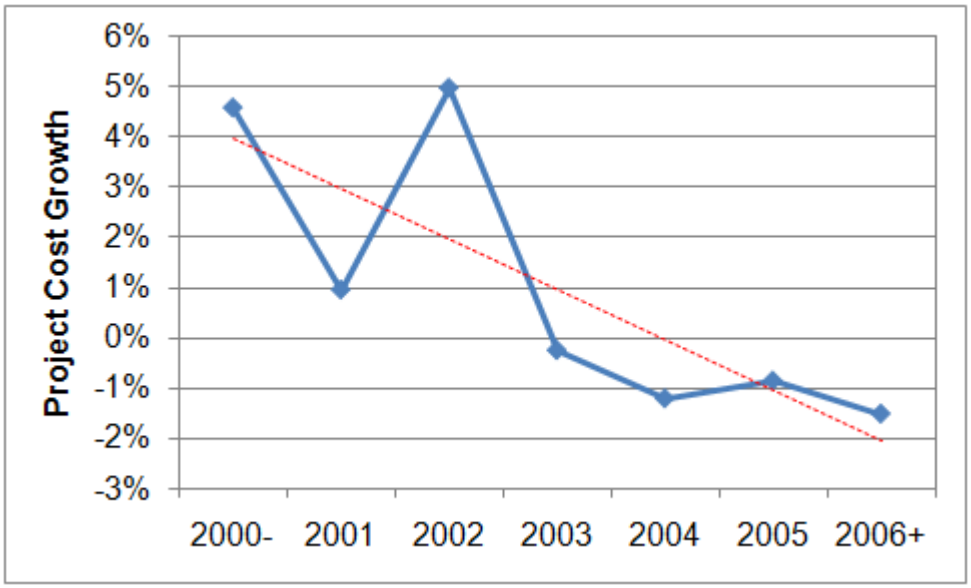
(Performance Assessment Lab (PAL))

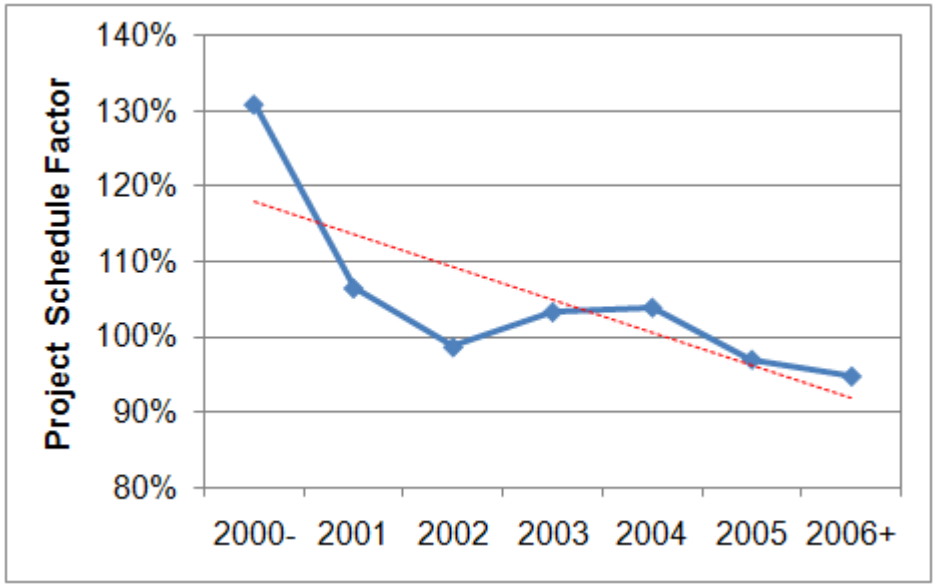


Can a
Performance Culture
Improve
Project Performance?

YES! (Benchmarking + Sector-Specific Research)

CII Pharmaceutical and Biotech Performance Research





Cost Performance

6% Less

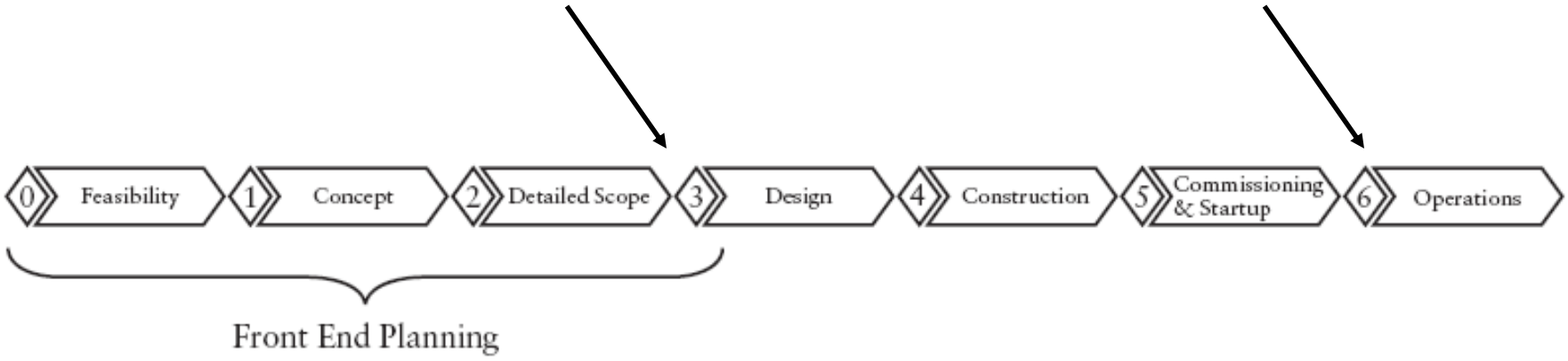
Schedule Performance

26% Less

How Do We Build a Performance Culture?

- Include COAA Benchmarking In Work Processes
  - Owner's Gated Asset Development Processes
  - Contractor's Operating Procedures Guidebook

USE COAA BENCHMARKING HERE



Questions?

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Construction Industry Institute
3925 W. Braker Lane (R4500)
Austin, TX 78759-5316
https://www.construction-institute.org

COAA Phase II Development Summary

- Types of Pipeline Projects
  - Product – Oil, Gas
  - Terrain Type- Rock, Clay, Sand/Gravel, Muskeg
  - Wall Thickness- Line pipe, Heavy wall
  - Installation- String, Weld, Joint coating, Lower in
  - Other?

COAA Phase II Development Summary

- Pipeline Project Considerations
  - By Product: Oil, Gas- Sweet, Sour, etc.
  - By Project Type: Green field, Looping program, Parallel foreign pipeline, etc.
  - By Siting: By Location, Terrain type
  - By Pipe Spec.:
    - Material, #valves (count)/Km and size of line pipe, mainline etc.
    - Pipe grade
    - Source of pipe: Country vs. Foundry
    - Parallel, Lateral Line
    - Thickness, coating ($), double jointing, freight (to stockpile), freight (stock pile to coater), freight (coater to stock pile),
    - By Schedule: Spring, Summer, Fall, Winter
    - By Other?

COAA Phase II Development Summary

- Pipeline Construction
  - Avg. Installed Pipe (km)/Day
  - $ Site Prep. (access and cleaning off right of way)/TIC (freight, clearing, ROW access, etc.)
  - % of terrain
  - $ Mainline Construction Cost/TIC (grading, stringing, bending, welding, coating of weld, ditching, Lowering in backfill)
  - $ Mainline Construction Cost/Wh(grading, stringing, bending, welding, coating of weld, ditching, Lowering in backfill)
  - $ Crossing Construction Cost/TIC and /km
  - $ Contractor Safety & Environmental/TIC
  - $ Survey/Km
  - $ Inspection/Km
  - $ Row Restoration/Km
  - Other?

COAA Phase II Development Summary

- Pipeline Construction Labour
  - Average Mainline Construction Crew size (by line item)
    - clearing, ditch, grade, bending, tie in, clean up, testing crew)
  - $ Mainline Construction cost (by line item)/TIC
    - clearing, ditch, grade, bending, tie in, clean up, testing crew)
  - Mainline WH (by line item)/Wh
    - clearing, ditch, grade, bending, tie in, clean up, testing crew
  - Equipment Cost
    - excavators, side booms, graders, dozers, etc.
  - Other?

COAA Phase II Development Summary

- Other Pipeline Metrics (Under Consideration)
  - # and Size of Crossings
  - Type of Crossings
    - HDD (Horizontal Directional Drilling)
  - Issues
    - %Redundancy
    - Operating Philosophy
    - etc.
  - Target: 30 Key Metrics
  - Questions?

Quantifying the Value

- What is the Value of:
  - Informed Decision-Making?
  - Specific Project Knowledge?
  - Project Performance Validation?
  - Best Practices?