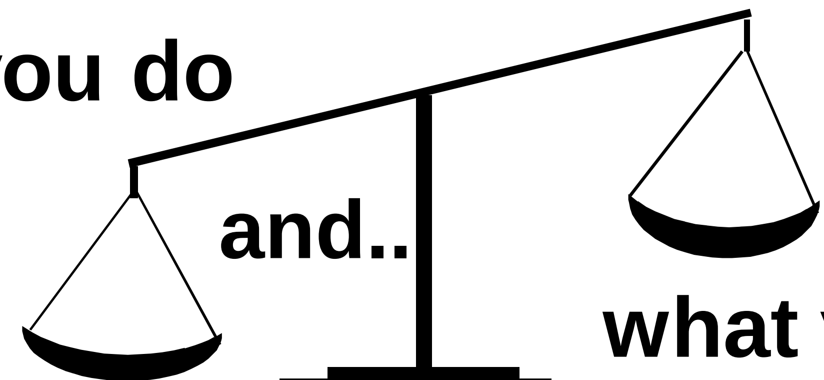
Creating Value through the Benchmarking of Capital Projects

Measuring the relationships between

what you do



and..

what you get

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Purpose of the Discussion

- Discuss the progress of the process industries in capital effectiveness
- Explore primary drivers of project excellence
- Bring data to some contentious issues

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Basis for the Discussion

- Each year Independent Project Analysis (IPA) conducts about 600 project evaluations for the process industries:
  - oil (upstream and down)
  - chemicals
  - pharmaceuticals
  - minerals
  - consumer products
  - power
- We now have databases containing over 5000 major projects and 1400 small projects

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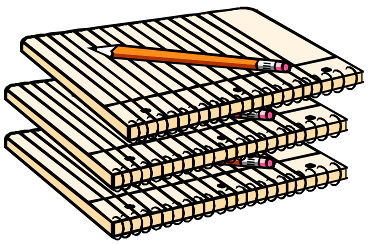
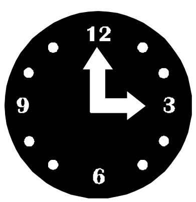
Characteristics of the Databases

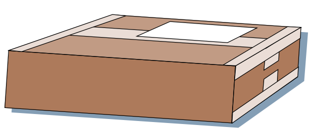


Data for each project are quite detailed: over 1500 variables describe the projects from inception to completion

All data were obtained through face-to-face interviews with the project teams and sponsors in addition to the documentation



All data are normalized to a common time and place and external factors are removed



We then develop statistical models to create indexes for cost, schedule, operability, etc.

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Outline

Progress in capital effectiveness

- þ Keys to improvement
- þ The role of contracting strategies
  - Ø Is fixed-price best?
  - Ø Do incentives work?

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Progress

- The cost of facilities has improved by about 12 percent in real terms over the past 5 years
- Execution schedules have improved nearly 30 percent over the past decade
- Construction safety has improved dramatically
- Operability has held steady

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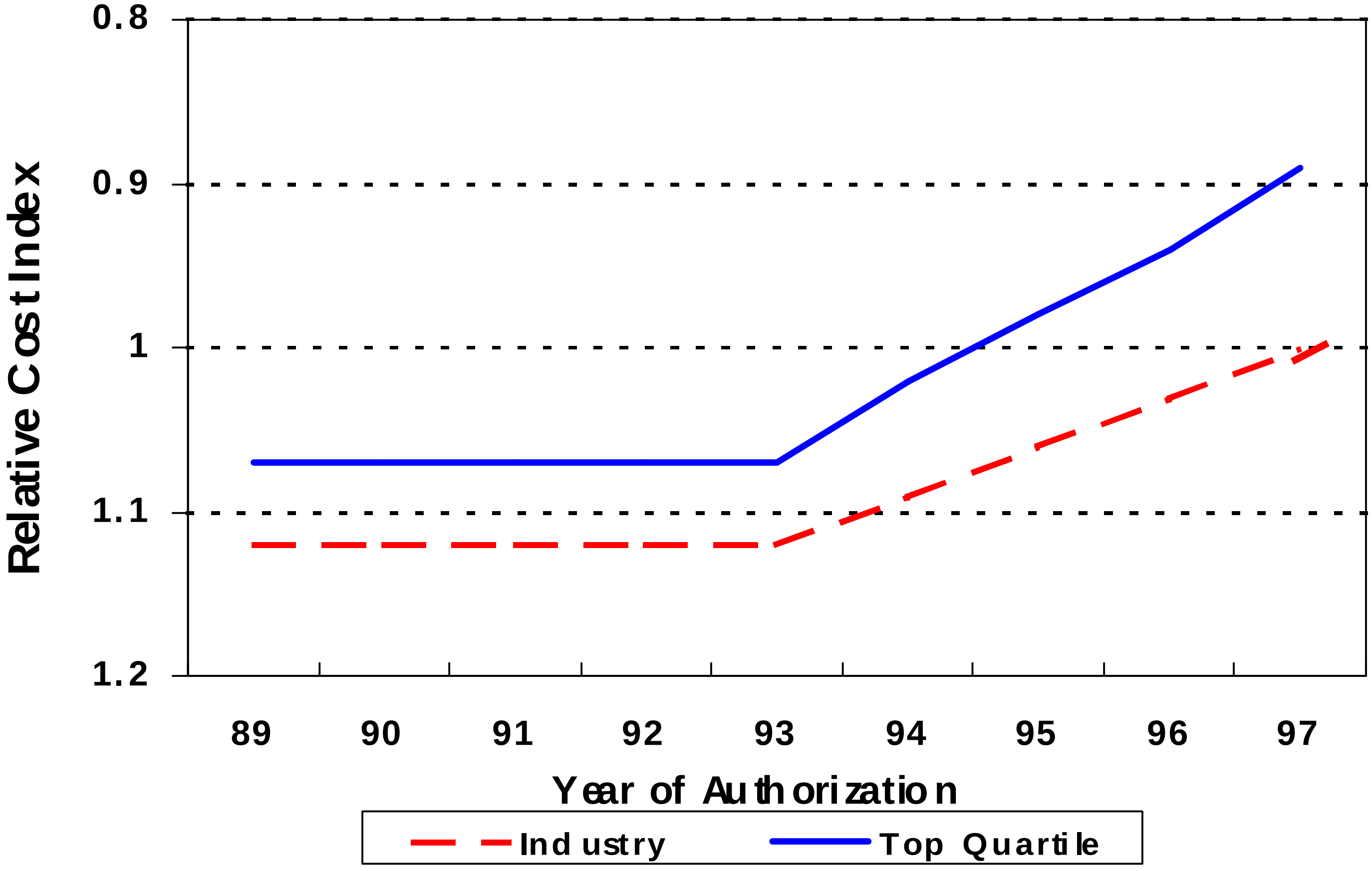
Cost Performance Is Improving



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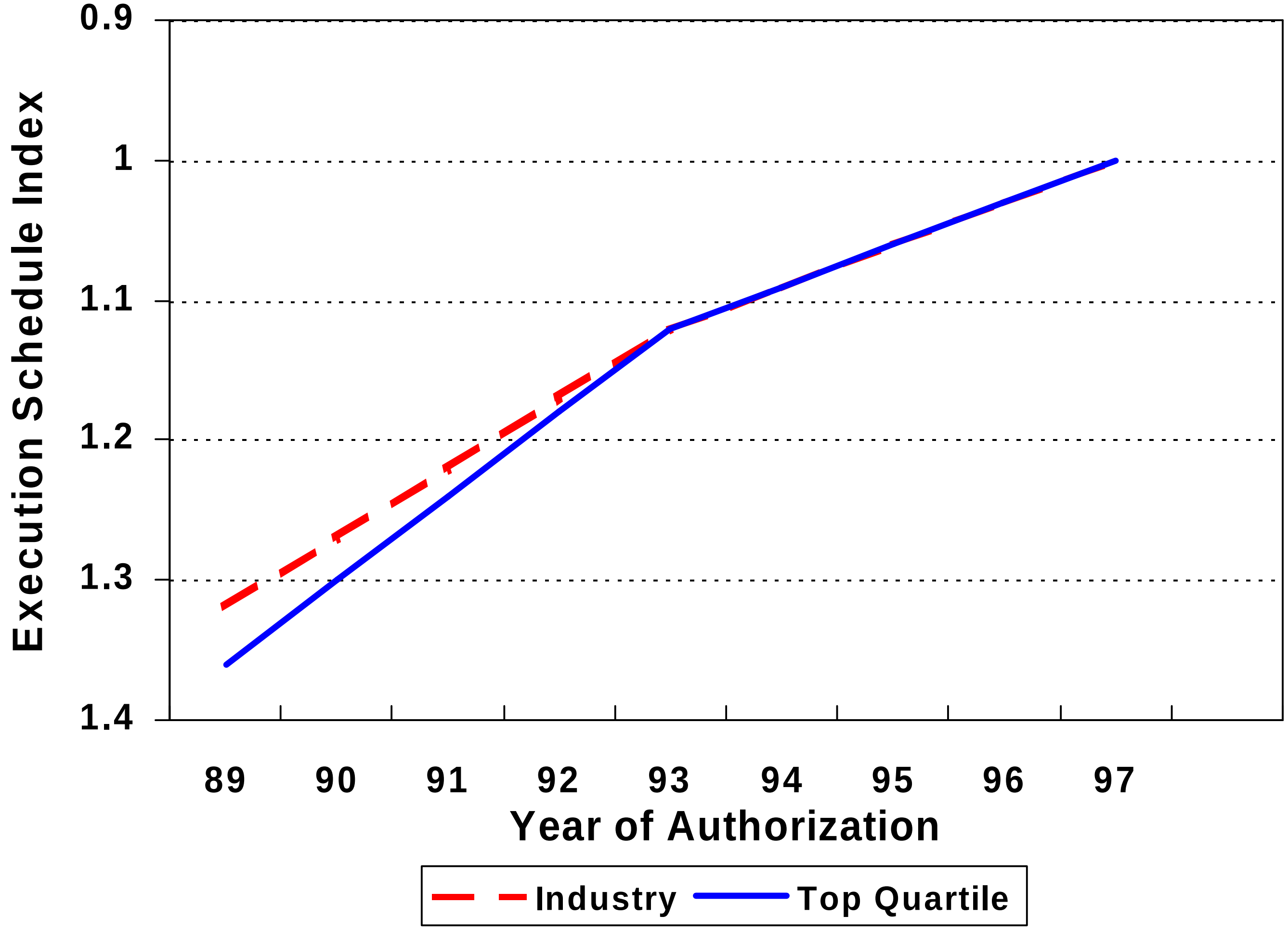
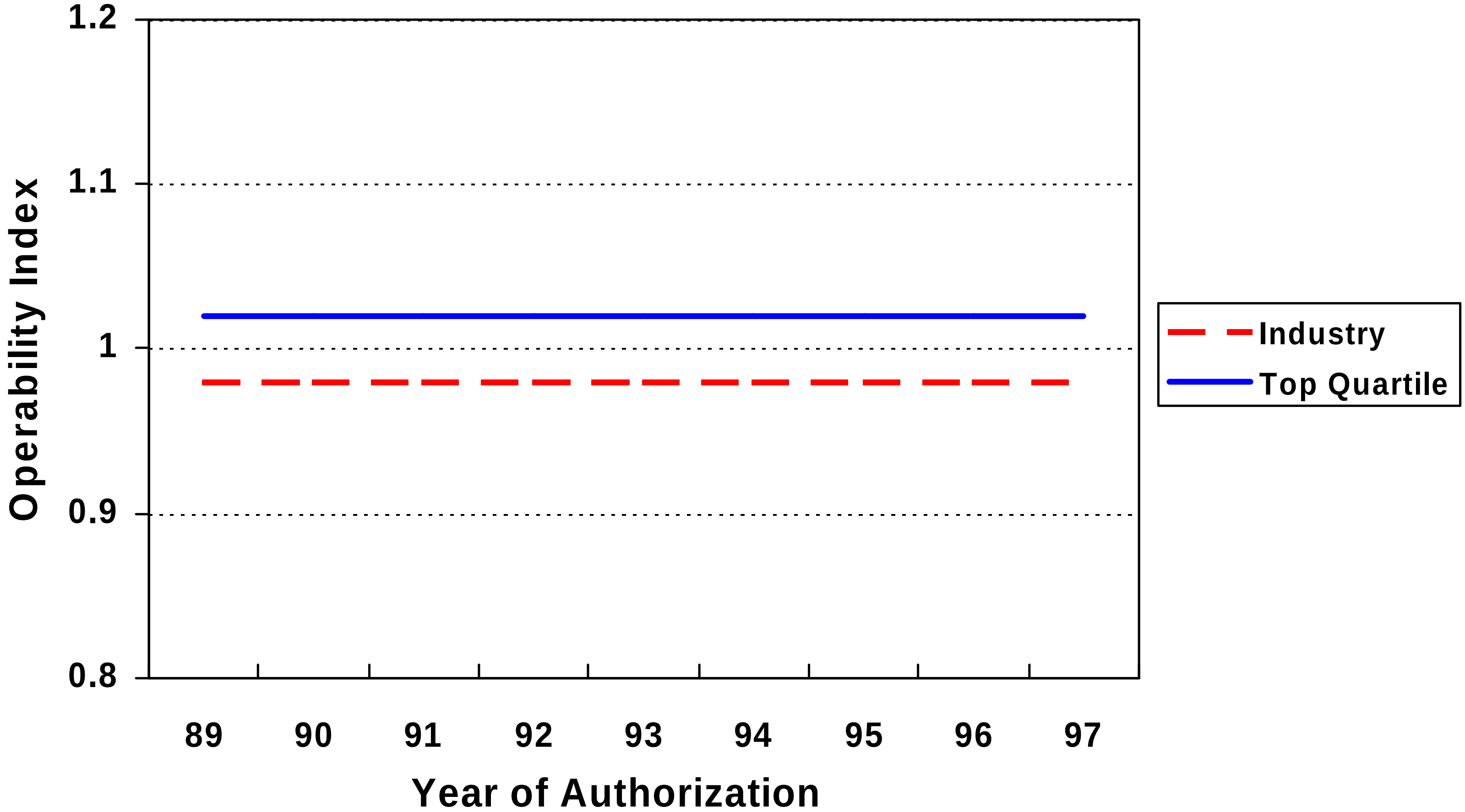
Schedules Are Improving



Operability Shows No Change



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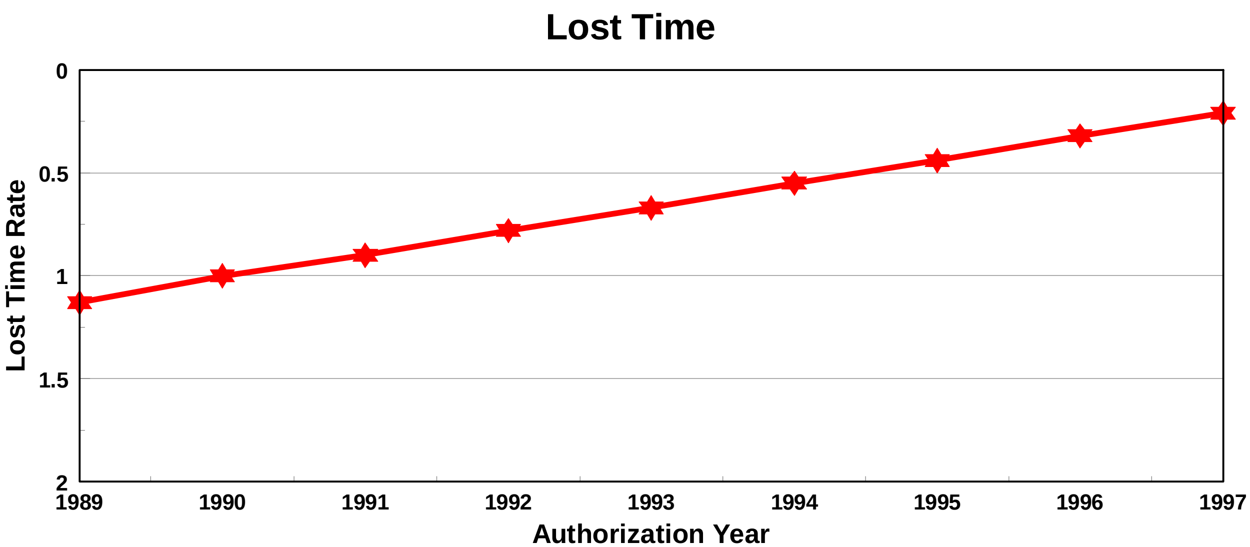
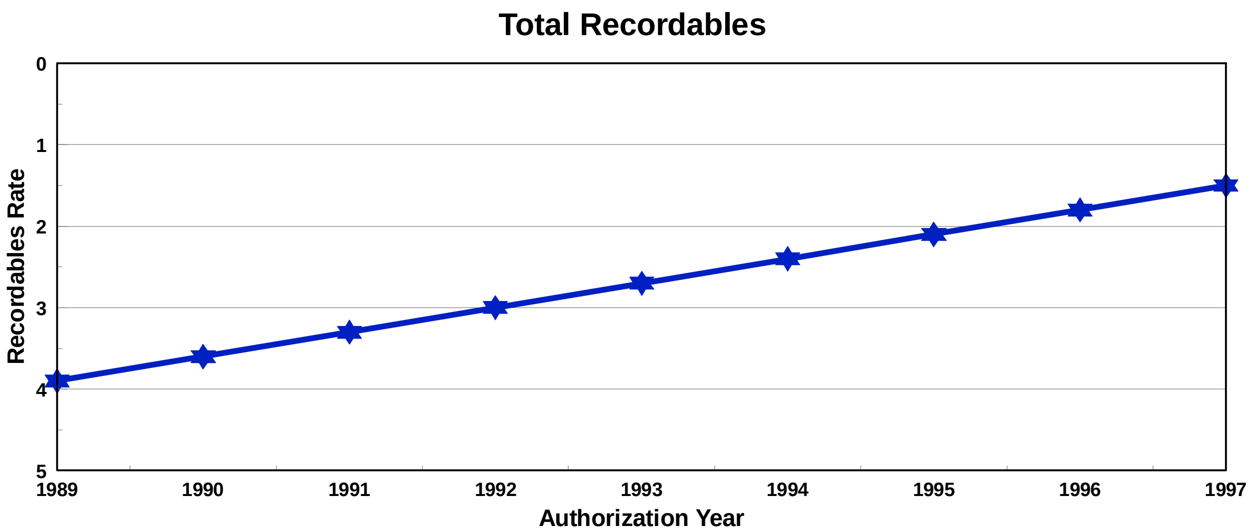
Safety Performance is Improving





**Using all PES database projects authorized after 1992.*

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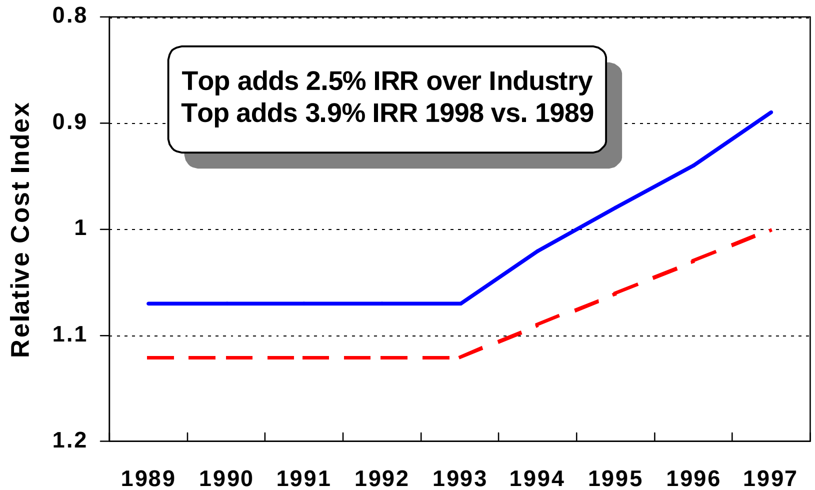
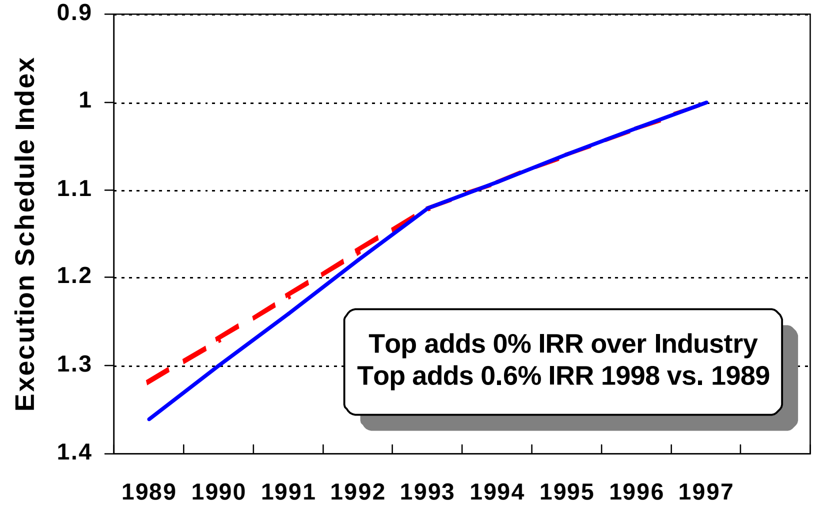
Top Quartile Performance Can Increase IRR by 5%

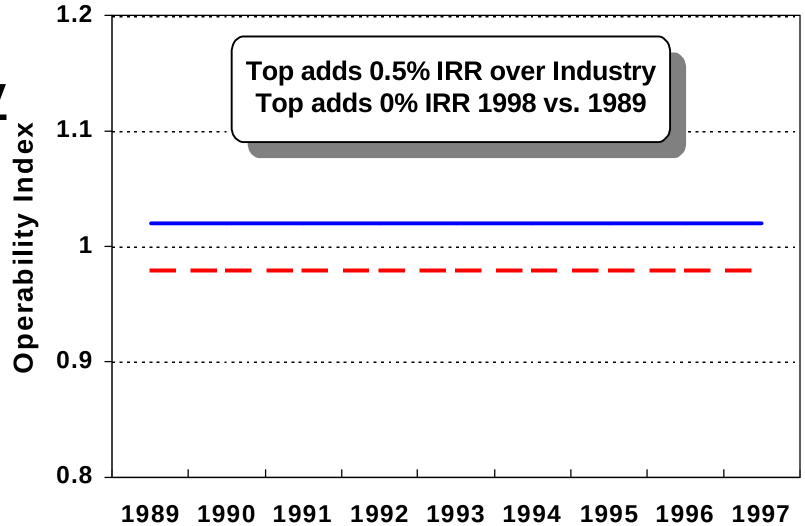
Cost



Schedule



Operability



Top adds 3% IRR over Industry
Top adds 5% IRR 1998 vs. 1989

Outline

- þ *Progress in capital effectiveness*
- þ Keys to improvement
- þ The role of contracting strategies
  - Ø Is fixed-price best?
  - Ø Do incentives work?

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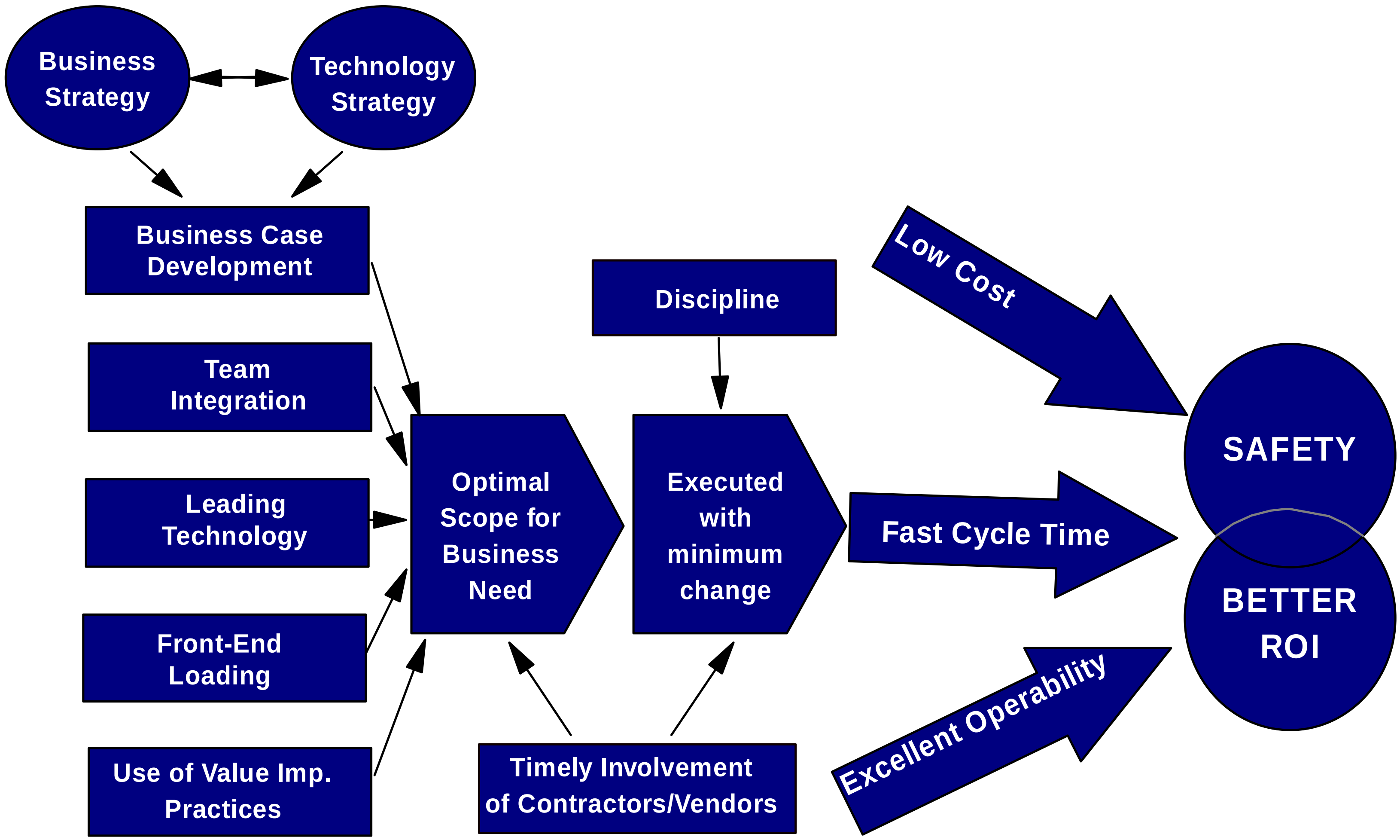
Elements of Capital Effectiveness



Key Leading Indicators

Key Performance Indicators

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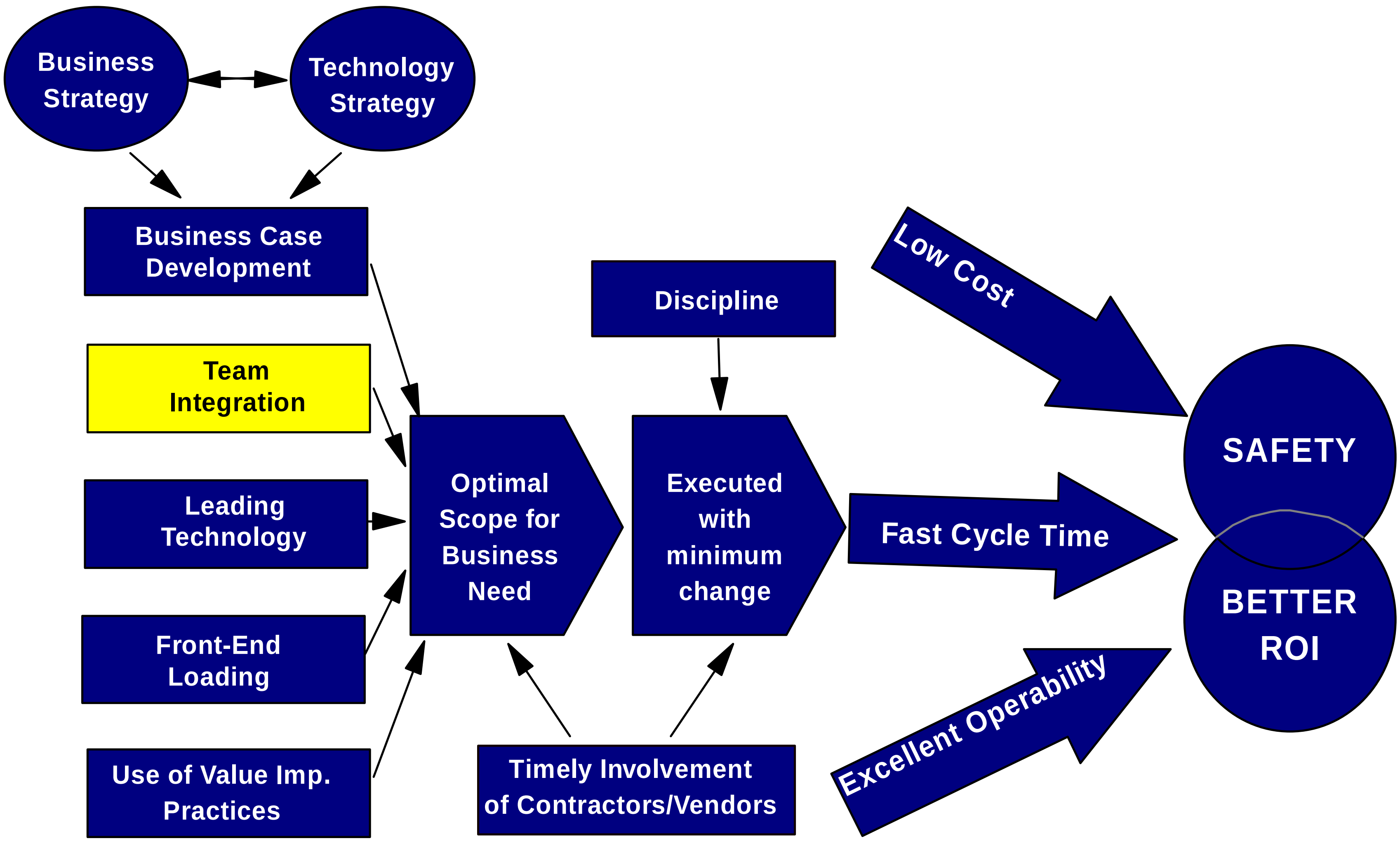
Elements of Capital Effectiveness



Key Leading Indicators

Key Performance Indicators

Integrated Project Teams

Definition of an Integrated Project Team

- An Integrated Project Team is a team of full or part-time representatives of the following areas (but are not limited to):
  - Business
  - Engineering
  - Construction
  - Maintenance
  - Operations/Production
  - Health and Safety
  - Environmental (if needed)
  - Contractor (if appropriate)
- These representatives are identified prior to project authorization and have specific responsibilities that are defined and understood by all team members
- These representatives have authority to make decisions for the function they are representing and provide functional input to the project manager.

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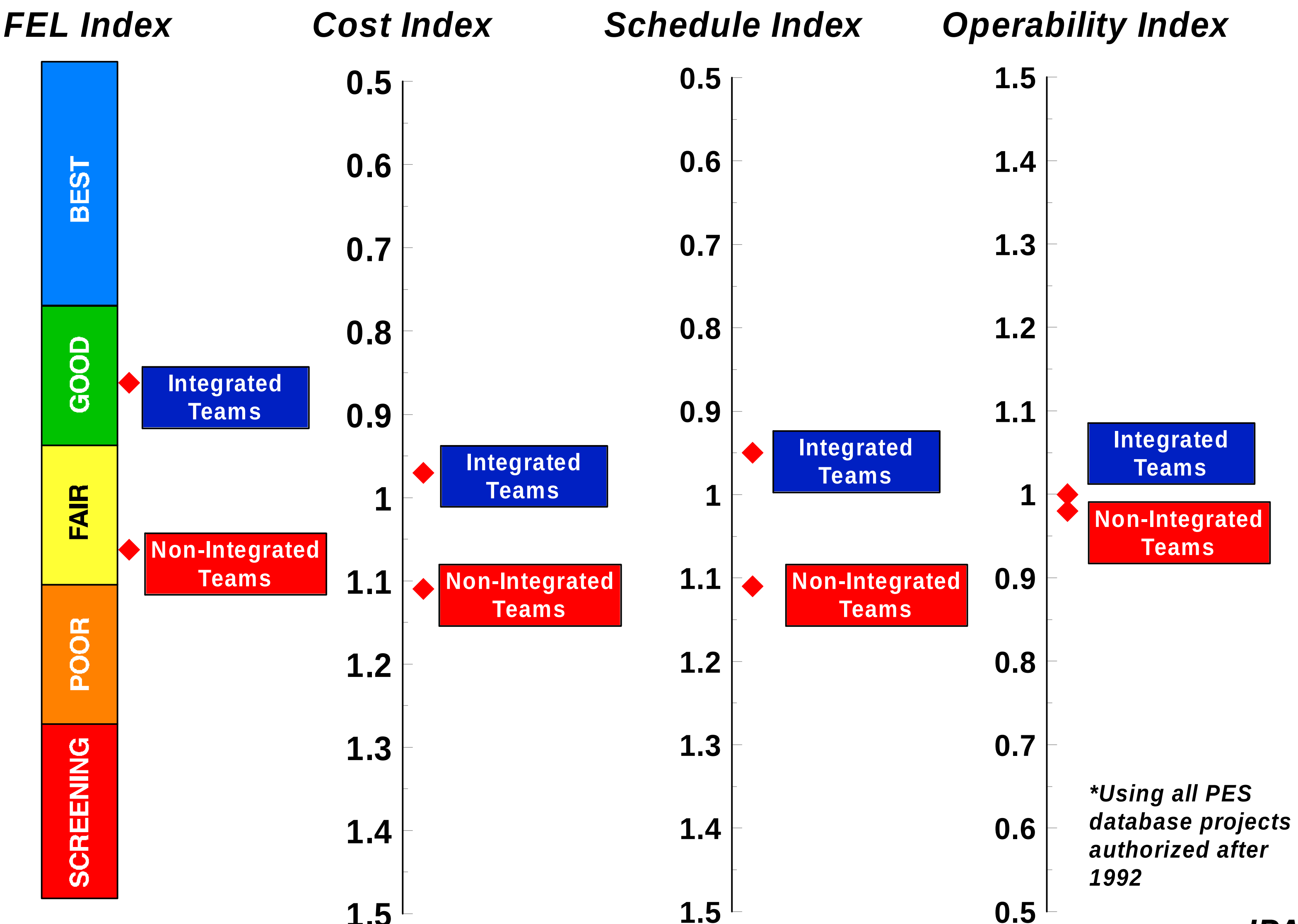
Integrated Teams Result in Better FEL and Therefore Better Performance



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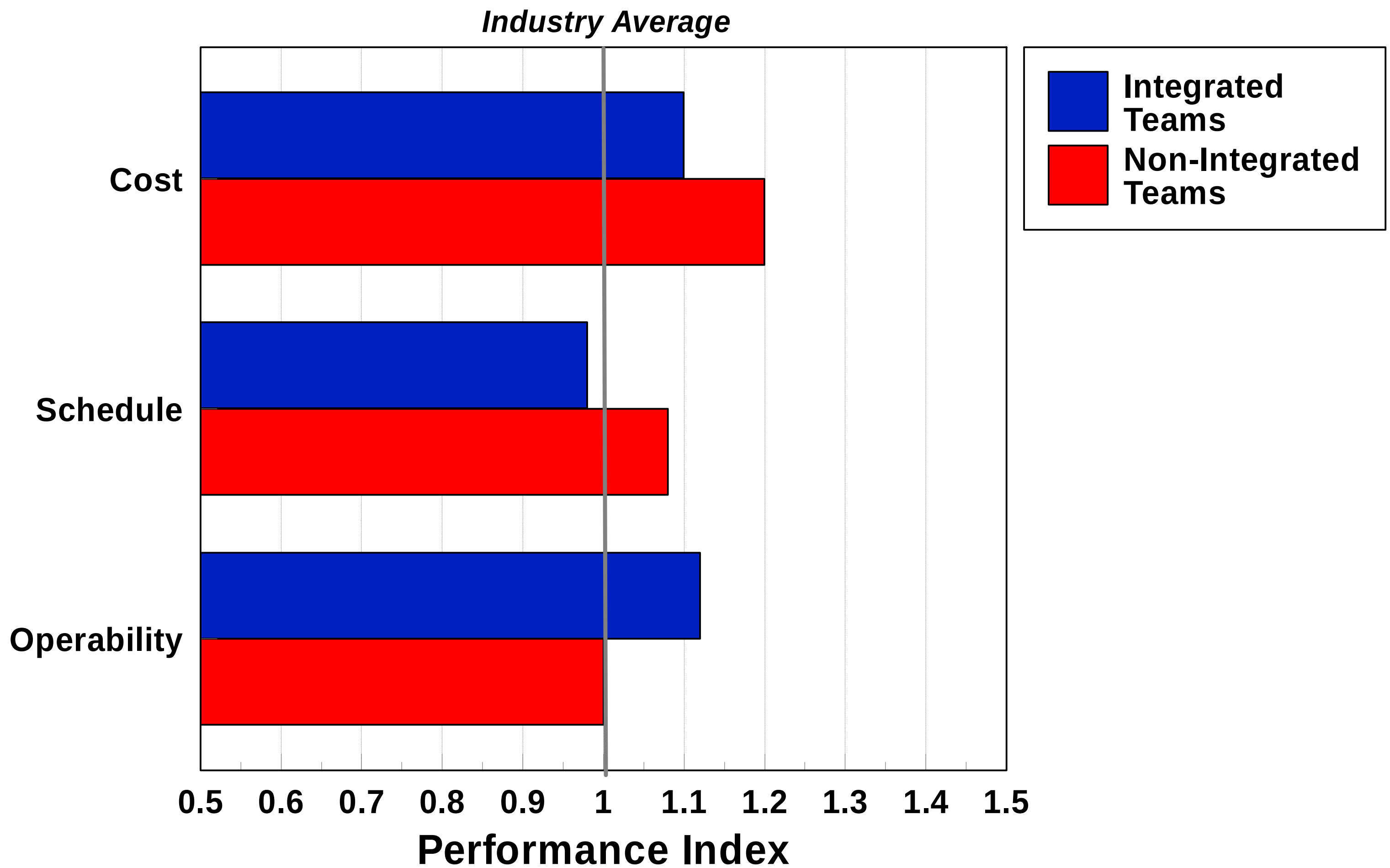
Integrated Teams Even Help Projects With Poor FEL



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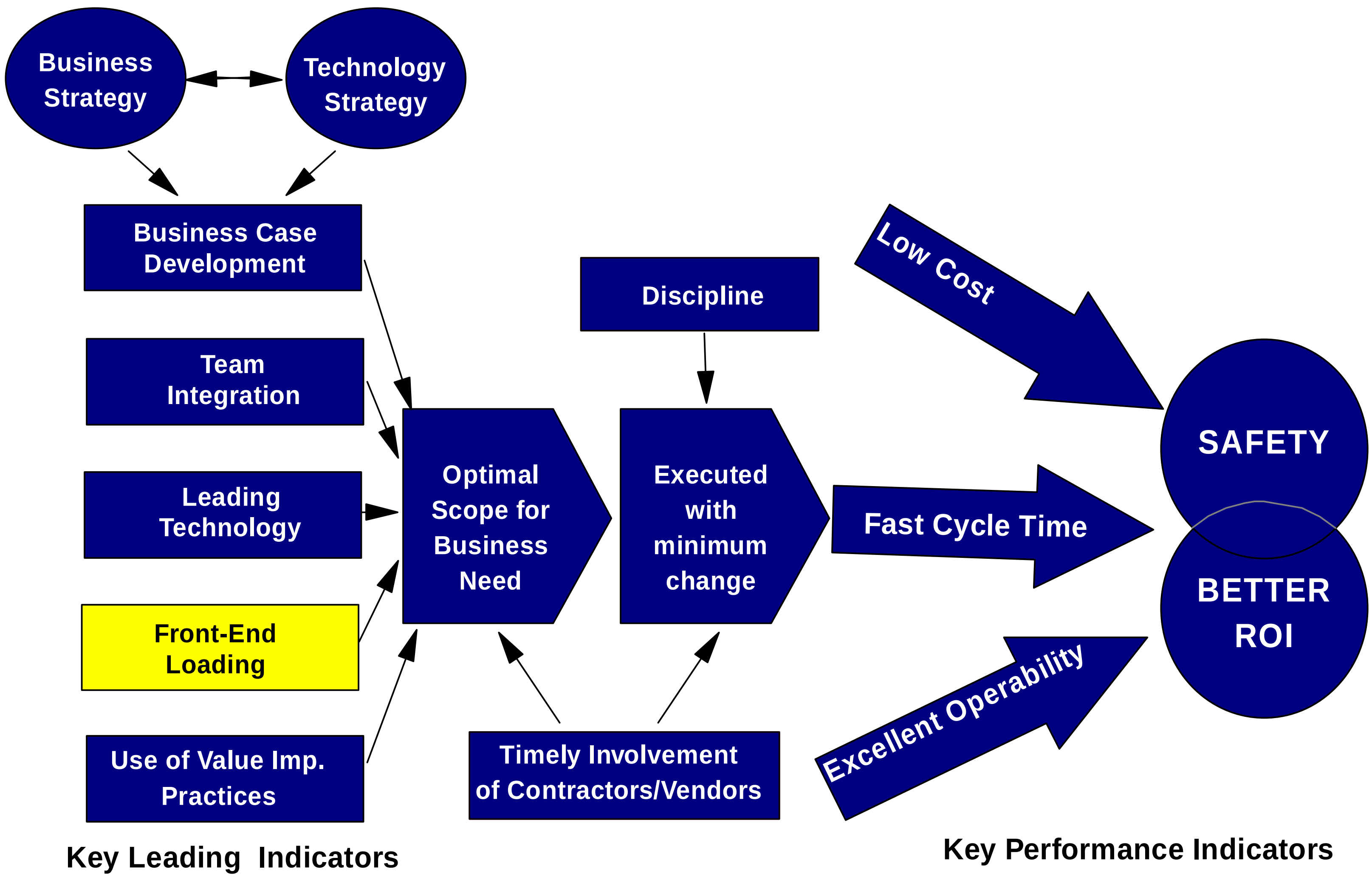
Elements of Capital Effectiveness



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Components of Front-End Loading

Site Factors + **Engineering Definition** + **Project Execution Plan** → **FEL Index**

Site Factors

- Local labor cost and productivity
-
- Materials availability
-
- Equipment layout
- Soils data
- Environmental requirements
- Health & safety requirements

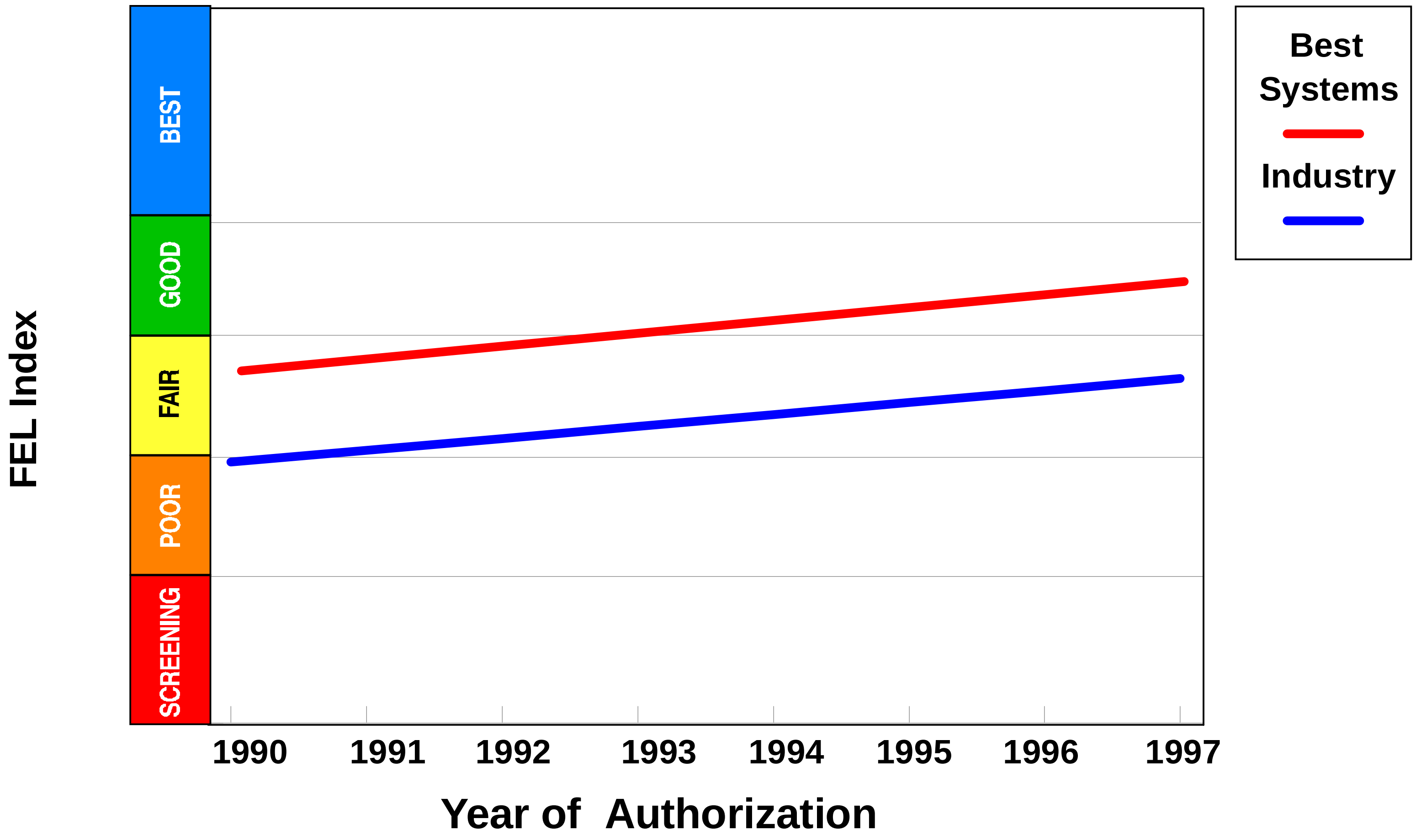
Engineering Definition

- Engineering tasks
  - Detailed scope
  - Feedstock/product properties
  - PFDs
  - H&MBs
  - P&IDs
  - One-line elec. diagrams
  - Major equipment specs
  - Cost Estimate
- Participation/buy-in of:
  - Operations
  - Maintenance
  - Business

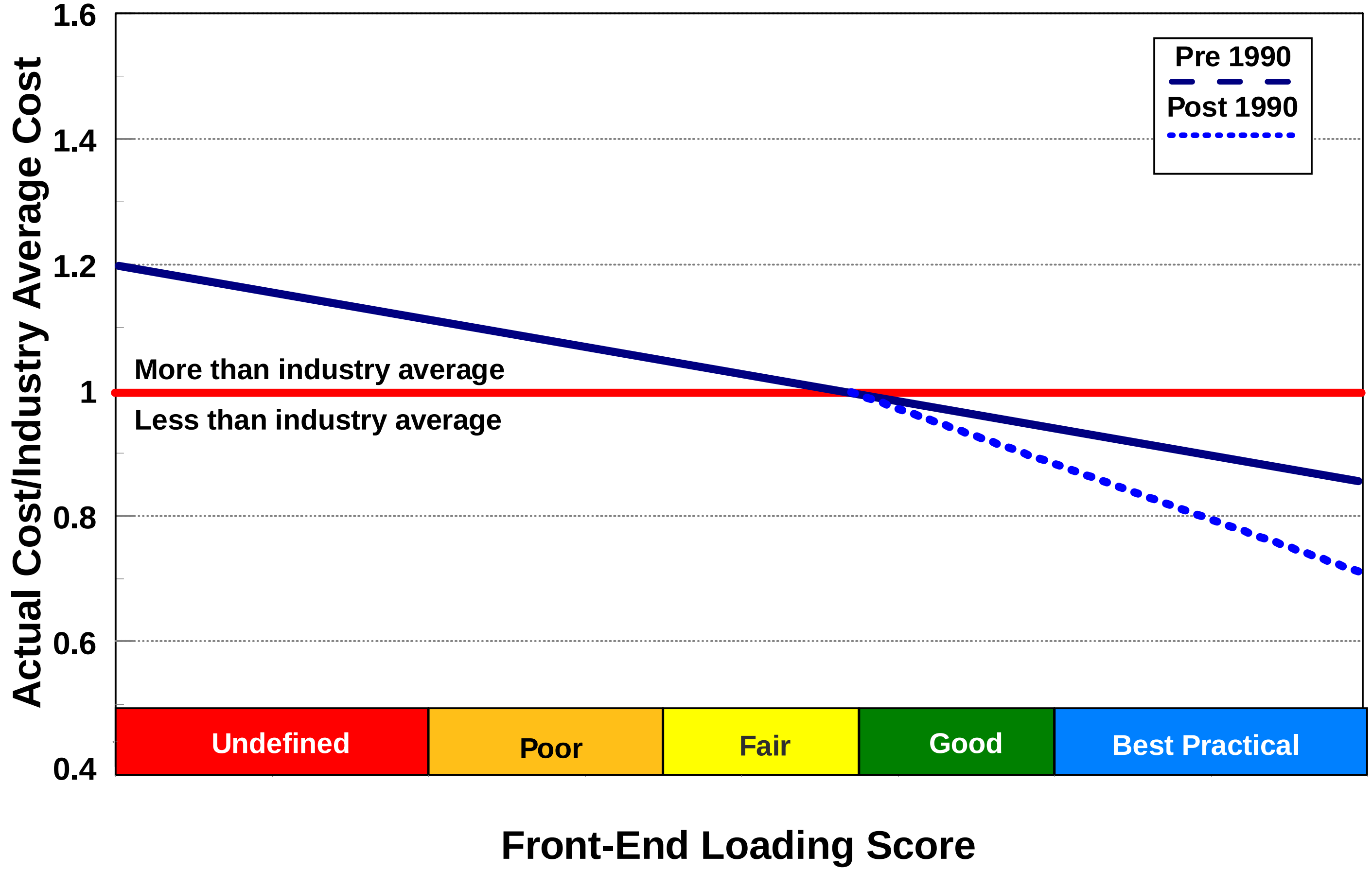
Project Execution Plan

- Contracting strategy
  - Who
  - How
- Team participants & roles
- Integrated schedule
  - Critical path items
  - Identification of shut-downs for tie-ins
  - Resource requirements
  - Overtime requirements
- Plans
  - Commissioning
  - Startup
  - Operation
  - Quality assurance
- Cost/schedule controls

FEL is Improving Slowly



Better Front-End Loading Saves Money



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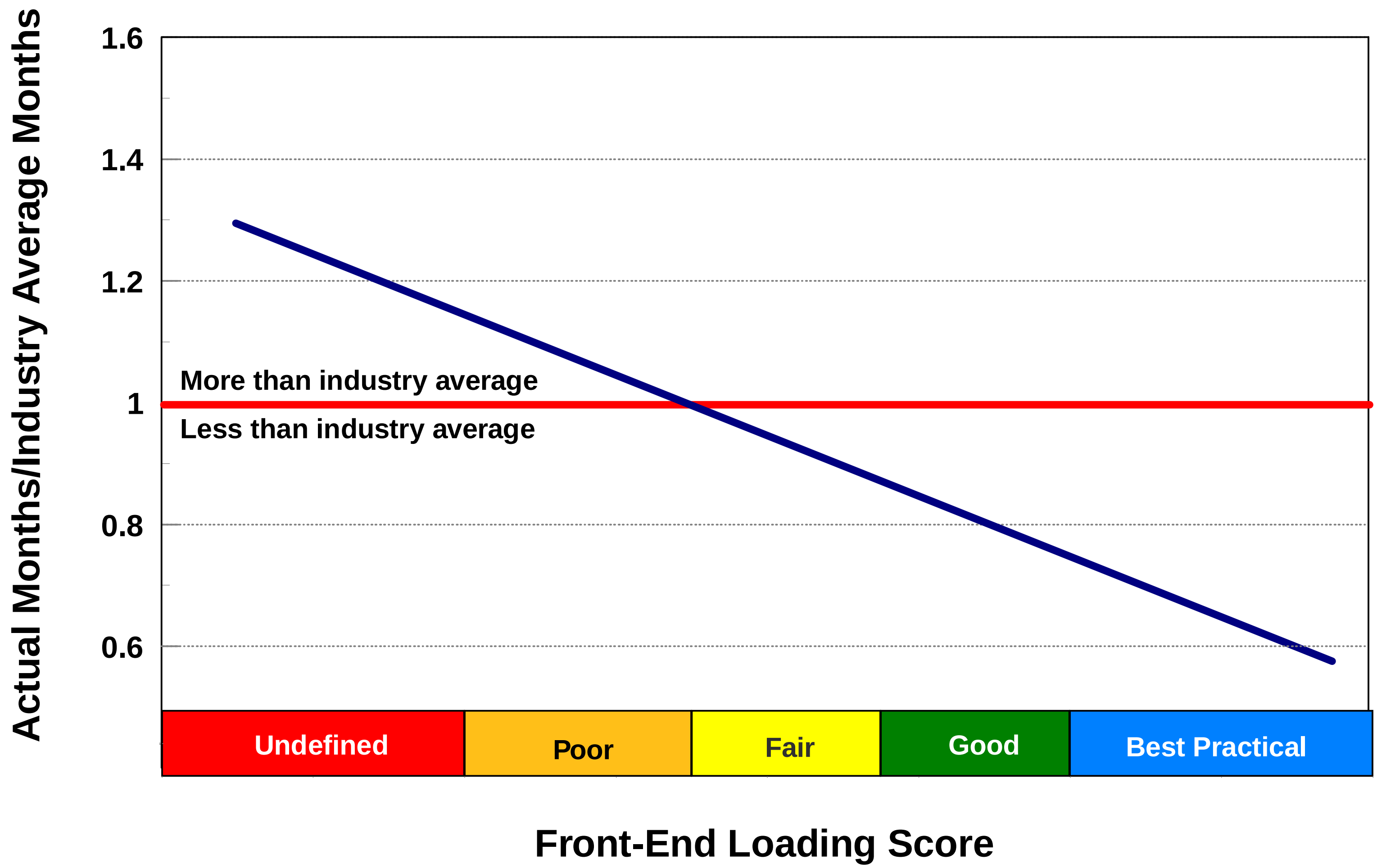
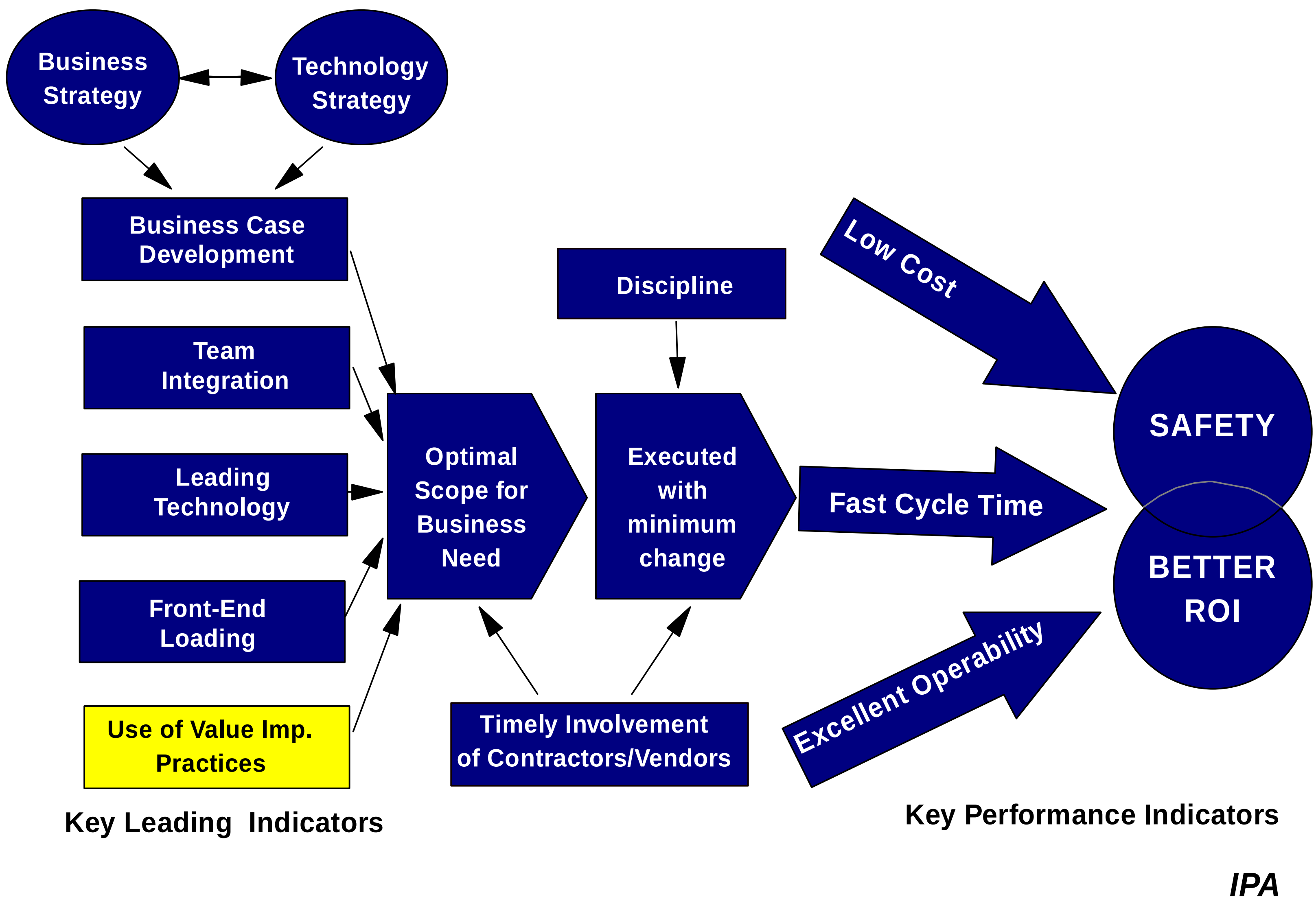
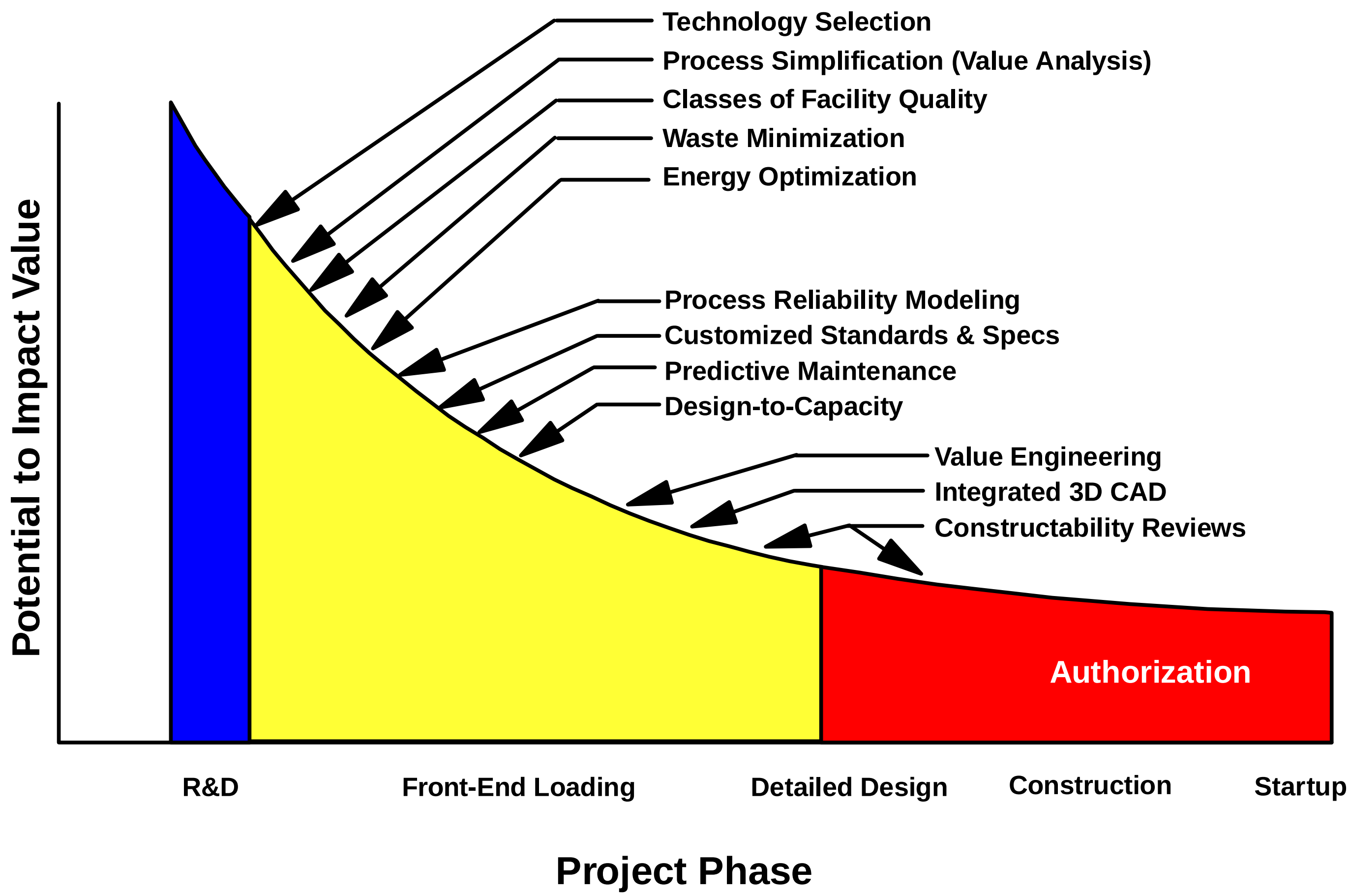
Better Front-End Loading Saves Construction Time



Elements of Capital Effectiveness



The Value-Improving Practices



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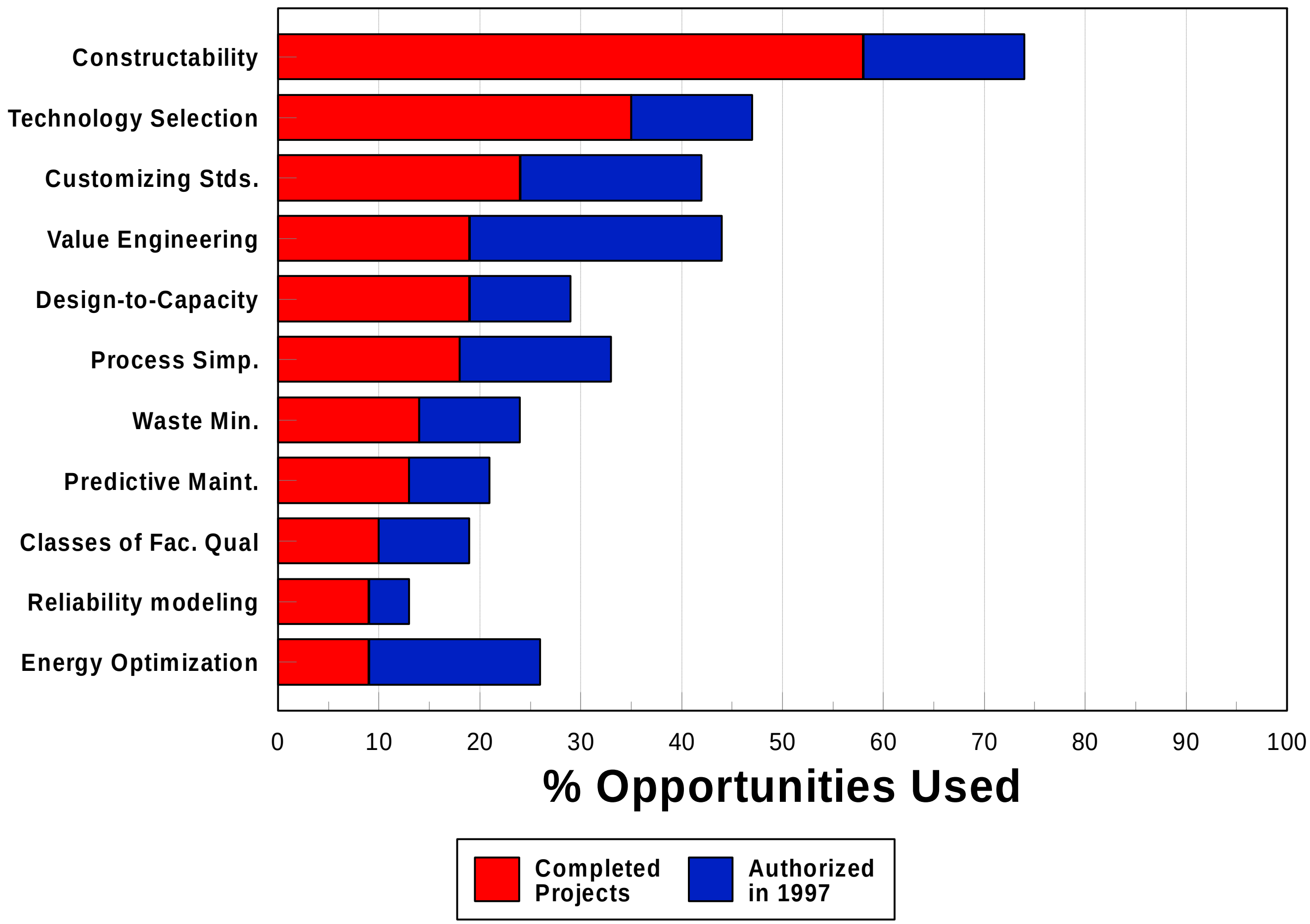
Which VIPs are Most Commonly Used



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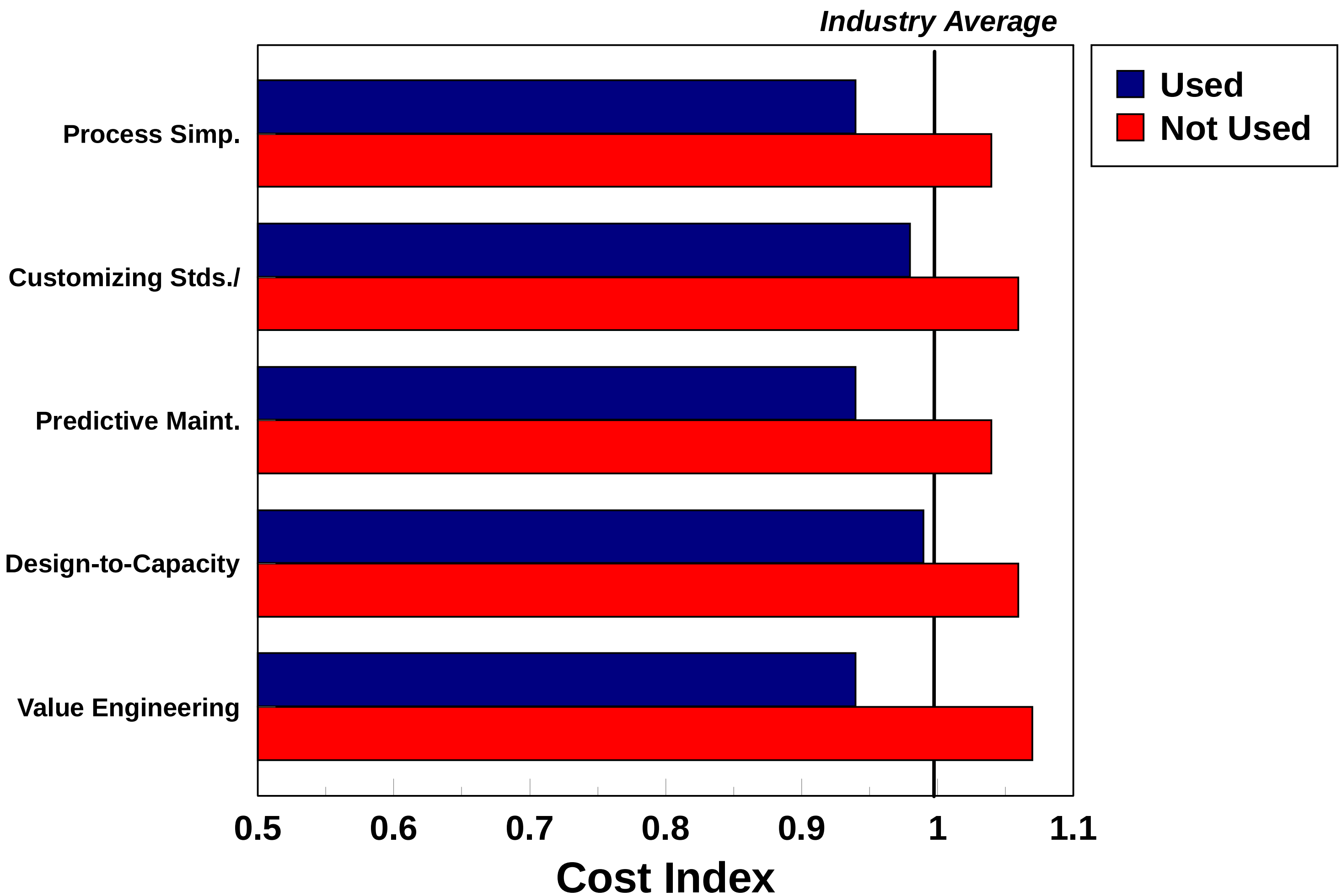
VIPs that Drive Cost Performance



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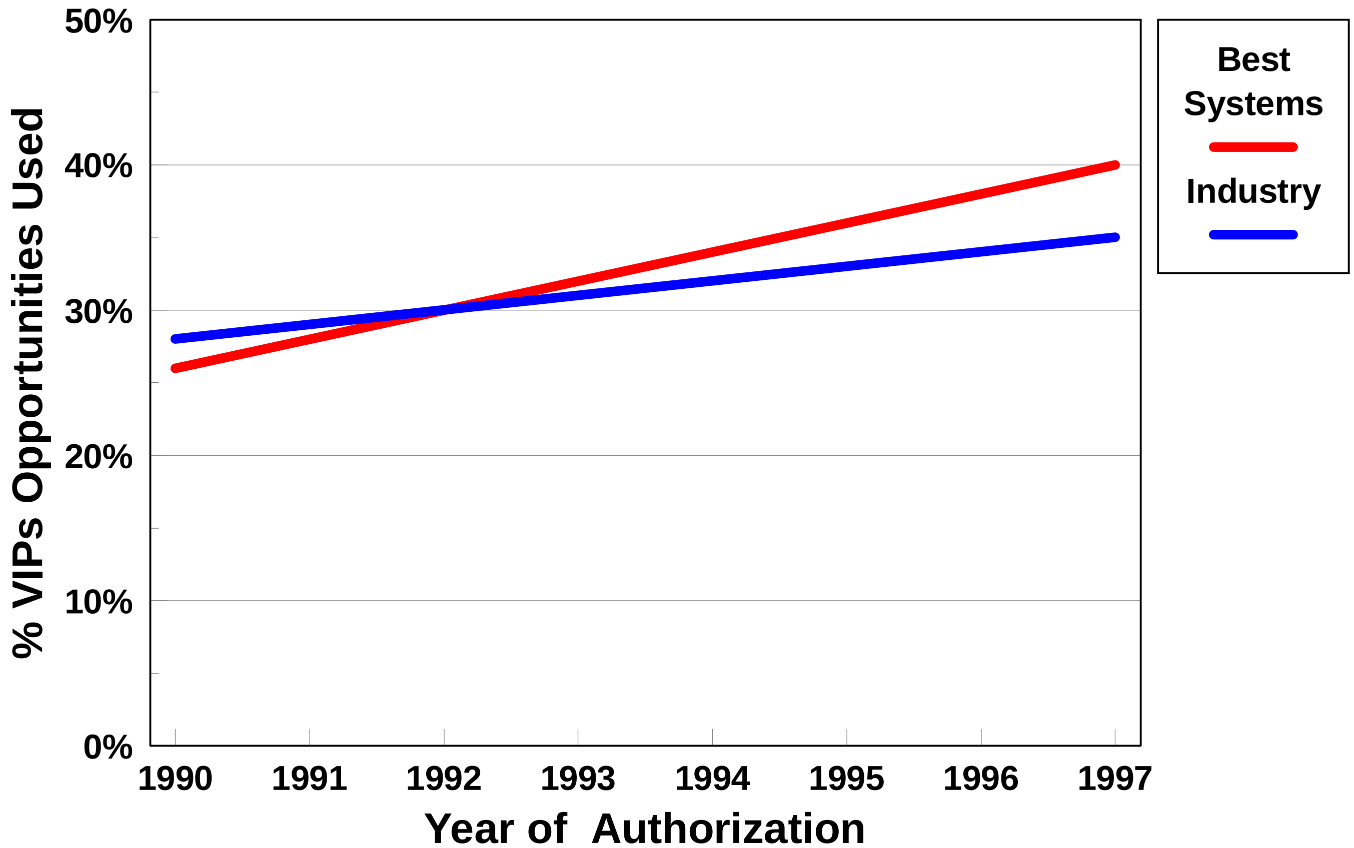
VIPs Use is Increasing



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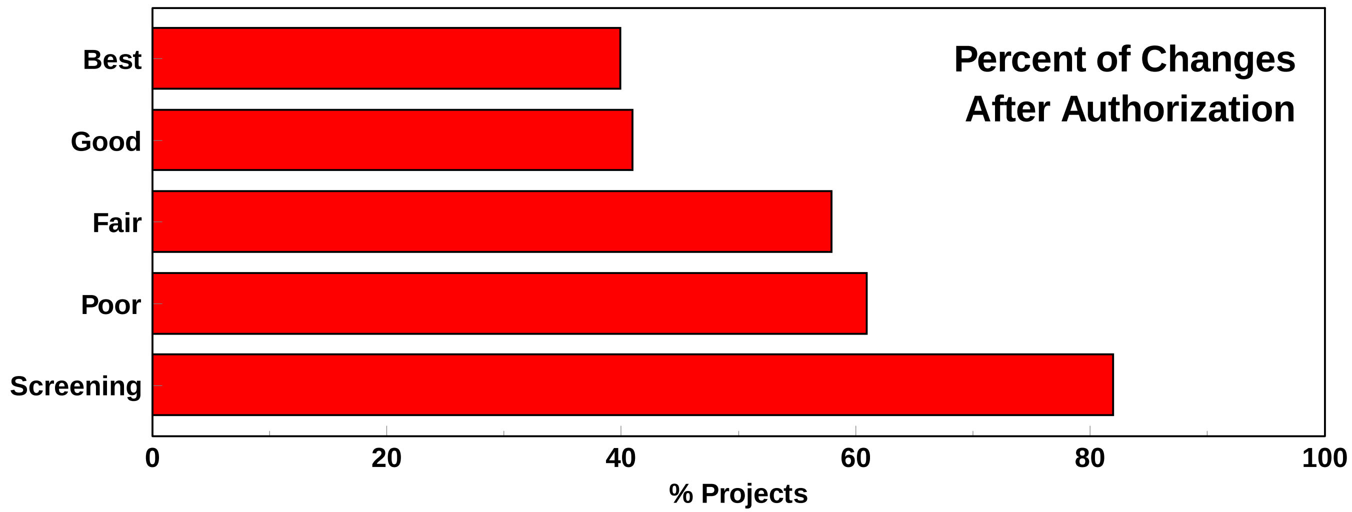
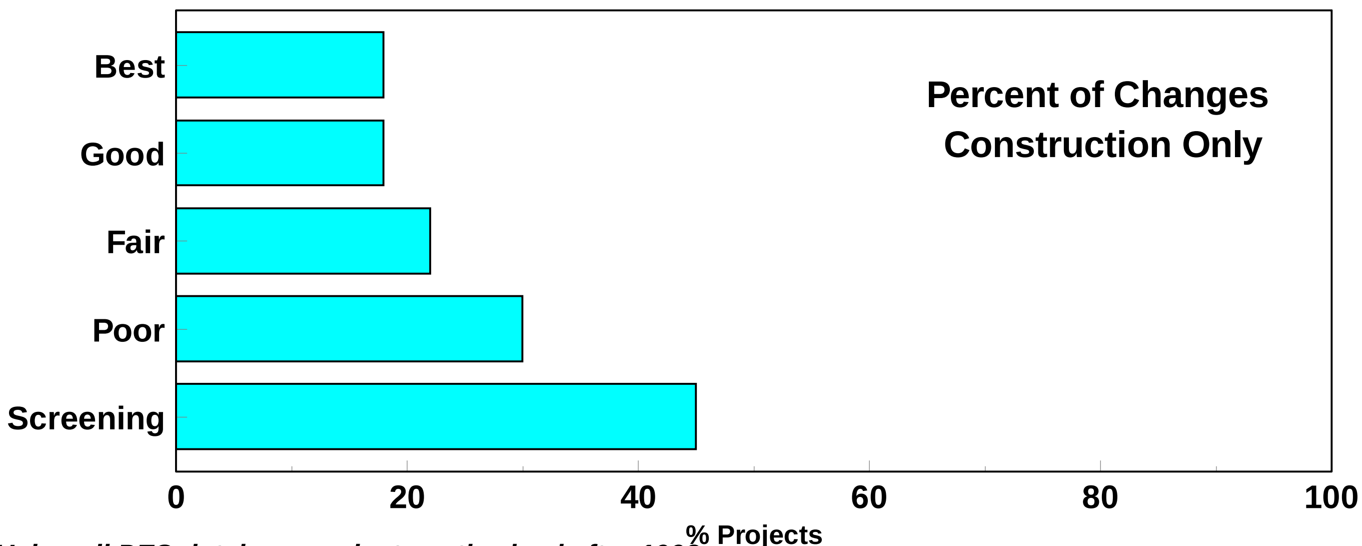
Lack of FEL Results in Changes





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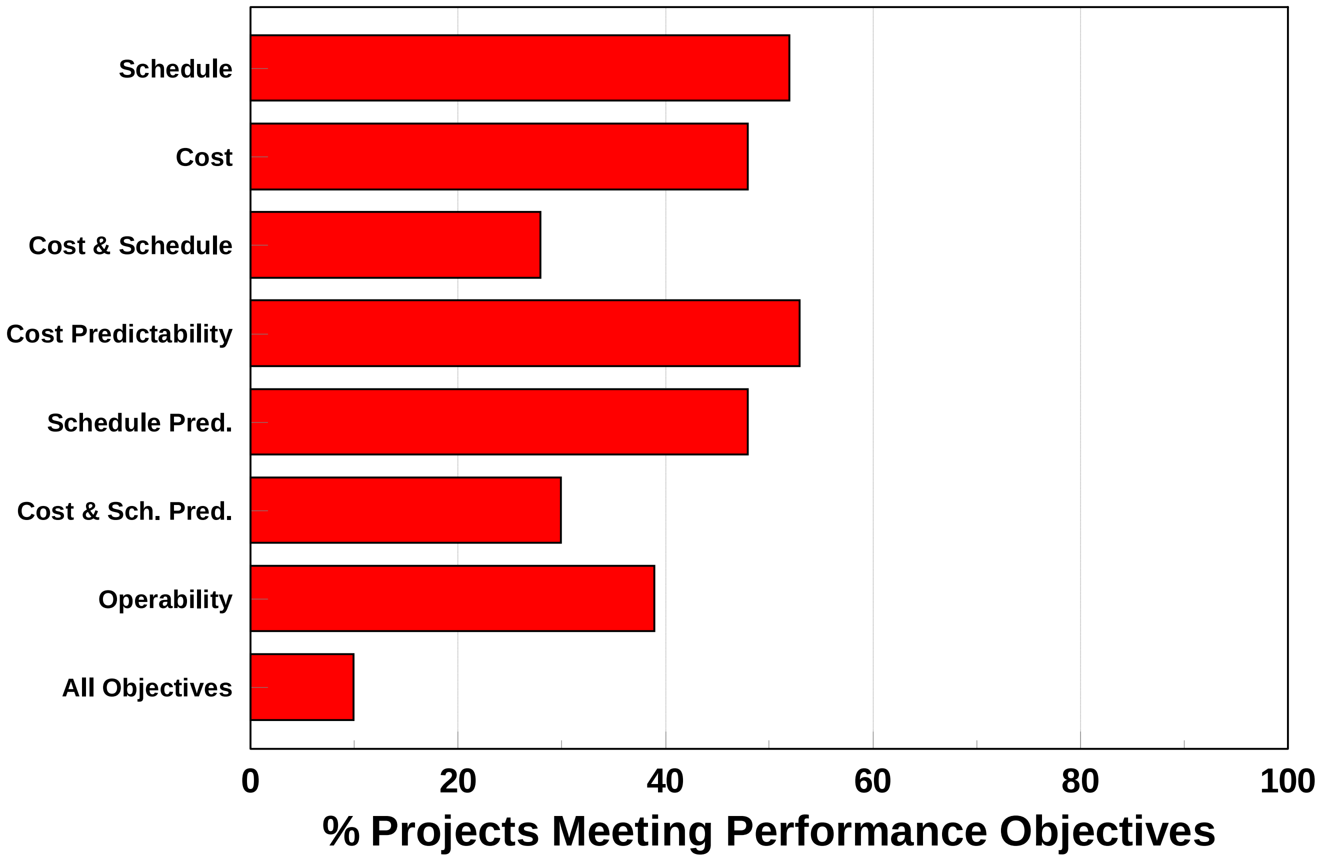
Few Projects Meet All Objectives



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Why is Capital Effectiveness So Difficult?

- In capital intensive businesses, capital effectiveness is an avenue to success
  - low cost producers have some volume, margin, and market share control
  - cycles provide opportunities as well as headaches
- Yet many commodity businesses waste large amount of capital, because...
  - work process is inadequate
  - accountability is poor
  - cross-functional cooperation is lacking

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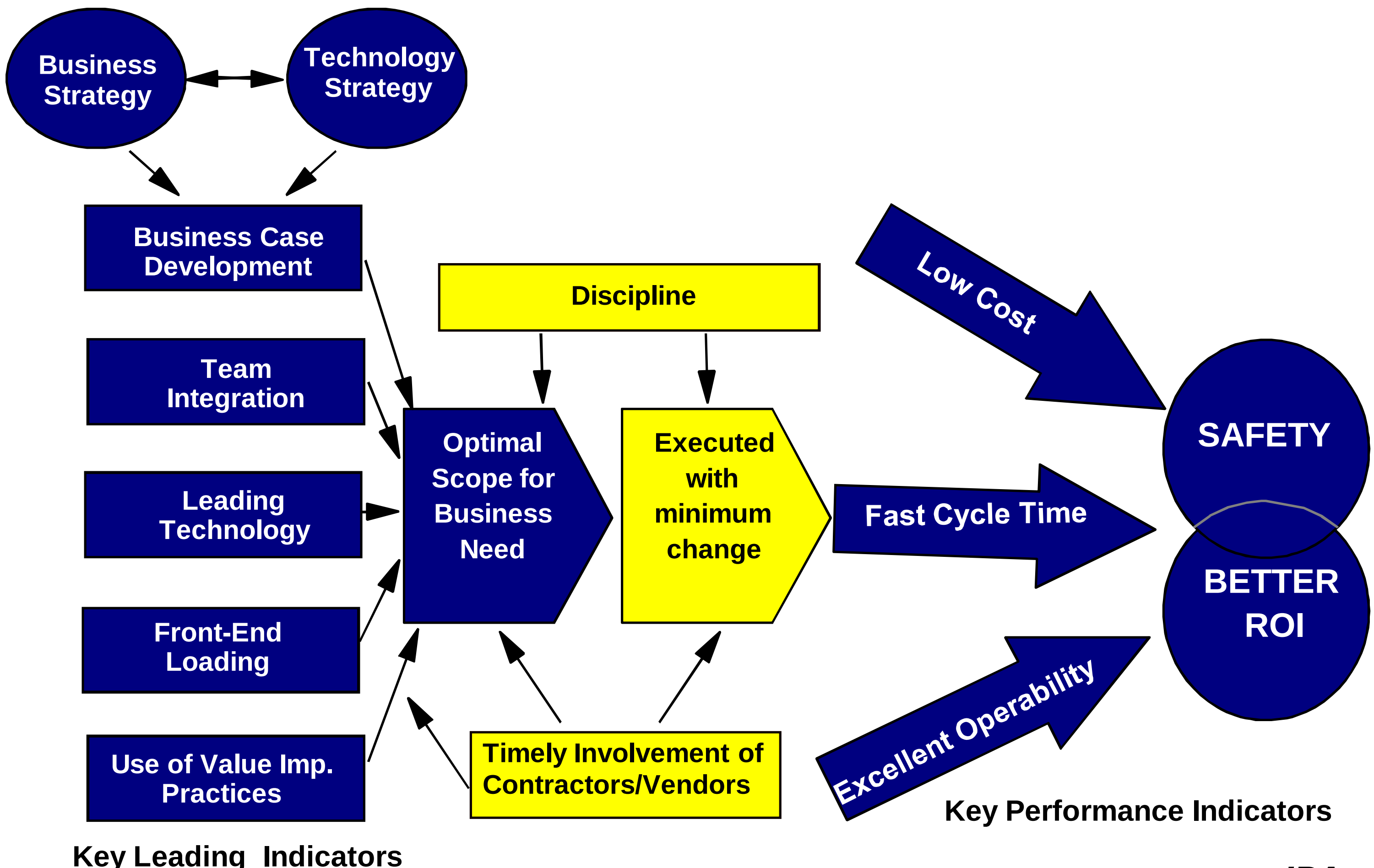
Elements of Capital Effectiveness



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The Contracting Strategy Problem

- There are strongly held, diametrically opposed beliefs about the relative merits of different contracting approaches
- In general, these beliefs are unsupported by systematic data
- The contracting problem is also confused by the inability of many to distinguish between
  - predictability and
  - effectiveness

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Contract Approaches Examined

- **EPC Lump-sum: detailed engineering, procurement and construction performed on a fixed price basis by same firm or consortium**
- **Reimbursable: all work performed on a cost-plus fee or cost-plus incentive fee basis**
- **Mixed: engineering & procurement performed on a reimbursable basis with predominantly fixed-price construction**
- **Results are controlled for definition; poorly defined EPC-lump sums have very large penalty**

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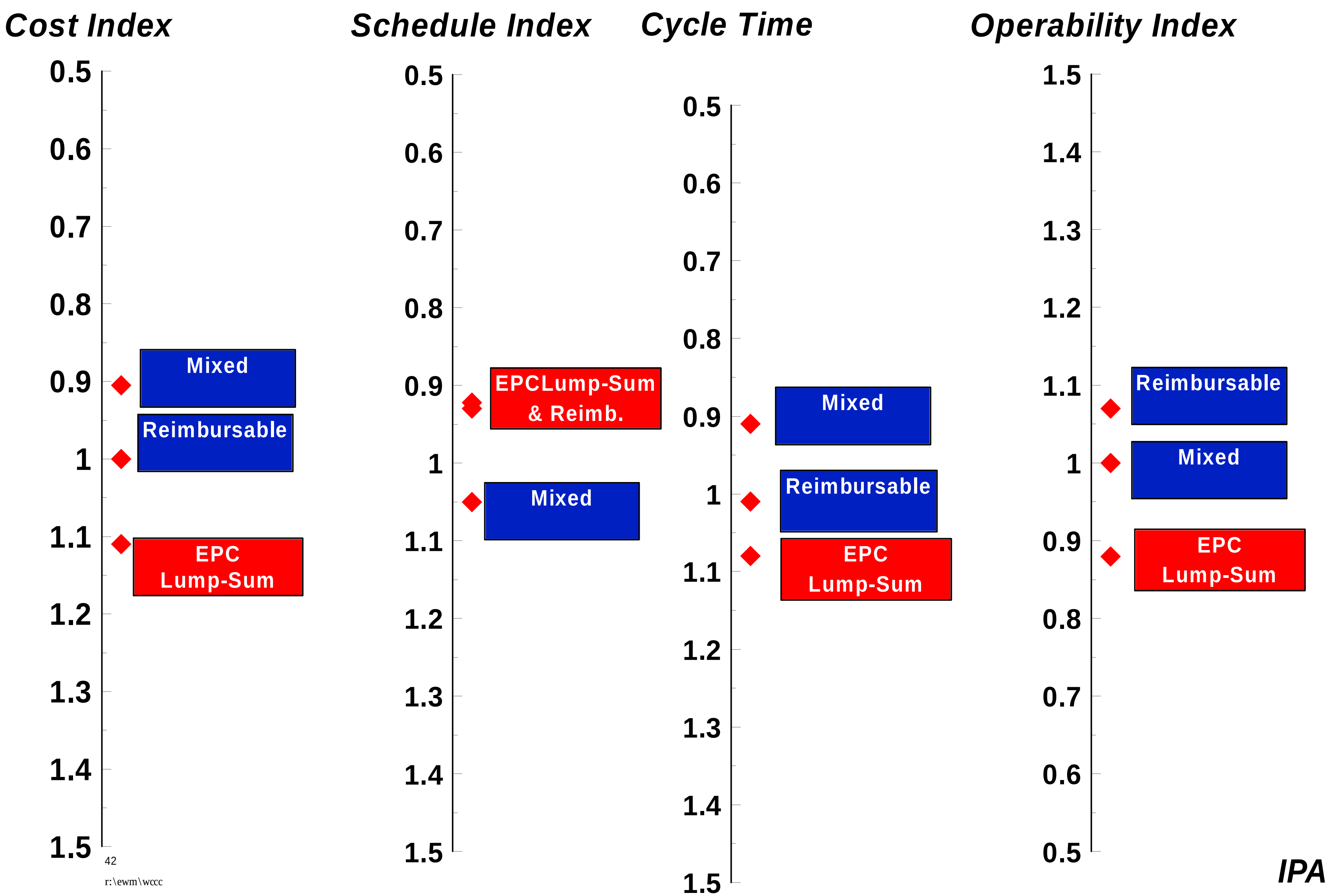
Contracting Strategy and Project Results



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Contracting Strategy Results

- EPC Lump-sum is on average significantly more expensive than average
- Reimbursable engineering followed by any form of fixed price construction (the "mixed strategy") is the most cost-effective approach
- Although Mixed strategy execution time is longer, the cycle time is shortest
- EPC Lump-sum carries a heavy operability penalty
- On average the Mixed strategy appears best and EPC lump-sum worst

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Why are EPC Lump-sums more Costly?

- This contract form seeks to shift risk to the contractor
- Theory is that because contracts lead execution, they should be better able to control risk
- However, contractors are not well-capitalized and cannot bear equity risks at low cost
- Therefore, contractors will normally bid on a higher than 50/50 basis
- The larger the project relative to contractor, the high the risk premium

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The Role of Incentives

- ***Engineering incentives*** **were amounts paid to the engineering contractor according to a formula for results versus targets**
- ***Construction incentives*** **were paid to the construction contractor**
- ***"Both"*** **are projects in which incentives were provided to both the engineering and construction contractors or to a single EPC contractor for overall cost and schedule results**
- **Too few contracts had *meaningful* provisions for operability incentives to be examined**

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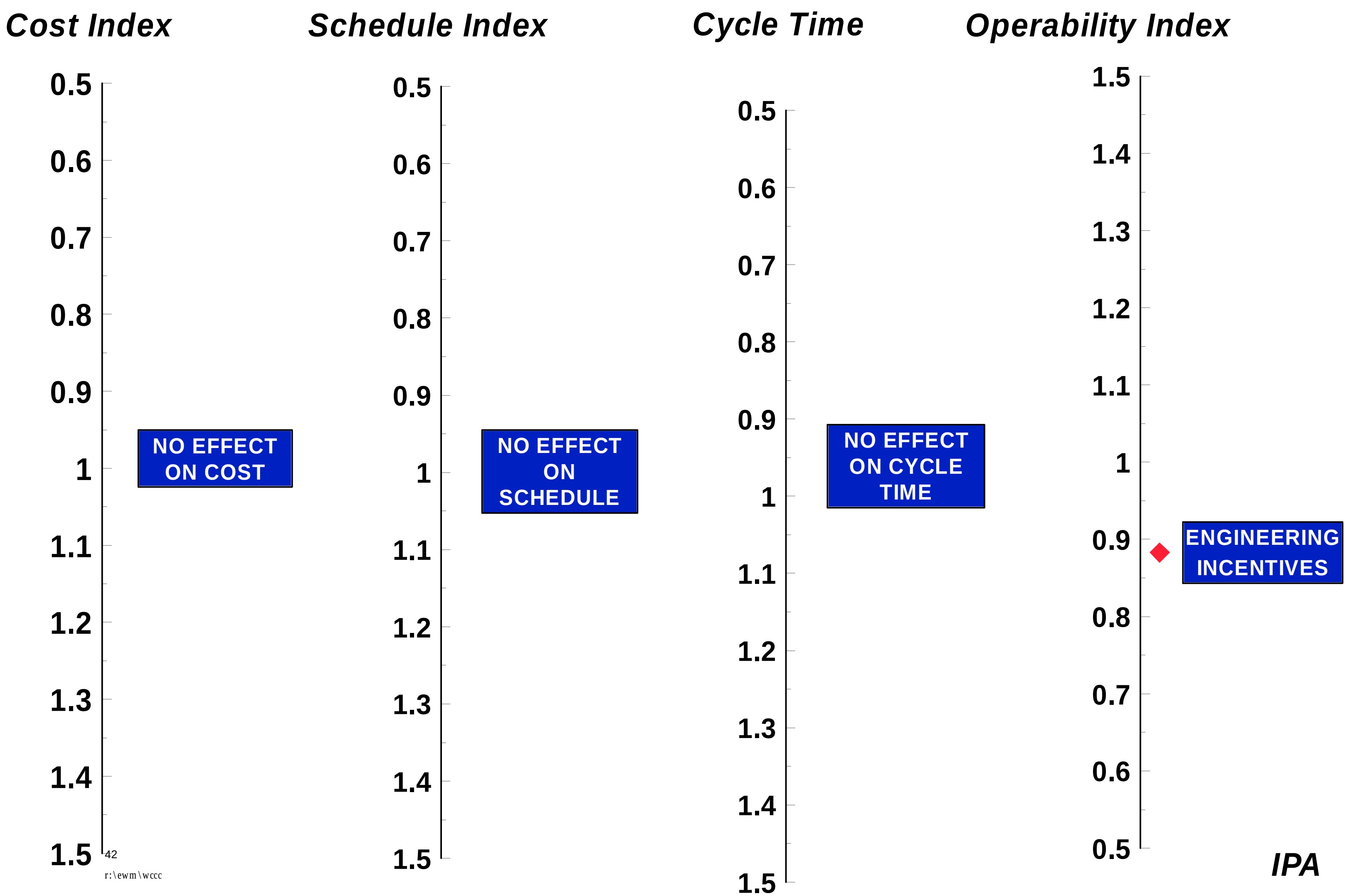
Contract Incentives and Project Results

(Non EPC-Lump Sum Only)



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Conclusions about Incentives

- The use of incentive contracting has no reliable effects on cost, execution time, or cycle time
- Directionally the results are poorer rather than better with incentives
- The use of incentives for engineering is strongly associated with *poorer* operability of facilities
- This conclusion holds for all types of projects we have examined
- The use of incentives as currently practiced should be reconsidered
- Contractors are better at this than owners

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If You Incentivize, Ask...

- Exactly, whose behavior are you seeking to change? How will the change mechanism work?
- Will engineers withhold good ideas unless their firm receives an incentive?
- Are there ways that the incentive can be "gamed", e.g. high estimates?
- Are there potential unintended consequences, e.g. managing to the incentives rather than the project?