The Knowledge Leader for Project Success

Leveraging 25 Years of Industry Leadership

Productivity Research Efforts

A Summary of Productivity Research (CII and COAA)

May 16, 2012

Stephen P. Mulva, Ph.D.
Associate Director

Agenda

- “Global Thoughts”
- COAA Benchmarking of Productivity
- CII’s Productivity Research Program (RT 252)
- Other Productivity Initiatives
  - NIST
  - ASTM
  - CSC
  - Petrobras
  - PER
- Path Forward

Global Thoughts

- McKinsey & Co.

  "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**."

Global Thoughts

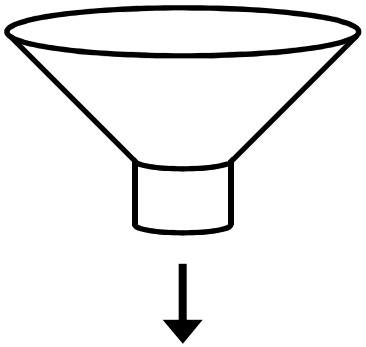
- Advancing the Competitiveness and Efficiency of the U.S. Construction Industry
  - Opportunities for Breakthrough Improvements:
    - Widespread Use of Interoperable Technology Applications (BIM)
    - Improved Jobsite Efficiency (Effective Interfacing of People, Processes, Materials, Equipment and 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

National Research Council (2009)

COAA Benchmarking of Productivity

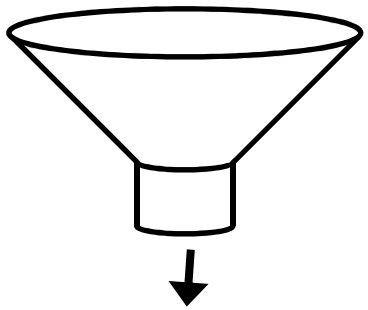
DISCIPLINE-LEVEL PRODUCTIVITY

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



ENGINEERING PRODUCTIVITY

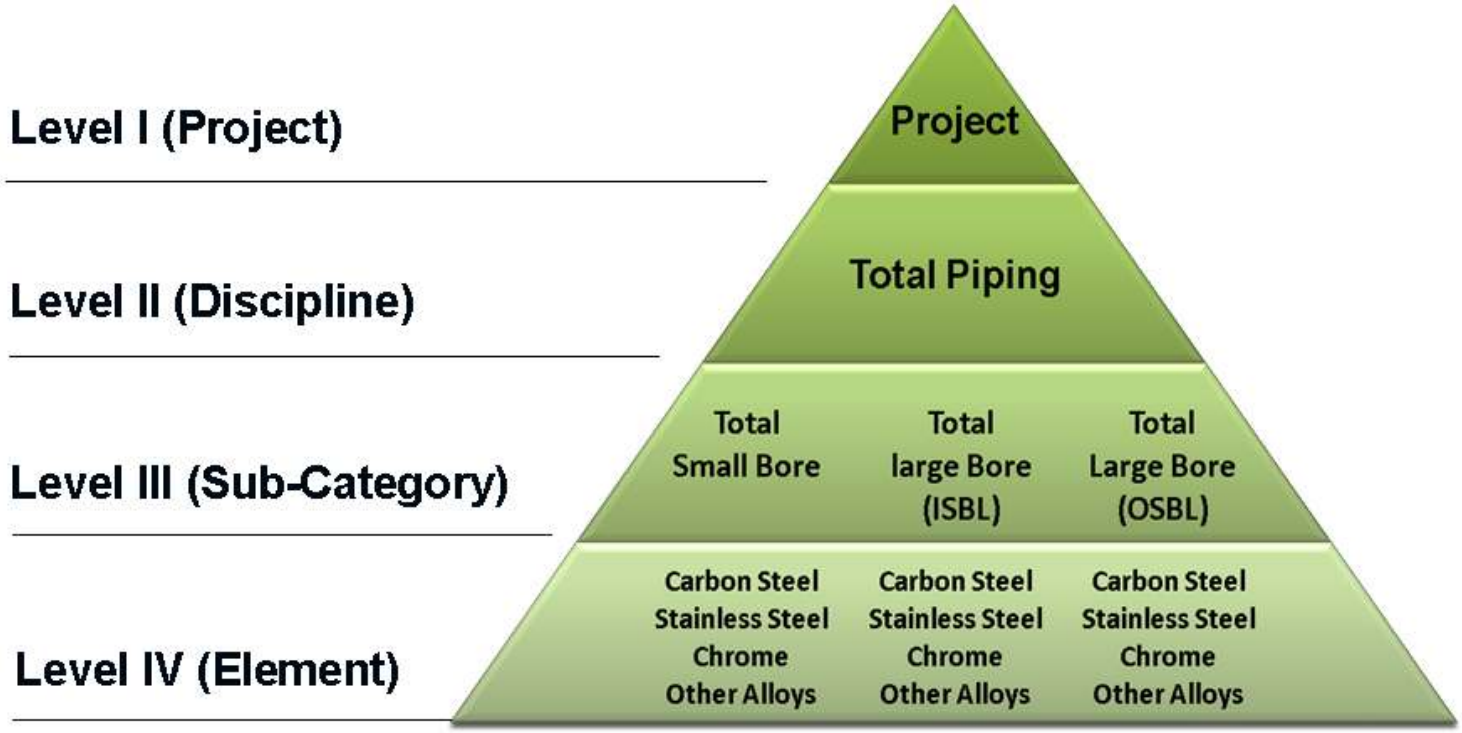
Concrete Construction Productivity
Structural Steel Const. Productivity
Piping Construction Productivity
Equipment Const. Productivity
Electrical Const. Productivity
Instrumentation Const. Productivity
Insulation Const. Productivity
Scaffolding Const. Productivity
Module Installation Productivity



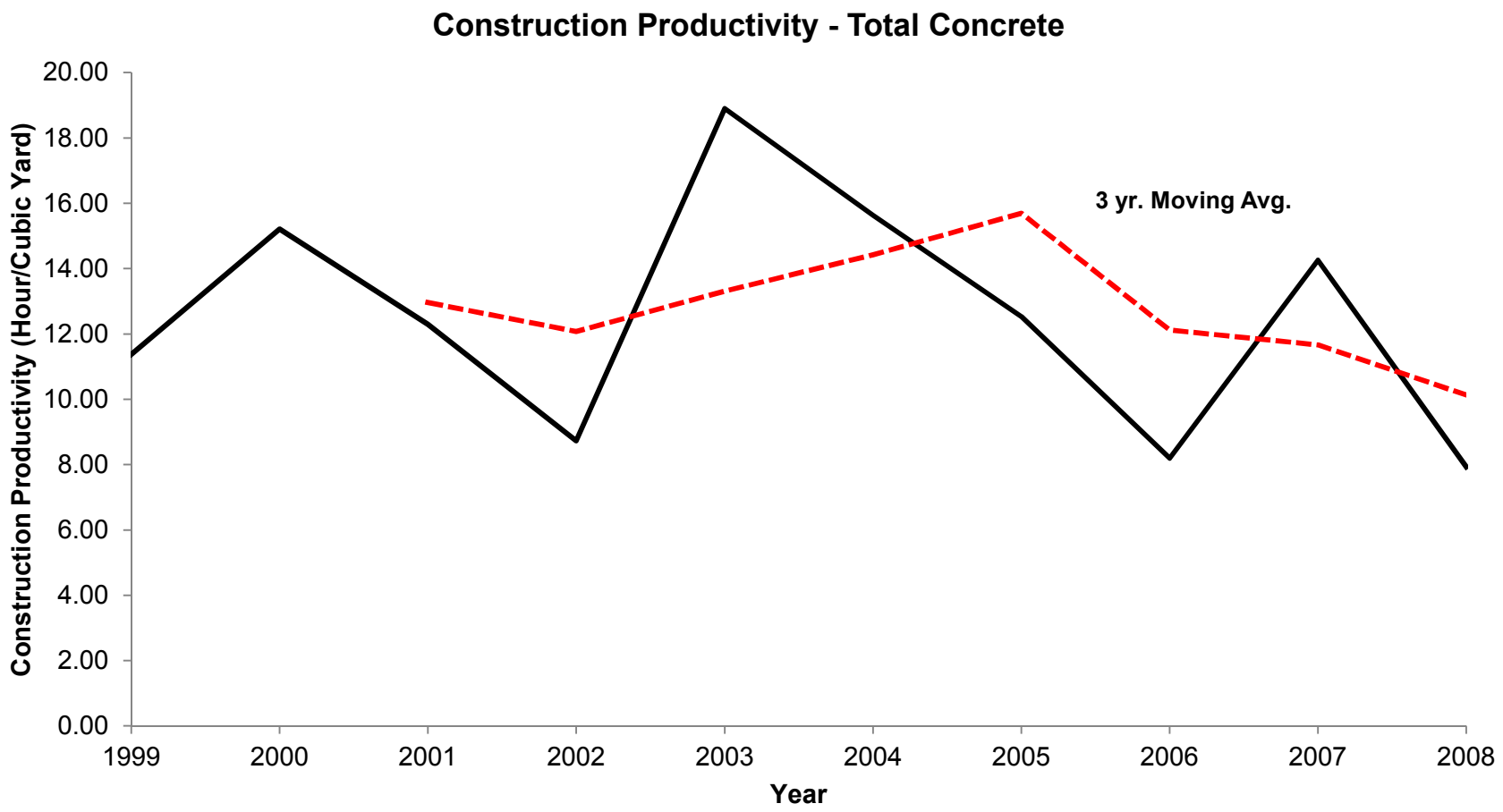
CONSTRUCTION PRODUCTIVITY

CII / COAA Productivity Hierarchy

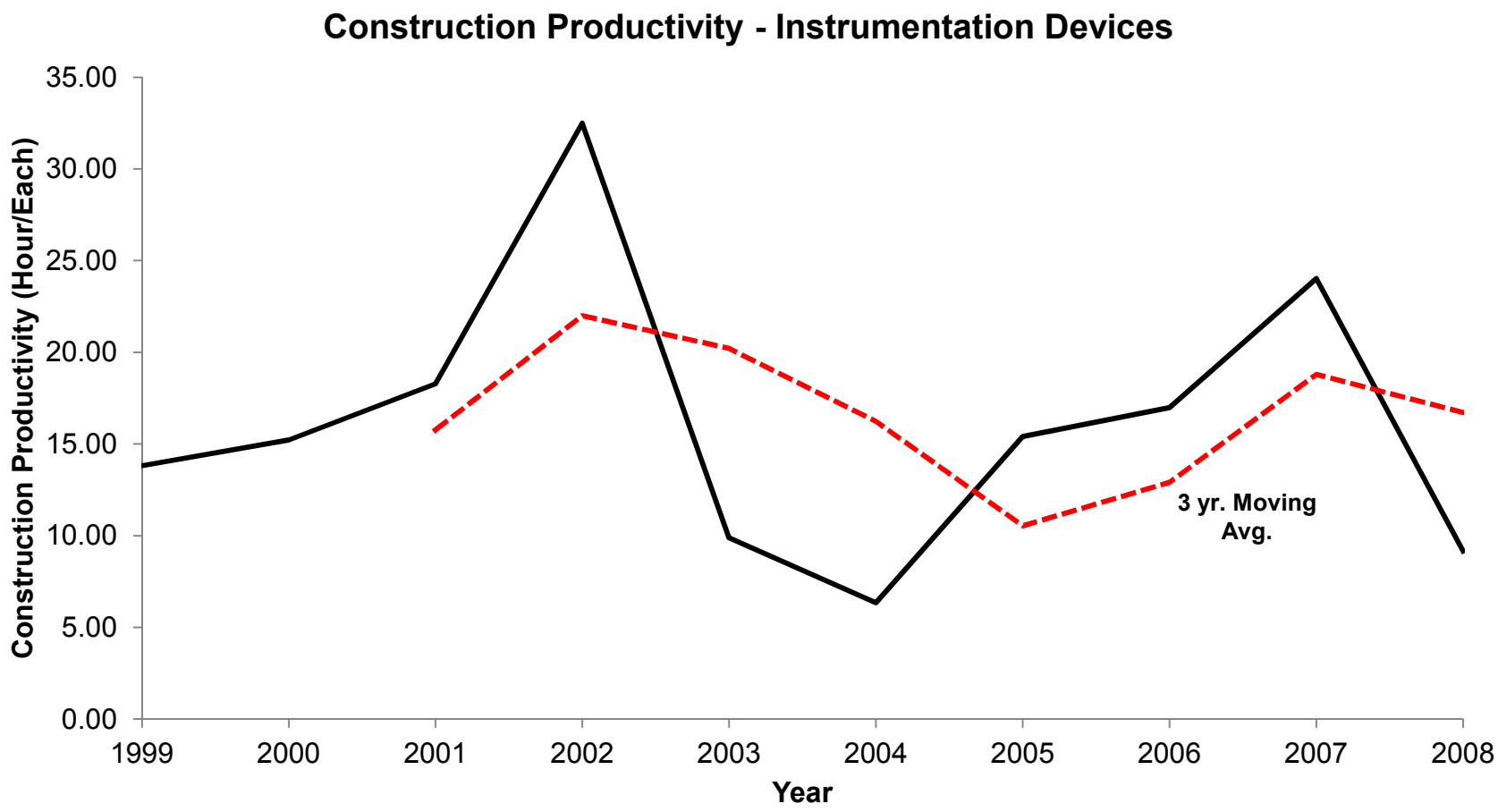
- Piping Engineering



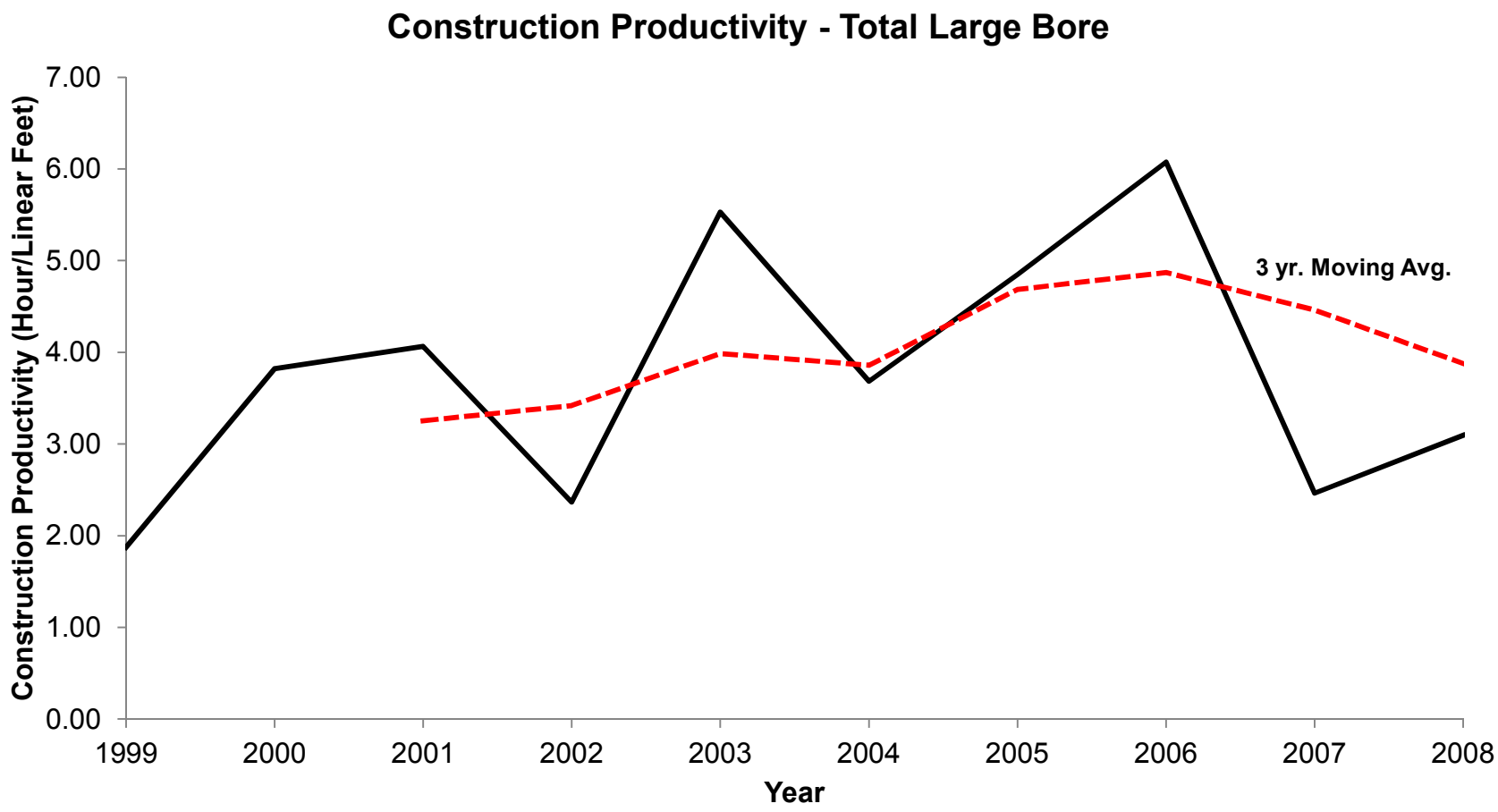
CII Construction Productivity - Total Concrete



CII Construction Productivity – Instrumentation Devices



CII Construction Productivity - Total Large Bore Piping



PAS Data Miner (COAA Phase II)

Data Mining V1.88CJ

Y-Axis Metric: General Performance | Cost | Project Cost Growth | RESET

X-Axis Metric: General Performance | Management/Supervisi | Management/Supervision | Select Range

Respondent
- Owner
- Contractor
- Both

Project Priority
- [x] Cost
- [ ] Schedule
- [ ] Balanced

Project Location
Component Types
Project Driver
Project Nature
Project Delivery Method
Contract Type
Work Involvement

Variables

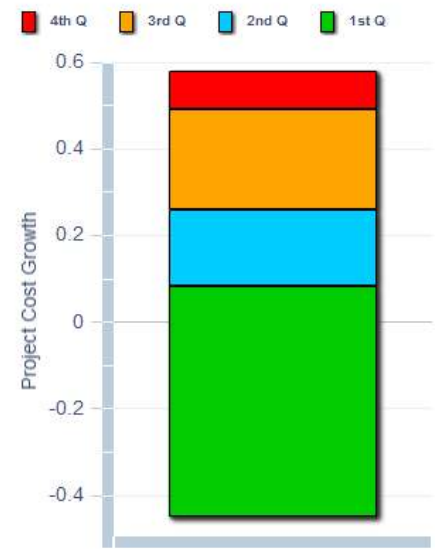
Project Variables

Selections
- % Planned Capacities Achieved During Startup
- % of Overtime Hours
- % Design Completion Prior to Authorization
- % Design Completion Prior to Construction
- % Modularization
- Schedule Change
- Actual Startup Phase Cost
- Actual Construction Phase Cost
- Actual Engineering Phase Cost
- Actual Front End Planning Phase Cost
- Actual Procurement Phase Cost
- Actual Change Cost
- Total Actual Project Cost
- Project Complexity
- Equipment Cost
- Direct Rework Cost
- Complete and Accurate Engineering Deliverables
- Engineering Deliverables Released Timely
- Product Quality Specifications Achieved
- Planned Project Quality Specifications Achieved
- Direct Rework Hours

Best Practices

Schedule Variables

Quartile Chart



Min	P10	Q1	Median	Q3	P90	Max
-0.45	-0.3029	0.08475	0.2595	0.4925	0.56600	0.58

N = 16

Respondent - Owner

Comparisons
- Project Priority - Cost

Variables

Save Chart Only | Save Chart With Info

Cost Min: Max: Compute

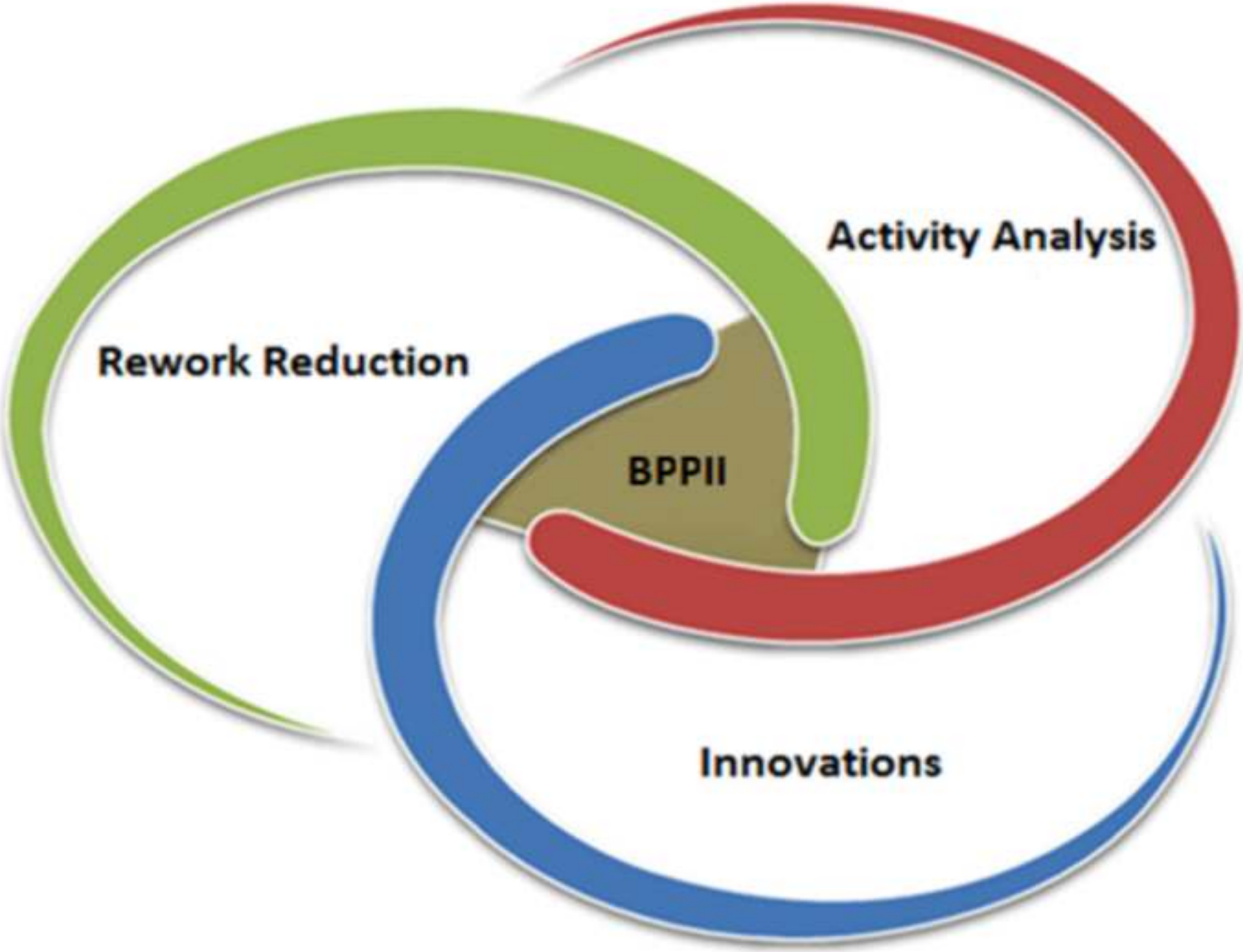
Year Min: Max: Compute

6-Year Voyage: Construction Productivity Research Program

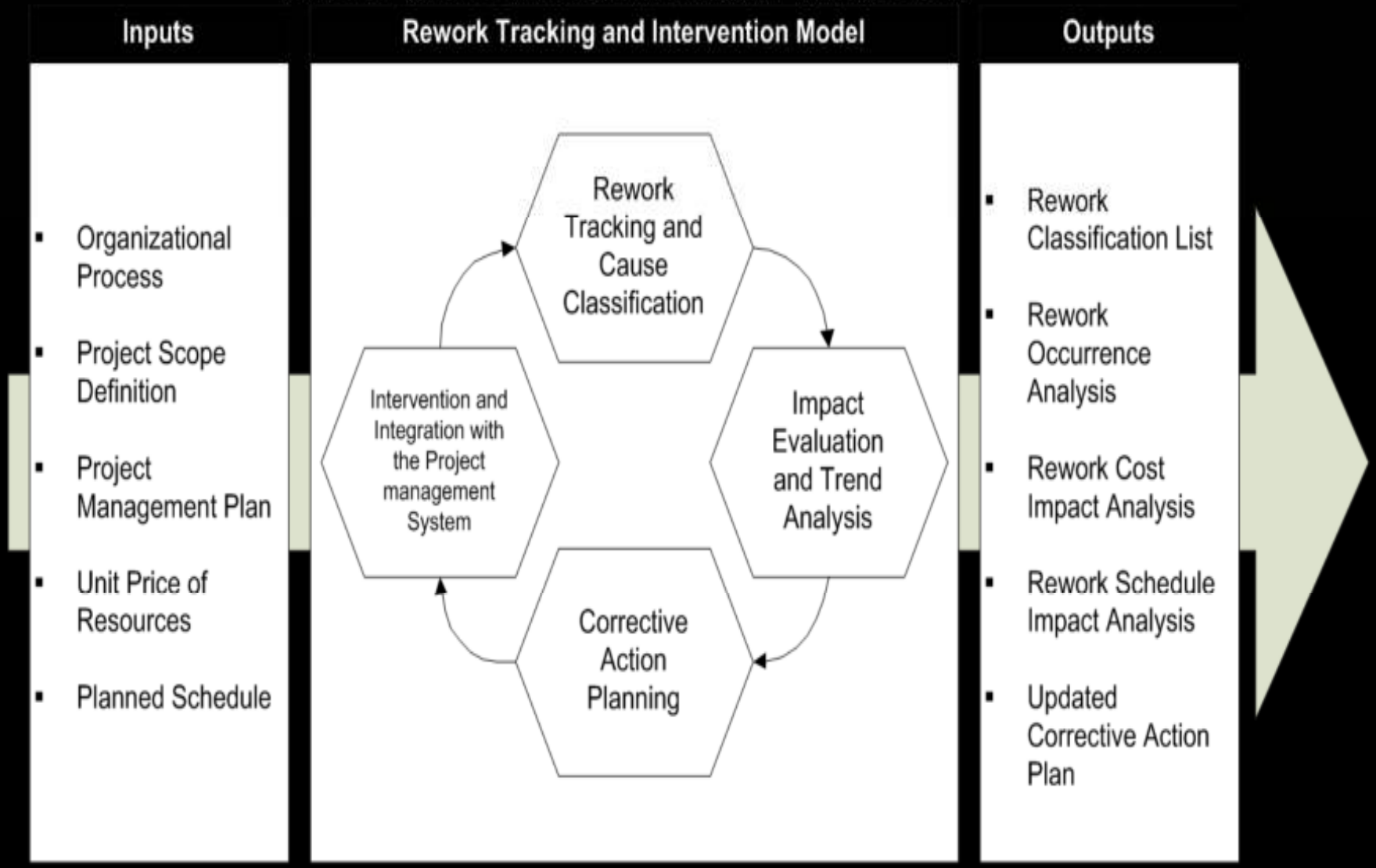
	2009	2010	2011	2012	2013
Innovations	Pipe Support Study Laser Scanning Case Study Weldless Pipe Joining Case Study Scaffolding Systems Case Study Eliminating Cut Length on Pipe Modules Case Study	Activity Analysis Guide Rework Reduction Tool Modular Formwork Case Study Self Consolidation Concrete Case Study	Workforce Development Index New Case Studies TBD		Report Out
Benchmarking & Metrics Data Analysis	Mechanical ·Safety ·System Integration ·System Automation ·Material Management ·Team Building ·Front End Planning	Electrical ·Safety ·System Integration ·System Automation ·Material Management ·Team Building ·Constructability	Concrete ·Safety ·System Integration ·Material Management ·Team Building ·Frond End Planning ·Constructability ·Change Management	Steel ·Best Practices to be determined	Report Out
Best Productivity Practices	Synthesize BPPII Framework Weight Index	Validation of Best Productivity Practice Implementation Index (BPPII)			Finalize Roadmap

Objectives of the Program:

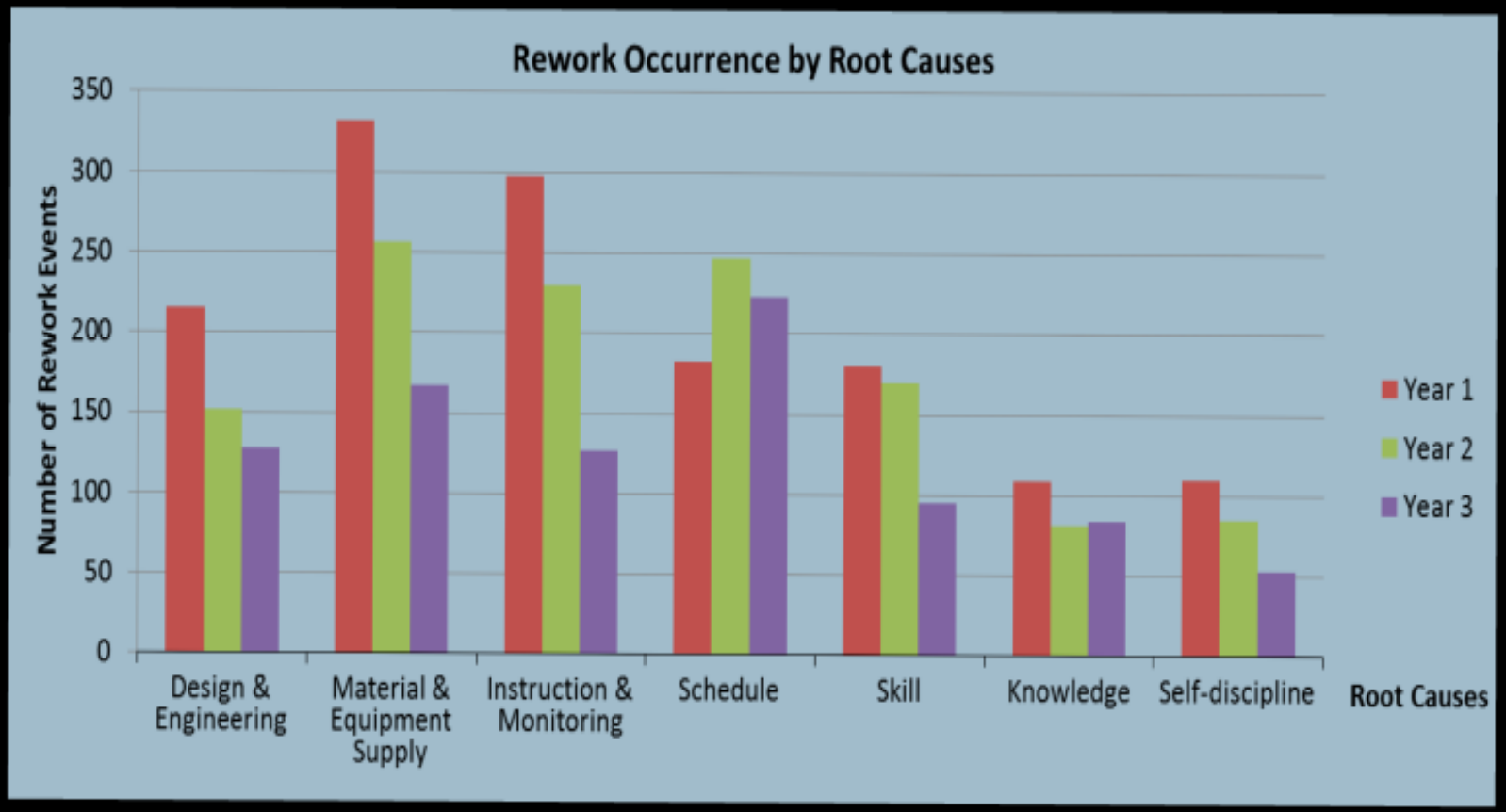
- Improve Direct Work Rates;
- Reduce the Number of Work Hours Required to Complete a Unit of Work; and
- Reduce Rework


Activity Analysis
Rework Reduction
BPPII
Innovations

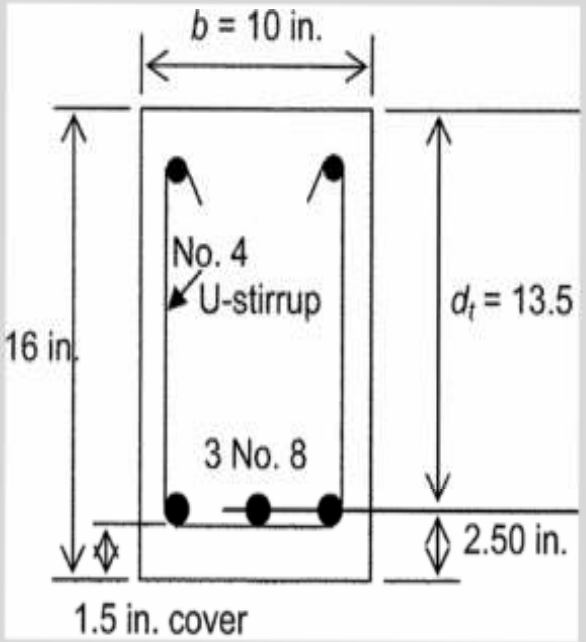
Rework Reduction Model

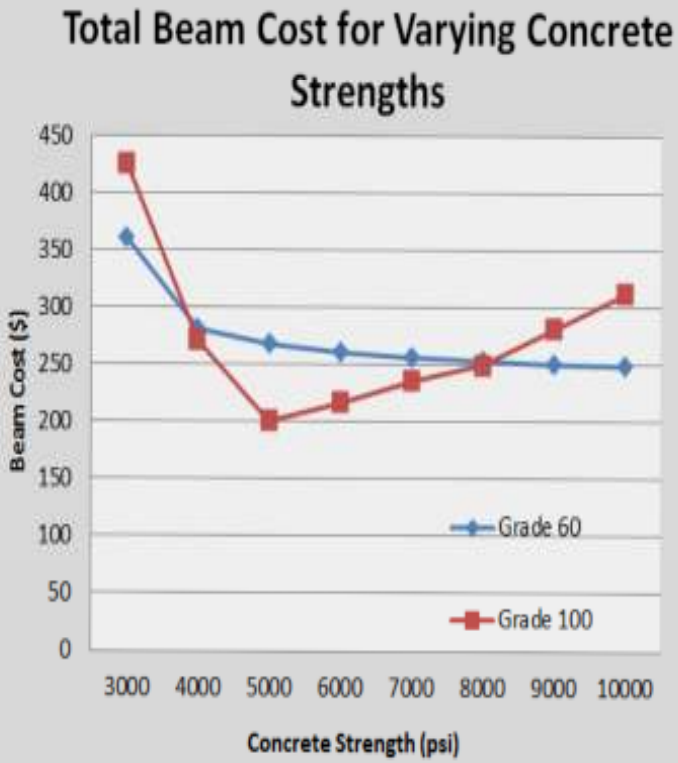


Rework Reduction: Data Analysis



High Strength Steel Reinforcement



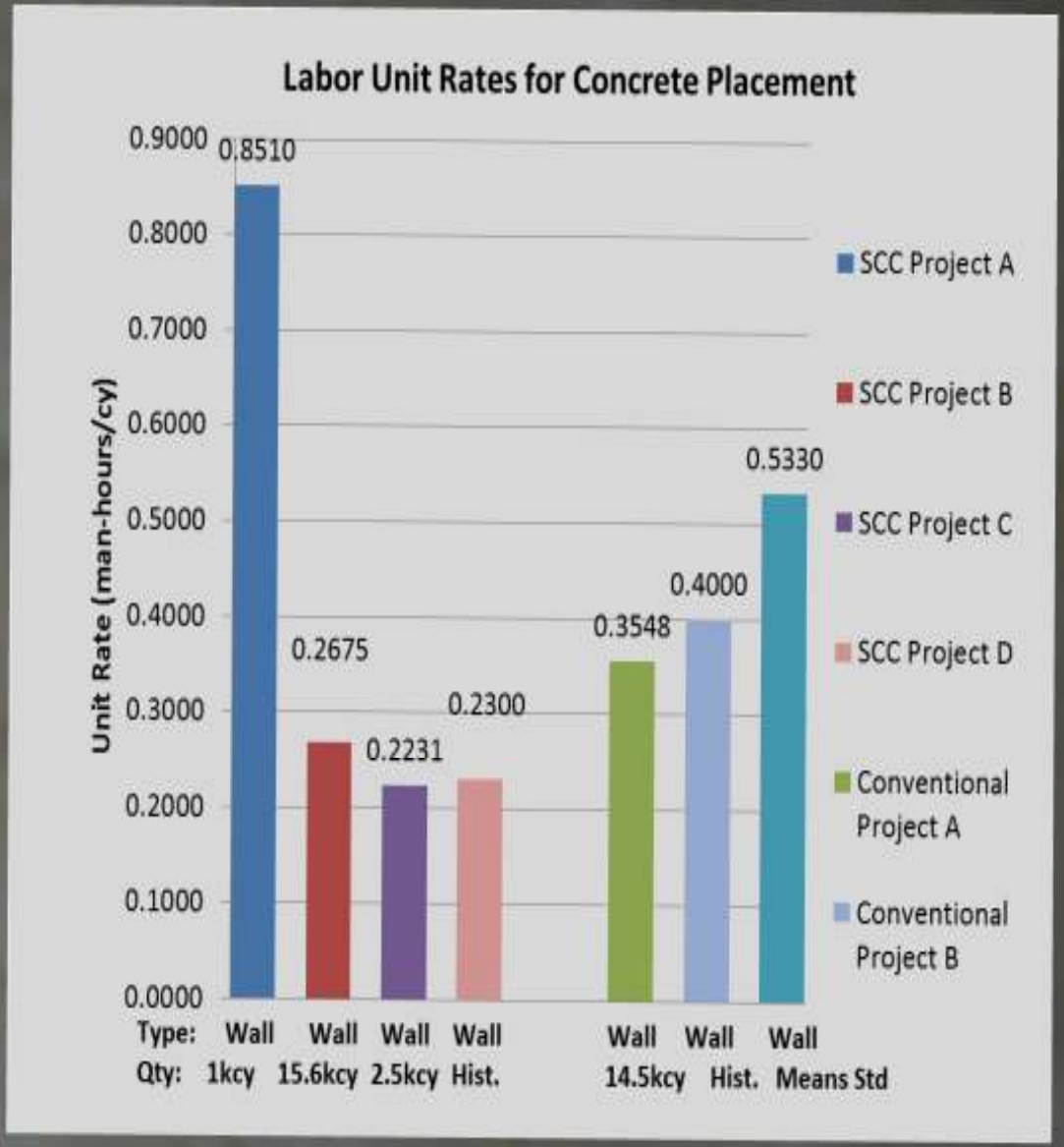


*Costs given for 32' long, 14"x23" beams

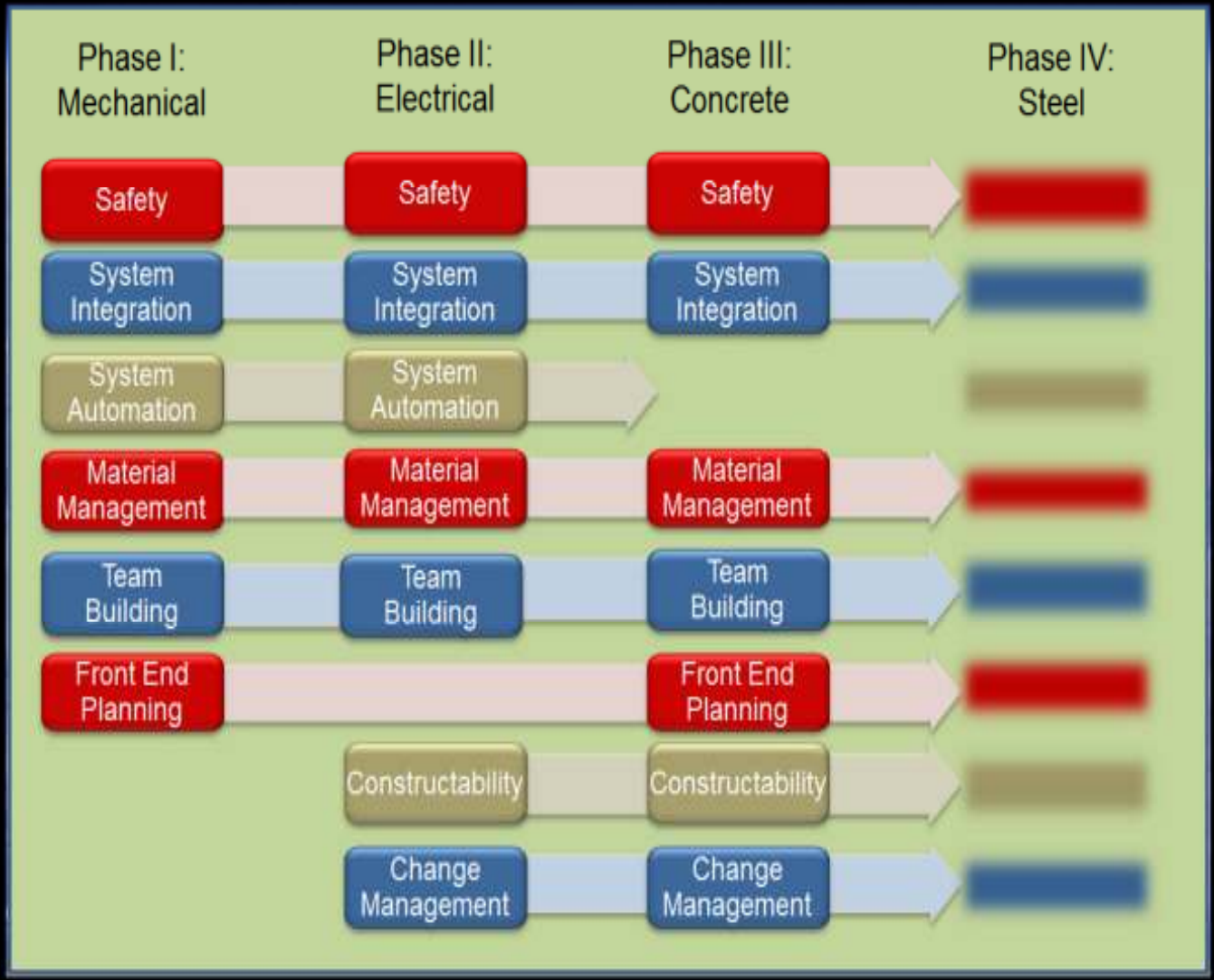
Modular Formwork

	Modular	Prefab-custom unit	Stick-build
Purchase or Rental	Rent + buy	Buy bulk + Buy reusable units	Buy bulk
Manpower for fabrication	Low (but need trained labour)	High on initial stage and then low	High
Crane	Need (usually)	Need (usually)	Need (rarely)
Fabrication on Site	No	Required on initial stage	Usually
Fabrication Areas	No	Need	No
Flexibility	Medium	Low	High
Speed of Erection	Fast	Medium	Low

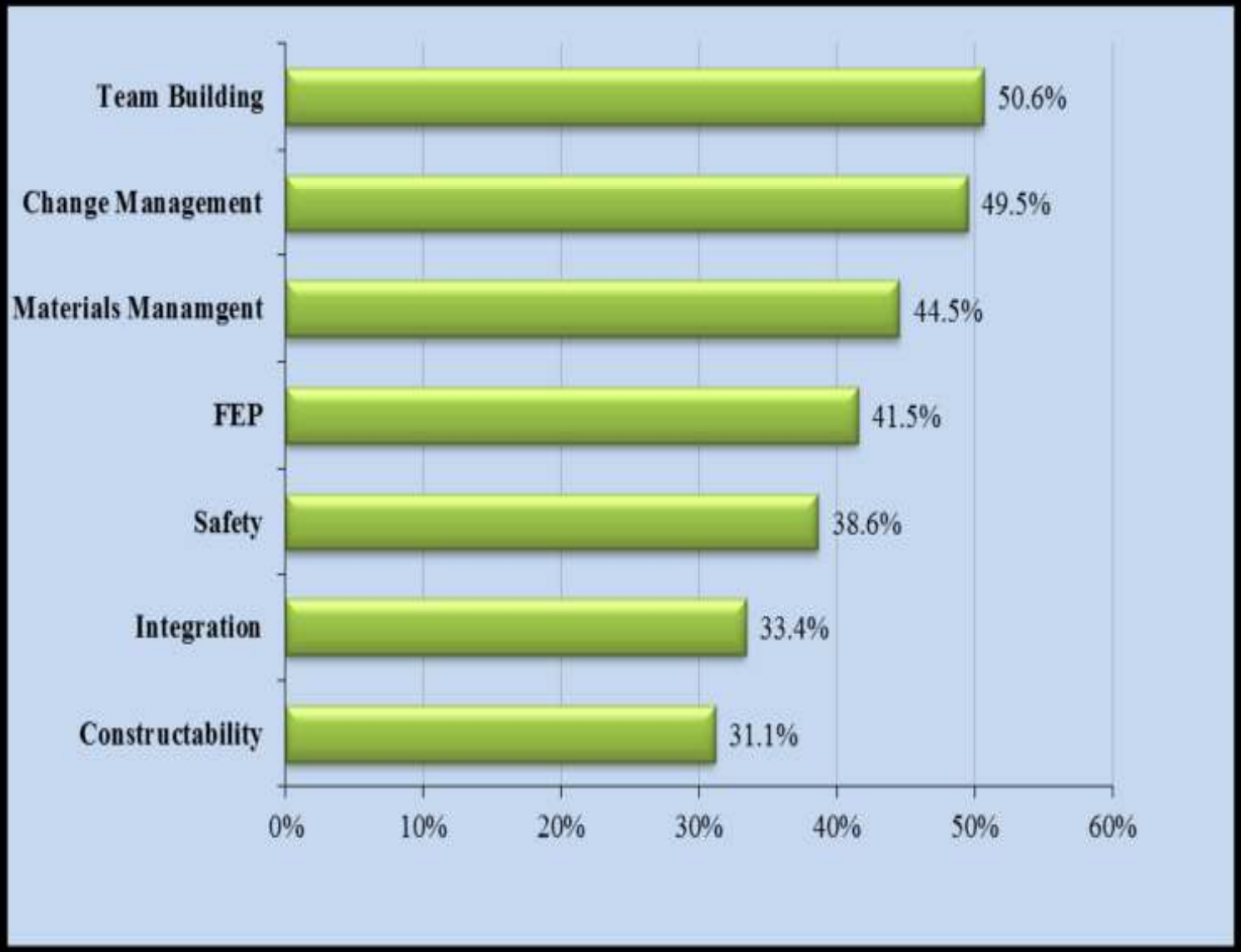
Self Consolidating Concrete



Productivity Practices



Actual Productivity Difference by Practices in the Concrete Trade



Other Productivity Initiatives

- U.S. Dept. of Commerce / NIST / BFRL
  - CII Benchmarking Productivity Research
    - Best Practices, TUI, and Economic / Craft Productivity
  - Intelligent Test Bed (for Case Studies)
    - Fall 2011 Workshop (BLS, Census, CII, AGC, etc.)
    - Sector Measures of Construction Productivity
  - Standard Industrial Chart of Accounts
- ASTM JPM (Job Productivity Measurement)
  - Voluntary Standard E2691-09 (SPC)
- Construction Sector Council (CSC) in Canada
  - Concluded Summer 2011

Other Productivity Initiatives

- Petrobras / ABEMI / CE-EPC / CII
  - CII Fab Yard Productivity Metrics (Offshore Projects)
  - Work Sampling / Time & Motion Studies
  - Case Study at 2011 CII Annual Conference (Chicago)
- PER (Productivity Enhancement Resources)
  - Chris Buck, President
    - Statistical Productivity Improvement (SPI) vs. PF
    - Productivity Data Management System (PDMS)
    - PF Forecasting and “Budgetivity”
- Mulva: Piecework and Cycle Time?

Questions?

Dr. Stephen Mulva
Associate Director
(512) 232-3013
smulva@cii.utexas.edu

Dr. Jiukun (Jason) Dai
Research Engineer (Benchmarking & Metrics)
(512) 232-3050
jiukun.dai@cii.utexas.edu

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