

INDEPENDENT PROJECT ANALYSIS, INCORPORATED

Research and Metrics Measuring Capital Project Best Practices

Presented by: Carlos Tapia

NWCC Meeting

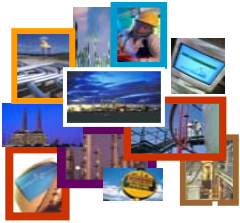
Bellingham, WA
February 25, 2004

THE AMERICAS ♦ EUROPE ♦ AUSTRALIA ♦ CHINA

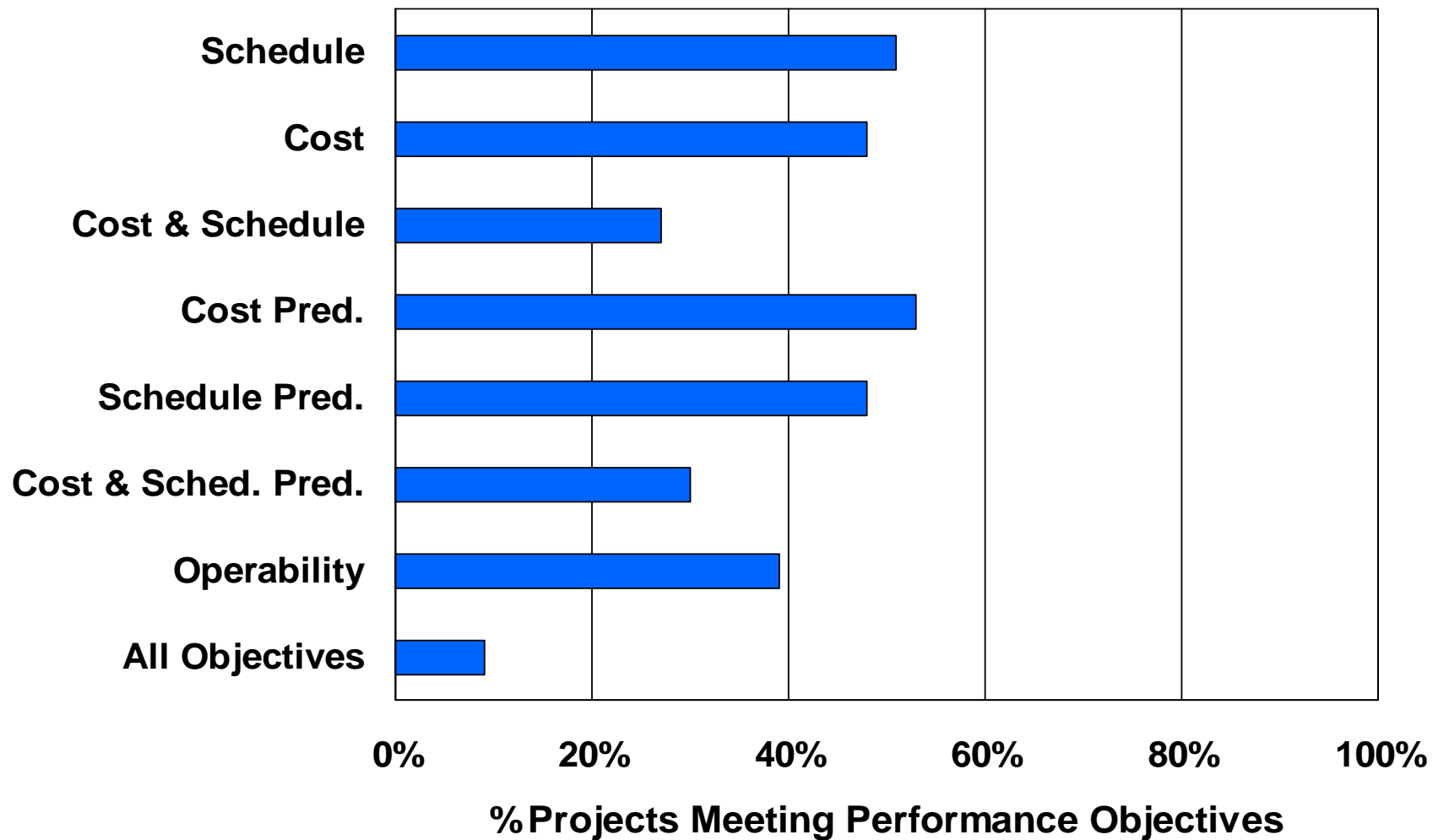


Focus

- **In this presentation we will focus on capital project Best Practices identified and researched through the IPA methodology**
- **These Best Practices have been quantified and their effect on projects has been measured**
- **IPA clients routinely apply this knowledge in the definition and execution of their capital project portfolio**
- **What are the keys to successful project execution?**



Few Projects Meet All Objectives



Outline

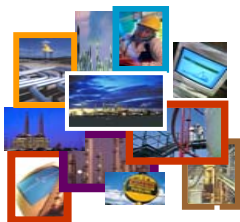
- *IPA Background*
- **Best Practices: Research and Metrics**
- **Special Study: Labor Productivity**
- **The Challenge**

IPA Corporate Background

- **Founded in 1987 to provide a unique project research capability for the chemical process, petroleum, and minerals industries**
- **Staff includes engineers, economists, scientists, statisticians, and operations researchers with most members holding an advanced degree**
- **Offices in the United States, The Netherlands, China, and Australia**
- **Mission is to improve competitiveness of our customers by improving their use of capital**
- **Devoted exclusively to the analysis of capital projects as a field of empirical research**

IPA's Customers

- **Petroleum Industry**
- **Chemical Industry**
- **Pharmaceutical Industry**
- **Pulp & Paper Industry**
- **Specialty chemicals and consumer products**
- **Mining, Minerals Processing and Metals**
- **Contractors**



Clients Represented in the IPA Databases

Abbott Laboratories
ABB Lummus
Abitibi-Consolidated
AEC East
Agip
AGRA Simons
AIOC
AIR Liquide
Air Products
AKZO Nobel
Alcan
Alcoa
Alyeska
AMEC
Amerada Hess
Amoseas
Anadarko
Apperyl
Army Corps of Engineers
AstraZeneca
Atlantic LNG
AtoFina
Australian Magnesium Corp.
Australian Paper
BASF
Bayer
Bechtel
BE&K
BHP Billiton
Bluewater
Borealis
British Borneo
British Gas
British Nuclear Fuels
BP
Bristol-Myers Squibb
Caltex
Cargill Dow Polymers
Chevron Texaco
China Three Gorges Project
Development Corp.

Chiyoda
CITGO
Clark Refining & Marketing
CNRL
Codelco
Condea Vista
Colonial Pipeline Company
Comalco (Rio Tinto)
Cominco
ConocoPhillips
CRI
CSR Timber Products
CYTEC
DeBeers Diamonds
Degussa-Hüls
Department of Defense (US)
Dofasco
Dow Chemical Company
DSM
DuPont
DuPont Dow Elastomers
Eastman Chemical Co.
EC Erdolchemie
Edison Company
Eichleay Engineering
Elf Atochem
Eli Lilly & Co.
Entergy
Enterprise Oil Ltd.
ExxonMobil
Fluor Daniel
Florida Power & Light
FMC Corporation
Foster Wheeler
Gaz De France
General Electric
GlaxoWellcome
Hammersley iron
Hoffman-La Roche
Honeywell
Husky Oil

ICI
Iluka Resources
Incitec
Inland Paperboard & Packaging
International Paper
Iscor
Jacobs
JGC
Kellogg Brown & Root
Keyma
Kimberly Clark
Koch
Kodak
Kvaerner
Lasmo
LTV Steel
Lundin Malaysia
Lyondell Citgo
Magnesium Intl. Ltd.
Malaysian Refining Co.
Marathon Ashland
Marathon Oil
Mead
Merck & Company, Inc.
Merial
Milliken
Montell
Morton International
NAOC
Nederlandse Aardolie Mj.
Noranda Falconbridge
Norsk Hydro
North Star Steel
Nova Chemicals
Nycomed Amersham
Orica
Owens Corning

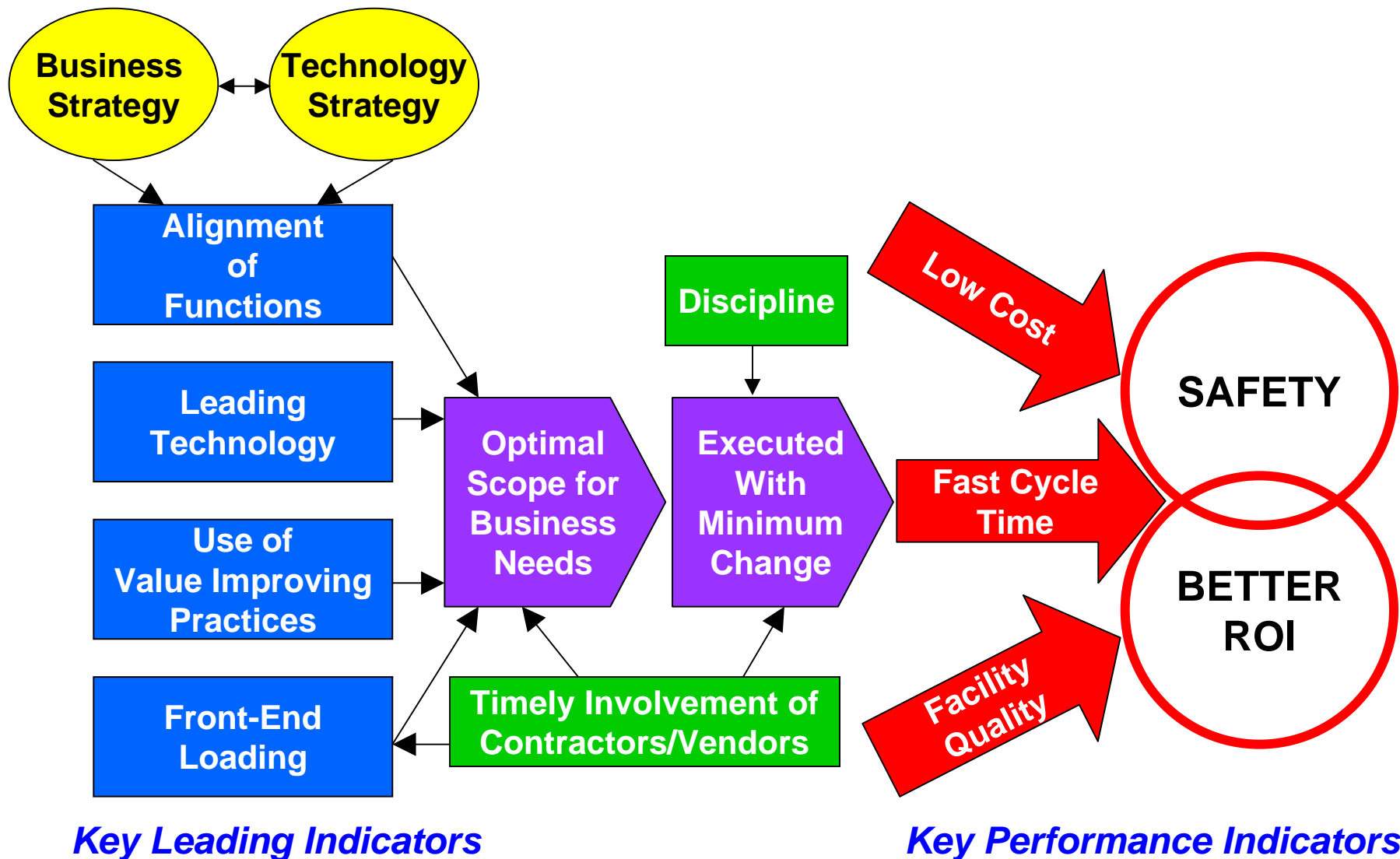
PEMEX
Petrobras
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Petróleos de Venezuela
Pharmacia
Pillsbury
Portland Pipeline
Potlatch
Procter & Gamble Co.
Qatar General Petroleum Co.
Quimica Fluor
Repsol YPF
Rhodia
Rohm & Haas
Royal Dutch Shell Group
South Australian Magnesium
SAPPI
Sasol
Saudi Aramco
Shell Oil Company
Shell Canada
Shell MIning
Solutia
Solvay
Southern Natural Gas
Statoil
Stepan
Stone & Webster
Suncor Energy
Sunoco
Syncrude
TotalFinaElf
Toyo
Union Carbide Corporation
Unocal
US Gypsum
US Steel
Valero
Wellman
Weyerhaeuser
WMC
Woodside

Outline

- IPA Background
- ***Best Practices: Research and Metrics***
- Special Study: Labor Productivity
- The Challenge

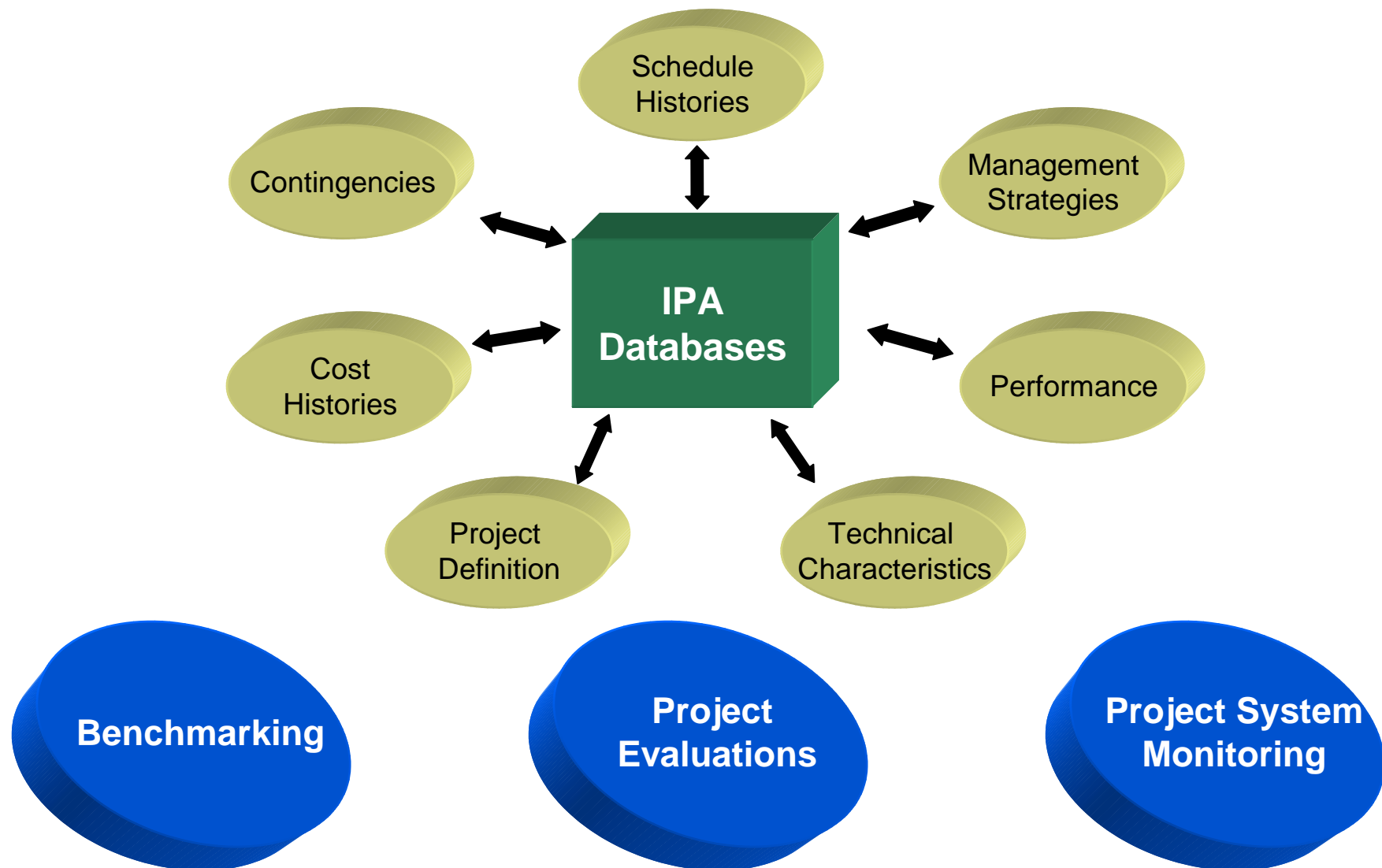


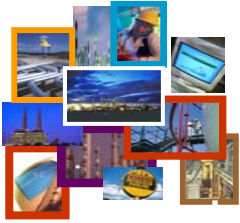
Elements of Capital Effectiveness





Application of the IPA Methodology





The Approach: Linking Inputs to Outputs

Project Performance Inputs

KEY PROJECT PRACTICES

Parametric
Statistical
Techniques

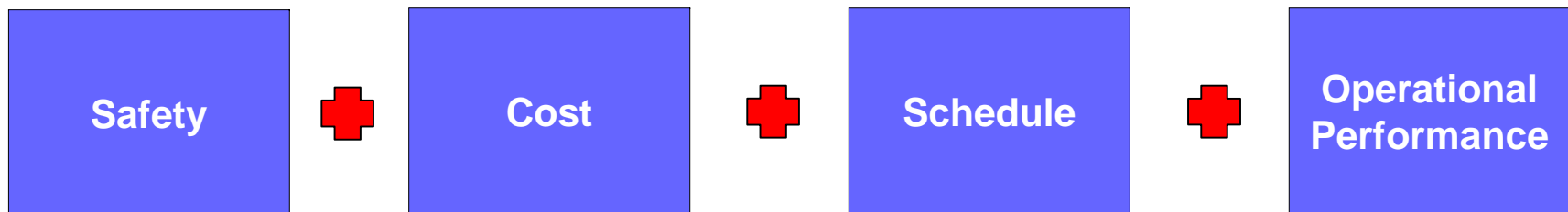
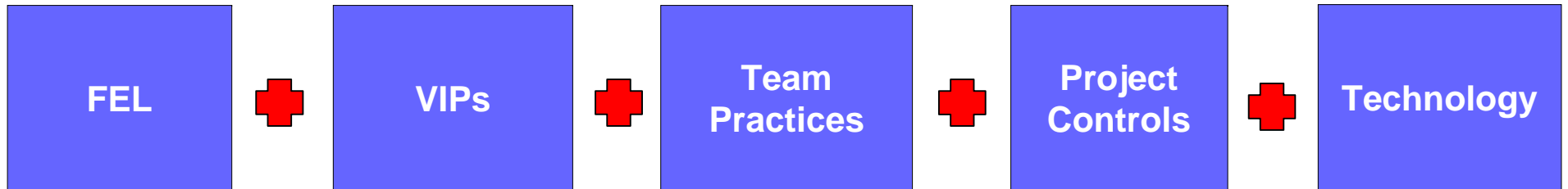
KEY PROJECT RESULTS

Project Performance Outputs



The Approach: Linking Inputs to Outputs

Project Performance Inputs



Project Performance Outputs

Outline

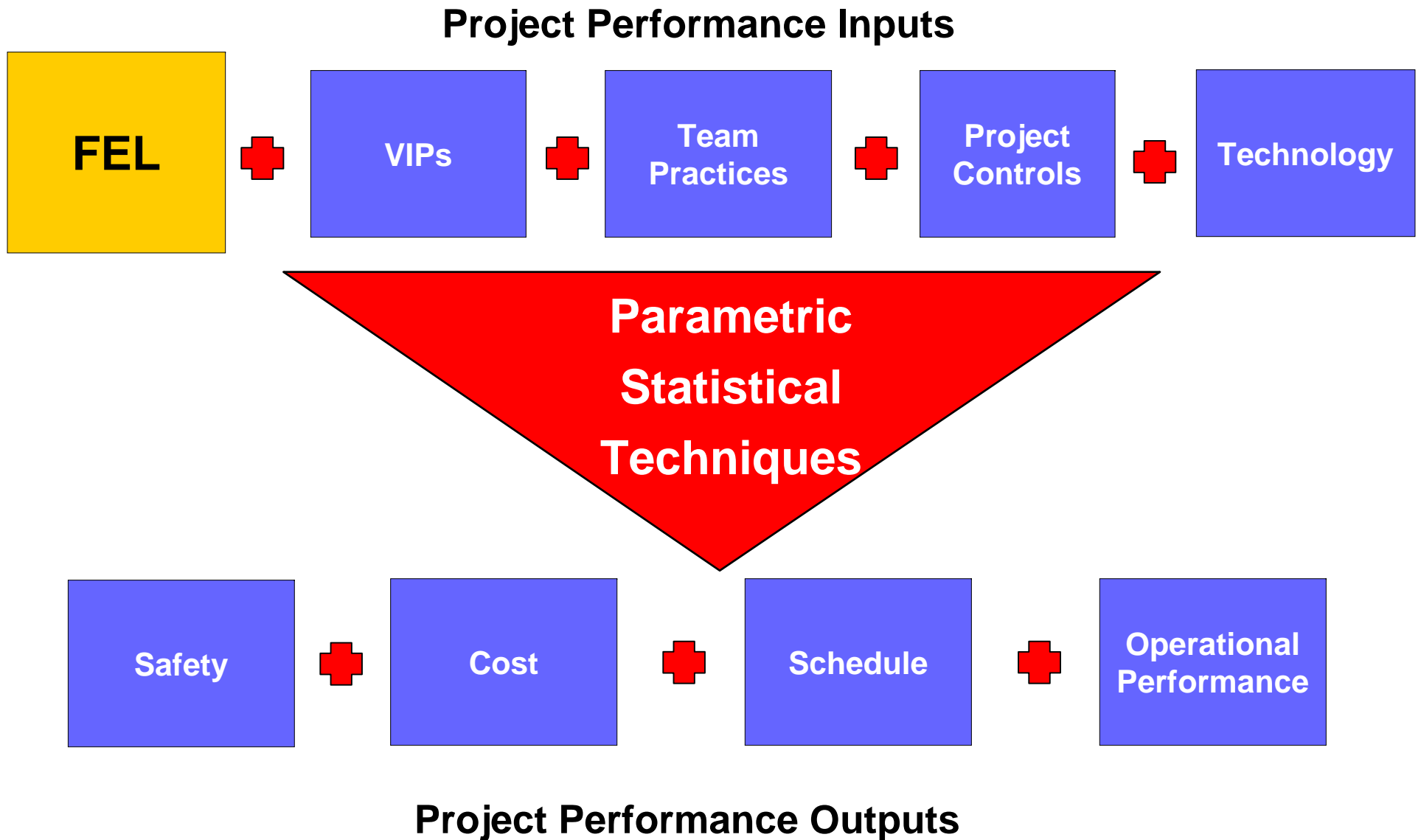
- **IPA Background**
- ***Best Practices: Research and Metrics***
 - *Safety First*
 - *Front-End Loading*
 - *VIPs*
 - *Teams and Core Competencies*
 - *Project Controls*
- **Special Study: Labor Productivity**
- **The Challenge**

Drivers of Project Safety

- **IPA research has identified a set of primary drivers of project safety:**
 - **Excellent Front-End Loading**
 - **Strong, interactive new-hire safety orientation effort**
 - **Craft worker review of the safety program**
 - **Pre-task planning after changes**
 - **Individual recognition awards for safety**



The Approach: Linking Inputs to Outputs



What Is Front-End Loading?

Front-End Loading (FEL) is the process by which an owner develops a detailed definition of the scope of a capital project to meet business objectives

-- Why

-- What

-- When

-- Where

-- How

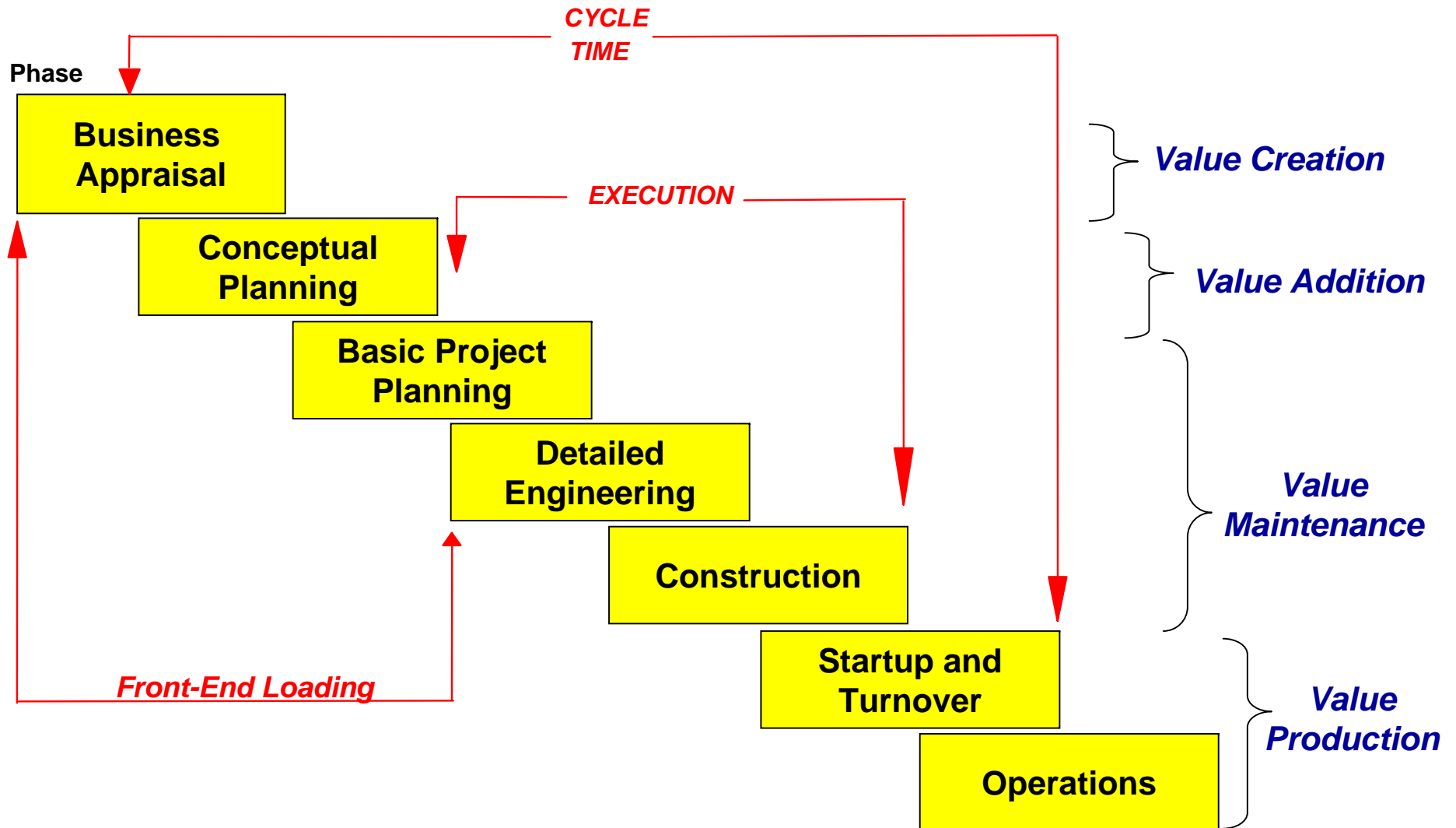
-- Who

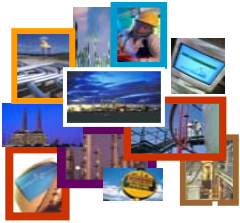
What Is Front-End Loading?

**FEL is
the primary
Best Practice
in project execution**

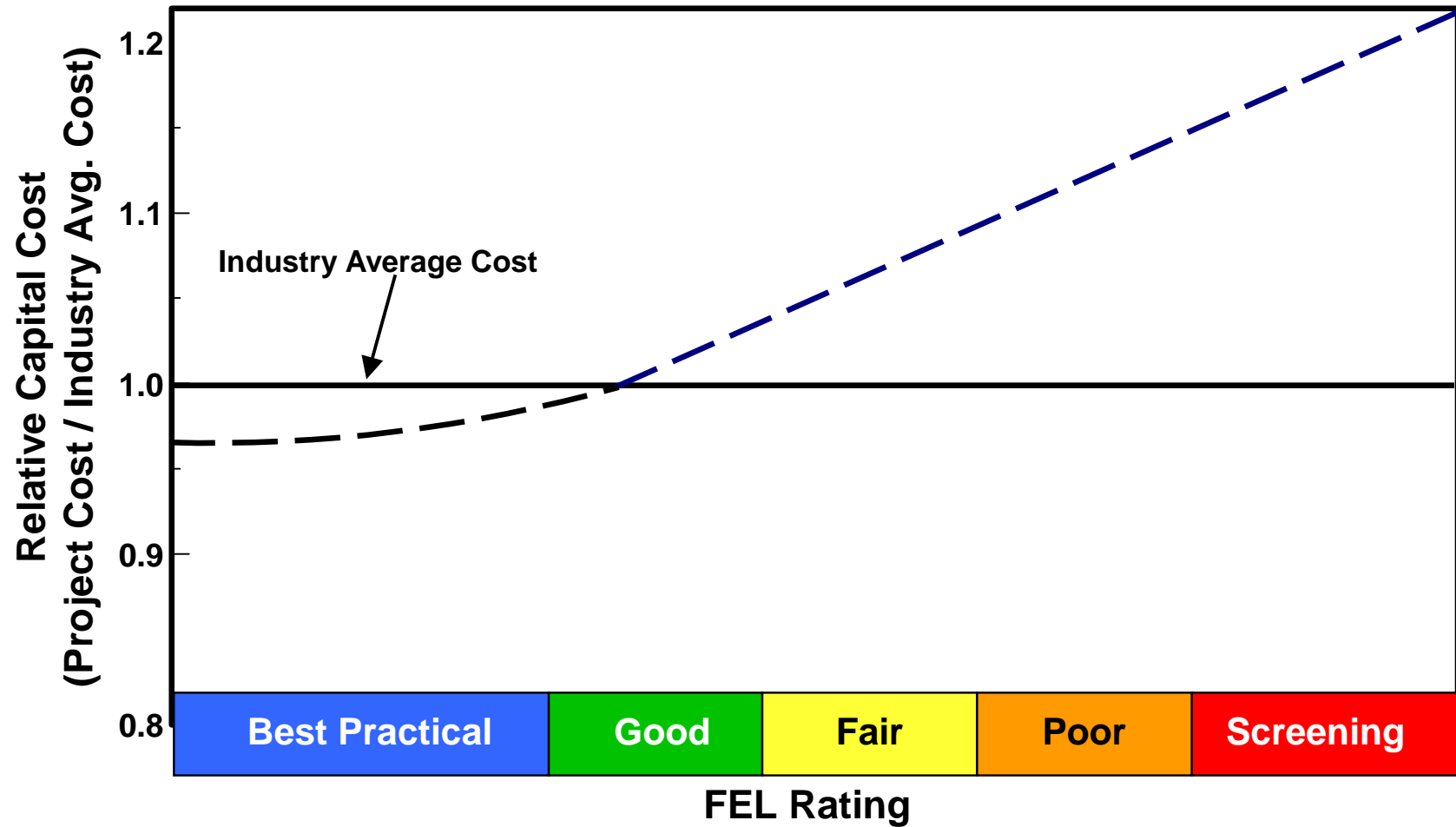


Capital Project Life Cycle



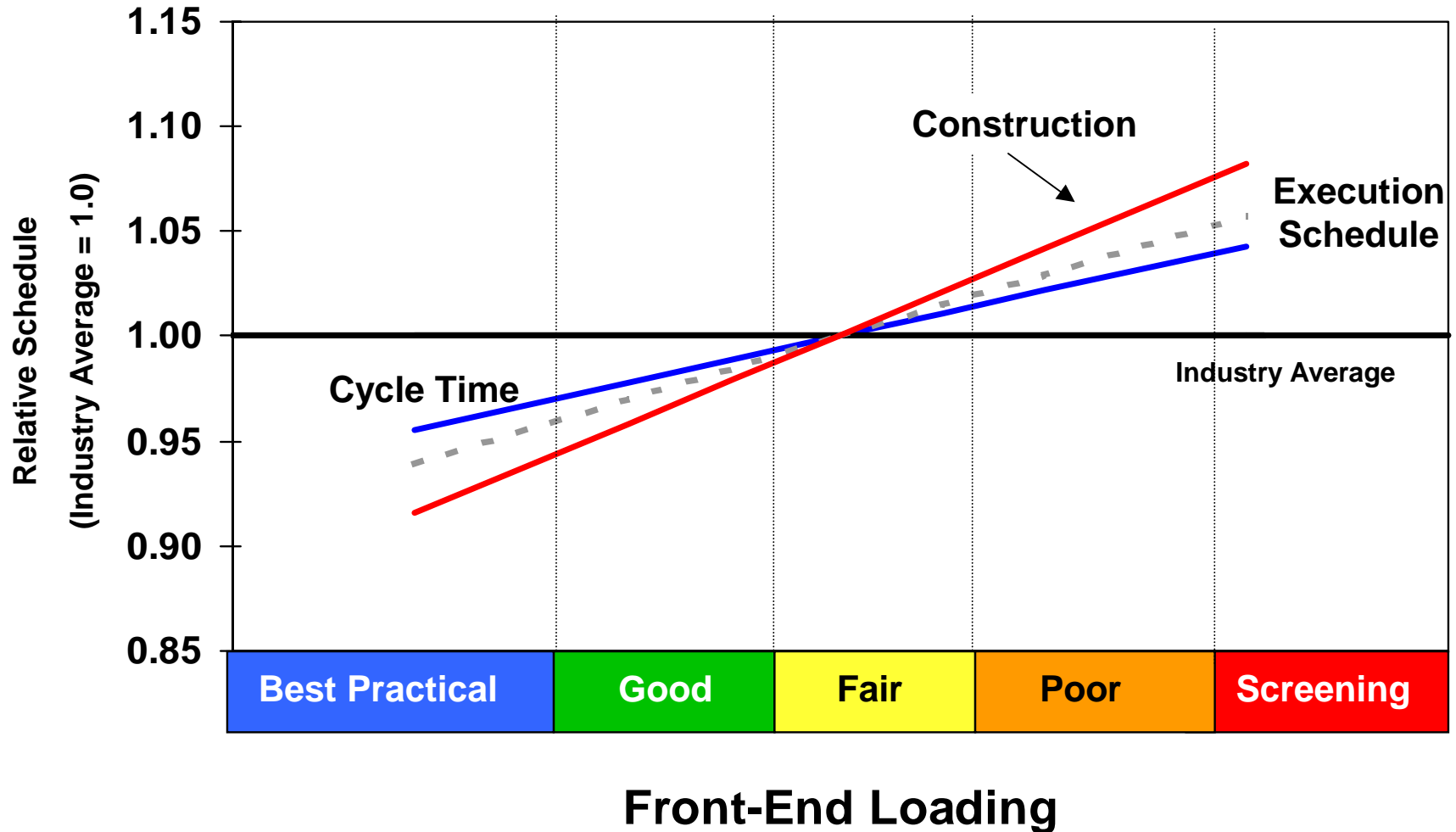


FEL Drives Absolute Cost Performance





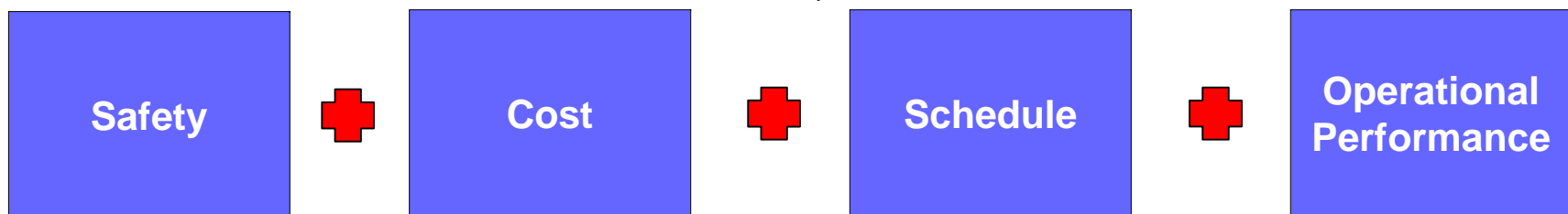
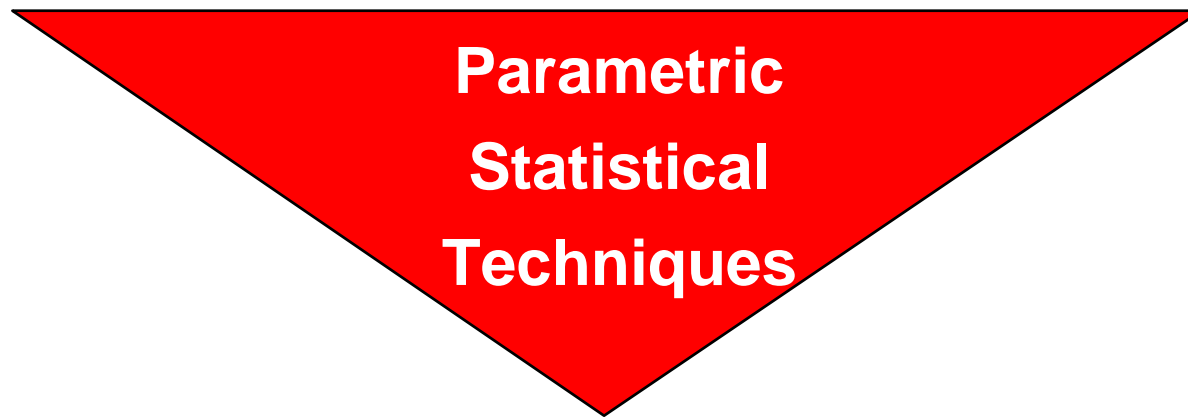
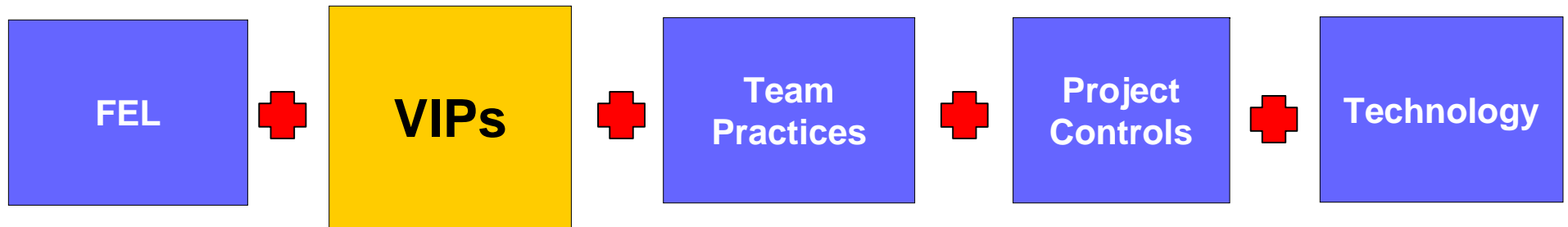
Better Definition Shortens Project Schedule Durations





The Approach: Linking Inputs to Outputs

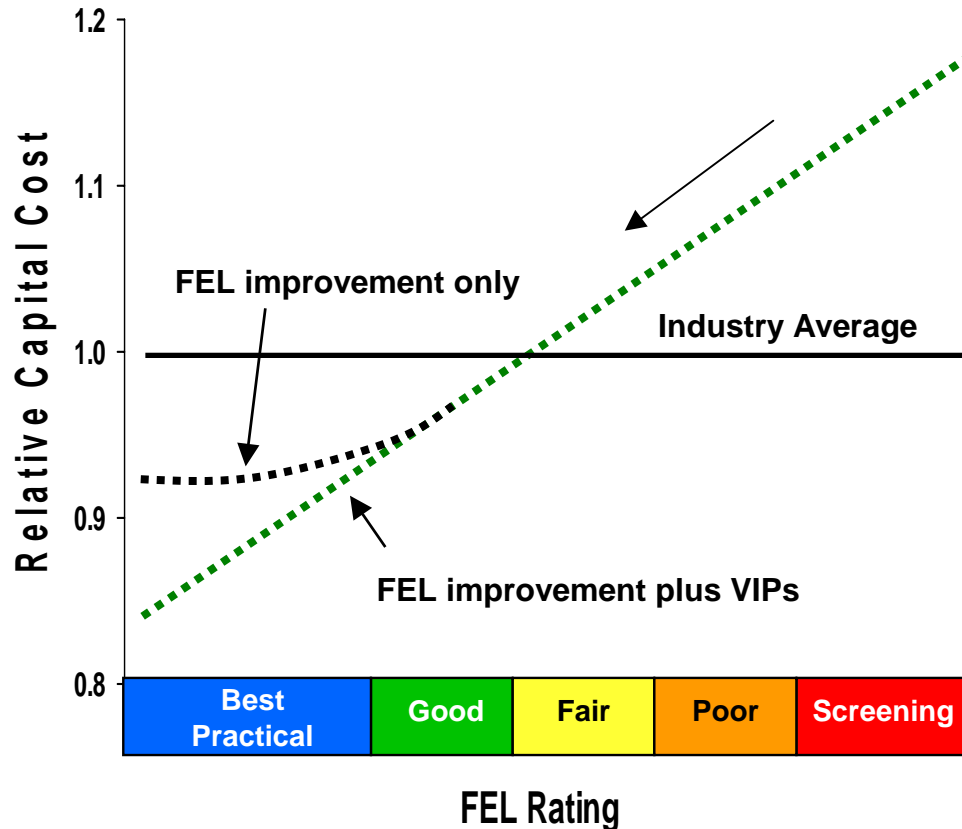
Project Performance Inputs



Project Performance Outputs

Value Improving Practices

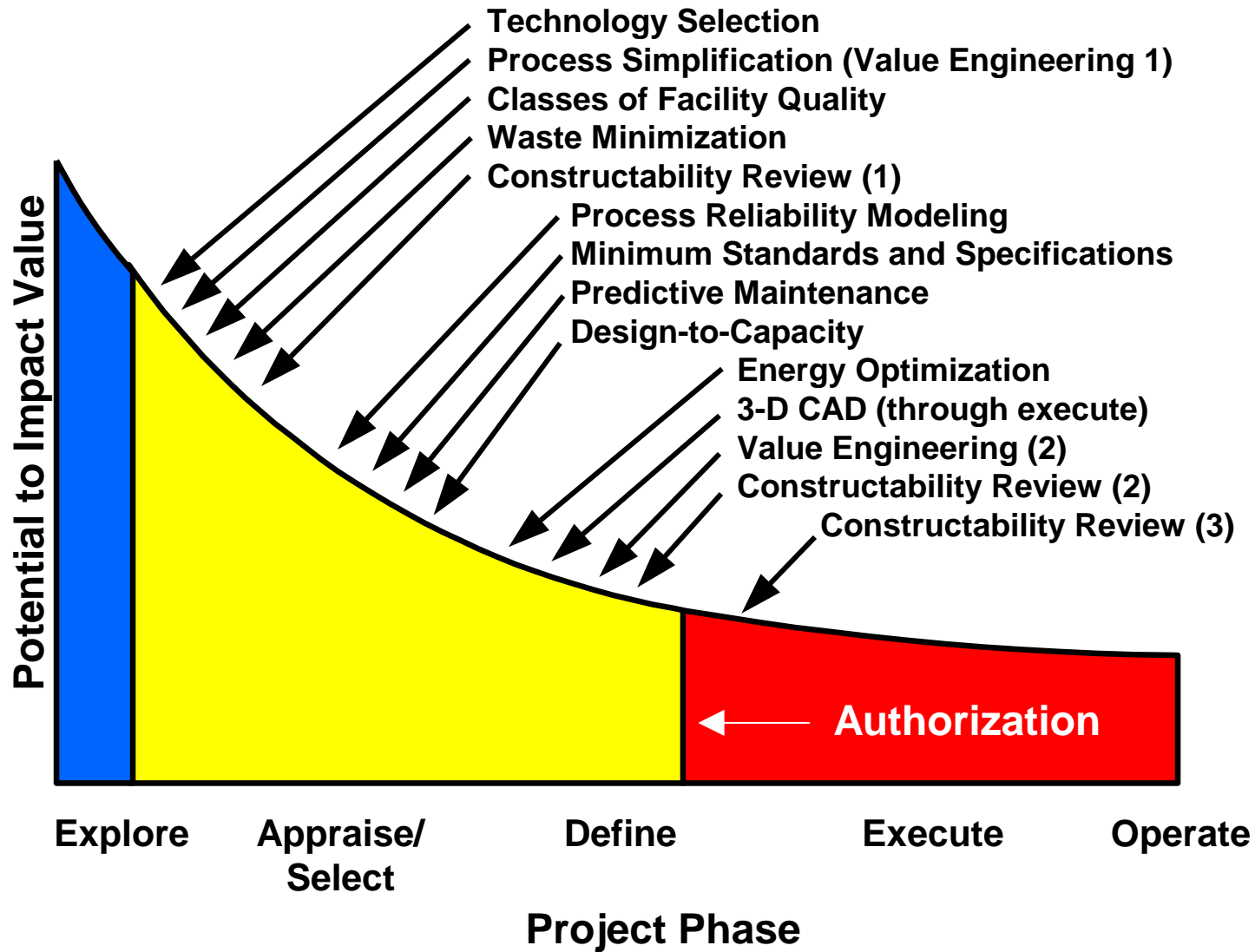
VIPs are out-of-the-ordinary practices used to improve cost, schedule, and/or reliability of capital projects

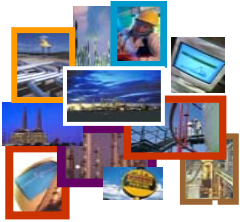


- Formal, documented practices that use a repeatable work process
- VIPs are almost always facilitated by specialists outside the project team



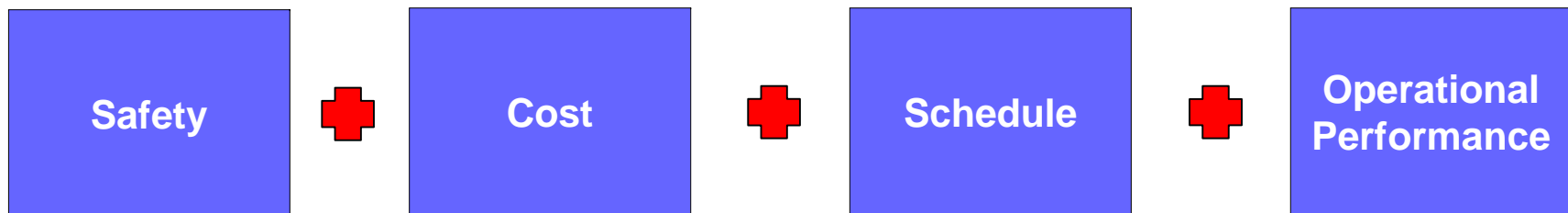
Value Improving Practices





The Approach: Linking Inputs to Outputs

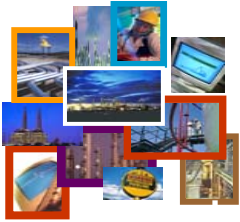
Project Performance Inputs



Project Performance Outputs

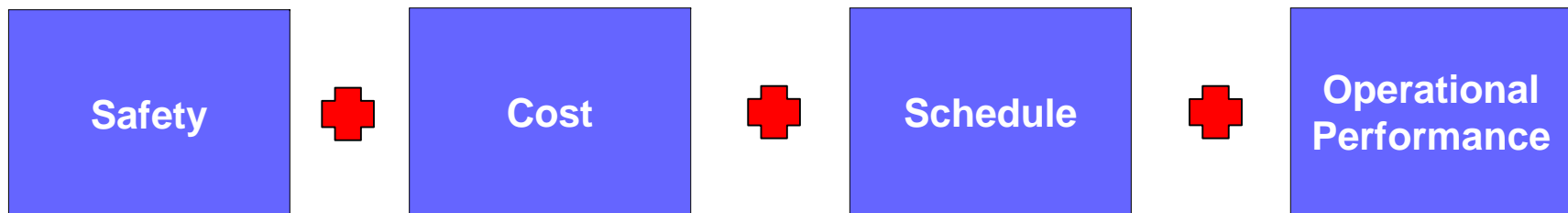
Team Development

- **IPA research and work has shown that well developed and integrated project teams are a key driver of project success**
 - Increased cost effectiveness
 - Faster projects
- **Project teams must be formed during FEL and remain stable through execution**
- **Characteristics of a well developed project team:**
 - **Clearly defined project objectives**
 - **Strong project manager with authority**
 - **Functional representation from key stakeholders**
 - **Clearly defined roles and responsibilities**
 - **Guided by a clear project implementation process**



The Approach: Linking Inputs to Outputs

Project Performance Inputs



Project Performance Outputs

Background

- **Owner companies have downsized and outsourced various engineering and project management functions for nearly two decades.**
- **The effects of downsizing on project performance and the rationale for downsizing are not clearly understood.**
- **In 1992, IPA studied contractors' role in Front-End Loading (FEL) and concluded that owner leadership during FEL is a key driver of project success.**
- **In 2002, IPA studied project competencies and found distinct cost and schedule advantages to owners retaining certain competencies in-house.**

What Is a Core Competency?

A set of project functions or skills that are

a source of **competitive advantage** and

that cannot be **effectively** and **reliably**
secured from the market

**Which competencies are
considered *Core* by Owners?**

Core Competencies

- The following competencies are usually considered **core** by owner companies:
 - Convert research to project
 - Formulation of business case
 - Conceptual cost estimating (60/40)
 - Conceptual Design
 - Environmental/Permitting
 - Safety
 - Procurement and Contracts Admin.
 - Project Management
 - Commissioning and Startup
 - Continuous Improvement

Non-Core Competencies

- The following competencies are usually considered **non-core** by owner companies:
 - Detailed Engineering
 - Construction

The Project Management Competencies

- **All owners with successful capital project systems consider project management a core competency**
- **Most consider the supporting competencies core too:**
 - **estimating**
 - **scheduling**
 - **procurement**
 - **controls**

Some Conclusions

- **Competitive advantage for the project execution phase is significantly more likely to reside with owners that:**
 - **Build at least a core in-house detailed engineering capability for large projects**
 - **Maintain a strong control function**
 - **Use in-house construction managers when**
 - > **Portfolio of projects includes substantial revamp work**
 - > **Risk of changes during startup is high**

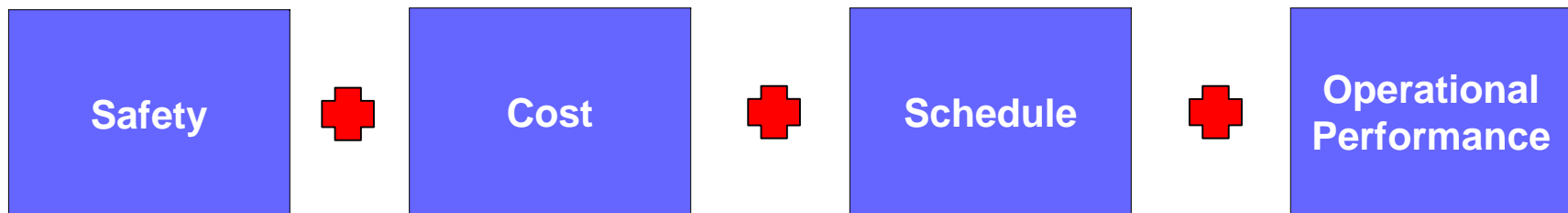
How Do I Make The Right Sourcing Decision?

- I have to own the competency if I can't buy it reliably from the market.
- If I decide to get rid of the competency, I must be a savvy buyer.
 - If I don't do this in-house, can I *be* a savvy buyer?
- If I believe that I can perform this competency more effectively in-house than buying from the market, I may decide to keep it.
 - After factoring in the “valley” periods when some of those jobs might not be needed.
 - > Need data!

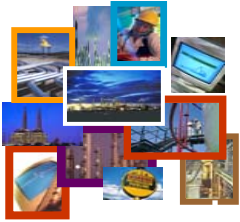


The Approach: Linking Inputs to Outputs

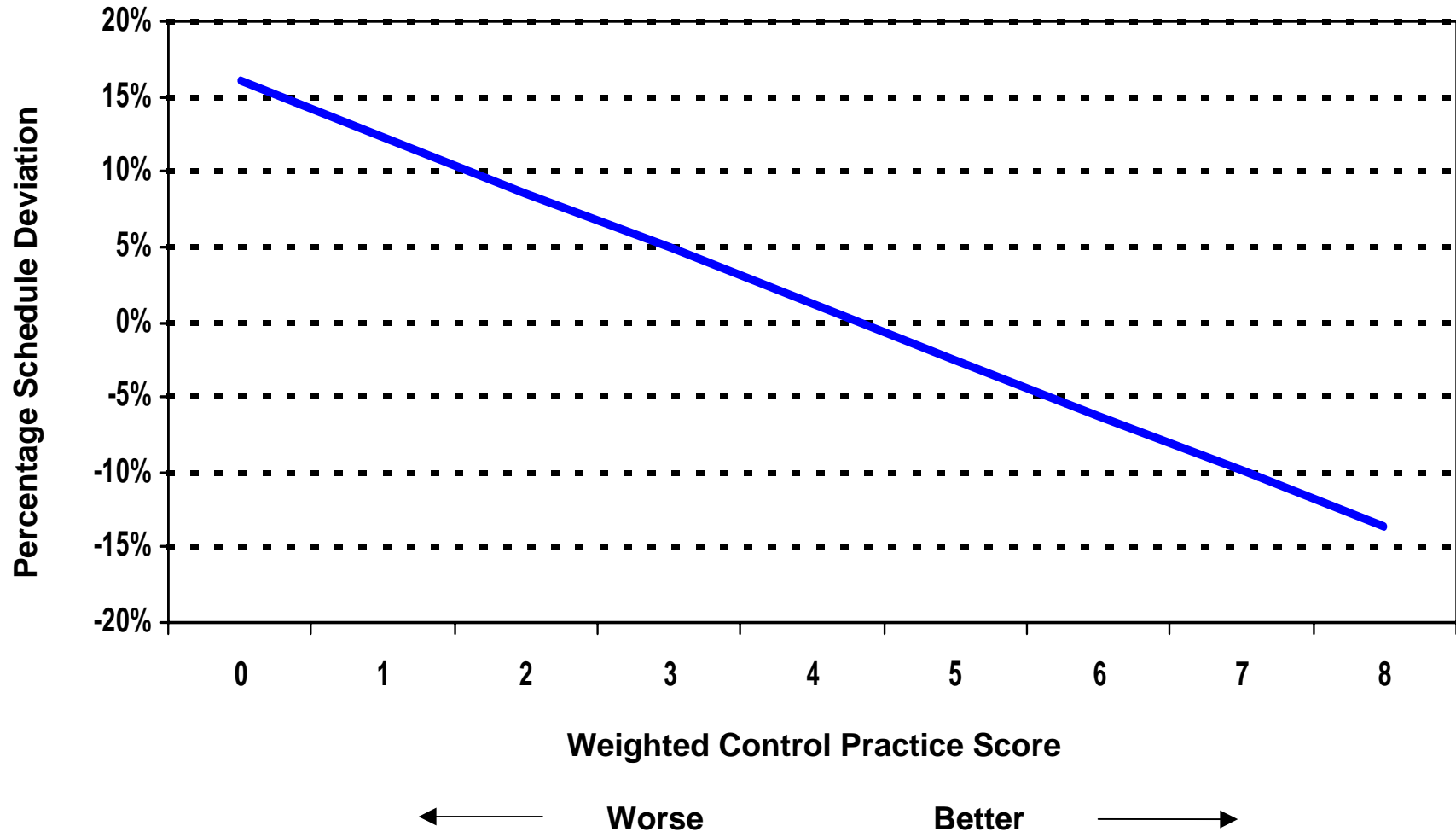
Project Performance Inputs



Project Performance Outputs



Good Project Control Practices Reduce Execution Schedule Slip



Best Practices

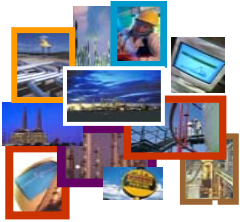
- **IPA has identified a set of Project Inputs that when applied correctly constitute Best Practices**
- **Best Practices should be implemented primarily during project definition and maintained during execution**
- **The primary Project Inputs are:**
 - **FEL or Project Definition**
 - **Use of VIPs**
 - **Team Development**
 - **Project Controls**
 - **Use of New Technology**
- **“Class A” project systems implement these practices in a concerted manner**

Outline

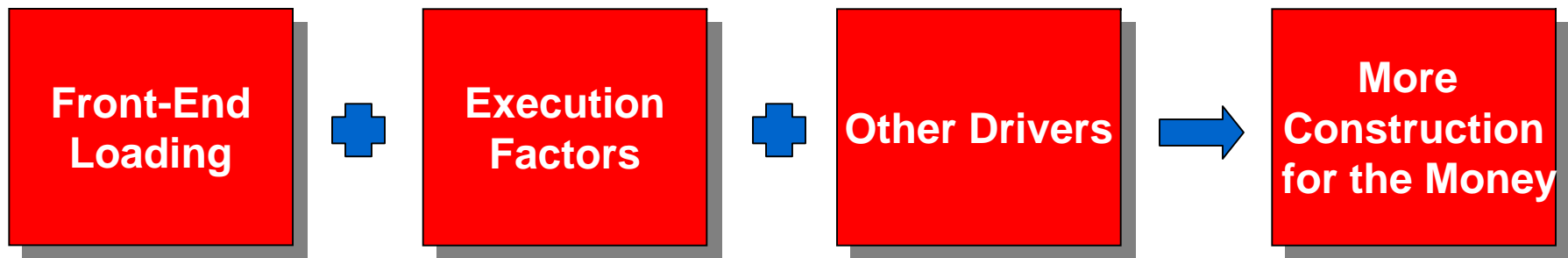
- **IPA Background**
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- ***Special Study: Labor Productivity***
- **The Challenge**

Keys to Better Productivity

- **Detailed execution planning is the single most important driver of better field productivity**
 - **Execution planning has been progressively outsourced to contractors**
- **But the data are clear: owner execution planning and control are central to securing good labor productivity**
- **The principal role of the engineering contractor is to provide timely, high-quality engineering documents to construction; it is not to take the place of the owner in the execution planning process**



Components of Improved Labor Productivity



- **Project Execution planning**
 - detailed schedules
- **Soils**
- **Health and Safety requirements**
- **Engineering status**
- **Equipment specs**
- **Key VIPs**

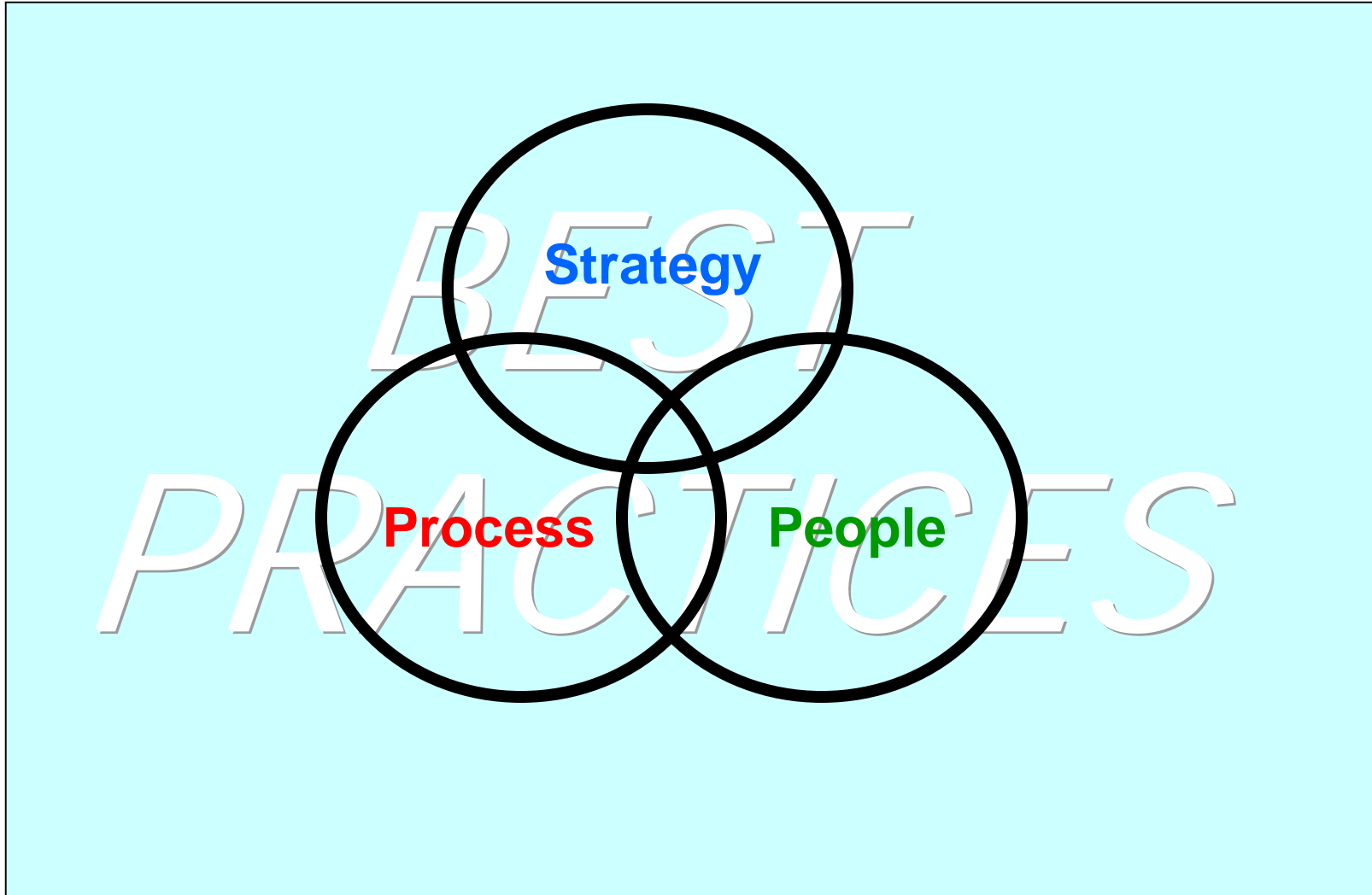
- **Use of Integrated 3D**
- **Working weather windows**
- **Effects of overtime**
- **Role of supervision**
- **Union/open shop effects**
- **Importance of schedule maintenance**
- **Control planning**

- **Quantitative weather effects**

Outline

- **IPA Background**
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What Really Matters?



The Challenge in Capital Project Execution

- **In the last 15 years, the process industry has made significant progress understanding the value of Best Practices in capital project execution**
- **However, the key challenge remains on the integration of processes and organization (within which Best Practices reside)**
- **The truly successful project systems have managed to master a process that is supported by a strong project organization (resources, core competencies, integrated teams); Best Practices are then inserted into both the process and the organization at the right time and level**

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Presented by: Carlos Tapia
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