



RICE GLOBAL ENGINEERING & CONSTRUCTION FORUM



Dr. Stephen Mulva
Associate Director



The Knowledge Leader for Project Success

Leveraging 25 Years of Industry Leadership

"10-10 Performance Assessment Program"

Dr. Stephen P. Mulva

- Associate Director of the Construction Industry Institute; University of Texas at Austin
- 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





- A consortium of leading owners, contractors, and academics working collaboratively to improve the constructed project and the capital investment process.
- An organized research unit of the Cockrell School of Engineering at The University of Texas at Austin.



History

- Organizational motivation was The Business Roundtable's Construction Industry Cost Effectiveness (CICE) Project in 1982.
- Founded in 1983 by 28 organizations; now 140
- Purpose is to measurably improve capital project delivery
- Mission is to create global competitive and market advantage for its members
- Alliances: Norway, Canada, Brazil, South Africa, Russia, Singapore, and Saudi Arabia

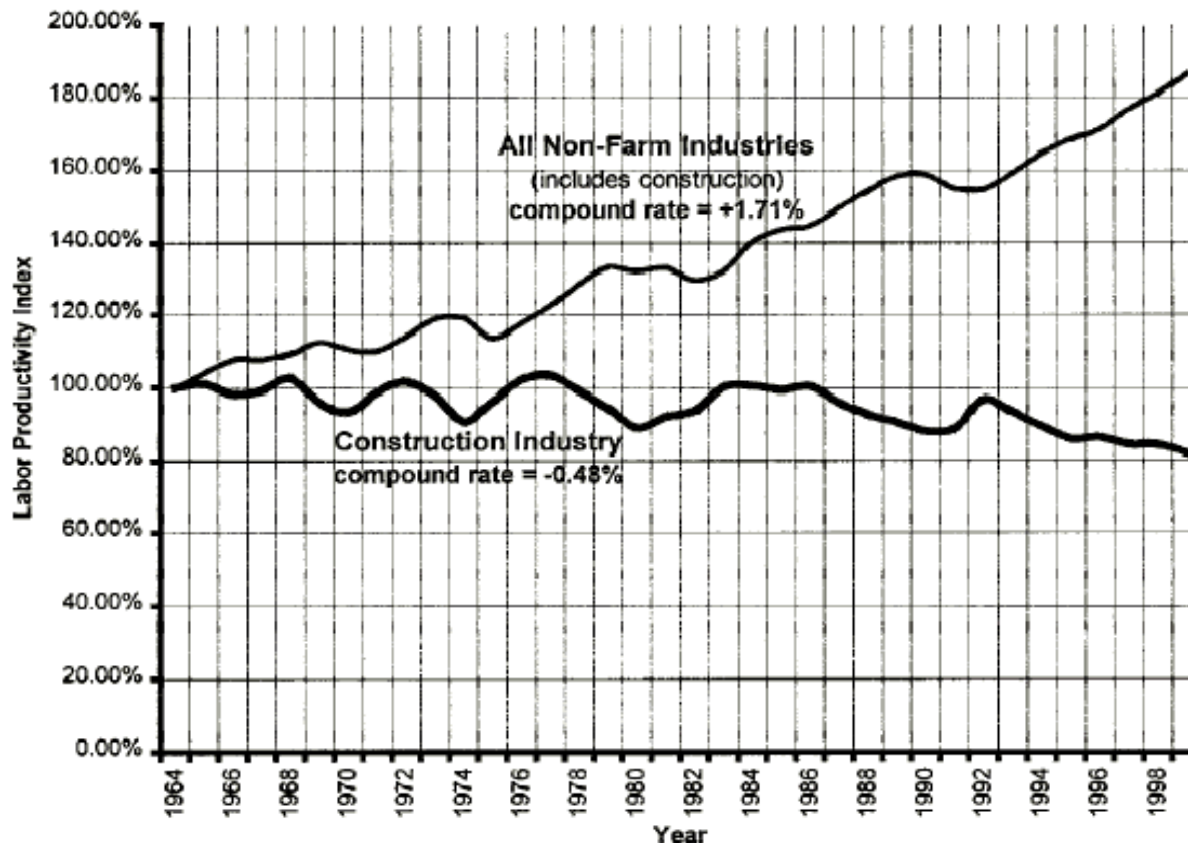


Construction Productivity Decline

Productivity Index (1964-1999)

(Constant \$ of contracts / workhours of hourly workers)

Sources: U.S. Bureau of Labor Statistics, U.S. Dept of Commerce



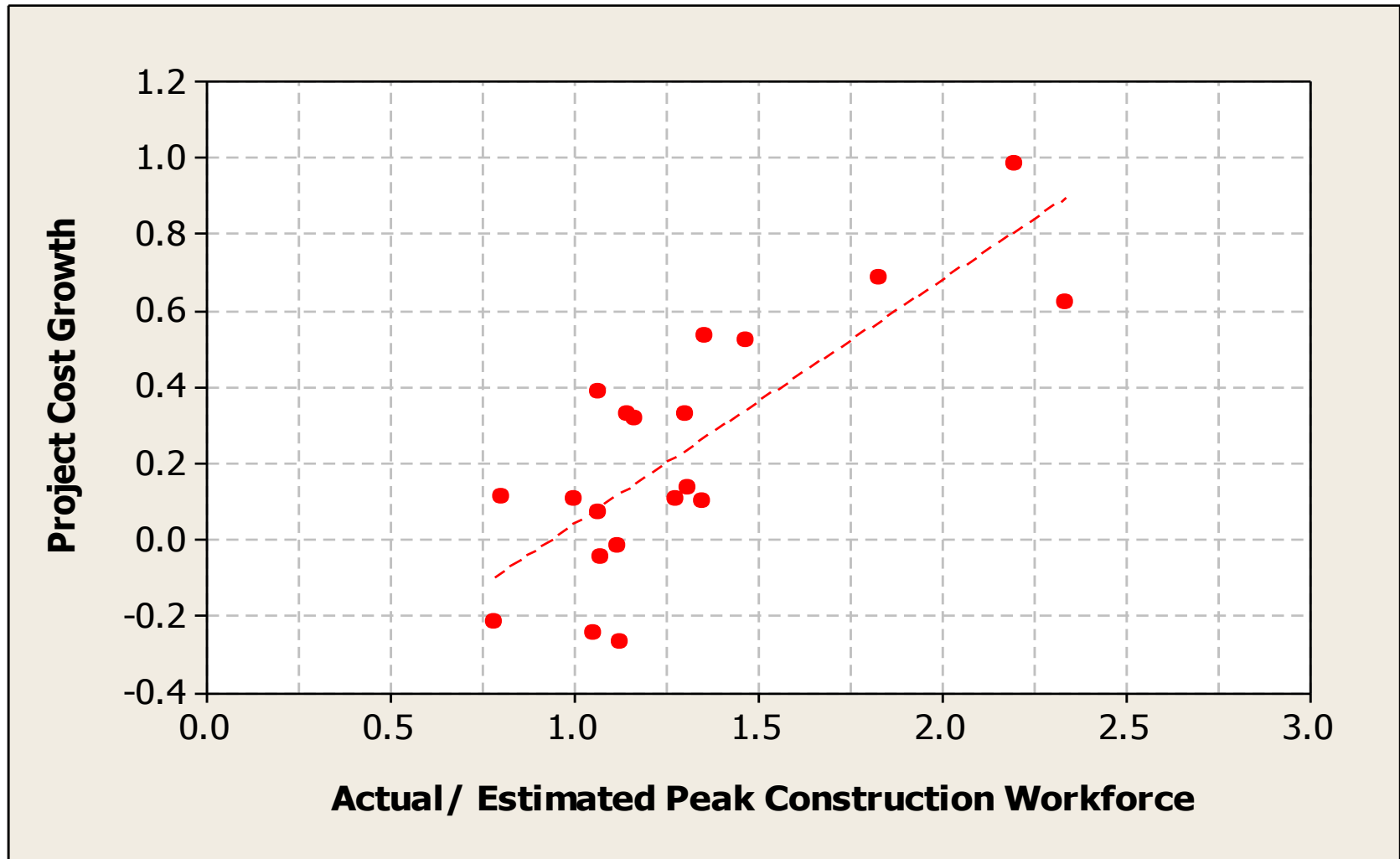
All Non-Farm Industries
+1.71%

Construction Industry
-.48%

Source: *Journal of
Construction Engineering
and Management*
(Sept./Oct. 2001)



Actual / Estimated Peak Construction Workforce



We Stand for the Project!

- What are the “governing dynamics” of project organizations?



5 Principles of Project Integration

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



Motivation

- Senior Management Disconnect
- Need for Actionable Information
- Measures Roll Up, Down

10 Input Measures

Planning

Controlling

Design Efficiency

Human Resources

10 Outcomes

Proj. Sch. Efficiency

Capacity Efficiency

Proj. Cost Efficiency

Burn Rate

CII 10-10 Program

\$/BOED, \$/GSF, Capacity Efficiency
Quality, Design Efficiency, Leading, HR


CII/COAA Benchmarking

Budget Factor, Change Cost Growth, WH/LF Piping, Safety, etc.

Currently editing - BMMAN TESTS

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

Project Process Legend: Not Started In Progress



Test General Large - Contractor

General Performance Key Report

Report Date: 10/05/2011

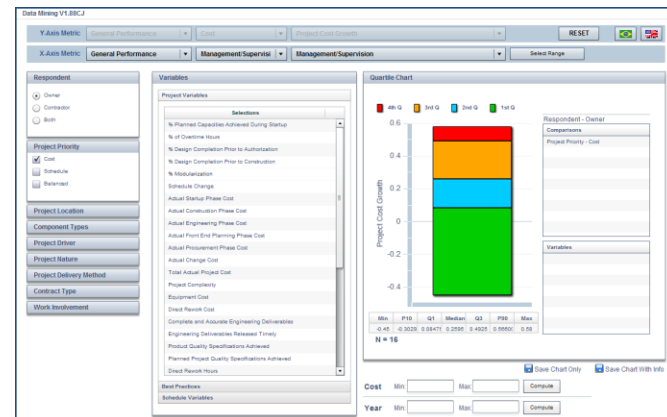
Project General Information			
Company Name	Teneco	Respondent Type (RT)	Contractor
Project ID	QIC0219	Questionnaire Type (QT)	General Benchmarking (Large)
Project Location	United States	Location Category (LC)	Domestic
Project Cost	\$105.9M \$1,849,000.00	Company Involvement (CI)	Design and Construct
Life Work Hours	4,000,000	Industry Group (IG)	Heavy Industrial
Overall Project Duration	988 Days	Project Type (PT)	Oil Sands SAGO
Design Start/Up Duration	988 Days	Project Nature (PN)	grass roots
Milepost of Construction	04/10/2007	Cost Category (CC)	\$10MM - \$100MM

Key Report Legend

- Q1, Q2, Q3 and Q4 stands for the 1st, 2nd, 3rd and 4th quarter respectively. If the quarter cell is colored, Q1 represents best performance and Q4 represents worst performance.
- If the quarter cell is not colored, Q1 represents the group with the highest metric value, while Q4 represents the group with the lowest metric value. (The three metrics, lower or higher scores are not necessary better.)
- LO 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 3 or more companies).
- ✓ in 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).

SEE TAB 1

General Performance - Cost													
Metric	Project Score	CI Database Mean	Quartile	Comparison Criteria									
				Q1	LC	CI	IG	PT	PN	CC	n		
Project Cost Growth	0.031	0.019	Q1	✓	✓	✓	✓	✓	✓	✓	✓	19*	
Delta Cost Growth	0.037	0.062	Q1	✓	✓	✓	✓	✓	✓	✓	✓	16*	
Project Budget Factor	0.979	0.950	Q1	✓	✓	✓	✓	✓	✓	✓	✓	16*	
Delta Budget Factor	0.030	0.063	Q1	✓	✓	✓	✓	✓	✓	✓	✓	16*	
Detail Engineering Cost Growth	0.026	0.068	Q1	✓	✓	✓	✓	✓	✓	✓	✓	15*	
Procurement Cost Growth	0.036	0.040	Q1	✓	✓	✓	✓	✓	✓	✓	✓	13*	
Construction Cost Growth	0.048	0.011	Q1	✓	✓	✓	✓	✓	✓	✓	✓	15*	
Startup Cost Growth			C	C	C	C	C	C	C	C	C	C	



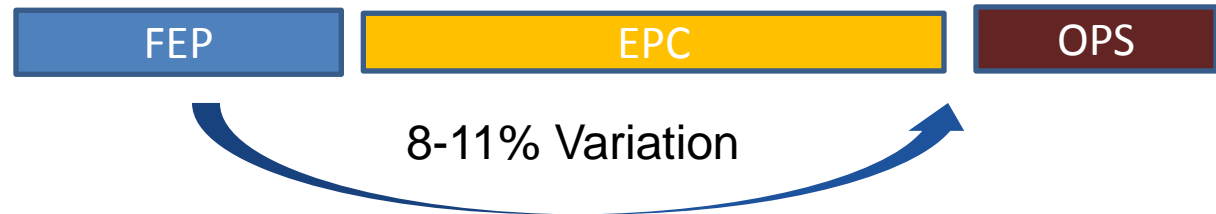
CII's 10-10 Program

- Simple and Important Measures
 - 10 Input Measures (Leading Indicators)
 - 10 Output Measures (Cost, Duration, Capacity, FTE, Quantities)
- Research-Based
 - 75% CII Research (e.g., Project Health Indicators)
 - 15% Capital Projects Research (CII Members)
 - 10% Other Industries (Project Management Measures)
- Launched July 2013 (CII Annual Conference)
- Industrial, Building, and Infrastructure Sectors (late March)
- Phase-Based Surveys
- CII Requested 10 Project-Phase Surveys from Each CII Member by May 2, 2014
- www.10-10program.org

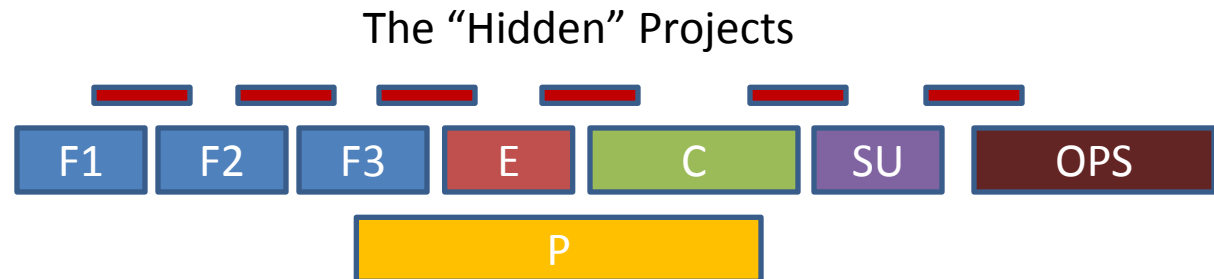


21st Century Project Context

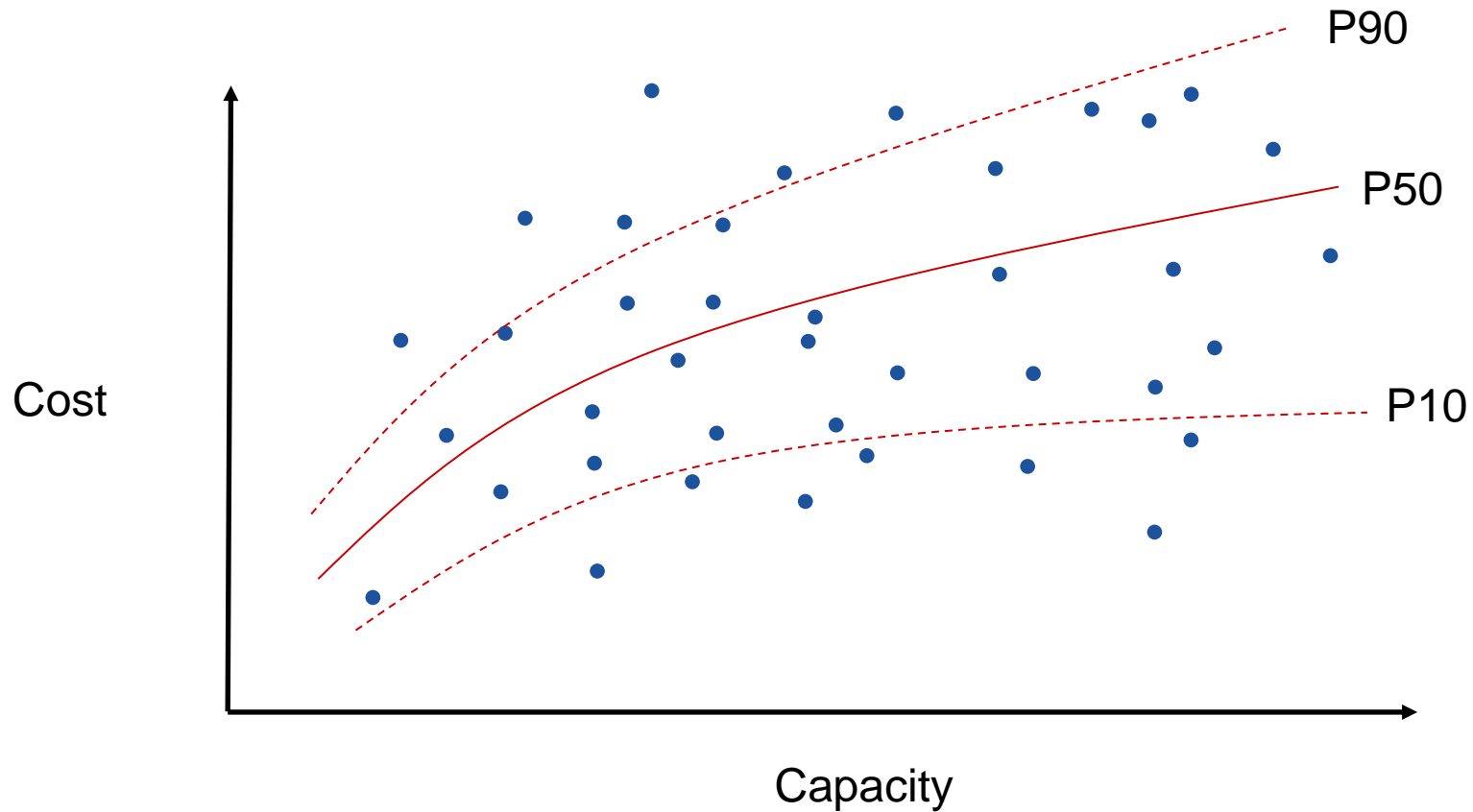
**“Old School”
Project Management**



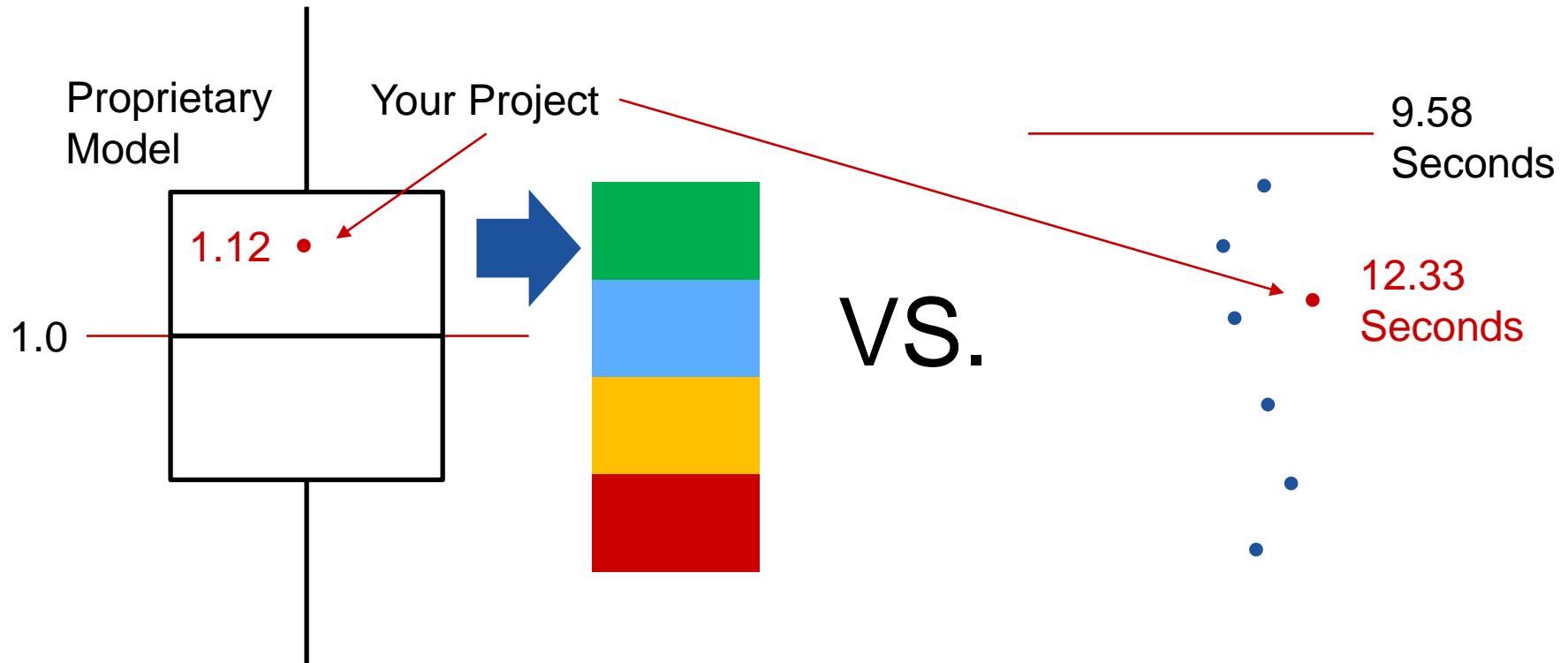
**Phase-Gate Based
Project Management**



20th Century Measurement: C Students

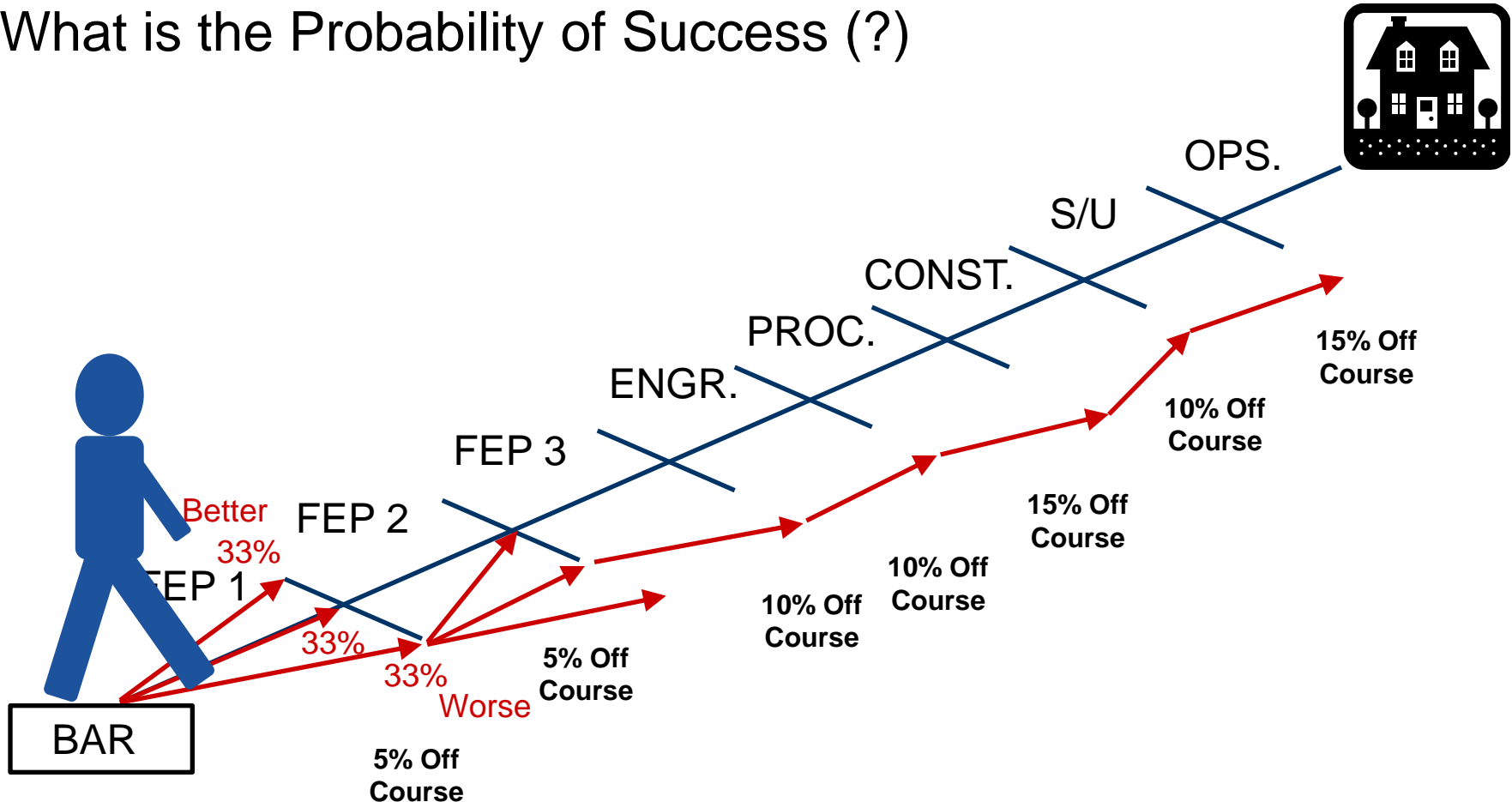


21st Century Measurement: Breaking Records



Phase-Based Surveys (Markov Chain Theory)

What is the Probability of Success (?)



Project Health Indicators (RT 220)


Microsoft Excel - PHI Tool

File Edit View Insert Format Tools Data Window Help

Type a question for help

A1

PLEASE MARK A CIRCLE THAT IS APPLICABLE FOR EACH LEADING INDICATOR.

NEED HELP? Click 

1. The project team is lacking in the necessary expertise, experience, breadth, and depth to successfully execute the project.

1 SERIOUS	2 MAJOR	3 MODERATE	4 MINOR	5 NONE	NOT APPLICABLE
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Move pointer here for measurement criteria of above Leading Indicator					RESET <input type="radio"/>

2. The project team is experiencing a high turnover rate and instability in team membership.

1 SERIOUS	2 MAJOR	3 MODERATE	4 MINOR	5 NONE	NOT APPLICABLE
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Move pointer here for measurement criteria of above Leading Indicator					RESET <input type="radio"/>

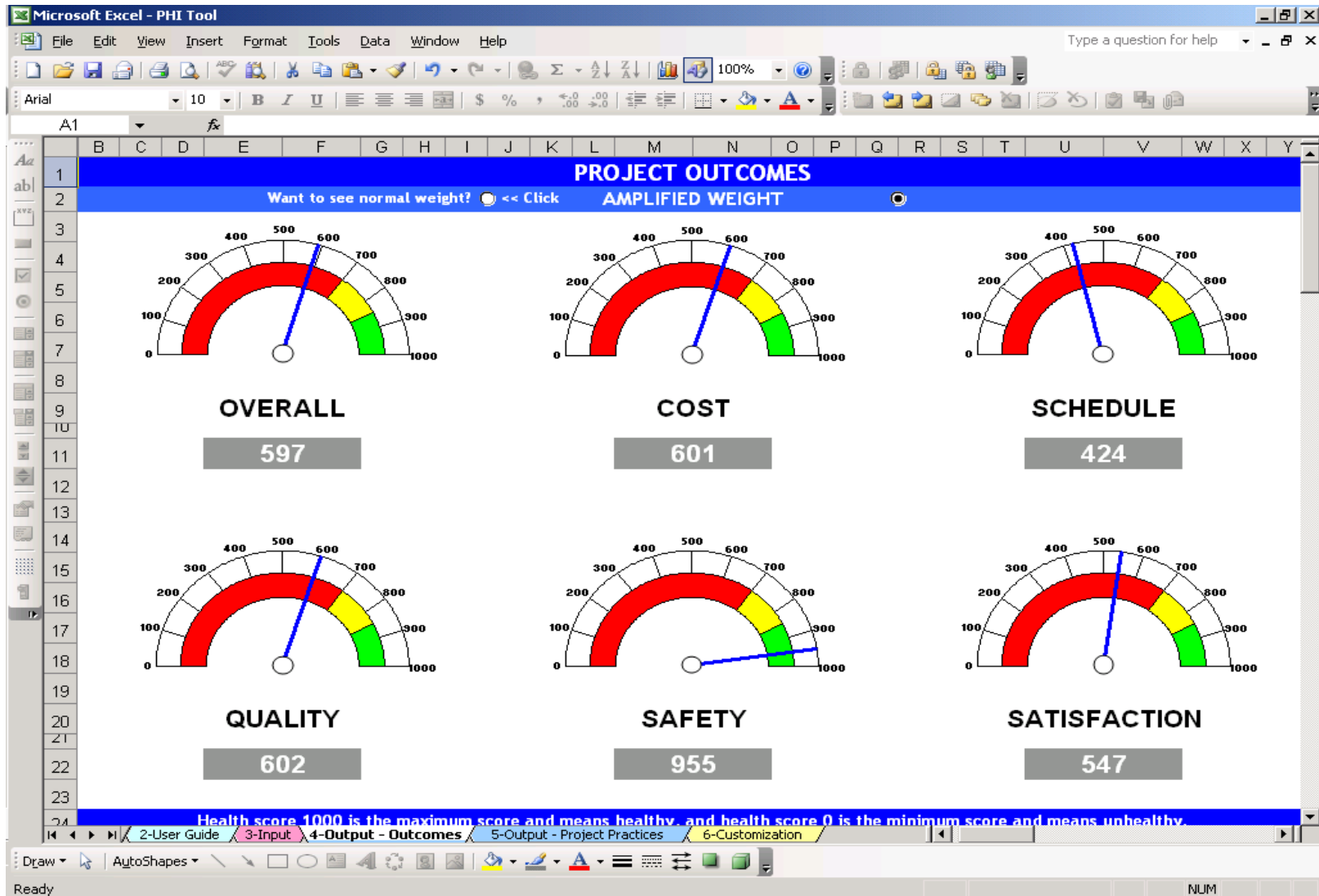
3. The project team's response to Requests for Information, questions, and changing events that can significantly impact the

1-Introduction 2-User Guide 3-Input 4-Output - Outcomes 5-Output - Project Practices 6-Customization

Draw AutoShapes

Ready NUM

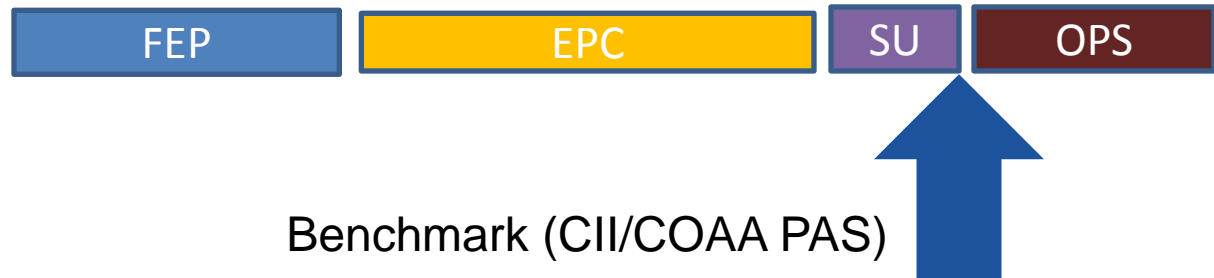
PHI (RT 220) – Predicted Outcomes



Traditional Benchmarking vs. 10-10 Performance Assessment Program

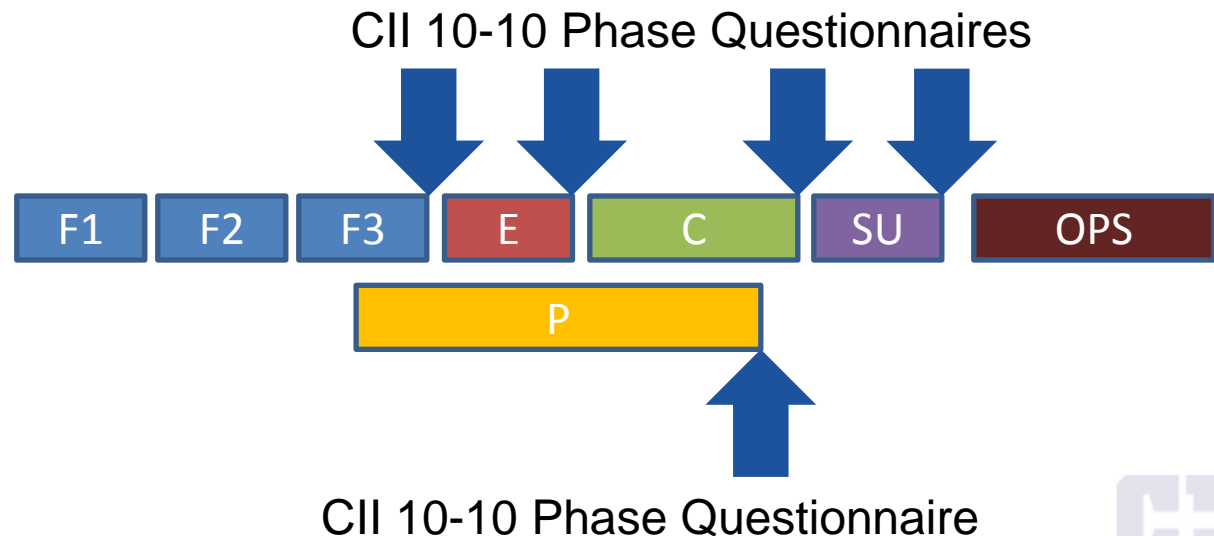
CII General Benchmarking Program

Process, Practice



CII 10-10 Program

People, Practice



How CII's 10-10 Program Works

Sample Statement-Based Question

26. The interfaces between project stakeholders were well managed.

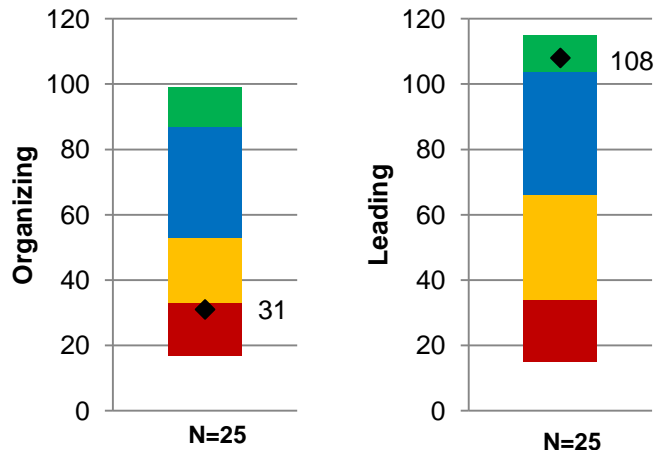
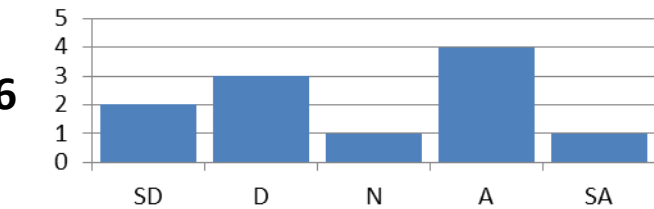
Strongly
Disagree

Neutral

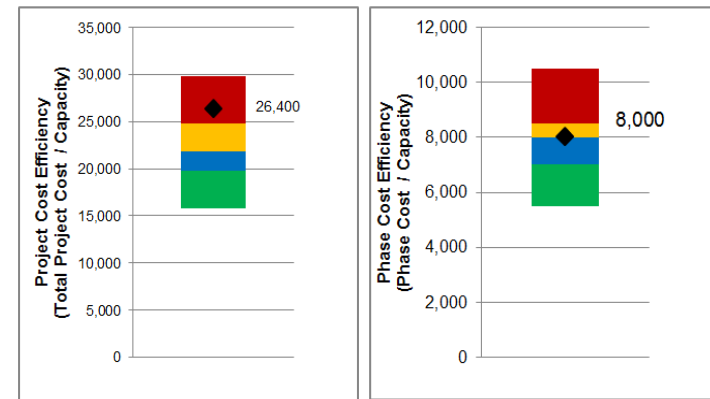
Strongly
Agree



Q26



Sample Input Metrics



Sample Output Metrics

- Project Diagnostics (KBSC)
- Implement CII Research and Tools

10-10 Questionnaires

- Practice-Based
 - Yes/No
 - 5-point scales (strongly agree ↔ strongly disagree)
- Phase-Based
 - Help for current projects
 - Answered as project nears phase completion
- Quantitative, yet simple to answer
- Research-based, empirically tested
- Internet-Based (2014+)
- Examples...

“Famous” Construction Quote

“Construction would be easy, if it weren’t for all the people involved”

– Ted VanWyck



FEP Questionnaire

The interfaces between project stakeholders were well-managed.

- A. Strongly Agree
- B. Agree
- C. Neutral
- D. Disagree
- E. Strongly Disagree

Input Metrics: Organizing, Leading



Engineering Questionnaire

The equipment procurement and vendor schedules were a significant challenge or problem for this project

- A. Strongly Agree
- B. Agree
- C. Neutral
- D. Disagree
- E. Strongly Disagree



Procurement Questionnaire

Preferred suppliers were used effectively to streamline the procurement process

- A. Strongly Agree
- B. Agree
- C. Neutral
- D. Disagree
- E. Strongly Disagree



Construction Questionnaire

The availability and competency of craft labor was adequate

- A. Strongly Agree
- B. Agree
- C. Neutral
- D. Disagree
- E. Strongly Disagree



Start-Up Questionnaire

The project experienced an excessive number of project management team personnel changes

- A. Strongly Agree
- B. Agree
- C. Neutral
- D. Disagree
- E. Strongly Disagree

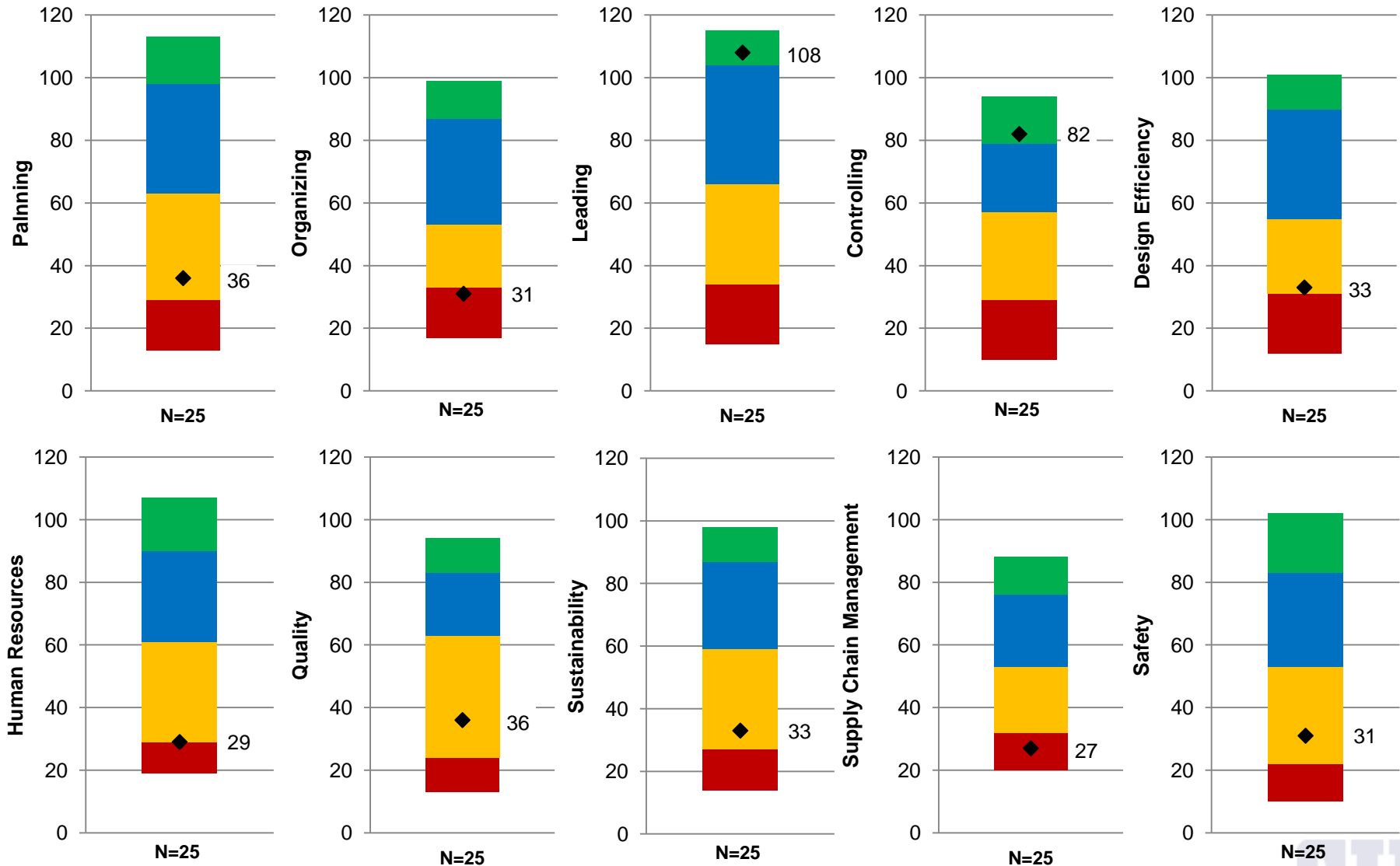


Start-Up Questionnaire

- Which of the following statements characterize the decisions made by the manager(s) of this project? (please check all that apply)
 - Considered final and not revisited
 - Collaborative and inclusive
 - Made at the lowest appropriate level in the organization
 - Communicated promptly to the team
 - Made in a timely and effective manner
 - Consistent with the delegation of authority
- Input Measure: Leading



10-10 Report: Input Measures

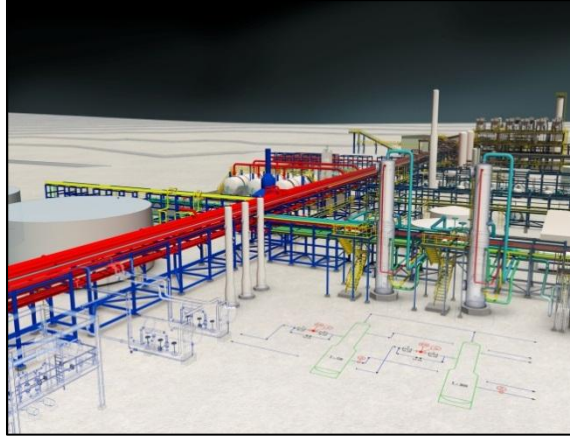


Output Measure: Capacity Efficiency

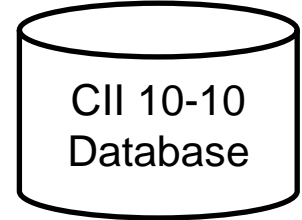
- CII Model Plant / CII Reference Project



- Project A
- Capacity: 2,600 tons/yr
- BOM: 1.78 RF

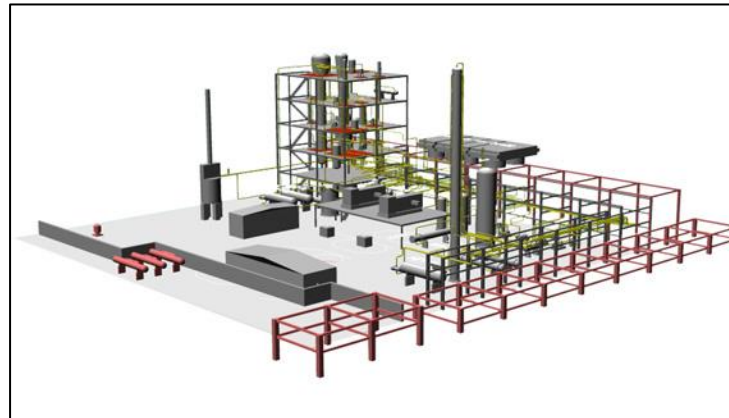


$$\frac{CAP_A}{RF_A} = 1,461 (DE)$$



$$\frac{CAP_B}{RF_B} = 1,386 (DE)$$

- Project B
- Capacity: 1,150 tons/yr
- BOM: 0.83 RF

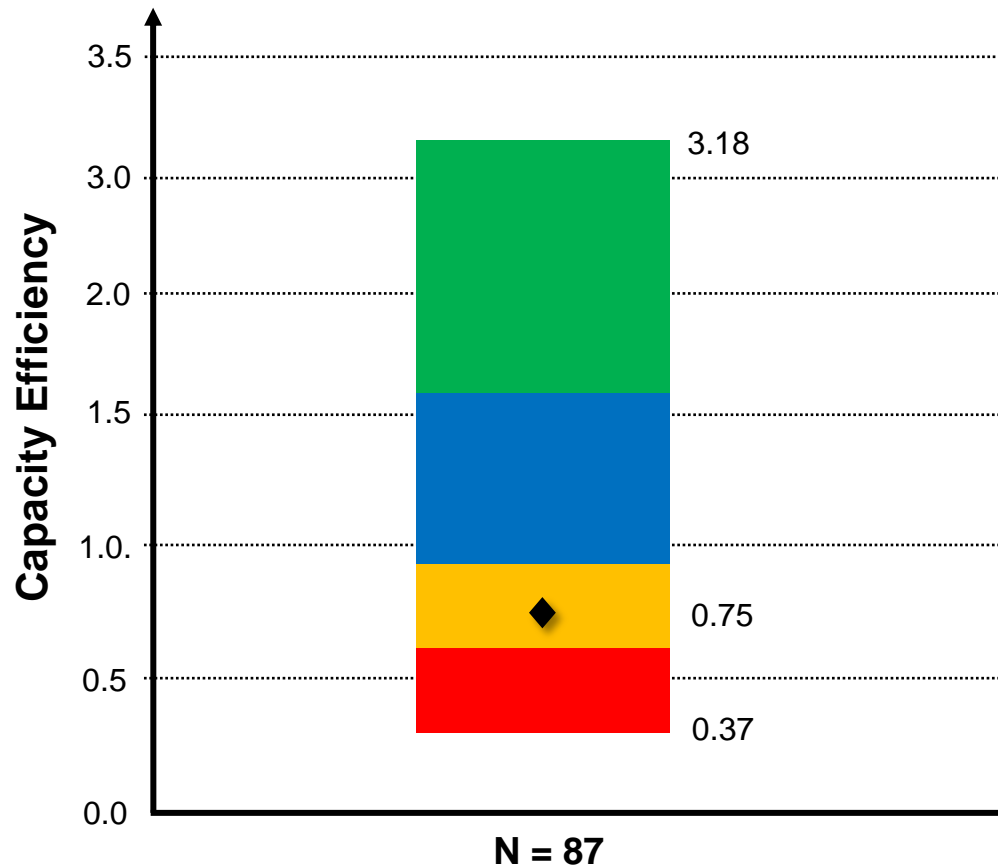


Bill of Material
(BOM) Work Hours

Baseline
Reference
Factor (RF)

10-10 Report: Output Measure (Capacity Efficiency)

$$\text{Capacity Efficiency} = \frac{(\text{Capacity/Reference Project Capacity})}{(\text{Installed Quantity/Reference Project Installed Quantity})}$$



10-10 Program Integration

Member Imperatives

- 10-10 Program
- Knowledge Base

CII Project Execution Knowledge Structure (C-PEKS)						
4/18/2014						
Knowledge Areas		Management Attributes	Project Phases	Project Functions or Roles		Resource Materials
Project Planning	Business and Project Processes	Planning	Feasibility	Project Business Sponsor	Operations & Maint.	Overview & Conclusions
Design	Project Controls	Organizing	Concept	Project Management	Health, Safety & Environmental	Key Supporting Graphics & Information
Procurement, Contracts & Materials Mgmt.	Risk Management	Leading	Detailed Scope	Architects & Engineering	Risk Management	Implementation Tools
Construction	HSE, Security & Sustainability	Controlling	Detailed Design (Engineering)	Project Controls	Quality Management	Key Performance Indicators
Commissioning & Startup	Information Mgmt. & Technology		Procurement	Procurement & Contracts	Business Dev. & Proposals	Presentations
Human Resource Management	Project Organization & Communication		Construction	Construction	SBU/Corp Functions	Education Materials
Project & Program Management	Quality Management		Commission & Startup	Commission & Startup	External Stakeholders	Journal Articles & Conference Papers
			Handover and Closeout			Reference Materials



10-10 Diagnostics (KBSC)

- Phase-Based, Sector-Based, Attribute-Based

List of CII Tools
1 Design Effectiveness Toolkit (64 Strategies)
2 17 Constructability Principles
3 eGuide for Materials Management
4 PEpC
5 Common Commodity Codes (?)
6 Product Integrity Concerns (video – no tool?)
7 Interim Product Database (IPD)
8 Industrial Engineering Techniques
9 Lean Principles in Construction (35 Principles & Sub-principles)
10 Planning for Startup SuPERTool
11 Activity Analysis
12 Rework Reduction
13 Crew Scheduling 'Look Up' Table
14 Best Practices Productivity Improvement Index (BPPII)
15 Voice of the Craft Worker (VOW) Tool
16 Attracting and Maintaining a Skilled Construction Workforce (75 Activities)?
17 Multiskilling Cost Model
18 Compass (Communications Project Assessment) Tool
19 Global Virtual Engineering Team (GVET) Planner
20 Project Priority Calculator – worthy of more investigation...
21 Core Competency Toolkit (Owner/Contractor Work Structure Process Handbook)
22 Management of Virtual Team Checklist
23 Partnering Toolkit
24 Leader Selection Guide
25 Team Leadership Planner
26 Team Health Check
27 Trust Evaluation System (RT24)
28 ValueShare Tool
29 QMS Correlation Matrix
30 Zero Field Rework Opportunity Checklist
31 Value Management Process (VMP) Selection Tool
32 Small Projects Toolkit
33 Quality Performance Management System (QPMS) superseded by QMS Correlation Matrix
34 Work Packaging Execution Model
35 Cost/Schedule Tradeoff Tool (CSTT) – 23 techniques
36 Project Health Indicator (PHI) Tool
37 Indirect Construction Cost (IDCC) Checklist

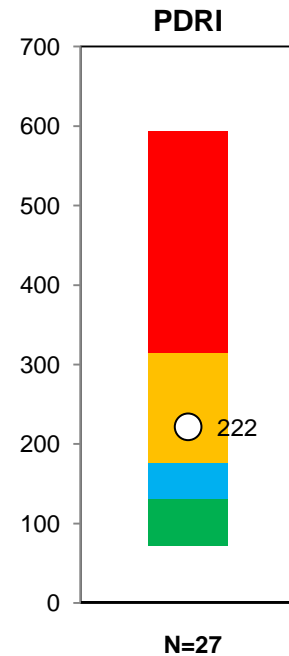
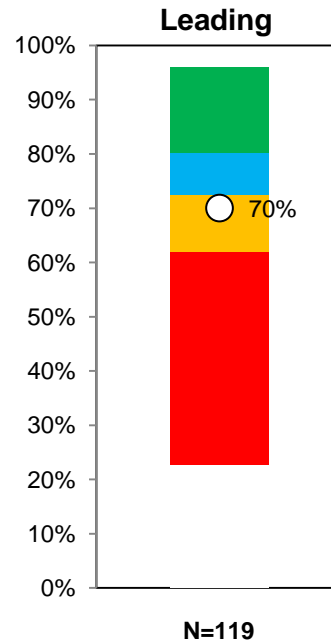
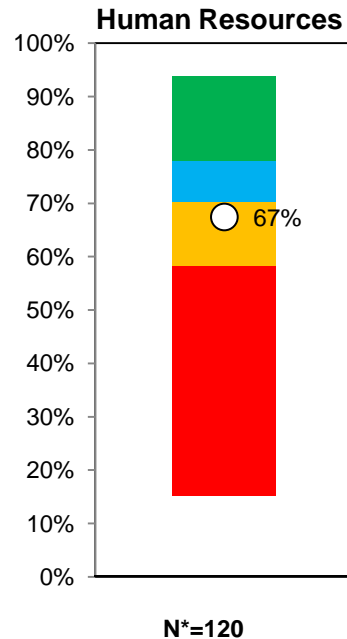
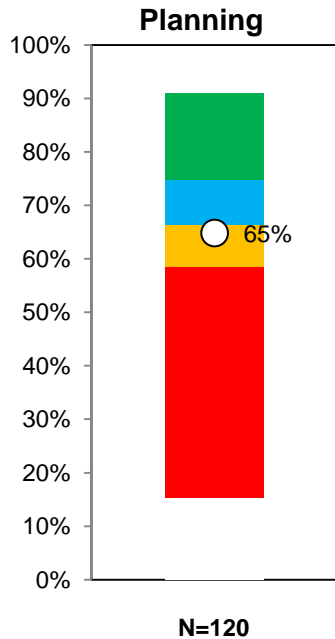
38 Project Controls and Management Systems (PCMS) Participants Involved Tool (interfaces)
39 Project Controls and Management Systems (PCMS) Information Flow Tool (interfaces)
40 Predictive Tools Road Map (?)
41 Interactive Risk Register Tool (incl. Probabilistic Risk Analysis)
42 Contract Strategy Selection Tool (from C/R RT 260)
43 Equitable Risk Allocation (ERA) Tool
44 Project Delivery and Contract Strategy (PDCS) Selection Tool
45 International Project Risk Assessment (IPRA) Tool
46 Dispute Review Board (DRB) Implementation Guidelines
47 Disputes Potential Index (DPI)
48 (Commodity vs. Value-Added) Contractor Services Communication and Evaluation Tool
49 Single-Party Risk Assessment Worksheet
50 Two-Party Risk Assessment Worksheet
51 Contractor Compensation Strategies (31 flavors) Checklist
52 Construction Contract Change Clause Checklist (vol. I and II)
53 "Hot Button" Risks Checklist (incl. Contract Language Table)
54 Risk Management Model and Checklist
55 Active and Passive Safety Leading Indicators Checklist
56 Checklist for Sustainable Construction Job Sites
57 Design for Construction Safety Toolbox, Version 2.0
58 Workers' Compensation Contractor Checklist
59 Environmental Information Gathering Checklist
60 Good Environmental Practice Criteria for Construction Projects Checklist
61 Zero Injury Techniques Checklist
62 Safety Self-Assessment Instrument
63 Guidelines for Managing Subcontractor Safety
64 Safety Program Guidelines for Contractors and Subcontractors
65 Integration Opportunity Assessment Tool
66 BIM Project Execution Plan Template
67 LEVER Technology Prediction Tool (Productivity)
68 EPC Macro Model Logic Diagram for Impact of Process Change
69 D/B/B Macro Model Logic Diagram for Impact of Process Change
70 EPC Macro Model Activity List (Information Management)
71 Advanced Construction Technology Systems (ACTS) Database
72 Lessons Learned Self-Assessment Questionnaire
73 Security Rating Index Tool
74 FEP Alignment Thermometer
75 PDRI for Industrial
76 PDRI for Building
77 PDRI for Infrastructure

10-10 Program Campaign

- August 2013 – May 2014
 - Collected 578 projects
 - Collected 700+ to date
- July 21-23, 2014 CII Annual Conference
- 2014 and beyond
 - August 2014: 10-10 online system launch
 - Norway, Canada (COAA), Singapore, etc.
 - Integration with CII knowledge base

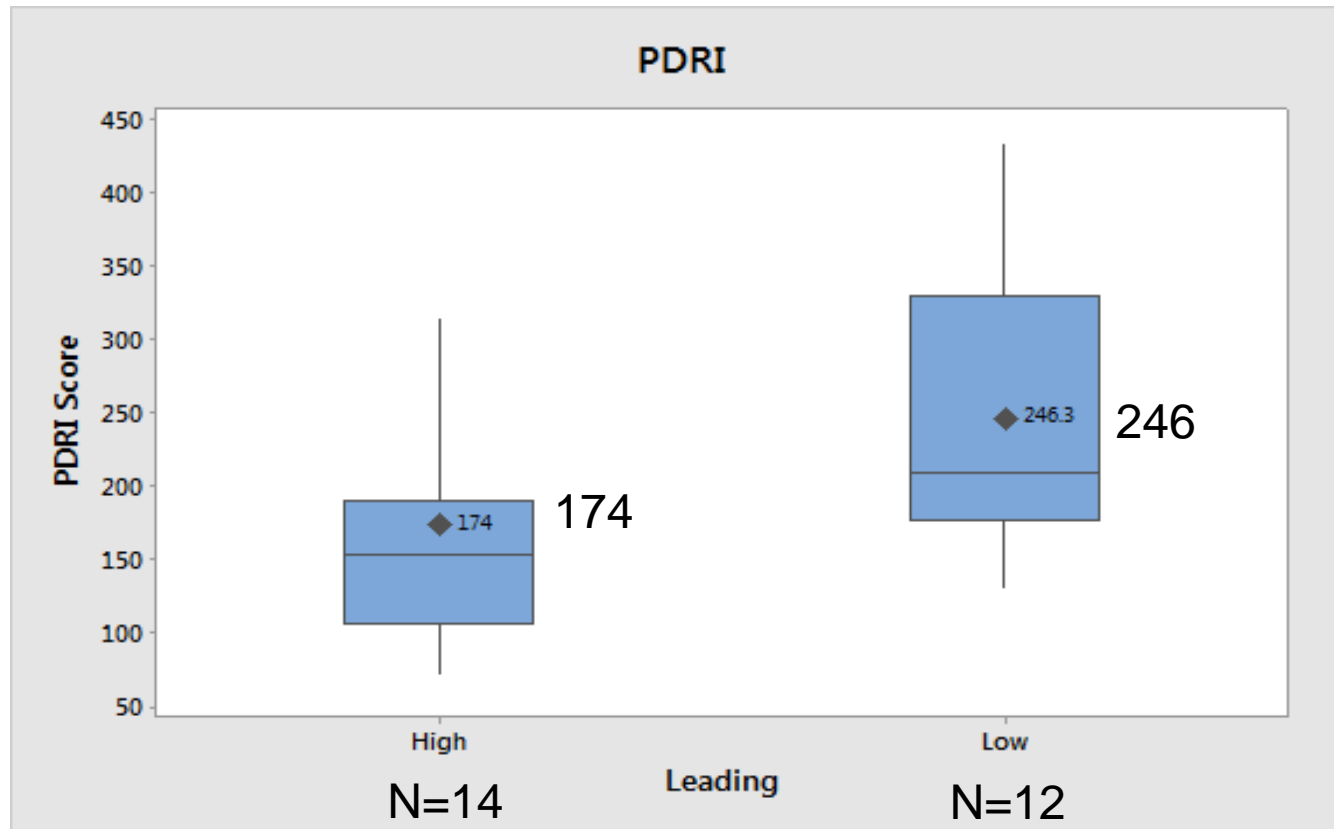
CII AC: Industrial Sector FEP Input Measures

- Wide Variation



CII AC: Industrial Sector FEP Input Measures

- Good Leadership = **29.3%** Better Scope Definition



p=0.085

Industry Recognition

TOP 400
ENR
ENGINEERING NEWS-RECORD



FORTUNE®
100 BEST
COMPANIES
TO WORK FOR

CH30
Projects of the Year



Questions?

Stephen P. Mulva, Ph.D.
Associate Director, CII
smulva@cii.utexas.edu
+1.512.232.3013

Daniel Oliveira, Ph.D.
Research Engineer, CII
daniel.oliveira@cii.utexas.edu
+1.512.232.3050

www.10-10program.org

