Improving Construction Project Outcomes and Project Returns

presented the

Northwest Construction Consumer Council

May 2002

Independent Project Analysis

Outline

- **Capital Effectiveness**
- **Industry Trends**
- **Best Practices**
  - **Selecting the right capital project**
  - **Doing the capital project right**
- **Organizing to Consistently Implement Best Practices**

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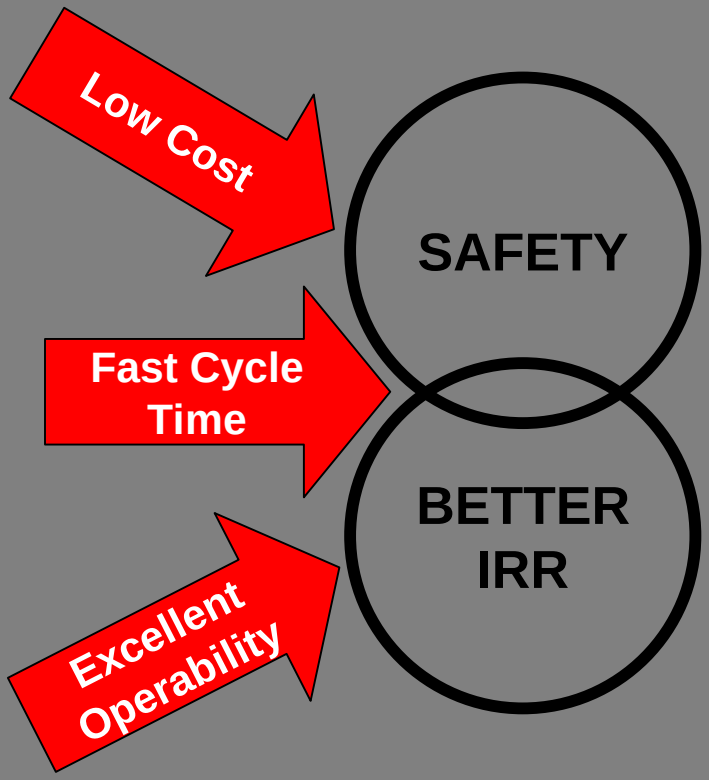
Defining Capital Effectiveness

- **The effective capital project system contributes to the success of the business it serves by:**
  - **assisting in the selection of the best scope for the opportunity the business defines**
  - **delivering a cost competitive facility**
  - **in a timely fashion**
  - **that is fully operable**
  - **without causing serious injury**
- **The best project systems add about 3 to 5 points to project returns**

Elements of Capital Effectiveness

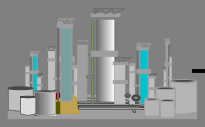


Key Performance Indicators

Basis of the Results Presented

- **IPA's Project Databases**
- **Data collected during face-to-face project team interviews**
  - **Consistency of definitions**
  - **Credibility**
- **Carefully normalized**
  - **Constant dollars**
  - **Common currency**
  - **Consistent scope**
  - **Overtime / multiple shifts**
  - **Locations**
  - **Operational performance: market / raw material availability**

IPA Proprietary Databases

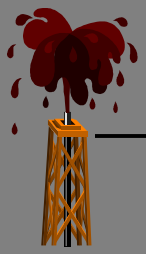


Manufacturing Plants PES® Database
Detailed histories of process plant projects > $5MM

Number of projects=5500+

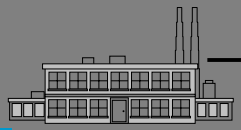
HAZRISK® Database
Environmental assessments/Cleanups

Number of projects=400+



Upstream PES® Database
Petroleum production platform worldwide

Number of projects=1000+



PES® Small Projects Database
Projects of less than $5MM from process industries

Number of projects=1000+

Retail Facilities Database **Service stations, c-stores**

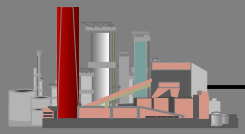
Number of projects=100+

Instrumentation & Control Projects
Automation, DCS, SCADA, etc.

Number of projects=70+

Information Technology
Applications development, telecommunication, implementation

Number of projects=150+



Megaprojects
$Billion class projects of all types

Number of projects=100+

Pipeline

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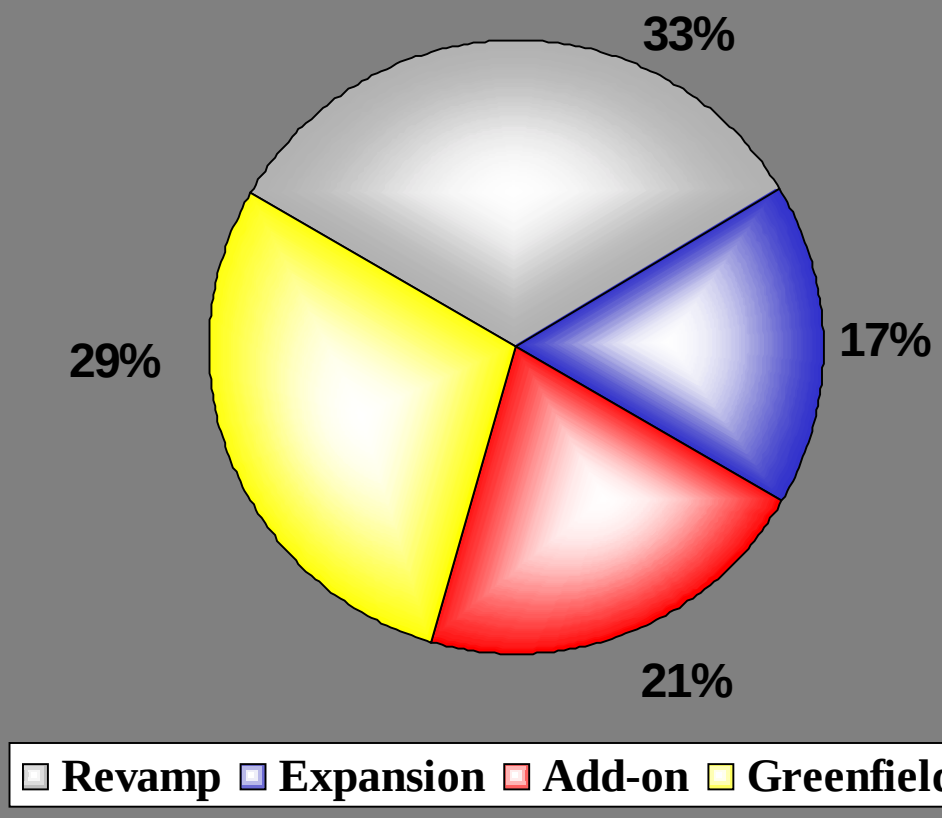
Pipelines Database
Pipelines, terminals, booster stations, etc.

Number of projects=270+

IPA's Manufacturing Plants Projects Database



- Project sizes range from $0.07MM to $36.0 + billion
- The database is current with 1995 as median year of authorization
- Global: 69% North America, 17% Europe, 6% Latin America, 7% Asia and 1% Africa
- Technology level ranges from off-the-shelf to truly novel
- 120 owners companies are represented
- Data are very detailed: ~1500 variables collected on each project
- >600 new projects added each year

Independent Project Analysis

Outline

- Capital Effectiveness
- ***Industry Trends***
- Best Practices
  - Selecting the right capital project
  - Doing the capital project right
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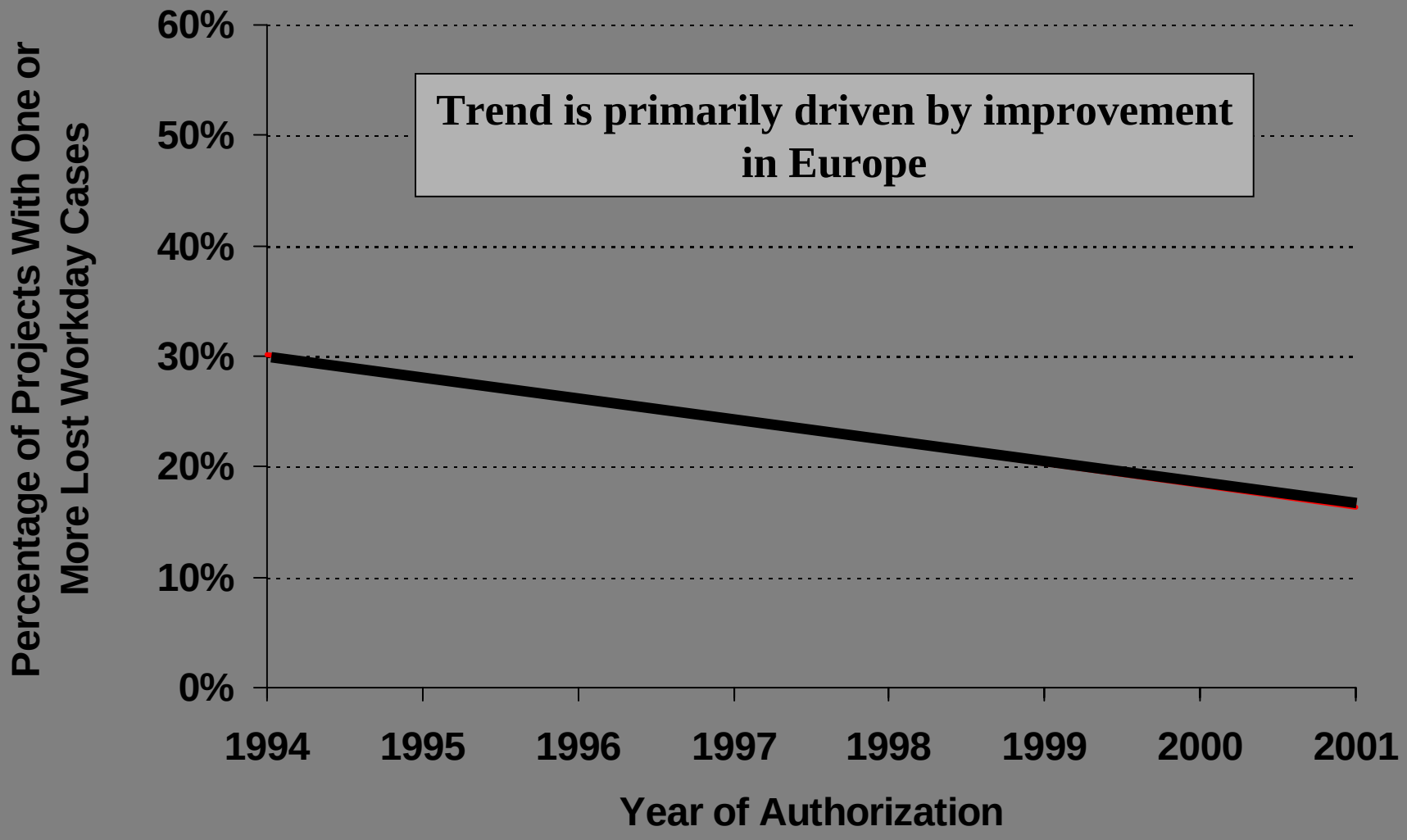
Some Definitions

- Lost Workday Cases = Cases resulting in days the employees would have worked or had to engage in restricted work but could not because of the job-related injury or illness per 200,000 field hours
- Cost Index = Project Engineering & Construction Cost / Industry Average Cost for Same Scope of Work
- Schedule Index = Project Execution (Start of Detailed Engineering through Mechanical Completion) Duration / Industry Average Execution Duration for Same Scope of Work
- Operability Index = Project Achieved Capacity Relative to Nameplate during Second Six Months of Operation / Industry Average Capacity Achieved Relative to Nameplate
- For current Indices: Industry Average = 1.0

Safety Performance



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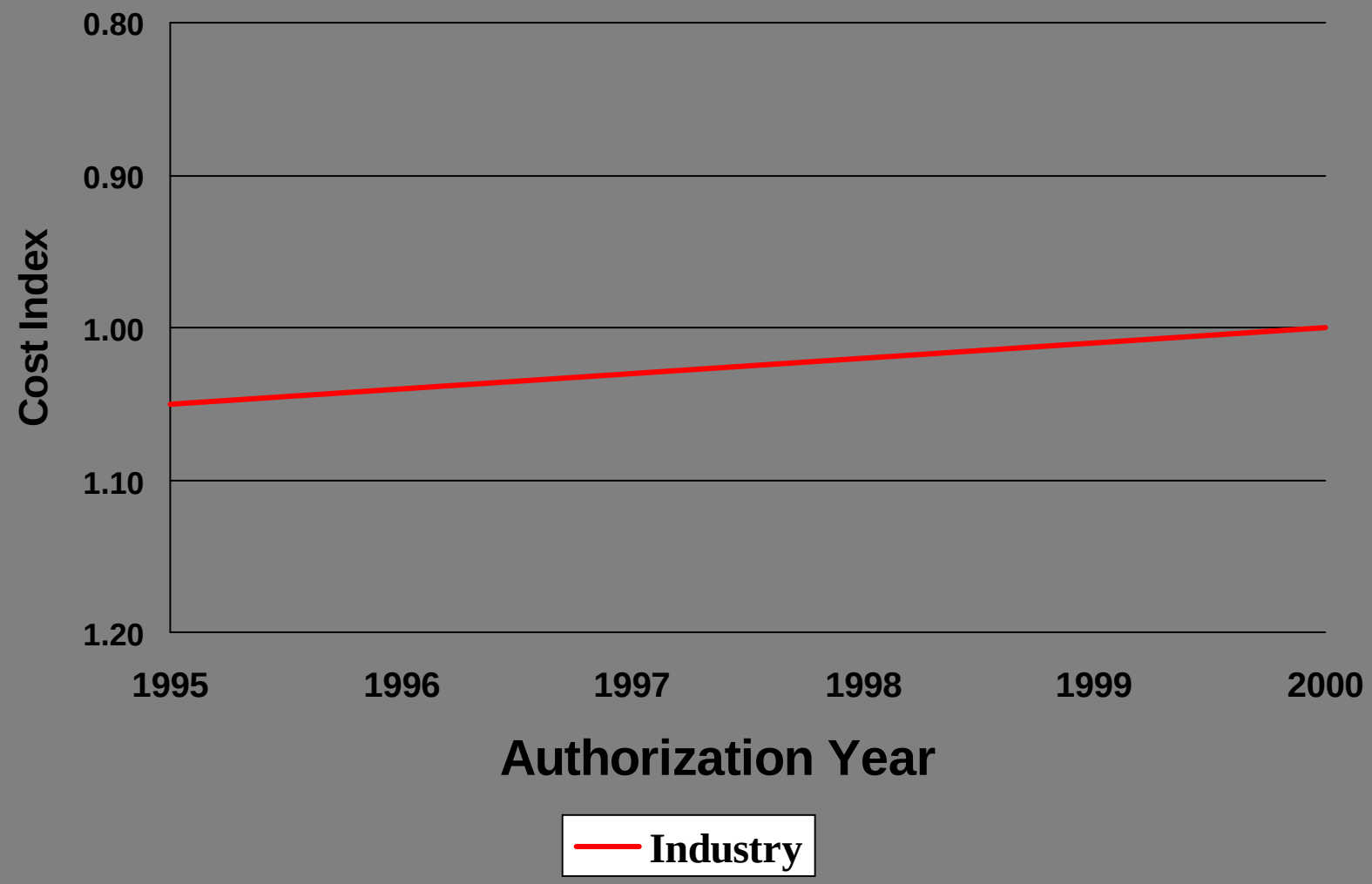
Cost Improvement Over Time



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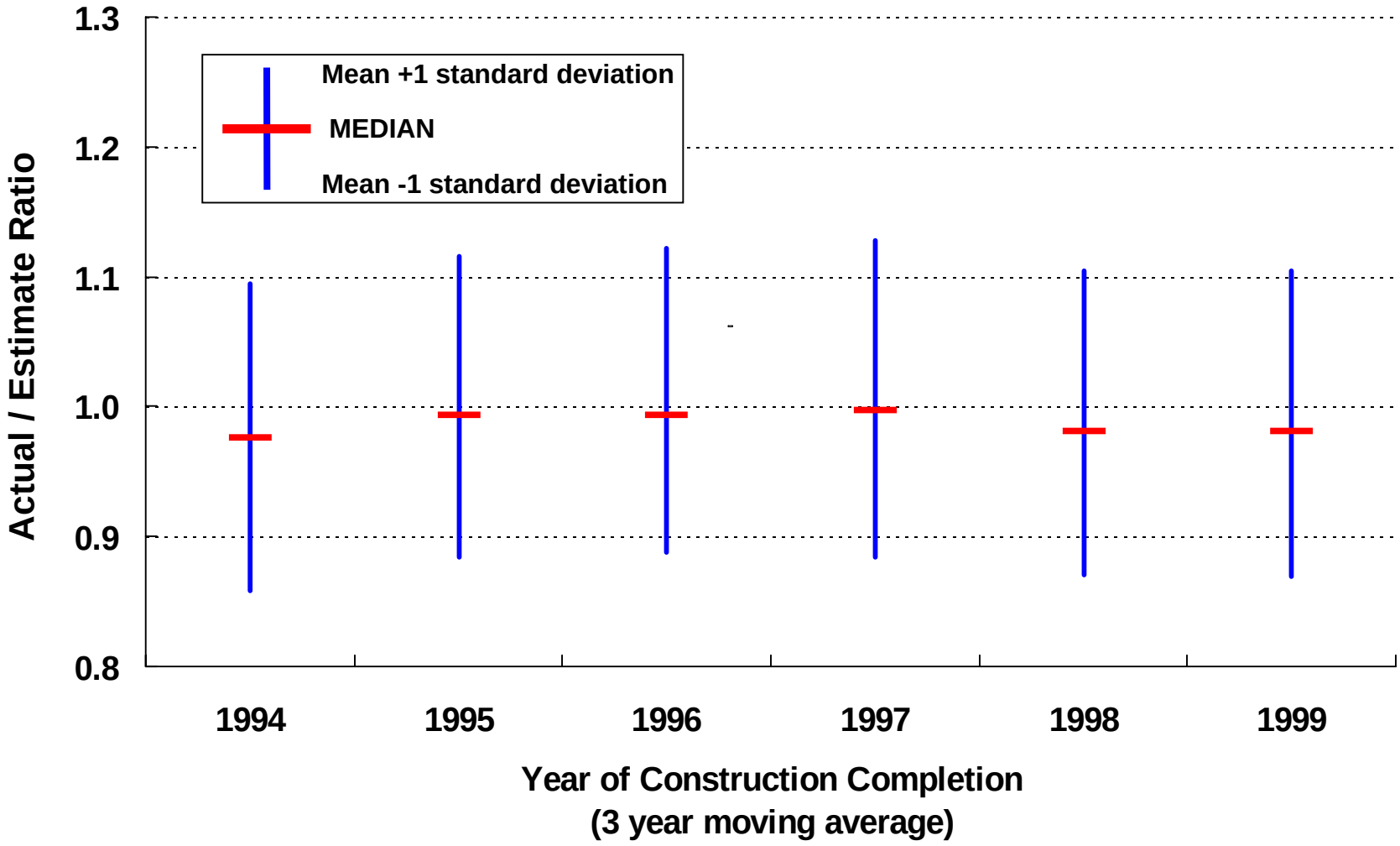
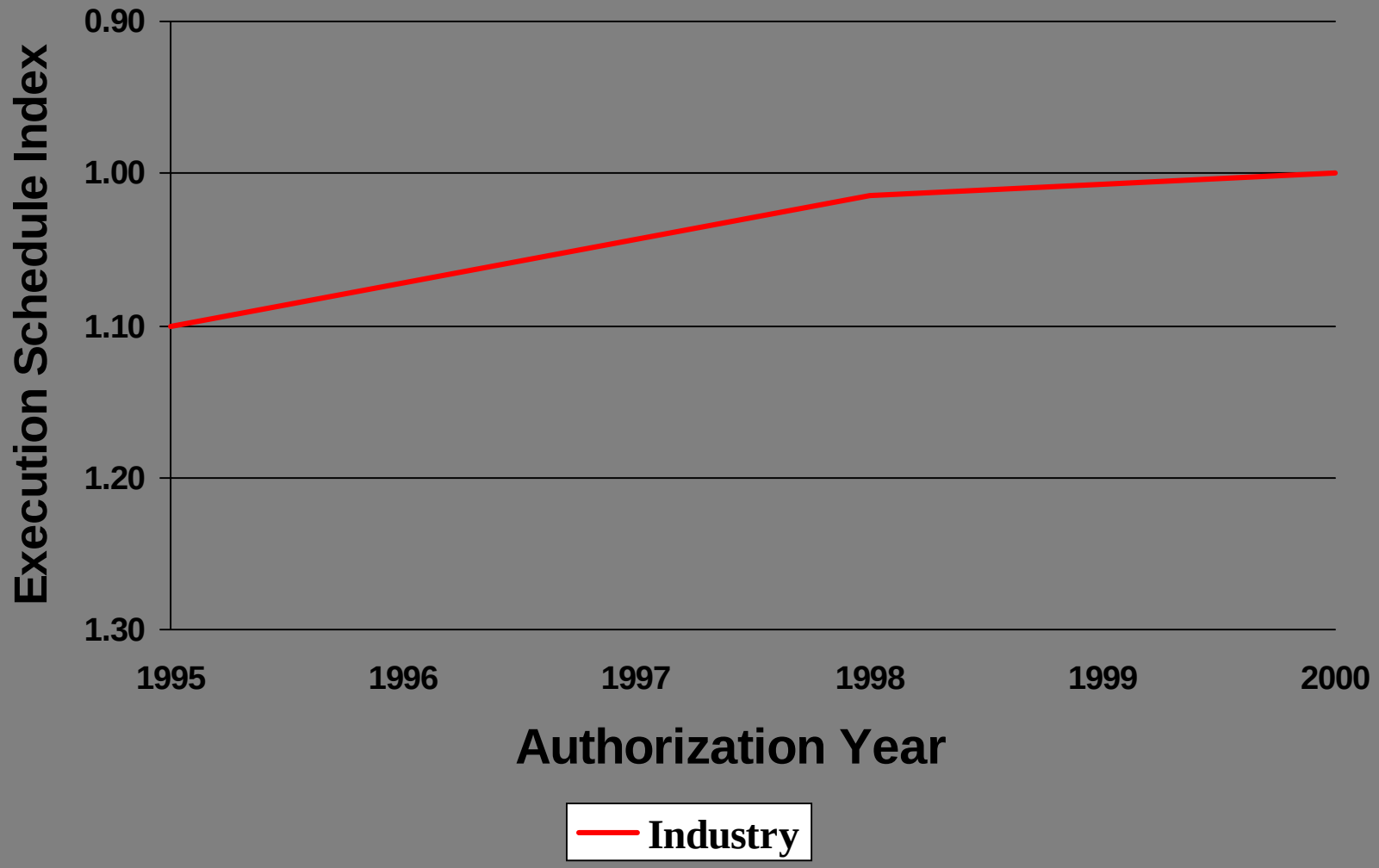
Cost Predictability has Stagnated



Execution Schedule Improvement has Leveled Off



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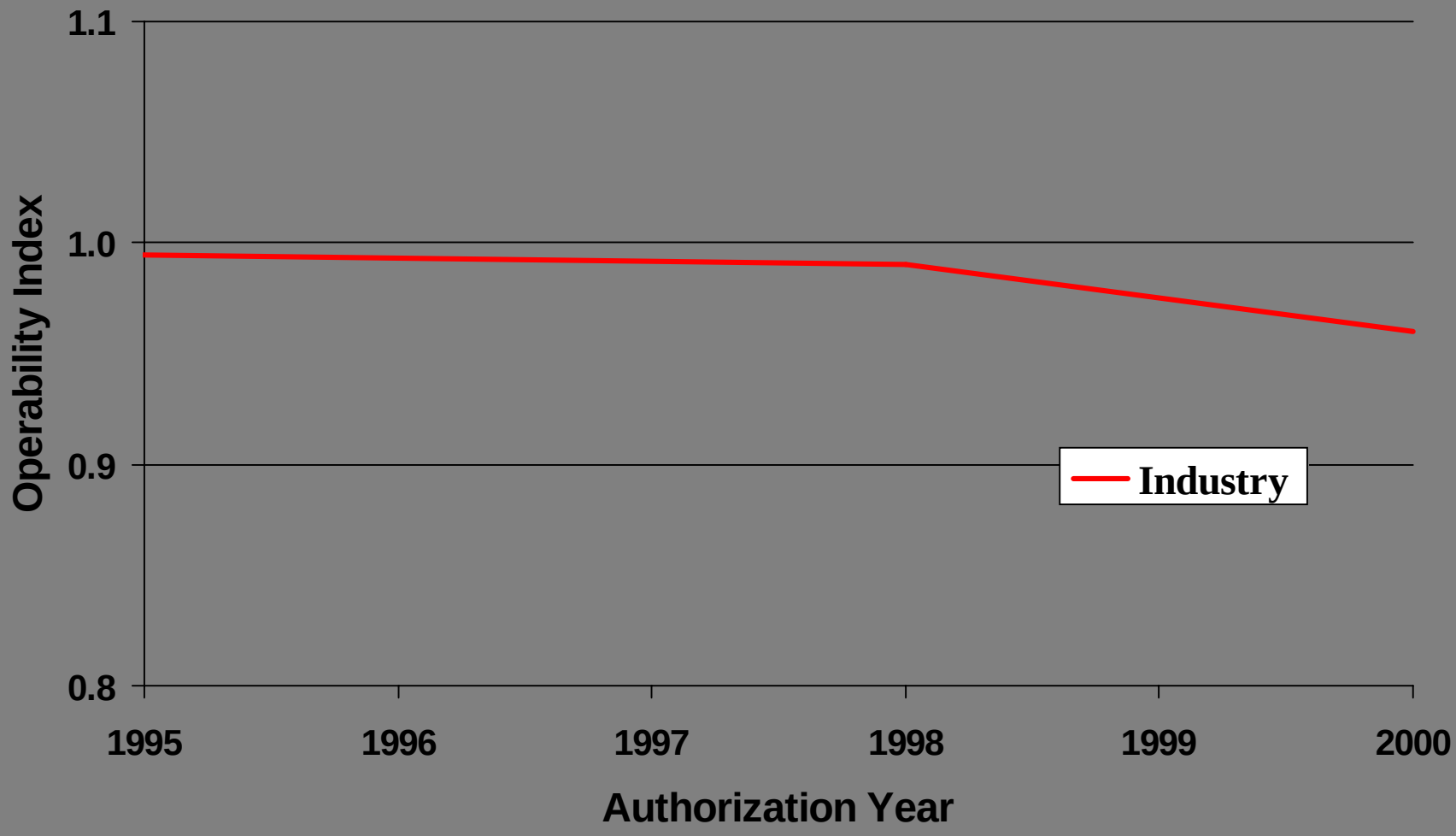
Operability Is Degrading



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Industry Trends

Over the past 15 years, a great many things have changed in the way that projects are delivered

- **detailed engineering has been almost completely outsourced**
- **contractor involvement in front-end work has increased**
- **increased reliance on contractors for cost estimating and project control**
- **engineering has been progressively globalized**
- **automated tools have come of age**
- **competitive pressures have intensified**

Industry Challenges

- Mergers, spin-offs, restructurings, and attempts to enter new product markets are changing the business personnel rapidly in many companies
  - The instability is causing:
    - use of projects for corporate cash flow and quarterly results control
    - increase in the number of business people who do not understand the project implications of their decisions
- Downsizing has left owner organizations anemic
  - Lacking ability to define cost-effective projects
  - Little ability to control projects
  - Aging expertise
  - Limited ability to assess ultimate project operational performance

Future Trends

- Some recognition that downsizing may have gone to far
  - one firm selecting a few projects to engineer in-house
- More firms working to strengthen gated processes
- More concern about retaining the right asset development competencies

Issues

Best performing companies are getting better faster than industry

What accounts for the project successes and failures?

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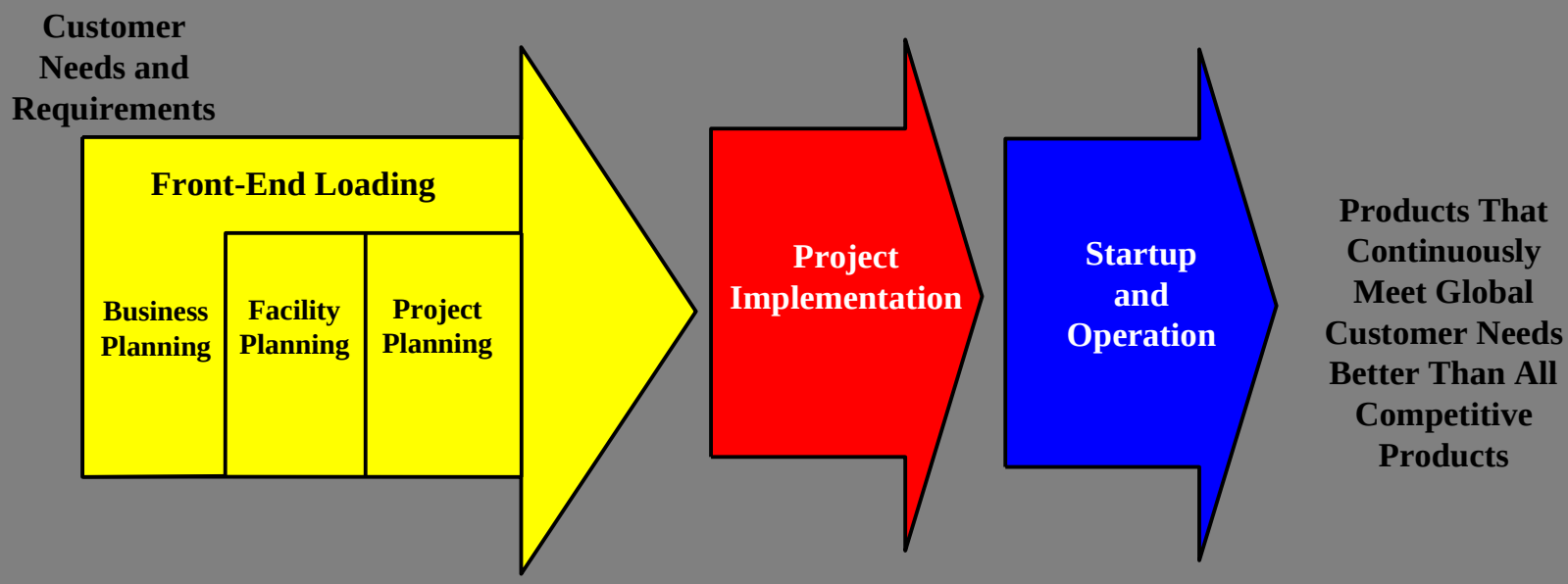
Supply Chain for Projects



What Is Front-End Loading?

Front-End Loading (FEL) is the process by which a company develops a detailed definition of the scope of a capital project meeting business objectives.

--Why

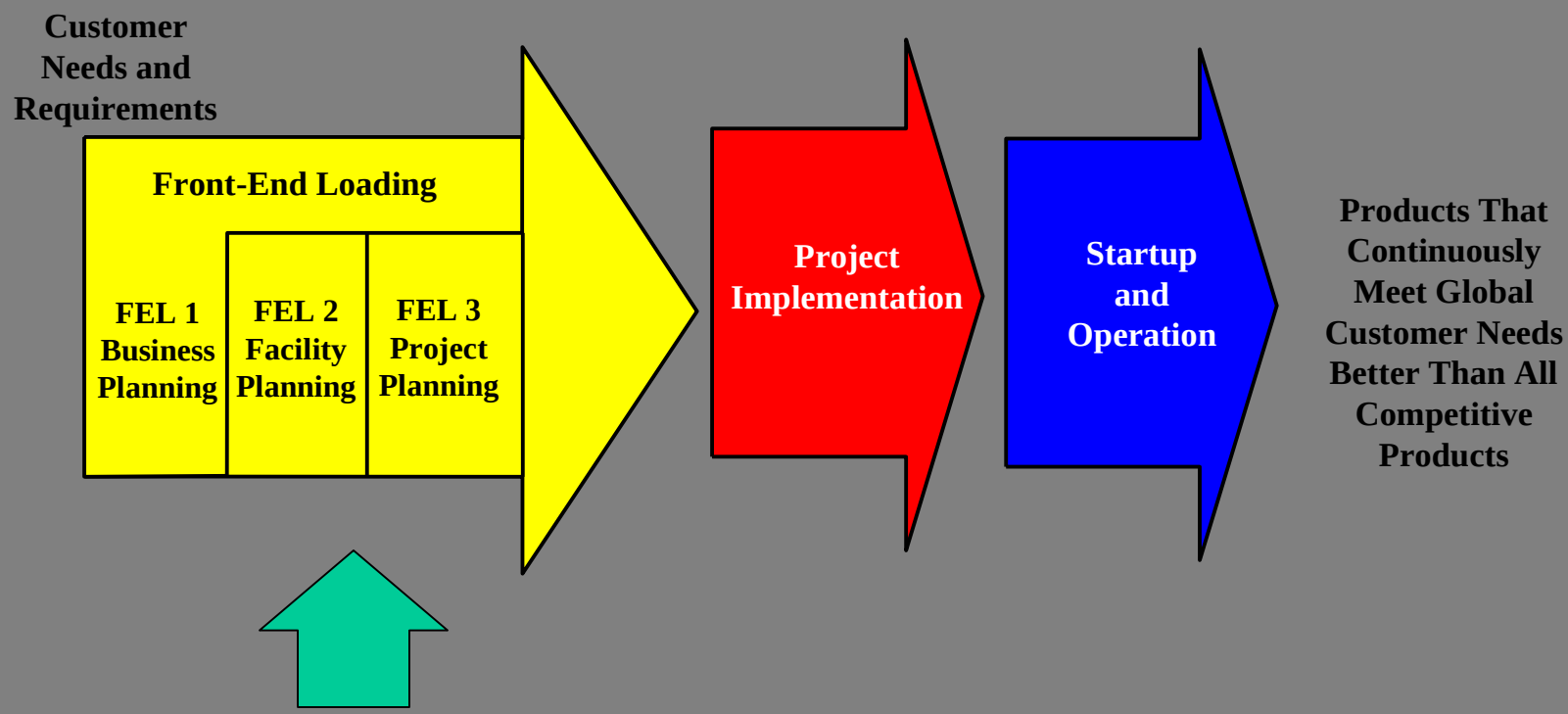
--What

--When

--How

--Who

Supply Chain for Projects



Selecting the Right Capital Project

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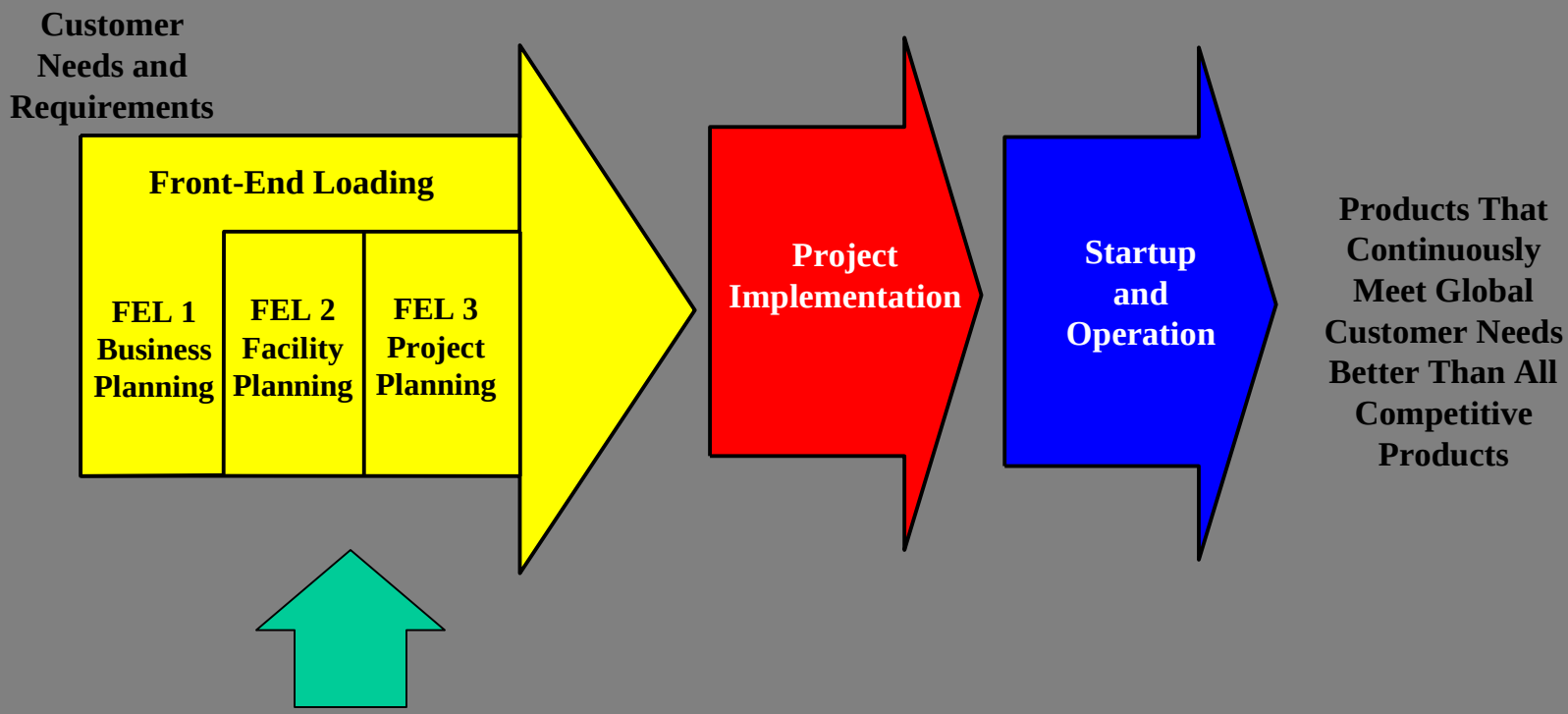
Supply Chain for Projects



What Practices Lead to Selecting the Right Project ?

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Can Project Business Success be Predicted?

- In 1995 with support from 23 CPI companies, IPA began an empirical study of the factors that govern the business success of a capital project
- In 1997, we started to implement a new tool to help forecast the business success of ventures
- Business success is measured as =

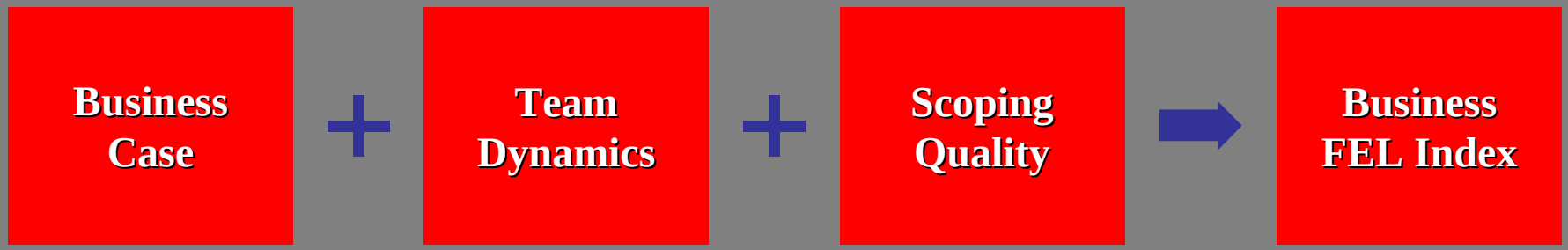
$$\frac{NPV_{ACTUAL} - NPV_{FORECAST}}{NPV_{FORECAST}}$$

- This tool is the ***Business Front-end Loading Index***

Business Front-end Loading Index

- Relates venture success (in terms of achieving NPV goals) to the quality and thoroughness of early...
  - analysis of the venture
  - scope development
  - teamwork between Business and Engineering functions
- The Index is *quantitatively* derived and validated through five years of use

Business FEL Index



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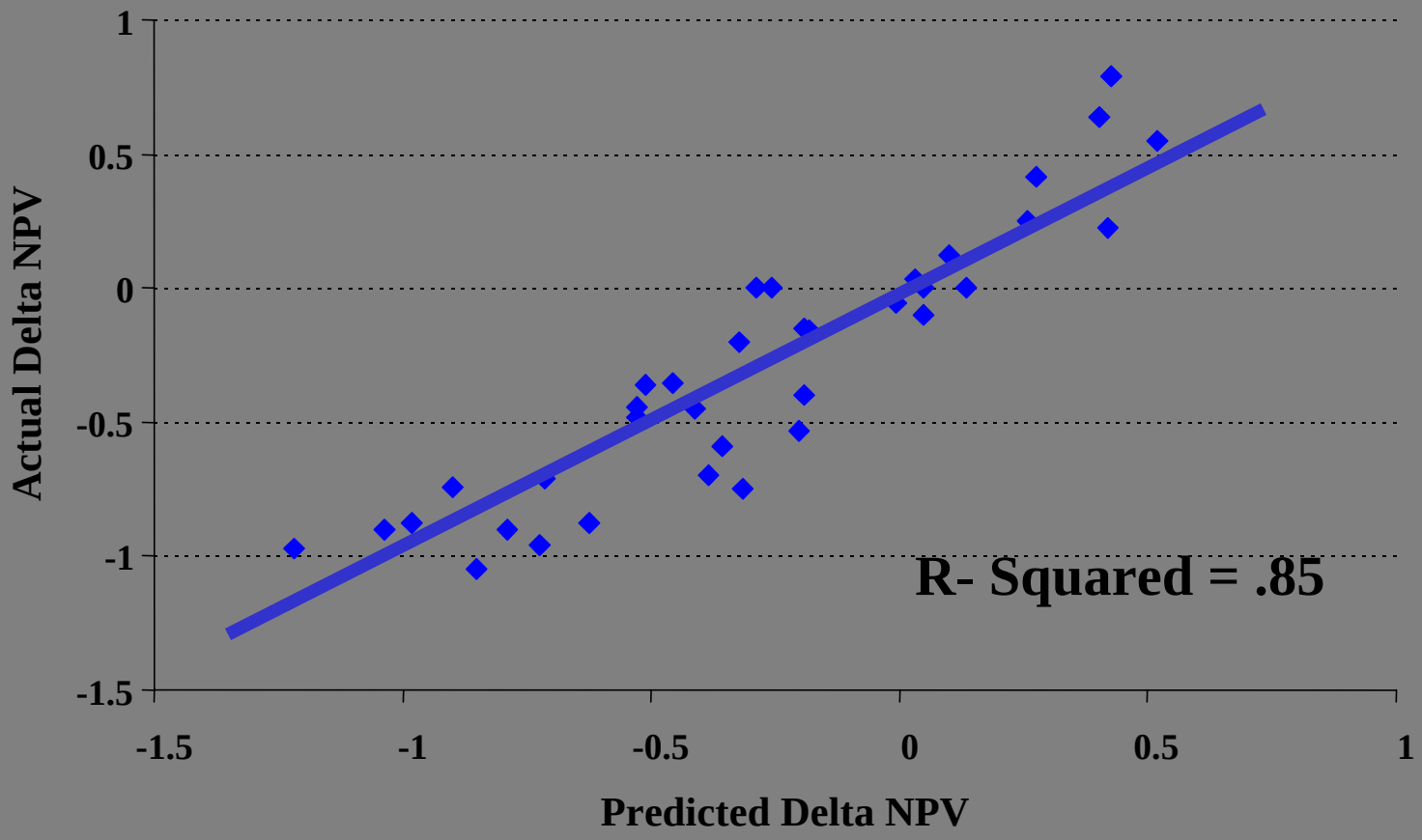
BFEL Index Explains Most NPV Variation



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Observations

- **Business Case development is the single most important aspect of venture success**
- **Effective communication between business and engineering is the second most; team integration is vitally important**
- **The engineering work in FEL-2 contributes, but does not dominate**
- **The reason to run a better project system from FEL-3 through startup is capital conservation more than basic venture success**

Importance of Business Front-end Loading

- Changing the success rate with capital projects--even slightly--will make your company more successful
- Significantly reducing-- or eliminating-- very bad projects is possible
- Blaming bad project selection on “the market” is neither necessary nor productive

Let's Kill Bad Projects Early!

"Nothing is so wasteful as perfecting that which should not have been done at all"

Peter Drucker

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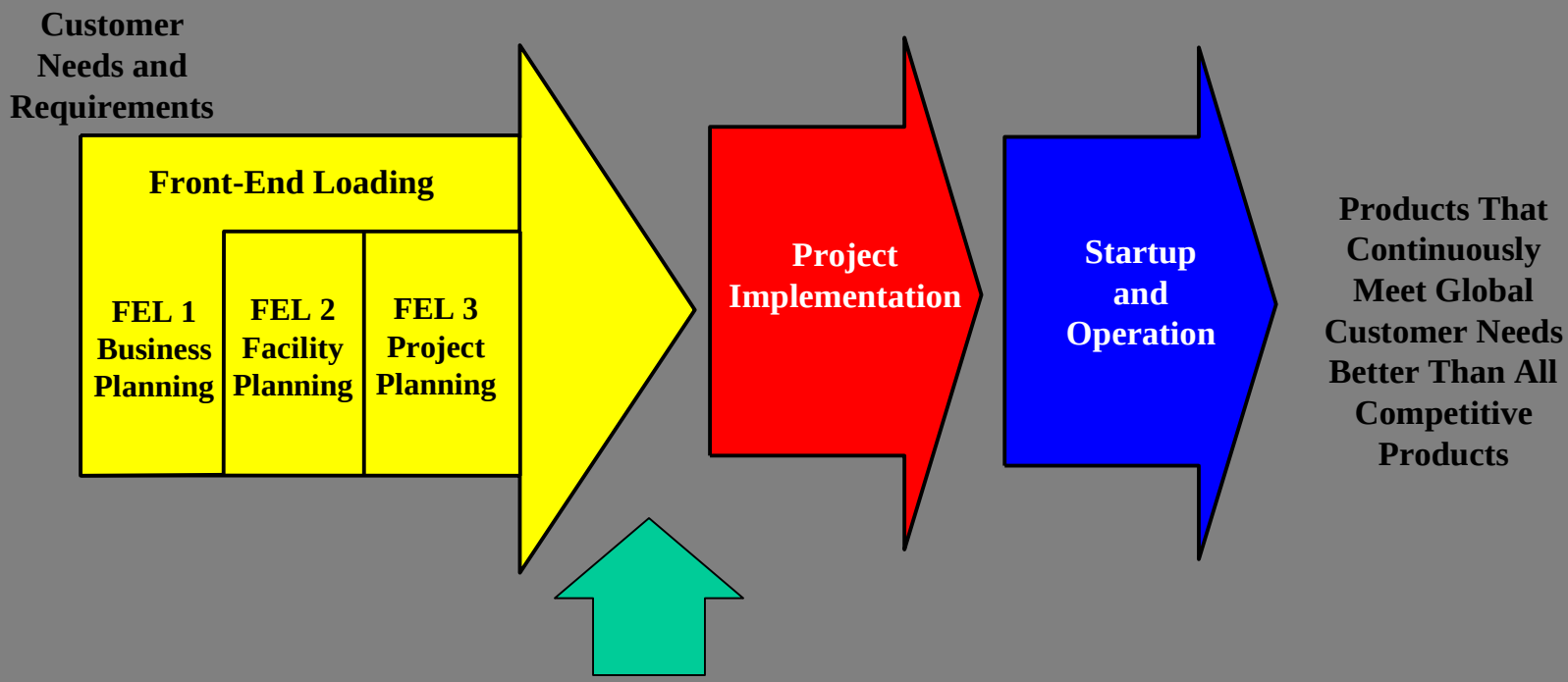

Doing the Selected Capital Project Right

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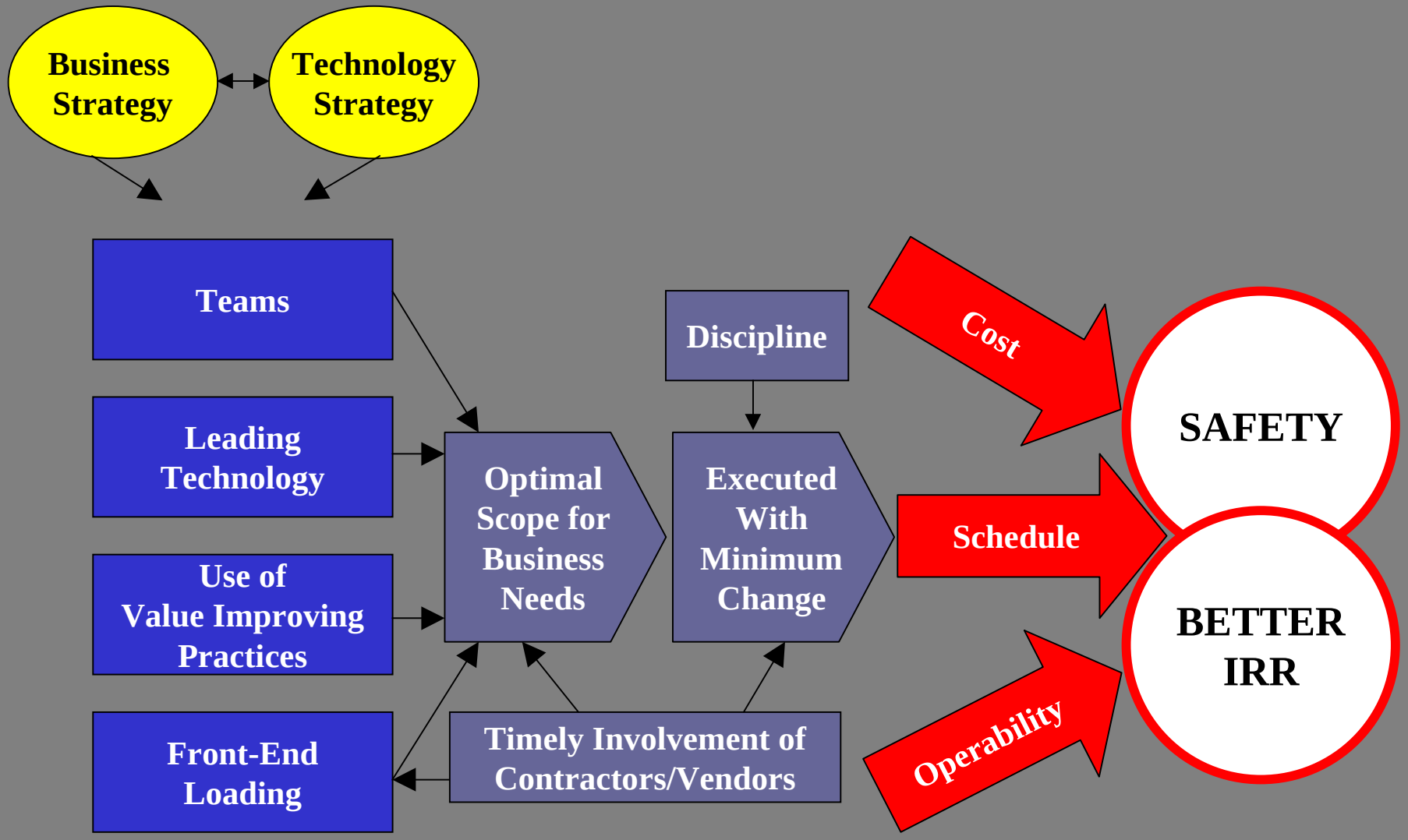
Elements of Capital Effectiveness

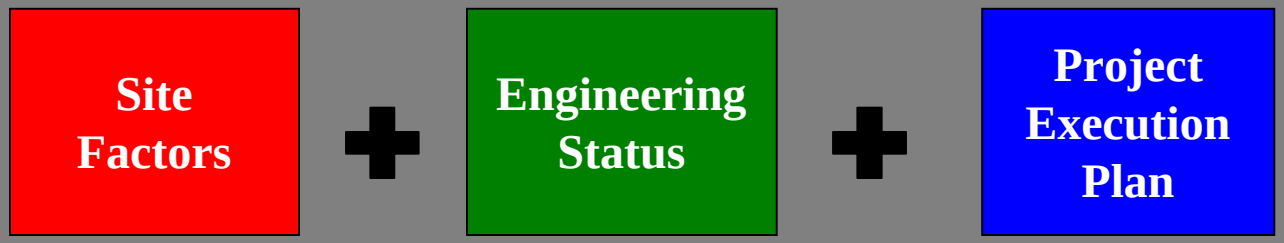


Key Leading Indicators

Independent Project Analysis

Key Performance Indicators

Front-End Loading Drives Better Project Outcomes



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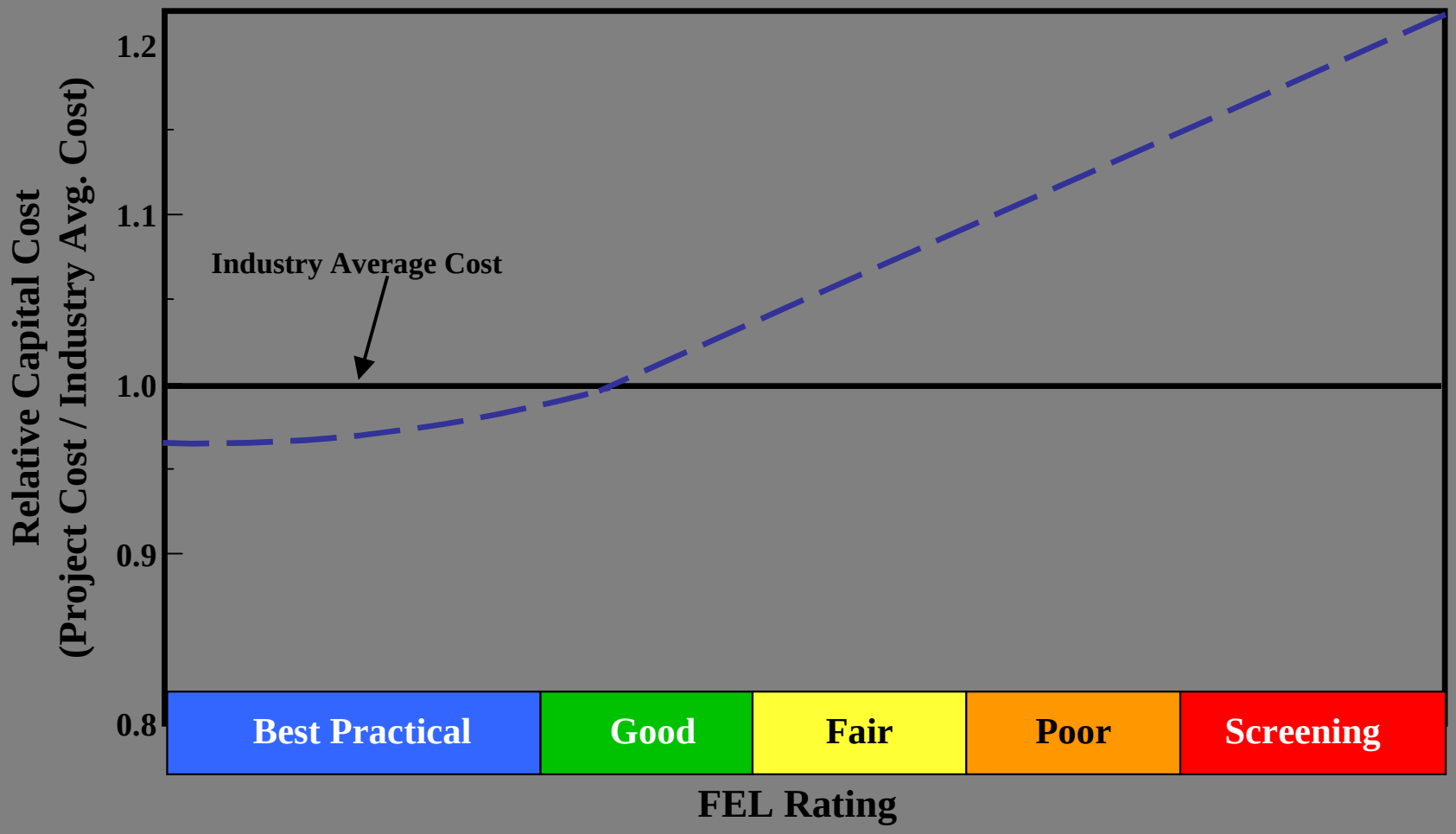
FEL Drives Absolute Cost Performance



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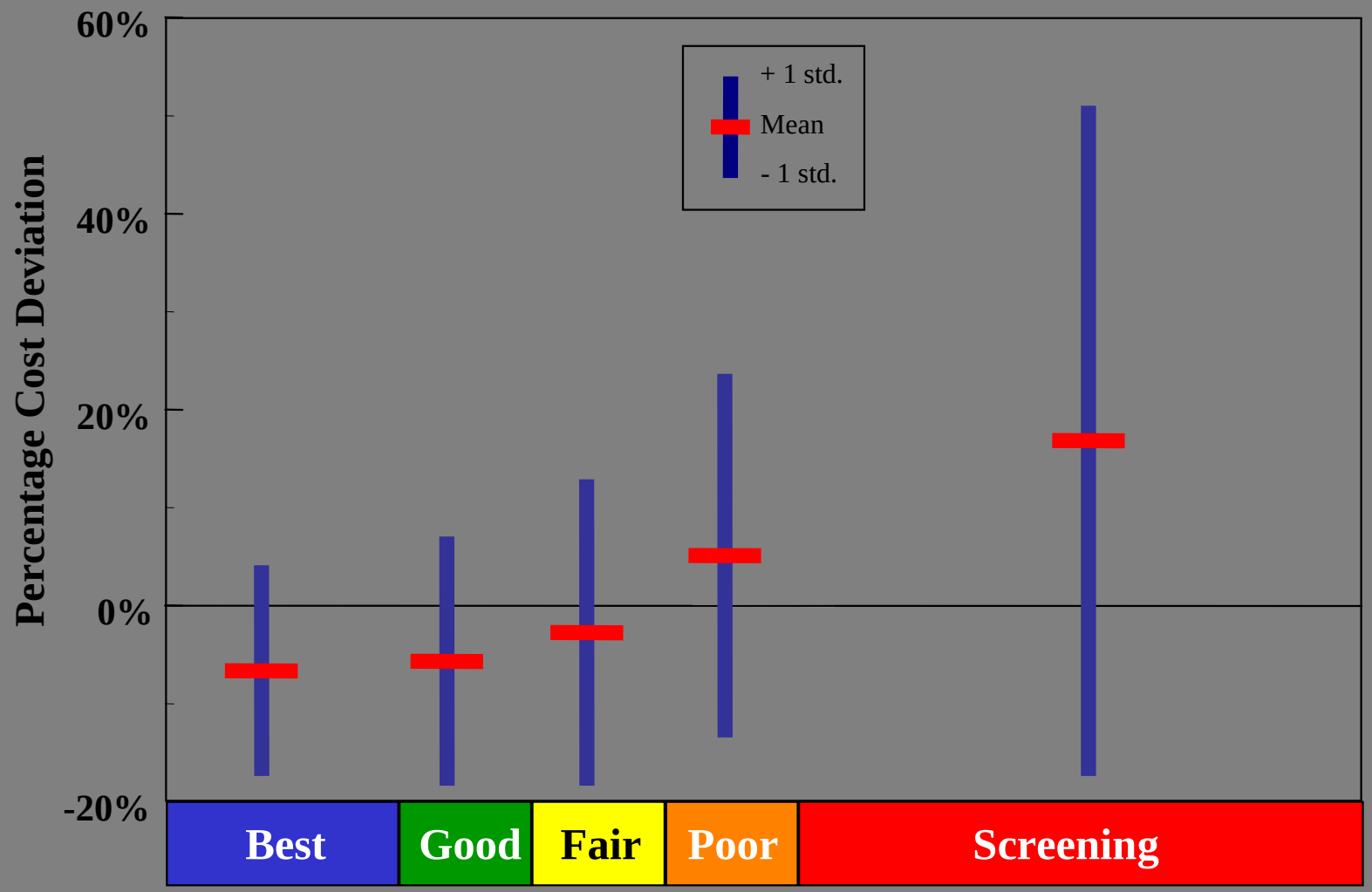
Good FEL Improves Predictability



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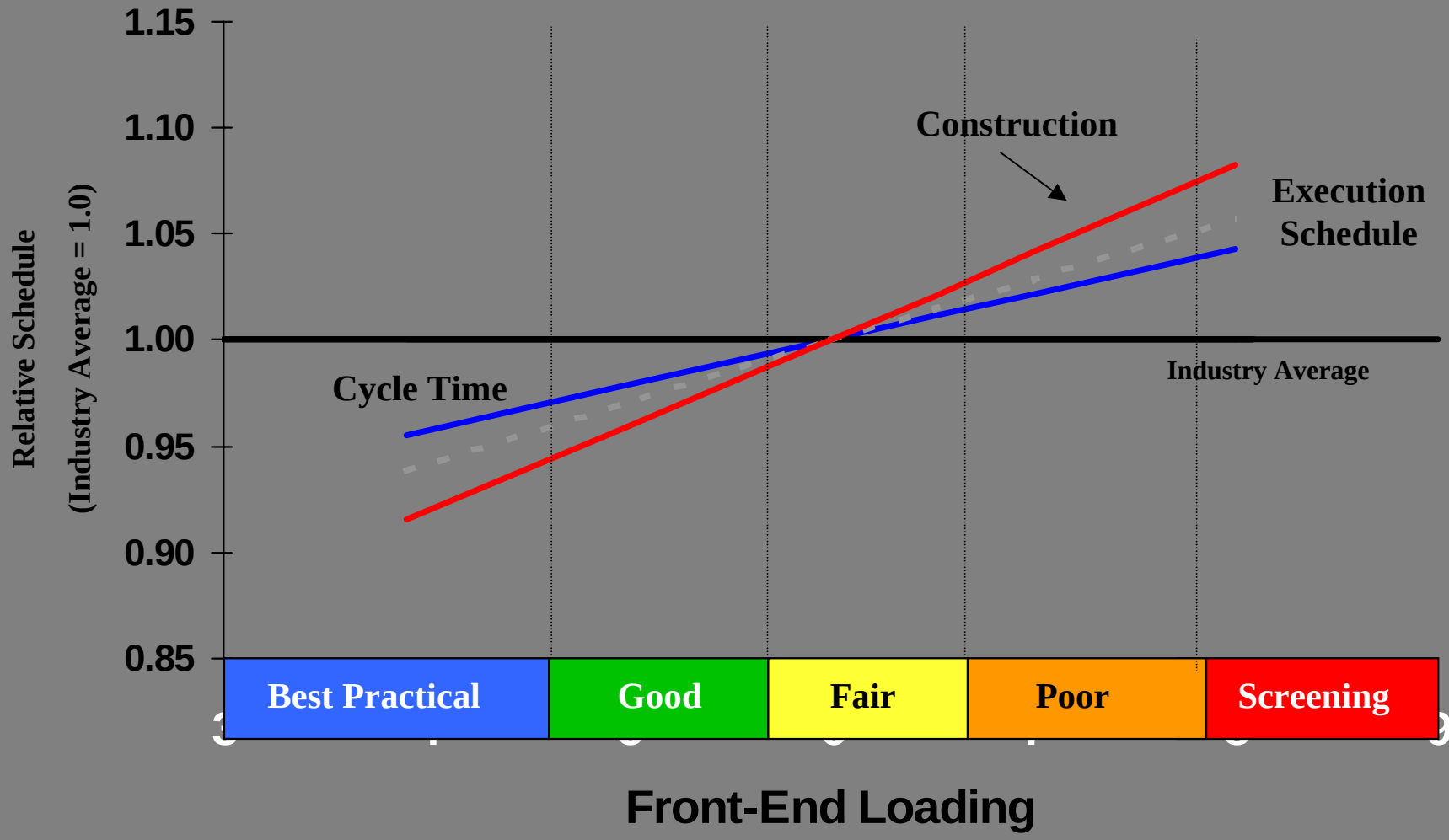
Better Definition Shortens Project Schedule Durations



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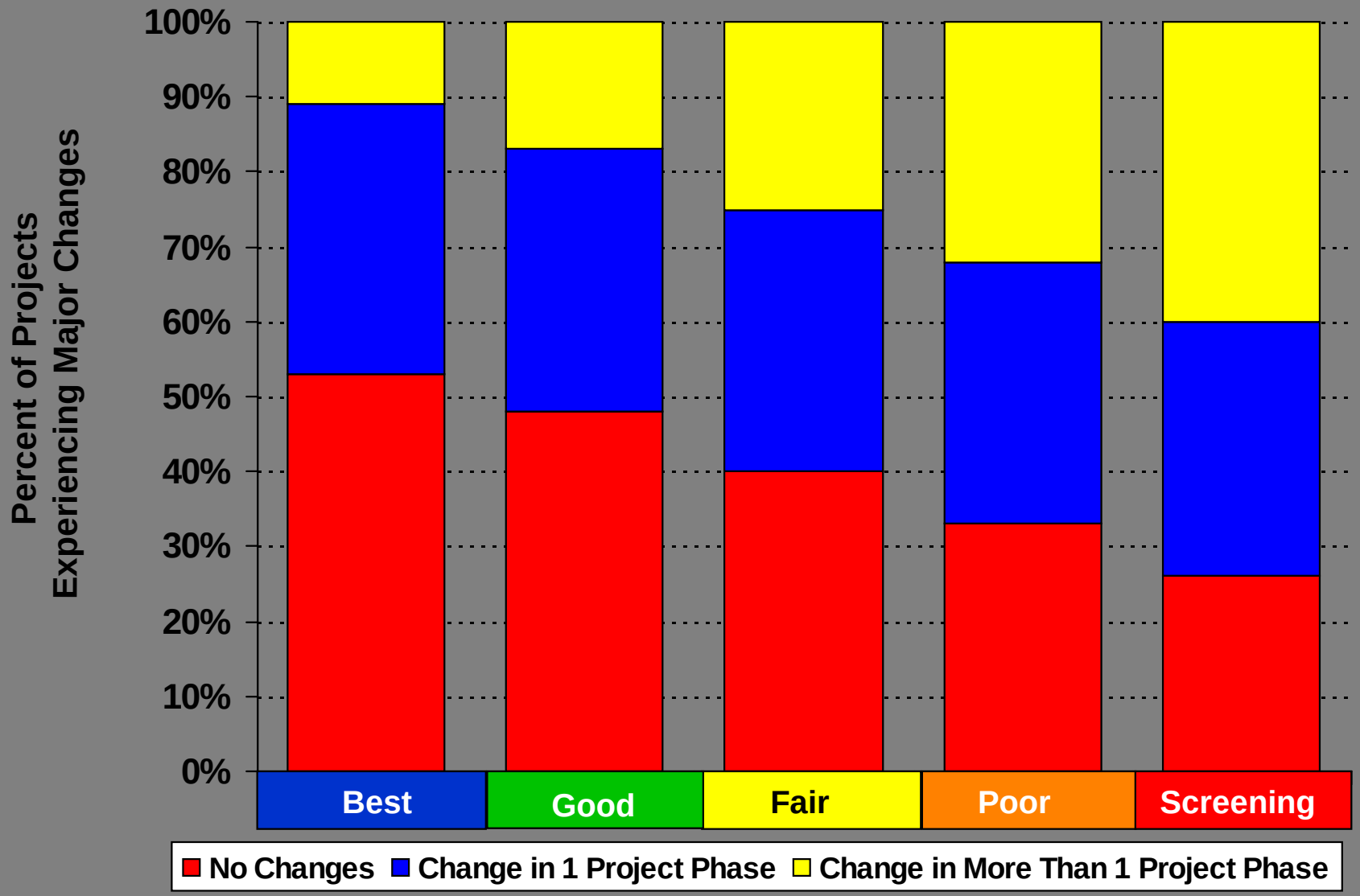
Better FEL Results in Fewer Changes



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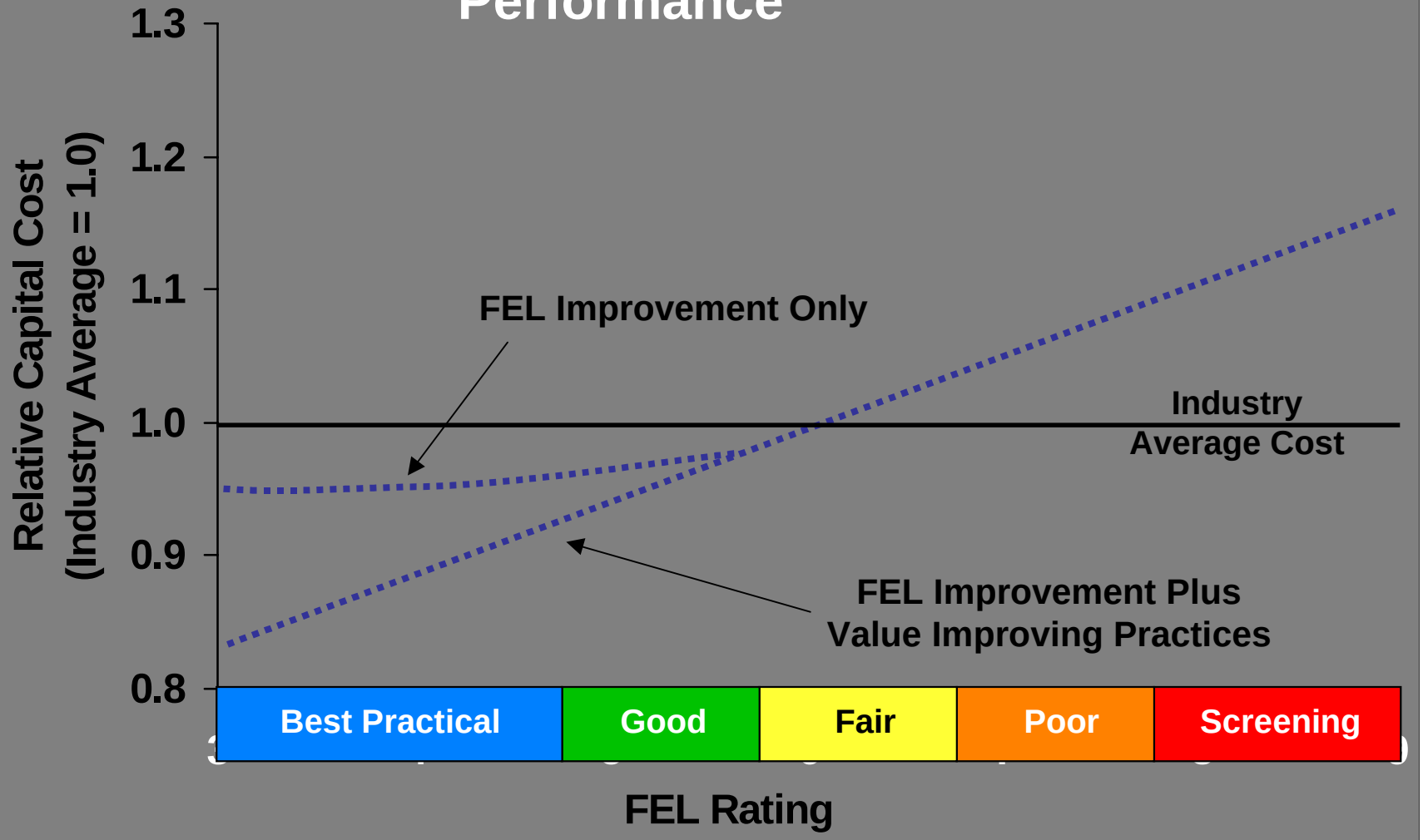
Use of a Few Value Improving Practices Combined with Good / Best Definition Further Drives Better Cost Performance



Independent Project Analysis

Elements of Best Practical Level of Definition at the Time of Project Authorization

Site Factors

- Finalized equipment location / plot plan
- Environmental permits applied for
- Health and safety reviews (e.g., HAZOP) completed
- Soil and site conditions understood

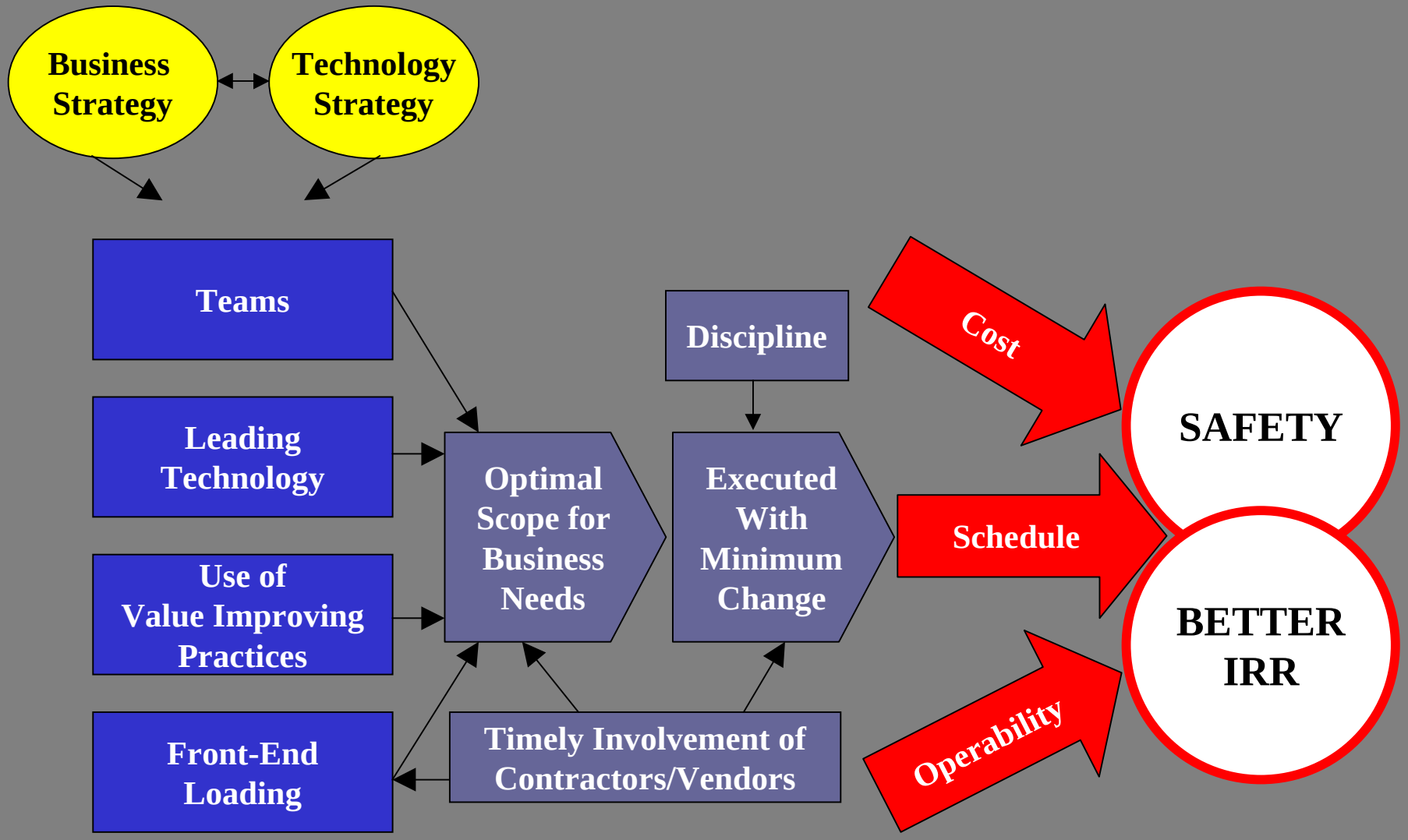
Engineering

- Key engineering deliverables completed (e.g., PFDs, P&IDs, Equipment specifications)

Project Execution Plans

- Execution plan developed (e.g., contracting strategy, schedule, startup plans)

Elements of Capital Effectiveness



Key Leading Indicators

Independent Project Analysis

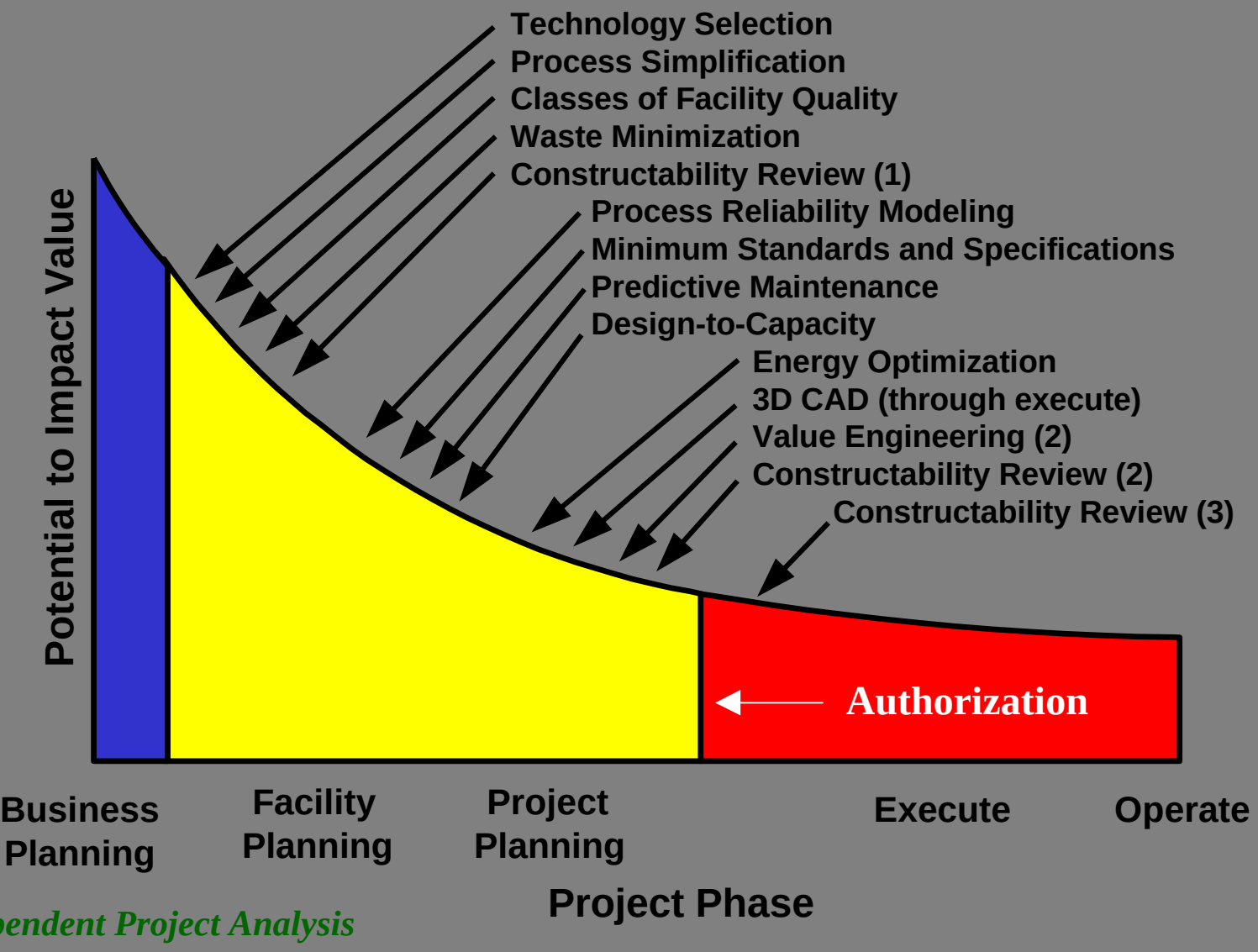
Key Performance Indicators

Defining Value Improving Practices

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

- Used primarily during Front-End Loading
- Formal, documented practices involving a repeatable work process
- Almost always facilitated by specialists from outside the project team

Value Improving Practices

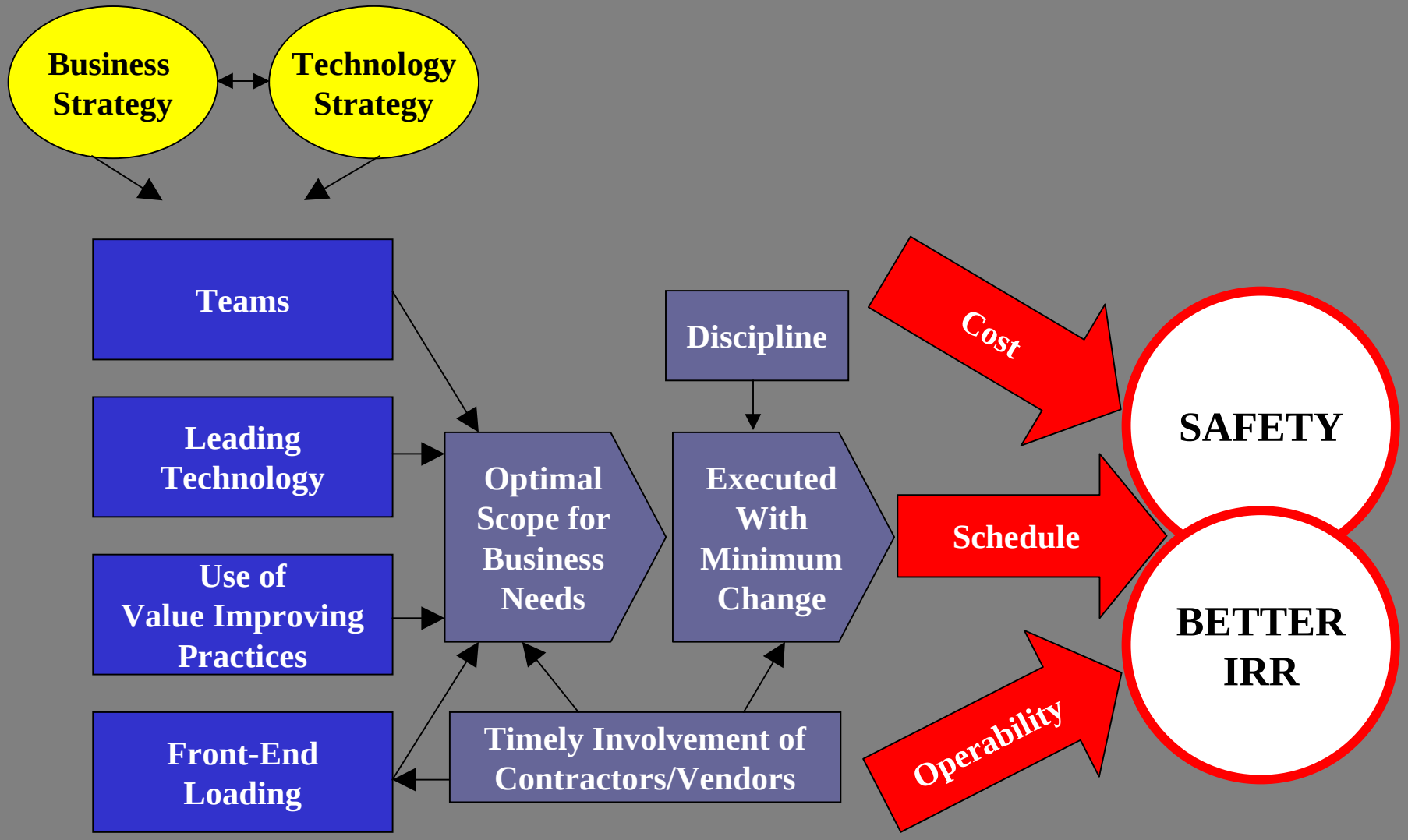


Independent Project Analysis

How Does a Practice Become a VIP?

- There are dozens of special practices used in the industry that are possible VIPs:
  - Decision Risk Analysis
  - Team-building, etc.
- Only practices with a demonstrated, statistically reliable connection between use and better outcomes are deemed VIPs

Elements of Capital Effectiveness



Key Leading Indicators

Independent Project Analysis

Key Performance Indicators

New Technology

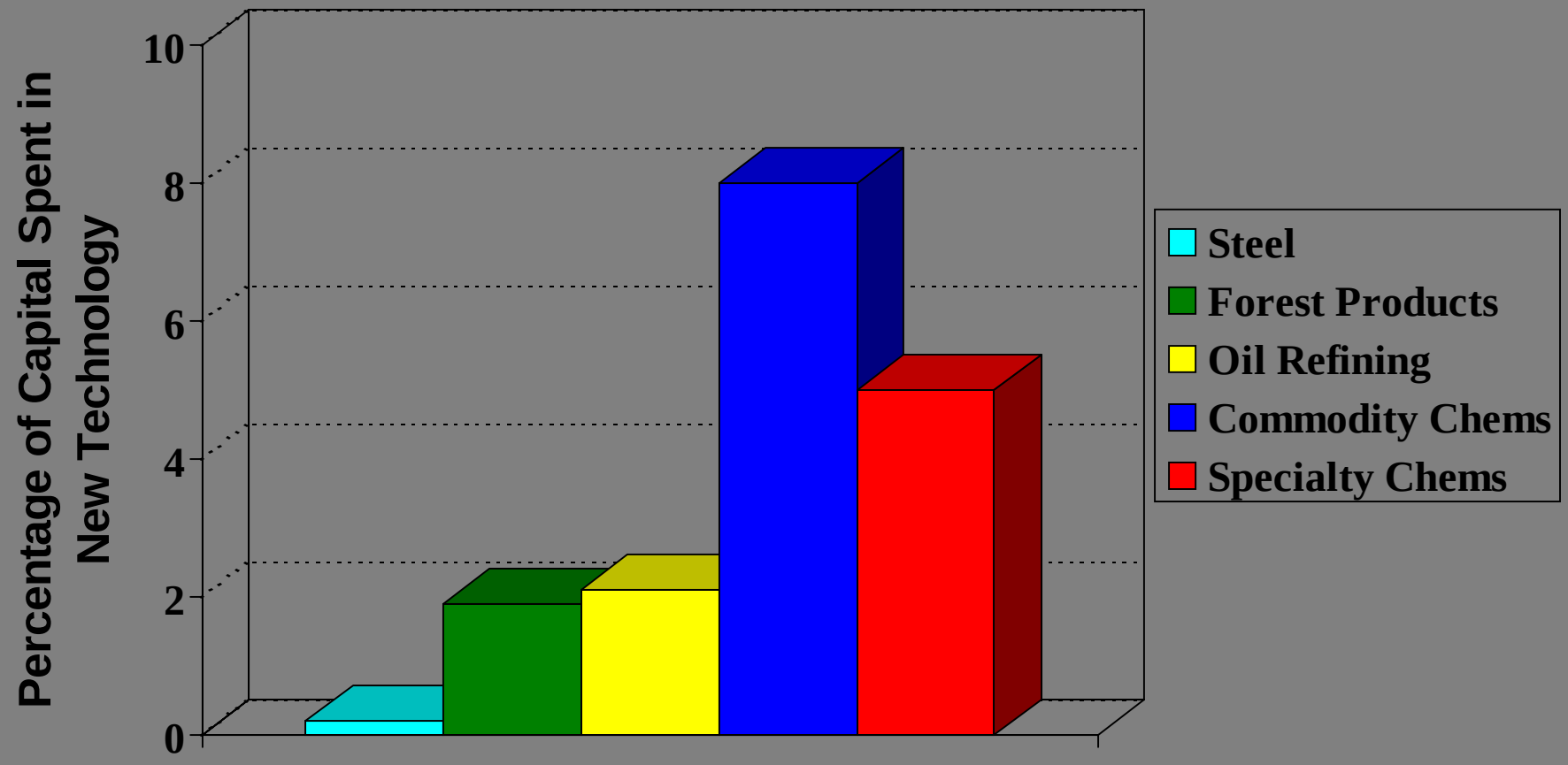
- New process technology continues to be essential to success in the process industries
  - Innovation yields lower costs for commodities
  - Innovation is the key to margins in specialties and pharmaceuticals
  - Innovation is sometimes forced by regulators

The Business Stake -- Does New Technology Pay Off?*

- An investment of $1.00 in chemical R&D yields, on average, $2.60 in operating profits in later years
- The bulk of the investment is realized 3-5 years after the investment and continues for 8 years
- Large firms are getting a bigger payoff than smaller firms ($2.86 vs. $1.79 for each R&D $1.00)

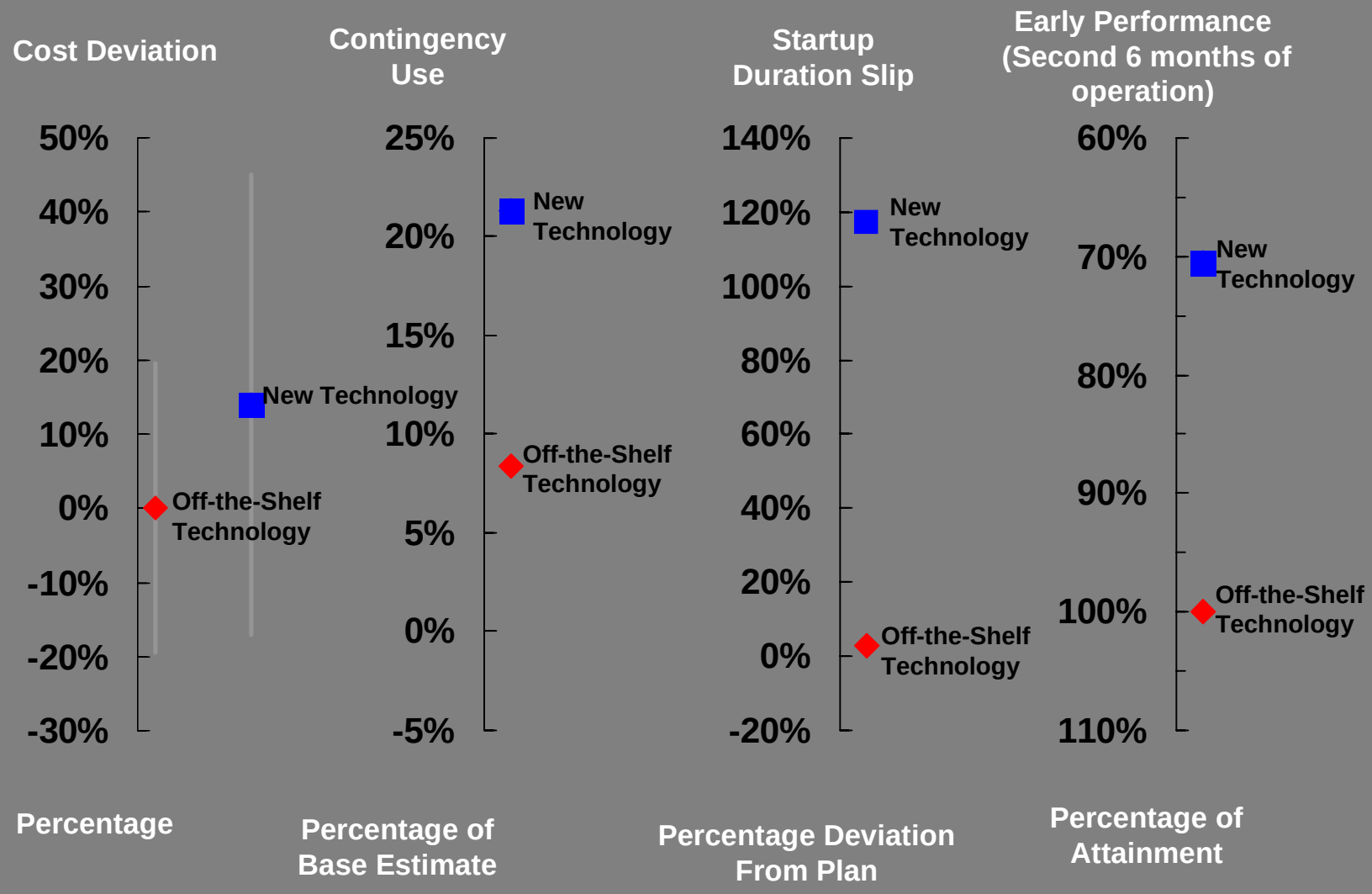
**** Based on the work of Lev and Aboody as described in Chemical and Engineering News, September 2000.***

Rate of Innovation in Process Industries



Independent Project Analysis

New Technology Projects Contain Risks Different Than Off-the-Shelf Technology Projects



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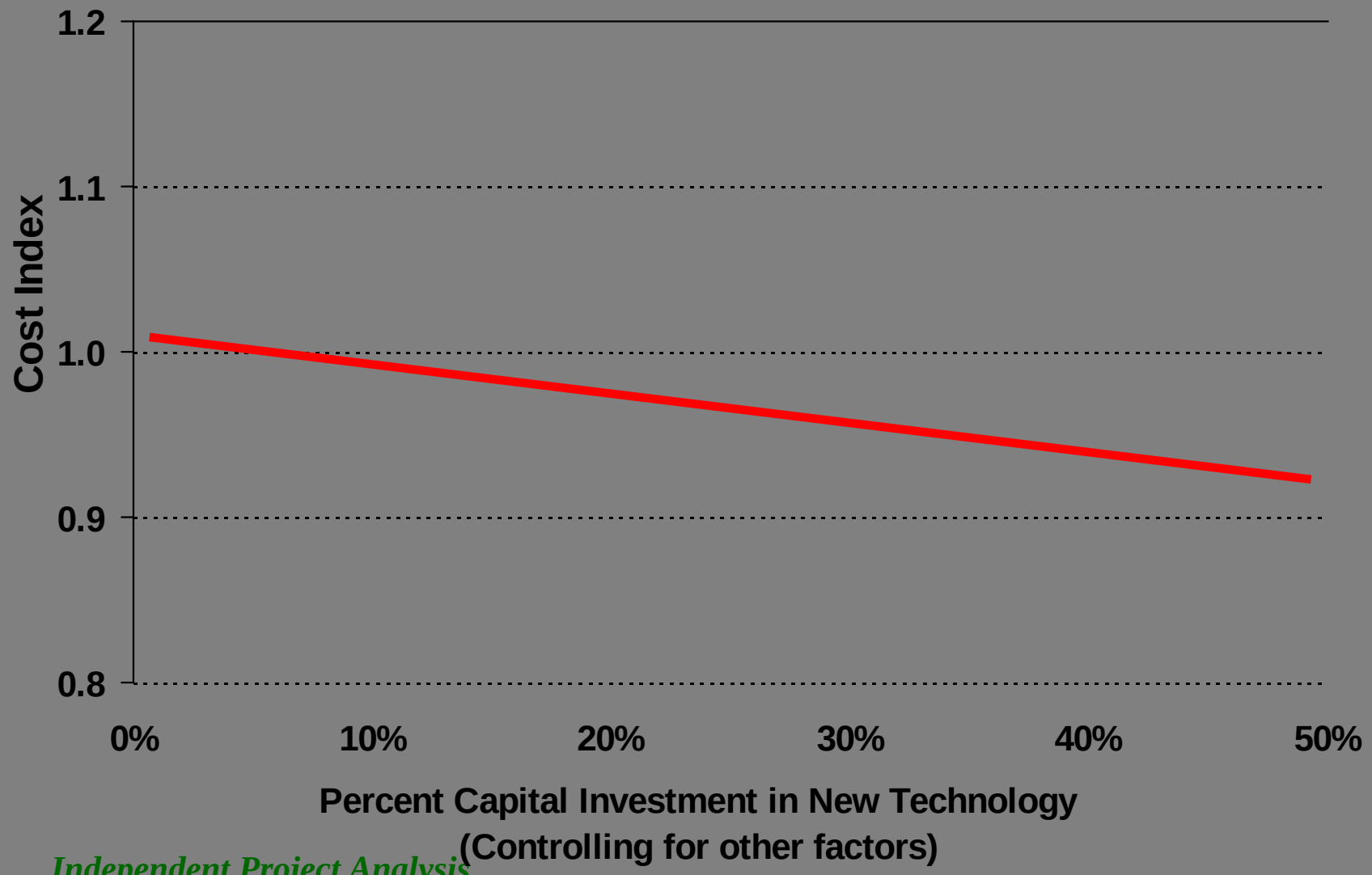
New Technology Drives Cost Down



Independent Project Analysis

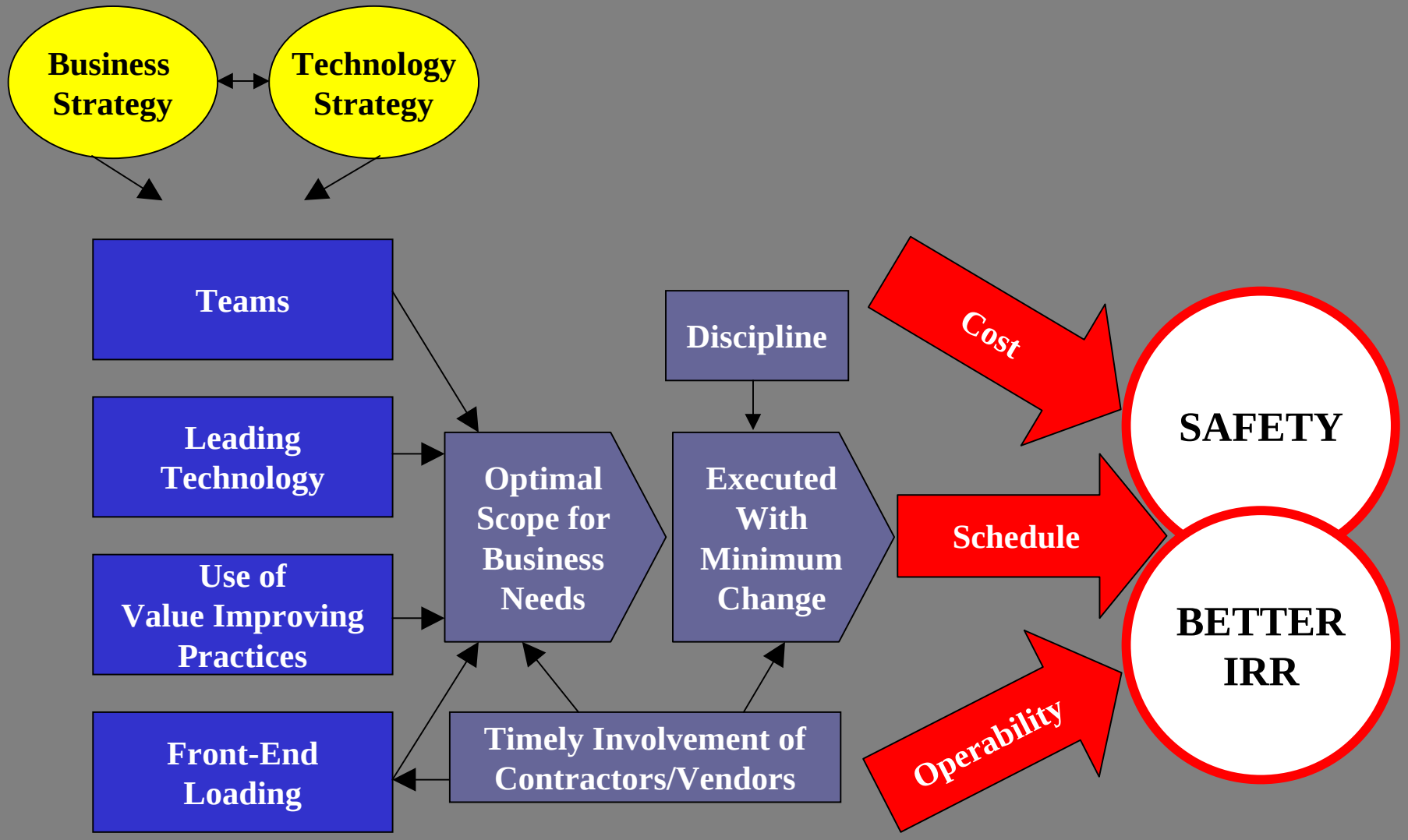
Implementing New Technology

- New technology projects are much riskier enterprises
  - More cost growth
  - Longer cycle times (but not longer execution)
  - Much poorer startups
  - More frequent long-term operability problems
- All of the risks can be managed down to acceptable levels

Key Practices for Successful Implementation of New Technology Projects

- Recognize an innovative project -- business and technical difficulty
- Schedule by Accomplishment (Good engineering cannot substitute for basic engineering data)
- Thoroughly define the project
- Ensure an effective team

Elements of Capital Effectiveness



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