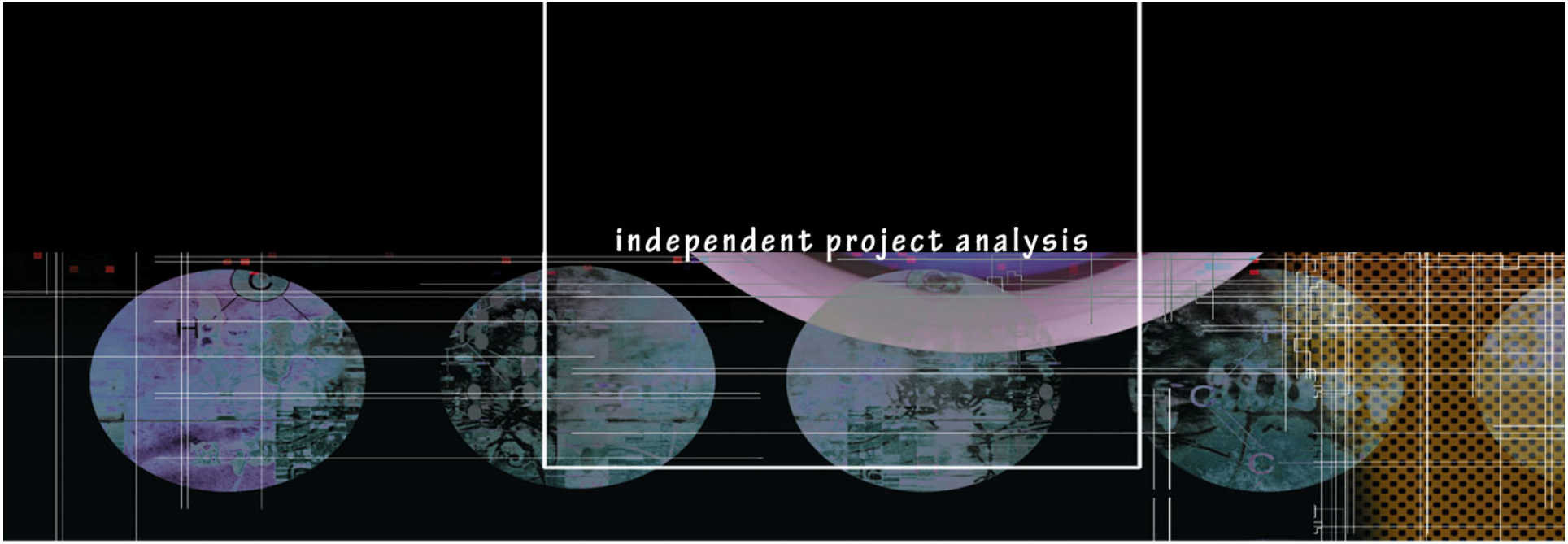


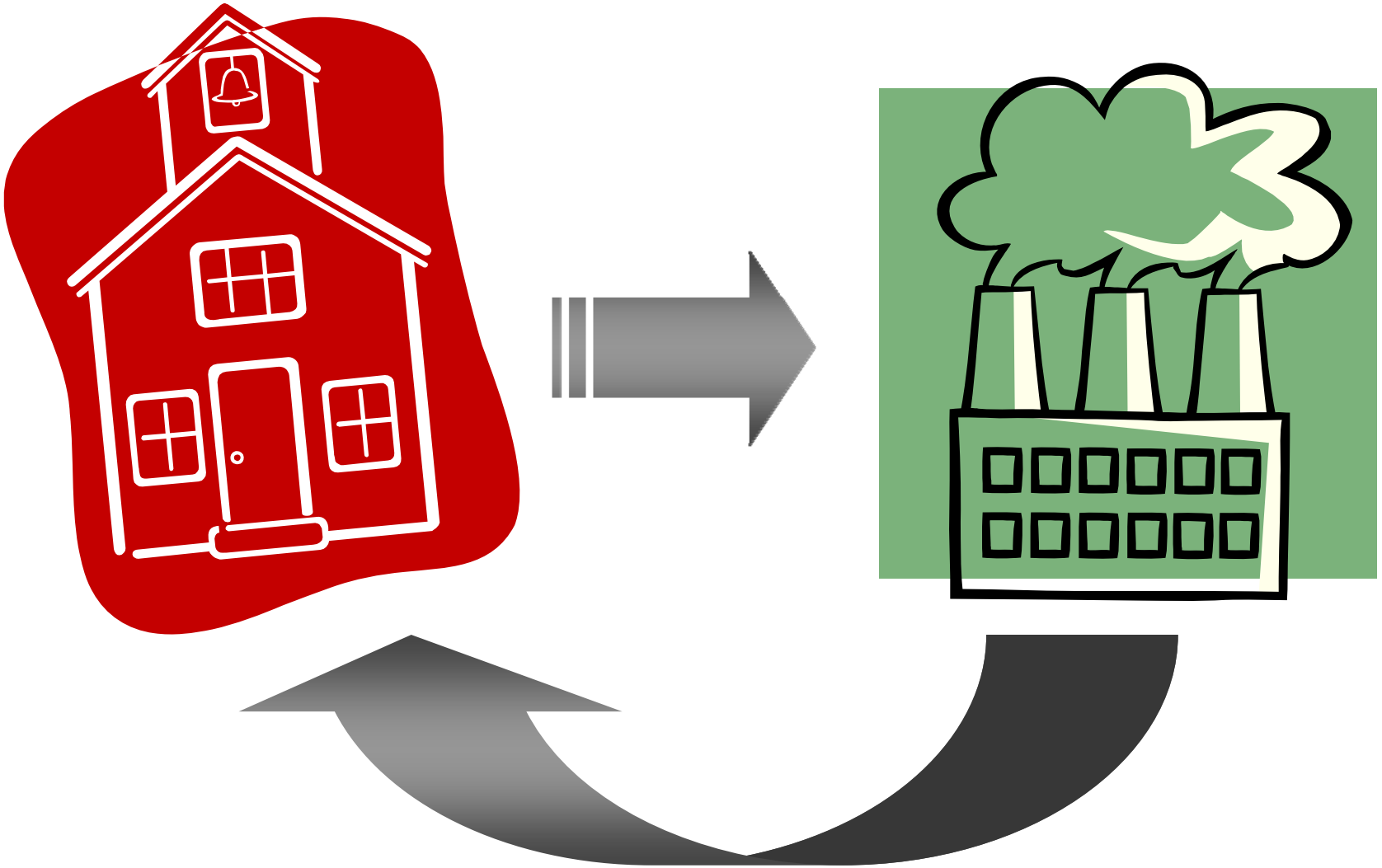
Lessons on Process for Evaluation

Presented at Evaluation 2010, San Antonio, TX

Kate Rohrbaugh

November 11, 2010

Why Are We Here?



Purpose

- **To:**
  - **Provide the audience with a process for planning evaluation**
- **By:**
  - **Demonstrating the capital project planning process**
  - **Discussing the drivers for successful capital projects**
- **For the purpose of:**
  - **Enabling you to apply these processes to evaluations**

Outline

- *Independent Project Analysis*
- Capital Projects and Goals
- Developing a Process
- Front-End Loading
- Team Development
- Practices in Execution
- Challenges
- Conclusions

Origins of Independent Project Analysis (IPA)

- For almost 25 years, IPA has been benchmarking capital projects in the process industries
- IPA grew out of research at The Rand Corporation on the sources of success and failure in capital projects, especially new technology projects
- Dupont was our first important customer and is still an important customer two decades later

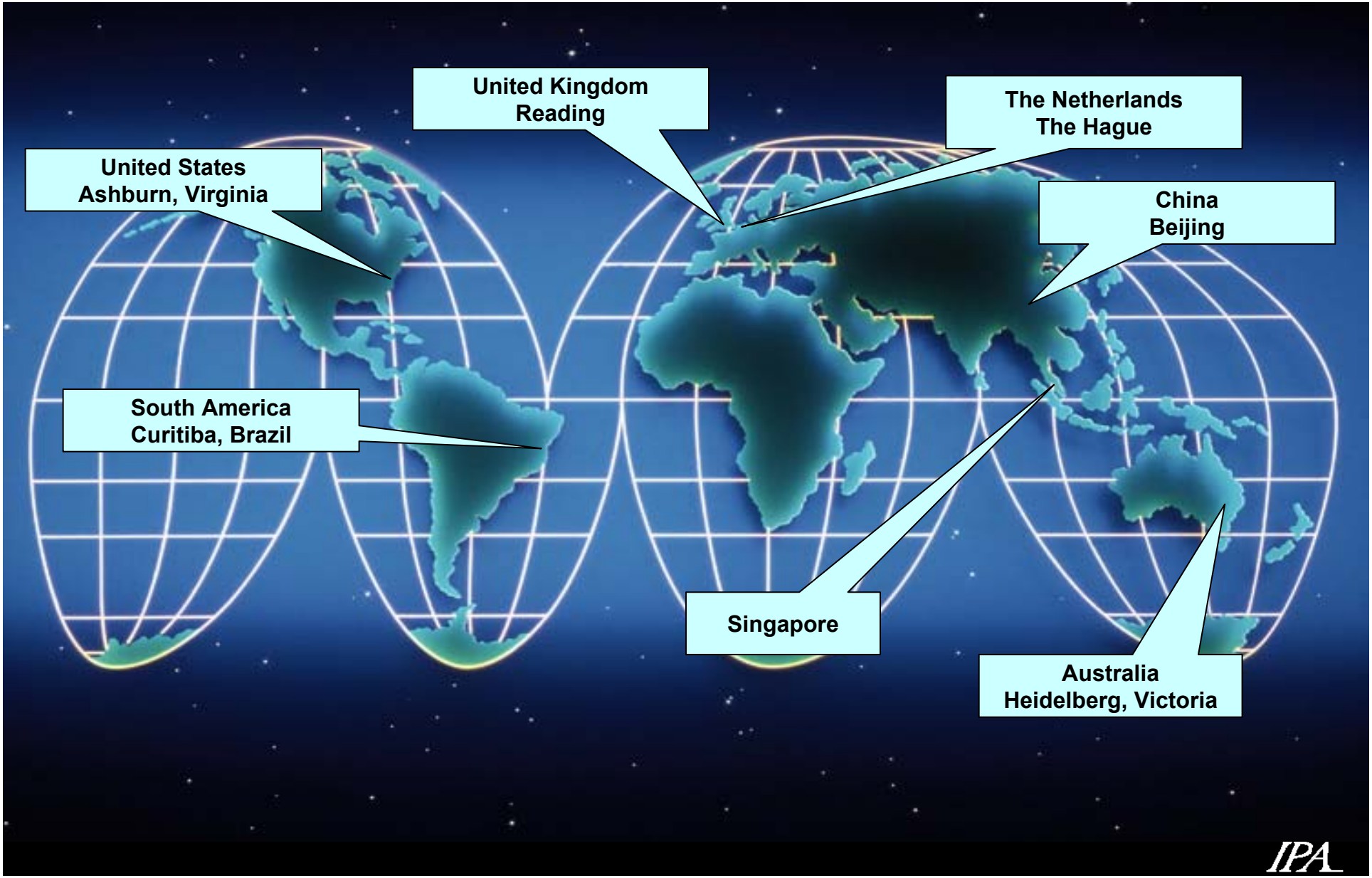
IPA's Purpose

IPA improves the competitiveness of our customers through more effective use of capital in their businesses.

It is our mission and unique competence to *conduct research* into the functioning of capital project systems, and to *apply the results* of that research to *help our customers* create and use capital assets more efficiently.

Above all else, however, IPA is in the business of *generating positive change!*

IPA Office Locations



IPA's Customers

- **IPA works for the extractive and manufacturing industries**
  - **Extractive: oil, gas, iron, copper, zinc, diamonds, etc.**
  - **Manufacturing: chemicals, fuels, pharmaceuticals, paper, food processing, consumer products**
- **Our primary focus is on companies that must invest large amounts of capital in facilities to meet their customers' needs**
- **We do very little work for governments, although we have done and will continue to do some**
  - **Environmental projects (USEPA, USDOE, COE)**
  - **Facilities construction (Navy, USDOE, State Dept.)**
  - **Alternatives fuels commercialization (USDOE, NREL)**

Clients Represented in the IPA Databases

Abbott Laboratories
Abitibi-Consolidated
Aditya Birla
ADNOC
Agip KCO
AGRA Simons
AIOC
AIR Liquide
Air Products
AKZO Nobel
Alcan
Alcoa
Allegheny Industries
Alyeska
Anadarko Petroleum
Anglo Platinum
Arkema
AstraZeneca
Atlantic LNG
Australian Paper
AVR
AWE
Barrick Gold
Basell
BASF
Bayer
BC Hydro
BG
BHP Billiton
Bluescope Steel
Bluewater
Borealis
Braskem
British Food
British Nuclear Group
BP
Bristol-Myers Squibb
Caltex
Cargill Inc.
Chevron
Chevron Phillips Chemical
China National Offshore Oil Co.
China Three Gorges Project Development Corp.
CITGO
Clark Refining & Marketing
CNRL
Codelco
Colonial Pipeline Company
Cominco
Condea Vista
ConocoPhillips
Copesul
CRI
CS Energy
CSR
CYTEC
De Beers
Department of Defense (US)
Department of Energy (US)
Dofasco
Dow Chemical Company
DowCorning
DSM
DuPont
Eastman Chemical Co.
Ecopetrol
Edison Company
Eli Lilly & Co.
Enbridge
EnCana
Eni Petroleum
Entergy
EPZ
ExxonMobil
Evonik Degussa
Falconbridge
Flint Hills
Florida Power & Light
FMC Corporation
Fosfatados Catarinenses
Fosfertil
Gaz De France
Genentech
General Electric
Georgia Pacific
Gerdau
GlaxoSmithKline
GS Caltex
GW Foods
Hess Corporation
Hoffmann-La Roche
Honeywell
Husky Oil
ICI
IMC Global
Incitec
Inland Paperboard & Packaging
Inpex
Invista
JGC
Johnson & Johnson
Kimberly-Clark
Kinder Morgan
Koch Industries
Kodak
Kraft
Kumba Iron Ore
Kuwait Nat'l Petroleum
Lanxess
Lasmo
LTV Steel
Lukoil
Lundin Malaysia
LyondellBasell
Malaysian Refining Co.
Marathon Petroleum
Marathon Oil
MeadWestvaco
Merck & Company, Inc.
Methanex
Mosaic
Motiva
Mineração Rio Norte
Murphy Oil
NAOC
Nederlandse Aardoilie Mj.
Newmont Mining
Nexen
Noble Energy
Noranda
North Star Steel
Nova Chemicals
Novartis
Nycomed Amersham
Numinco
OMV
Orica
Origin Energy
Owens Corning
Oxiteno
Pacific Energy Partners
Pasadena Refining
PDVSA
PEMEX
PEQUIVEN
PET
Petrobras
Petrochina
Petro-Canada
Petronas
Petroleum Development Oman
Pfizer (formerly Pharmacia)
Pillsbury
Pioneer Natural Resources
Portland Pipeline
Potlatch
Praxair
Procter & Gamble Co.
PTT Exploration & Production
Qatar Petroleum Co.
Quimica Fluo
Repsol YPF
Rhodia
Rio Tinto Alcan
Rohm & Haas
SABIC
SABIC Innovative Plastics
Samarco
Sanofi Pasteur
Santos
SAPPI
Sasol
Saudi Aramco
Schering-Plough
Schlumberger
SECCO
Shell
Singapore Refining Co.
Solutia
Solvay
Southern Company
Southern Natural Gas
Staatsolie Suriname
Star Petroleum Refining Co.
Statoil
Stepan
Suncor Energy
Sunoco
Suzano Petroquimica
Syncrude
Taqa
TransCanada
Tengiz Chevroil
Tesoro
Total
UK Government
Union Carbide Corp.
US Department of State
US Gypsum
US Steel
Vale
Valero
Votorantim Metais
Wacker
Wellman
Weyerhaeuser
Woodside

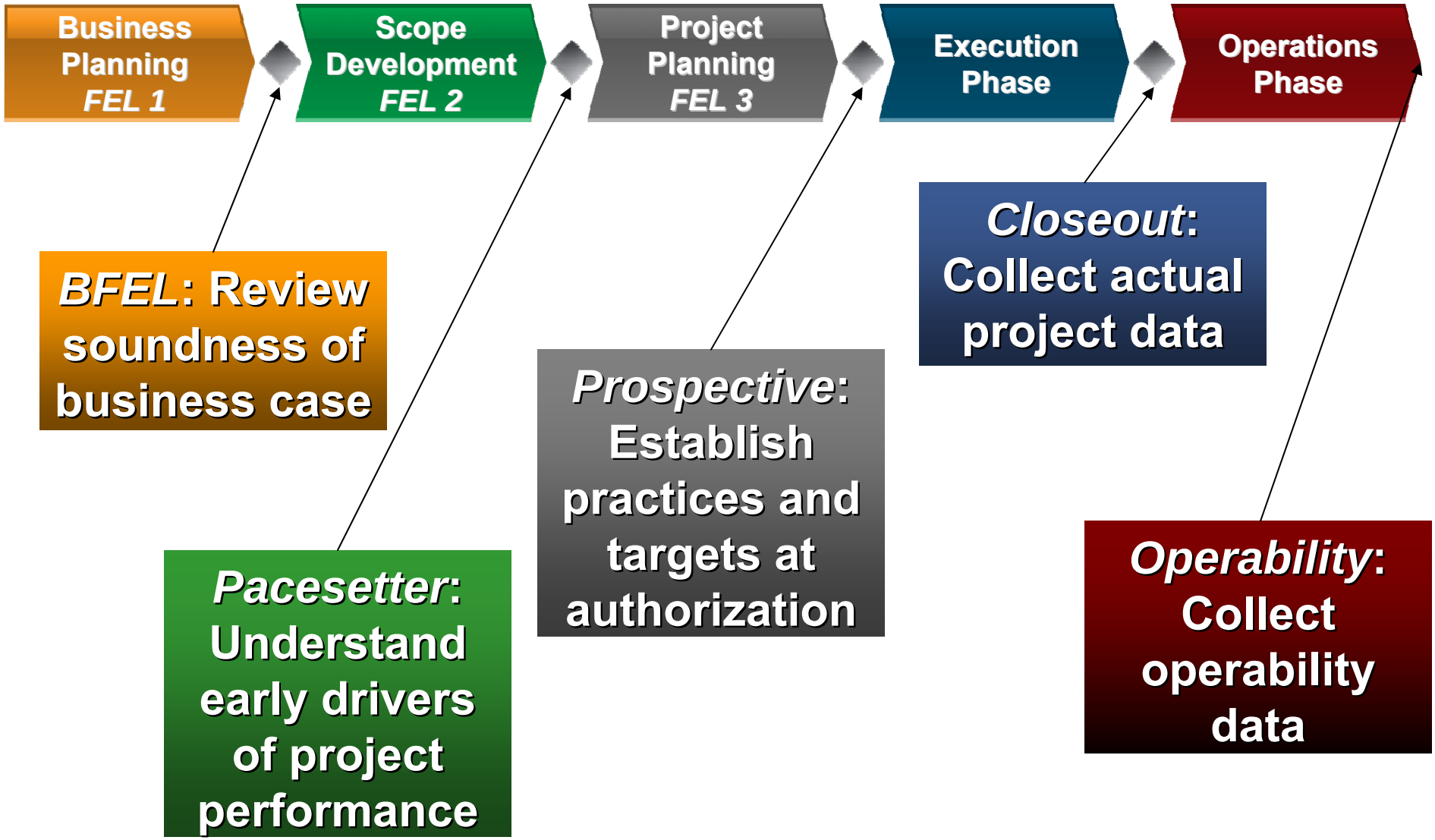
What Is a Capital Project?

A project that involves expenditure of an organization's monetary resources for the purpose of creating capacity for production.

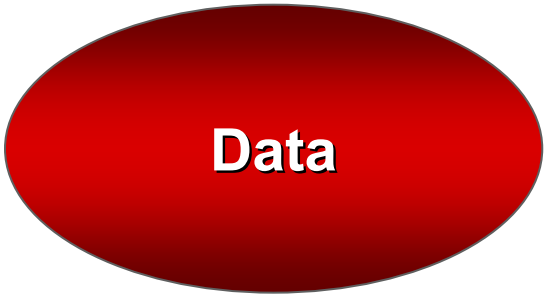
Much can be learned from capital projects in terms of practices that can be applied to an evaluation as a “project”

Planning and process matter

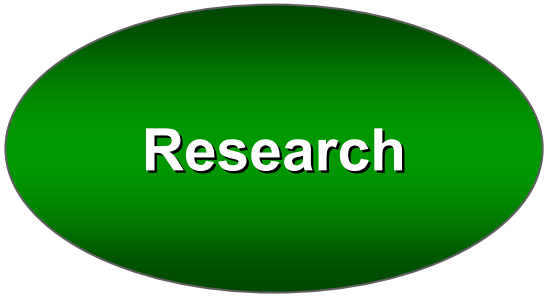
When Are Capital Projects Benchmarked?



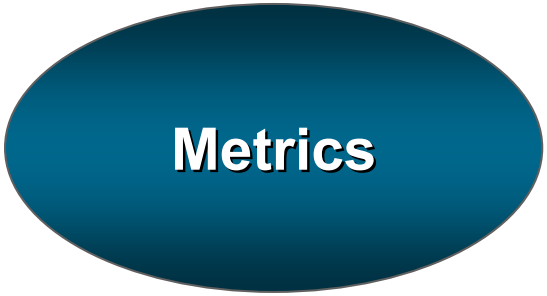
IPA Data



- 12,000+ global projects
- Information obtained directly from the project teams
- 2,000+ variables per project



- How practices drive outcomes
- Industry and sector trends
- Time trends



- Benchmarking of individual projects
- Company performance

IPA Works at Several Levels

- ***Individual projects*** **form the foundation of our work**
- ***Workshops*** **provide a roadmap for best project practices**
- **Diagnosing (benchmarking)** ***project systems*** **provides companies with the basis for improvement**
- ***Benchmarking Conferences*** **bring companies together to share practices and metrics**

IPA's Research and Methodology Is Based on Proprietary Databases

PROCESS PLANTS PES®*
>6,500 projects
Detailed histories of process plant projects > US$6 million

*** PES is a registered trademark of IPA**

PES SMALL PROJECTS
6,000+ projects
Projects < US$6 million from process industries

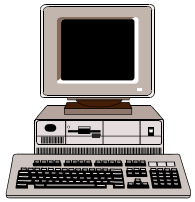
MEGAPROJECTS
300+ projects
US$Billion class projects, all types

HAZRISK
400+ projects
Environmental assessments and cleanups

ELECTRIC POWER PROJECTS
>150 projects
Single or combined cycle plants,

PLANNED SHUTDOWNS /TURNAROUNDS
250+ turnarounds
Facility turnarounds

INFORMATION TECHNOLOGY
270+ projects; including Applications Development, Telecommunication, etc.



INSTRUMENTATION & CONTROL
450+ projects
Automation, DCS, SCADA, etc.

Petroleum E&P
1,000+ projects
Petroleum production platforms worldwide

PIPELINES
800+ projects
Pipelines, terminals, booster stations, etc.

Outline

- Independent Project Analysis
- *Capital Projects and Goals*
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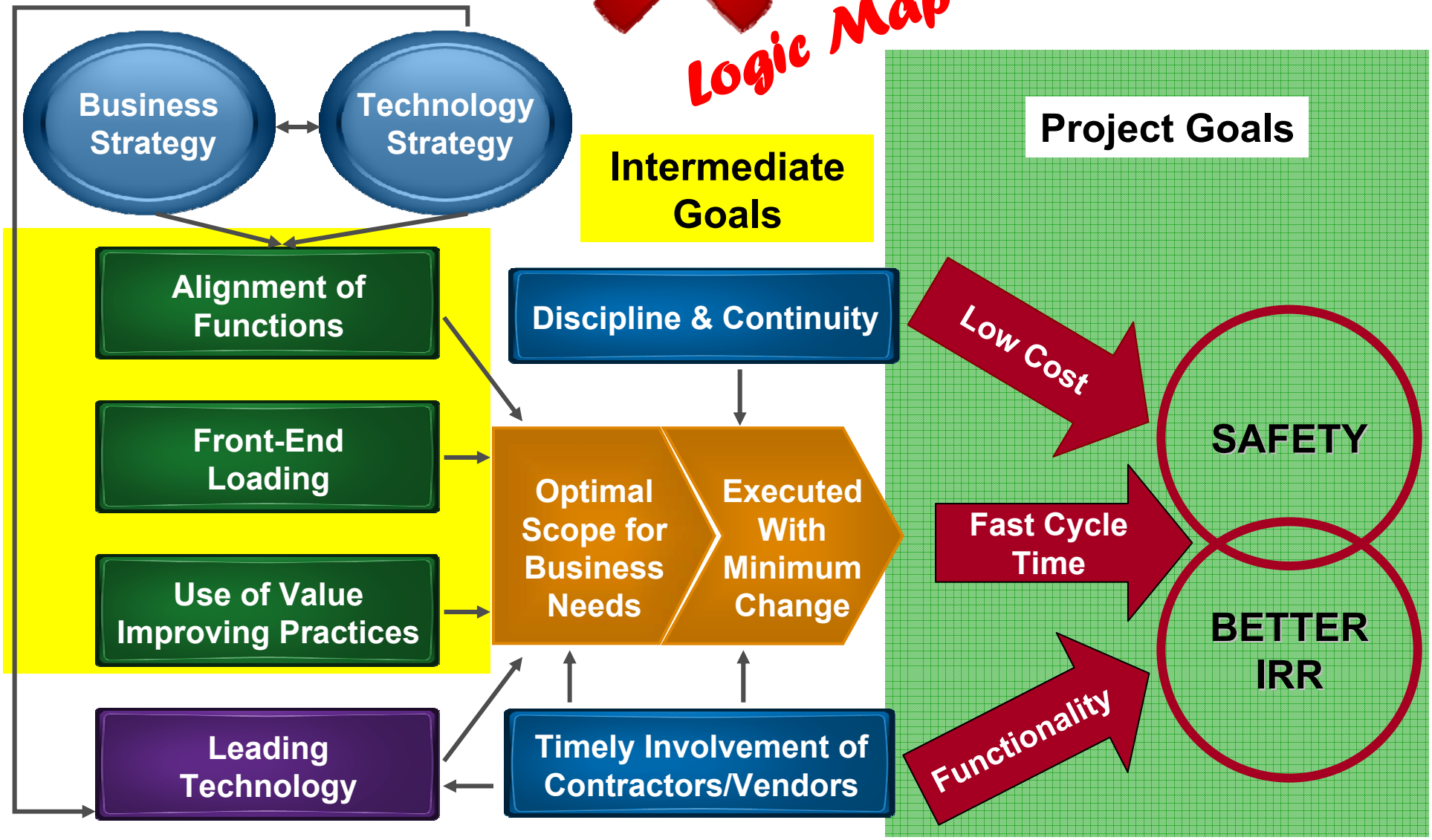
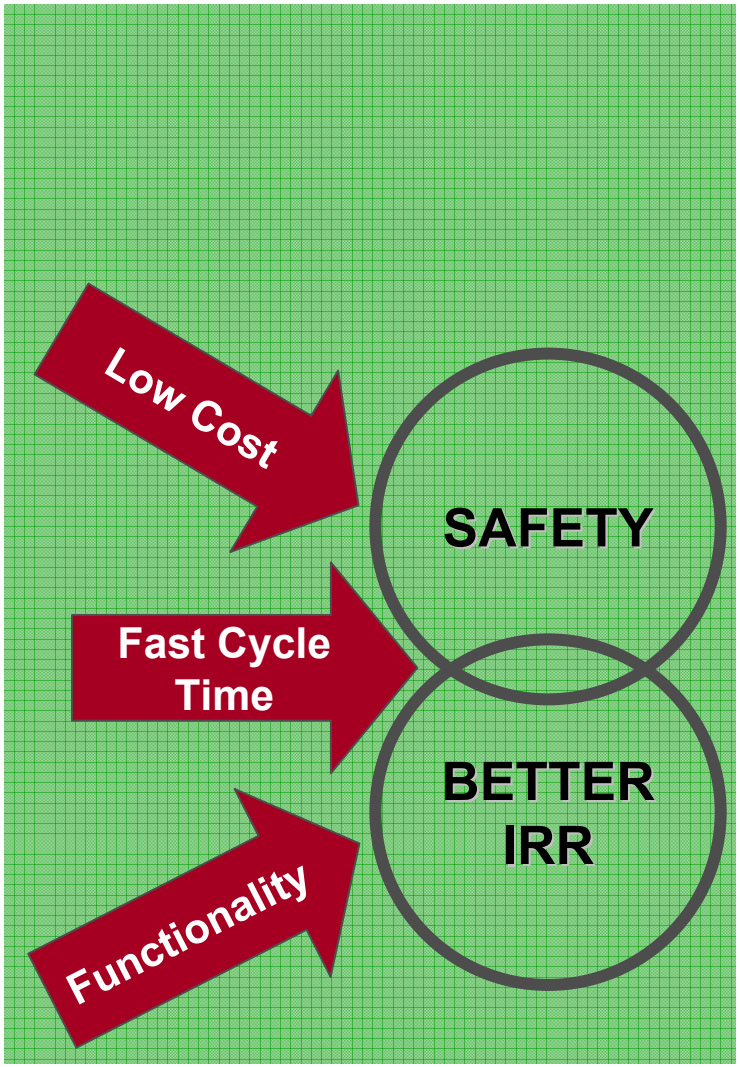
Elements of C[X]tal Effectiveness

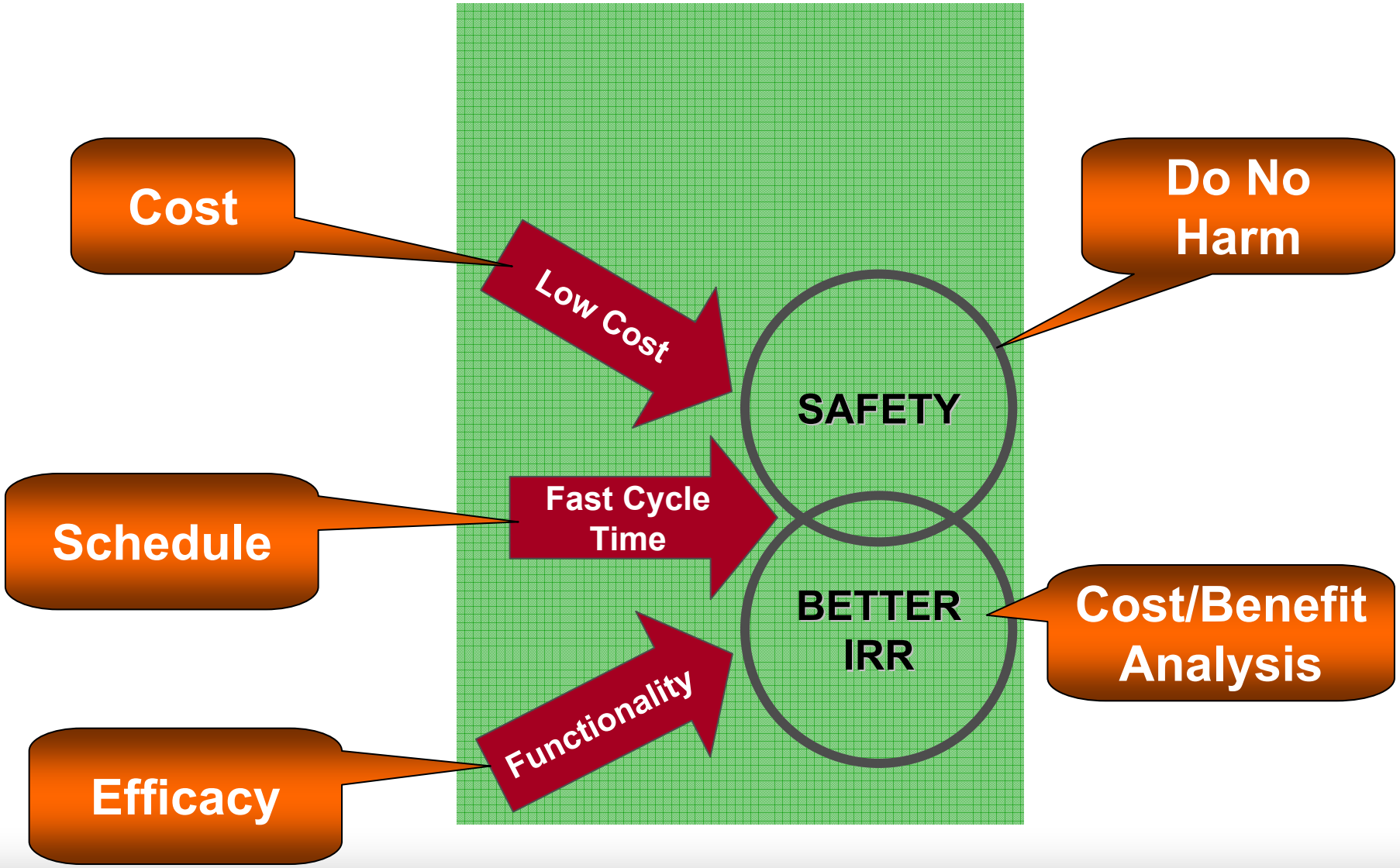
Logic Map



Project Goals – In Evaluation Terms



Project Goals – In Evaluation Terms



Predictability Indices

- **Project outcomes vs. targets established at authorization**

  (Project Actual / Project Estimate) - 1

  (0 percent means no deviation)

- **Can collect for evaluations as well –**
  - **Cost → ($90K / $100K) – 1 = -0.10**
  - **Schedule → (4 months / 3 month) – 1 = 0.25**

Competitiveness

- **Project effectiveness vs. Industry**

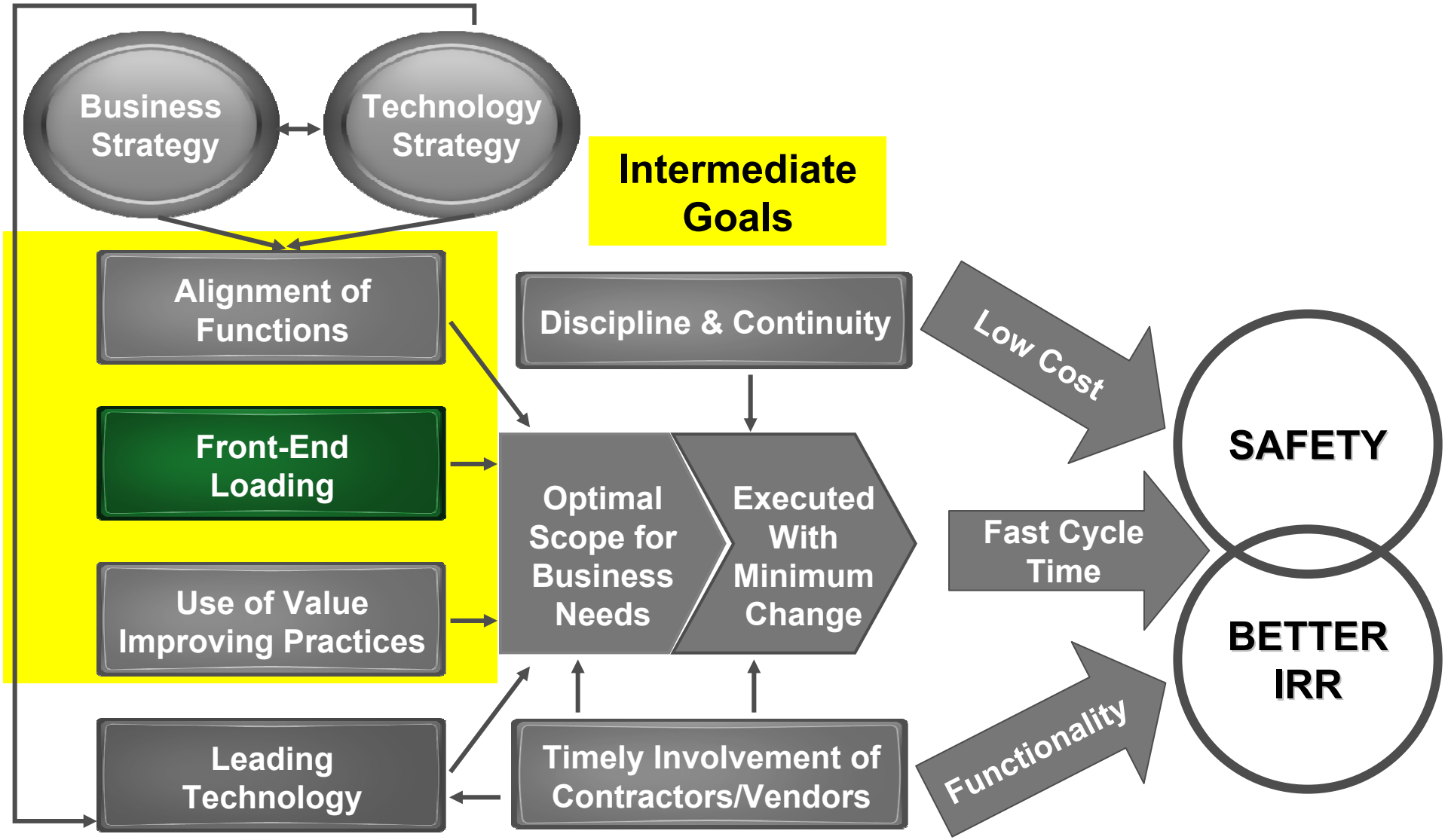
Project Actual / Industry Benchmark

(1.00 is Industry)

Industry Benchmarks:
Based on Statistical Models

- **IPA models are based on historical performance of past projects (i.e., projects in IPA's database)**
- **Generate an industry average prediction for projects with similar characteristics**
- **Provide a statistical range around the industry average**
- **We do this using multivariate regression**

Elements of Capital Effectiveness



How Do We Measure FEL?

Front-End Loading (FEL) Index

= **Site Factors** + **Engineering Definition** + **Project Execution Plan**

- Plot plans
- Soils data
- Environmental permitting
- Health & safety requirements

- Engineering tasks
  - –Detailed scope
  - –PFDs, H&MBs, P&IDs
  - –One-line electrical diagrams
  - –Equipment specs
- Cost estimate
- Sign-off from:
  - –Operations
  - –Maintenance
  - –Business

- Contracting strategy
- Team participants & roles
- Integrated schedule
  - –Detailed
  - –Critical path
  - –Resource loading
- Plans
  - –Procurement
  - –Commissioning/startup
  - –Etc.

Outline

- Independent Project Analysis
- Capital Projects and Goals
- *Developing a Process*
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- Practices in Execution
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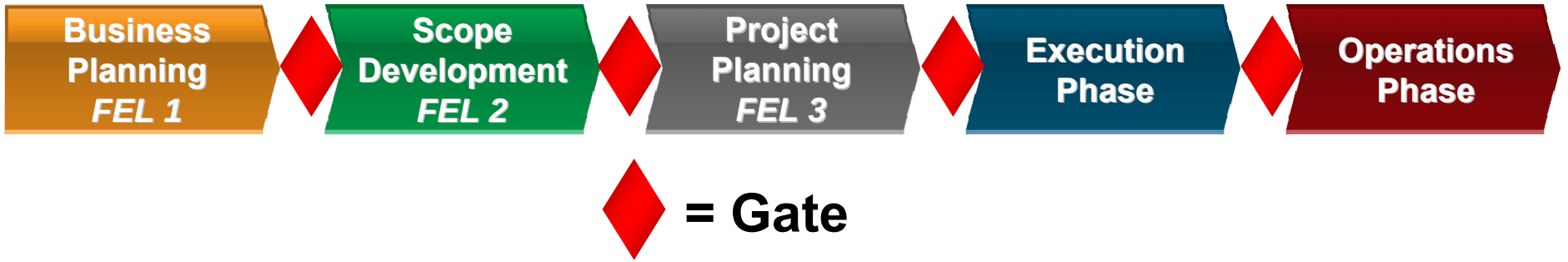
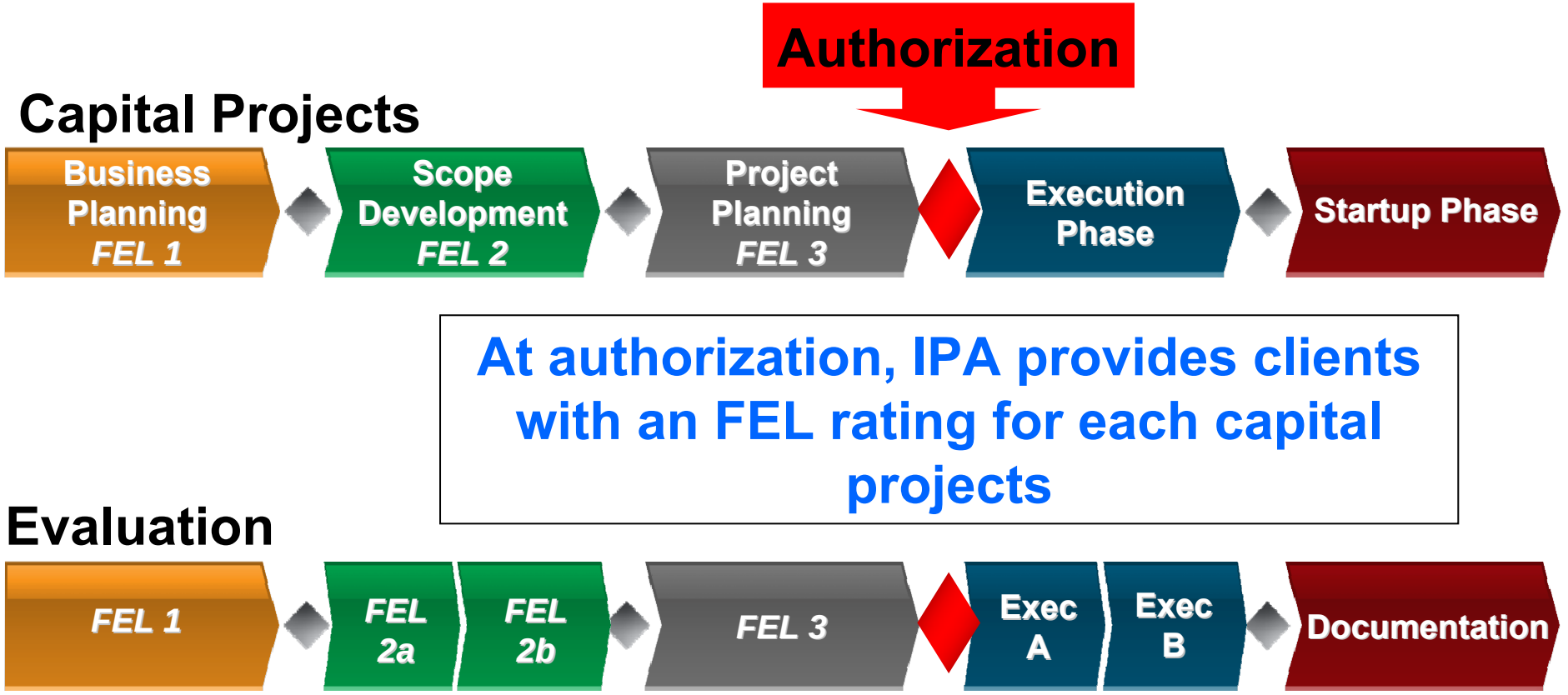
Gatekeeping in Capital Projects



- Gates are meetings where a "gatekeeper" (an independent reviewer) decides whether the project -
  - Should move to the next phase,
  - Should recycle, or
  - Should be terminated
- Gatekeeping meetings have specific deliverables that the project team or project manager is expected to prepare and distribute in advance of the meeting

Mapping to Evaluation



Business Planning
FEL 1

- **Questions addressed at gate:**
  - **Is it revenue generating?**
  - **Is it strategically important to our business?**
  - **Who are the stakeholders?**

Framing
FEL 2a

- **Questions addressed at gate:**
  - **What is the research question?**
  - **What is the problem we are trying to address?**
  - **Is it feasible?**
  - **What is the rough level of effort expected?**

Scoping
FEL 2b

- **Deliverables at gate:**
  - **Draft execution plan**
    - > **Major tasks identified**
    - > **Milestone schedule that identifies specific calendar dates for the major tasks**
  - **Cost estimate**

Execution Planning
FEL 3

- **Deliverables at gate:**
  - **Finalize Project Execution Plan (PEP)**
    - > **Specifically identify how the work will be accomplished**
  - **Document roles and responsibilities for the team members**
  - **Resource-loaded schedule**
- **Identify specific calendar dates and who is responsible for executing the tasks**

Execution

- For capital projects, execution involves engineering, construction, and installation
- For evaluation – Execution A
  - Instrument design
  - Data collection
  - Data cleaning
- Gate: Dataset completed

Execution

- For evaluation – Execution B
  - Analysis
  - Reporting
- Capital Projects End: Mechanical Completion
- Evaluation End: Final Delivered

Business Planning

- For capital projects, the last phase is “Startup phase”
- For evaluation:
  - Document the study
  - Maintain the final dataset
  - Secure any final deliverables
  - Dissemination
  - Goal is “replicability”

Outline

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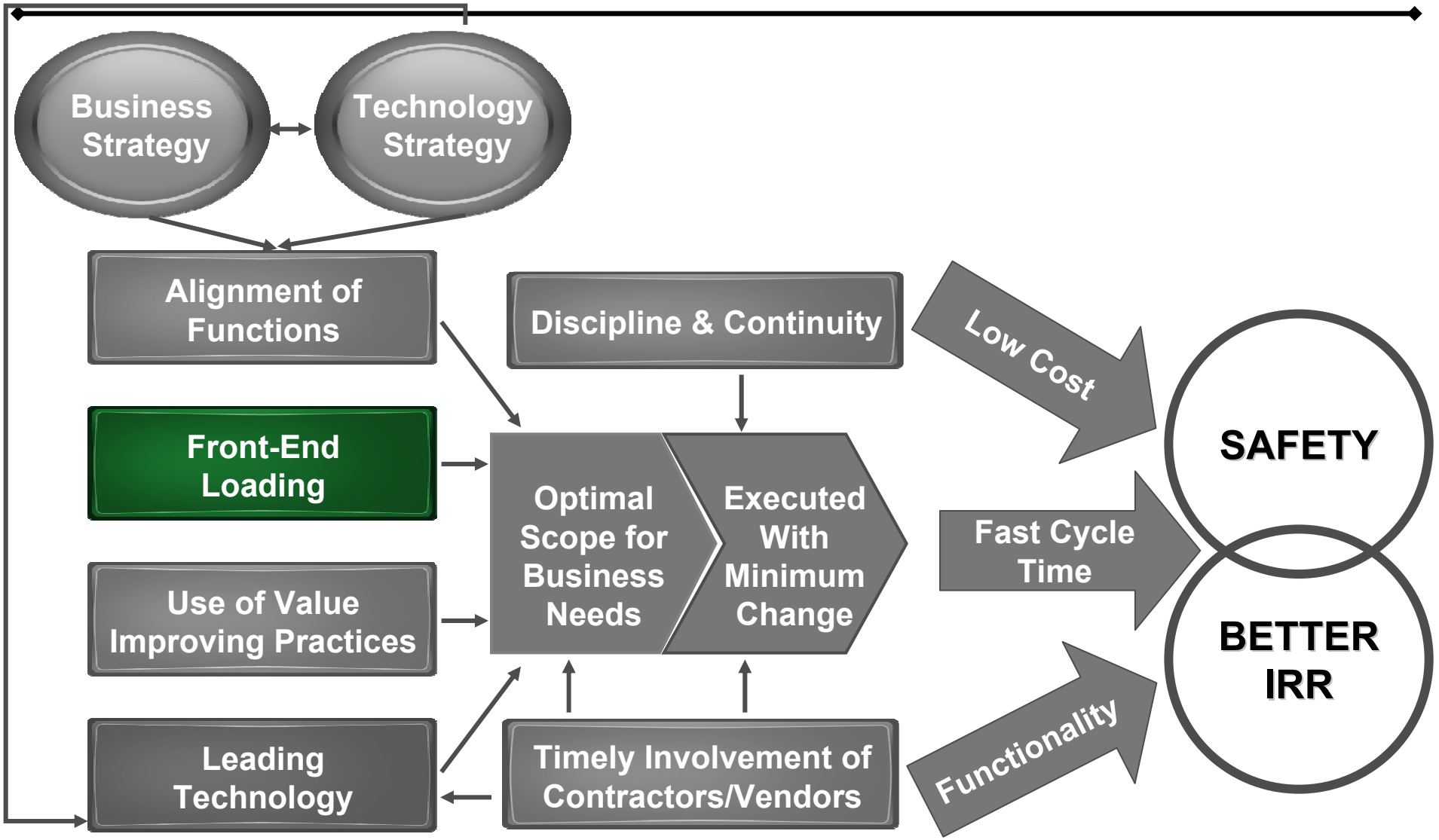
Elements of Capital Effectiveness



Key Leading Indicators

Key Performance Indicators

Capital Projects FEL

= **Site Factors** + **Engineering Definition** + **Project Execution Plan**

- Plot plans
- Soils data
- Environmental permitting
- Health & safety requirements

- Engineering tasks
  - –Detailed scope
  - –PFDs, H&MBs, P&IDs
  - –One-line electrical diagrams
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- Contracting strategy
- Team participants & roles
- Integrated schedule
  - –Detailed
  - –Critical path
  - –Resource loading
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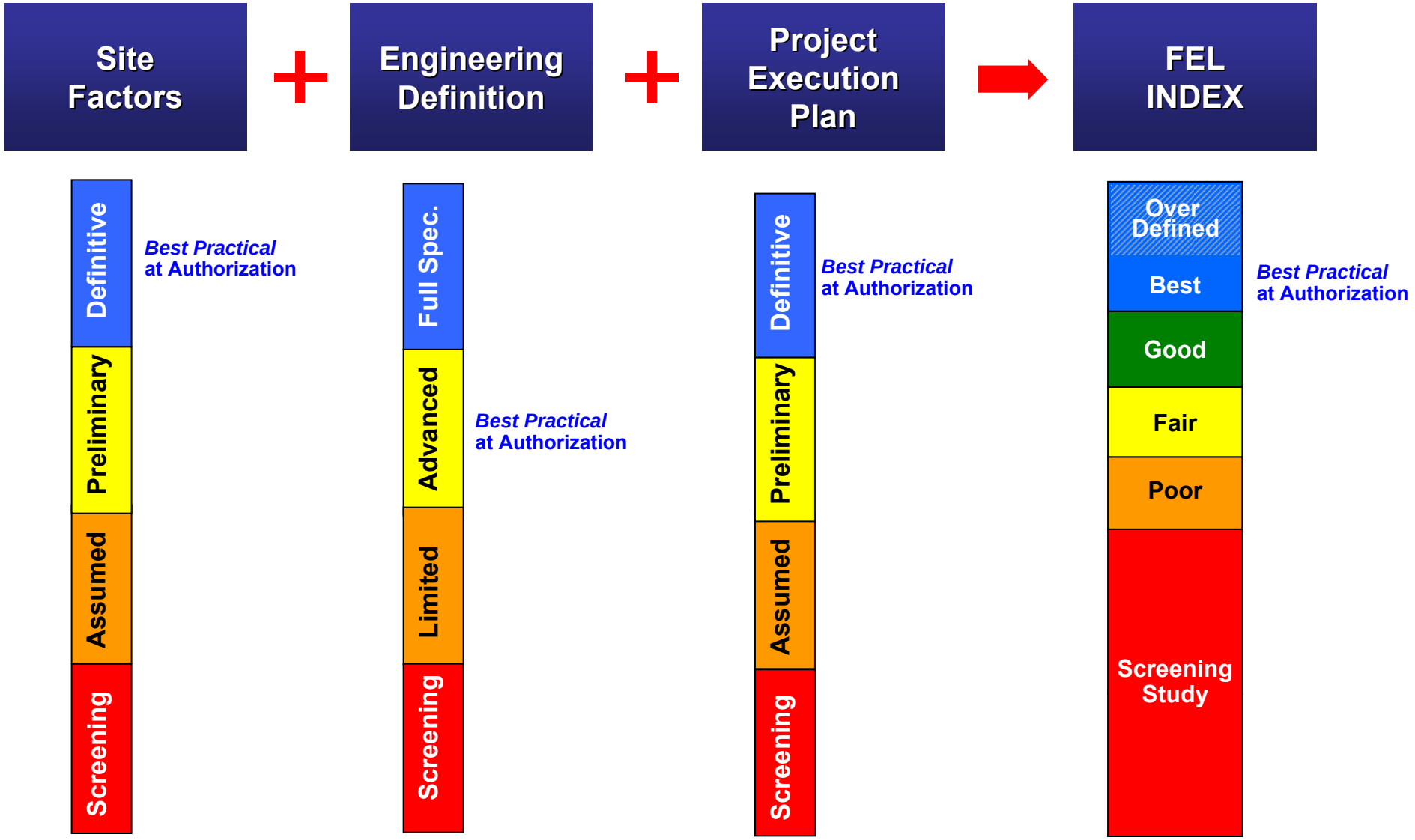
  - –Commissioning/startup
  - –Etc.

Calculating the Front-End Loading Index: *Prospective Evaluation*



Site Factors for Evaluation
"Subject Factors"

Site Factors

Subject Factors

- Plot plans
- Soils data
- Environmental permitting
- Health & safety requirements

- **Sample size**
- **Sample characteristics**
- **Government requirements (OMB clearance)**
- **Protection of human research subject requirements**

Engineering Definition for Evaluation
"Methodology"

Engineering Definition

Methodology

- Engineering tasks
  - –Detailed scope
  - –PFDs, H&MBs, P&IDs
  - –One-line electrical diagrams
  - –Equipment specs
- Cost estimate
- Sign-off from:
  - –Operations
  - –Maintenance
  - –Business

- **Hypothesis – identify dependent and independent variables in writing**
- **Articulation of problem**
- **Methodology for:**
  - –**Sampling**
  - –**Data collection**
  - –**Analysis**
  - –**Reporting**
- **Cost estimate**
- **Sign-off from external stakeholders**

Project Execution Planning for Evaluation

Project Execution Plan

Project Execution Plan

- Contracting strategy
- Team participants & roles
- Integrated schedule
  - –Detailed
  - –Critical path
  - –Resource loading
- Plans
  - –Procurement
  - –Commissioning/startup
  - –Etc.

- **Team participants & roles**
- **Integrated schedule**
  - **–Detailed**
  - **–Critical path**
  - **–Resource loading**
- **Plans for:**
  - **–Instrument development**
  - **–Data collection & cleaning**
  - **–Analysis**
  - **–Reporting**
  - **–Documentation**

Elements of an Integrated Schedule

- **Detailed**
  - **Provides specifics on what will happen when**
- **Critical Path**
  - **This is the longest path in your schedule**
  - **Activities on the critical path have zero total float**
  - **If any activity on the critical path is late, it can delay your project end date**
- **Resource Loaded**
  - **People required to do the work**
  - **Equipment needed to do the work**

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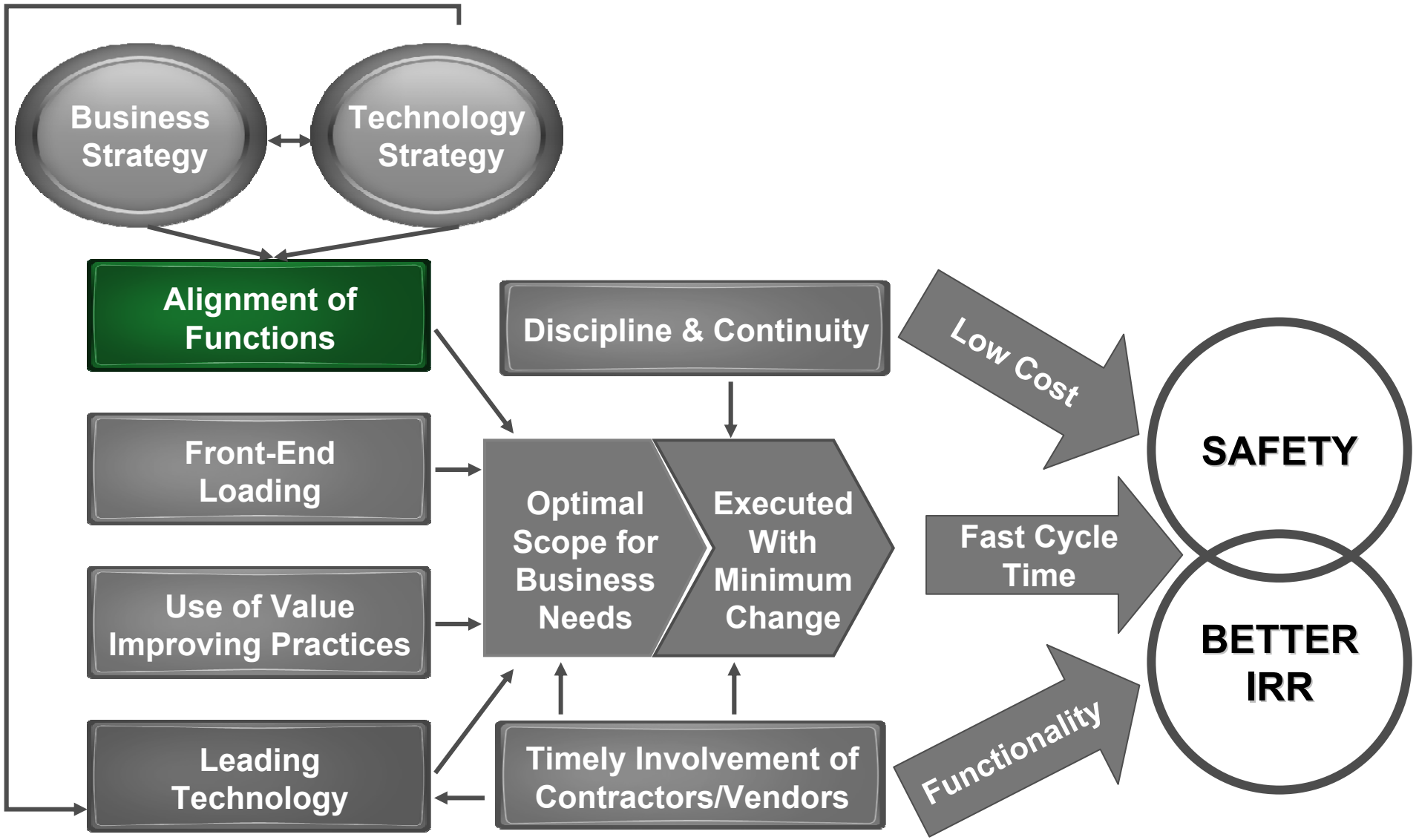


How Do We Measure Team Development?

Team Development Index (TDI)

= **Project Objectives** + **Team Composition** + **Roles & Responsibilities** + **Project Implementation Process**

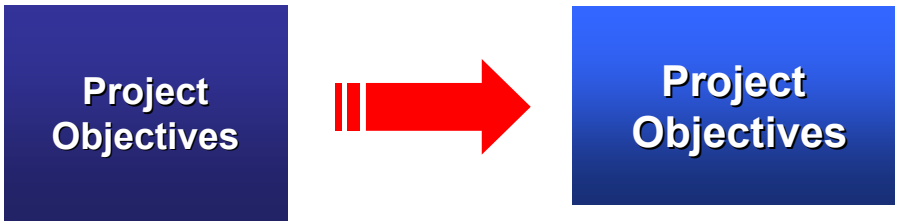
- Project objectives:
  - Documented
  - Communicated
  - Agreed to
- Trade-offs clear

- Integrated team
- Key functions represented:
  - Business
  - Ops/Maintenance
  - Engineering
  - Construction
  - Etc.

- Team member roles & responsibilities:
  - Defined
  - Agreed to
- Tasks identified
- Risks identified, analyzed, & mitigated

- Project implementation process in place
- Applied consistently on all projects
- Process understood & followed by team

Project Objectives for Evaluation



- Project objectives:
  - Documented
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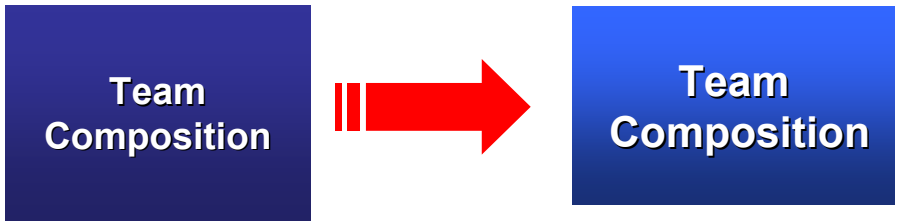
- **Project objectives:**
  - **Documented**
  - **Communicated**
  - **Agreed to**

Team Composition for Evaluation



- Integrated team
- Key functions represented:
  - Business
  - Ops/Maintenance
  - Engineering
  - Construction
  - Etc.

- **Integrated team**
- **Key functions represented:**
  - **Stakeholders**
  - **Principal Investigator**
  - **Etc.**

Team Integration

- An integrated project team includes (but is not limited to) a team of full- or part-time representatives from the following areas:
  - 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 function they are representing and provide functional input to project manager

What is an Integrated Team in Evaluation?

- **Who should be involved?**
  - **A representative from each key element of the evaluation should be involved early on**
  - **For example:**
    - > **Sampling statistician**
    - > **Instrument designer**
    - > **Etc.**

Roles and Responsibilities for Evaluation

Roles & Responsibilities

Roles & Responsibilities

- Team member roles & responsibilities:
  - Defined
  - Agreed to
- Tasks identified
- Risks identified, analyzed, & mitigated

- **Team member roles & responsibilities:**
  - **Defined**
  - **Agreed to**
- **Tasks identified**
- **Risks identified, analyzed, & mitigated**

Project Implementation Process for Evaluation

Project Implementation Process

- Project implementation process in place
- Applied consistently on all projects
- Process understood & followed by team

Project Implementation Process

- **Project implementation process in place**
- **Applied consistently on all evaluations**
- **Process understood & followed by team**

Outline

- Independent Project Analysis
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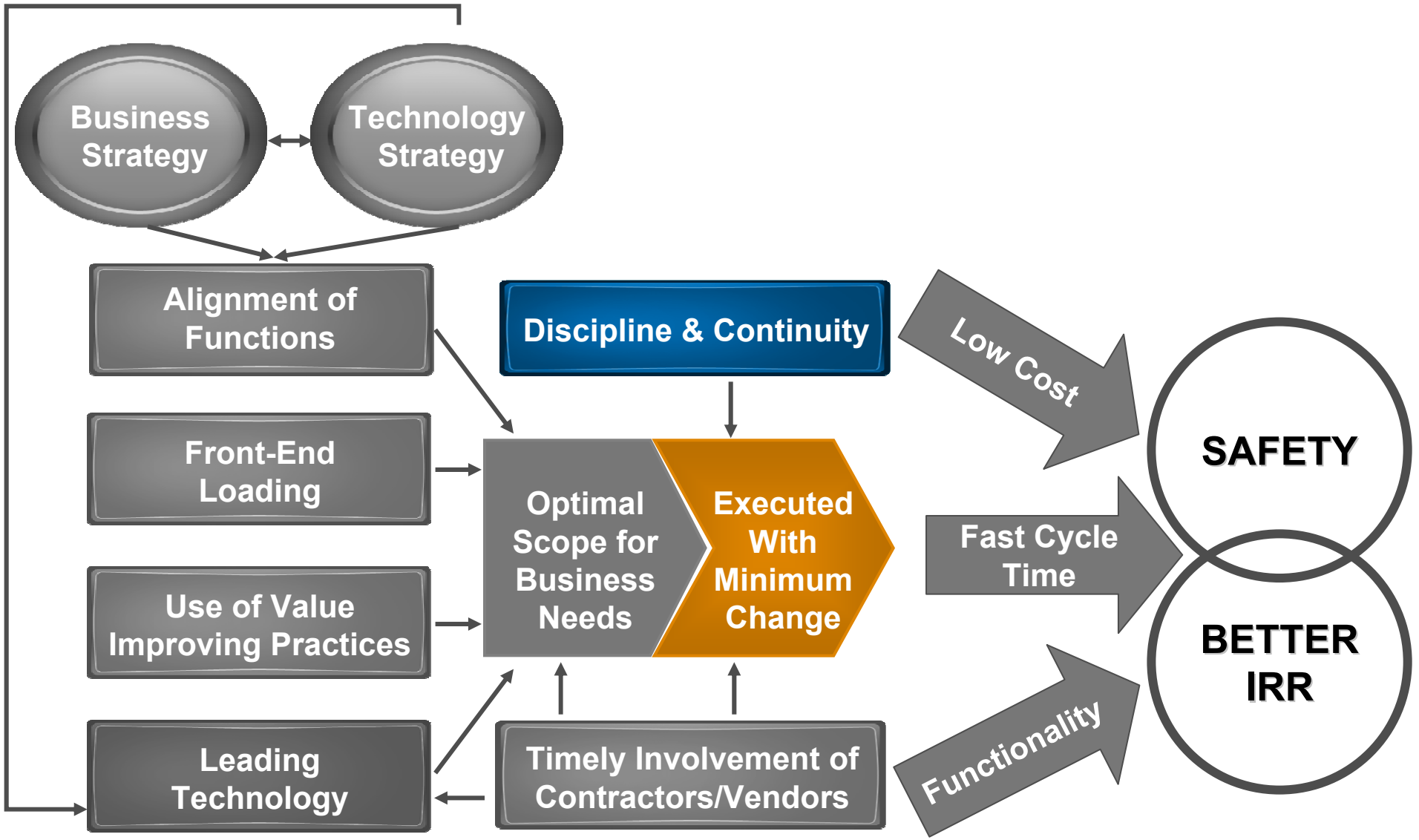

Key Leading Indicators

Key Performance Indicators

Discipline and Continuity

- **Discipline:**
  - **Following the PEP**
    - > **Are the hours expended as planned?**
    - > **Are calendar dates as planned?**
    - > **Are tasks getting done as planned?**
- **Continuity**
  - **Retaining the Principal Investigator and other key personnel**

Defining Changes

- ***Change*** **in projects is defined as a deviation from the planned (authorized) kit or configuration of kit in a project**

Design Changes	**Modifications to the intended configuration that do not involve a change in functionality or objectives**
Scope Changes	**Modifications caused by change in objectives or desired functionality** **–*Scope additions*** **–*Scope deletions***

- **A change is *major* if the *estimated* cost is greater than 0.5 percent of estimated total cost or is expected to cause a change of 1 month or more to schedule**

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- *Challenges*
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Challenges to Implementation

- **Scalability**
- **Human resistance to following a process**
- **Assumption that there are too many unknowns – that it is not worth it to plan in depth**
- **Challenges to resource loading**

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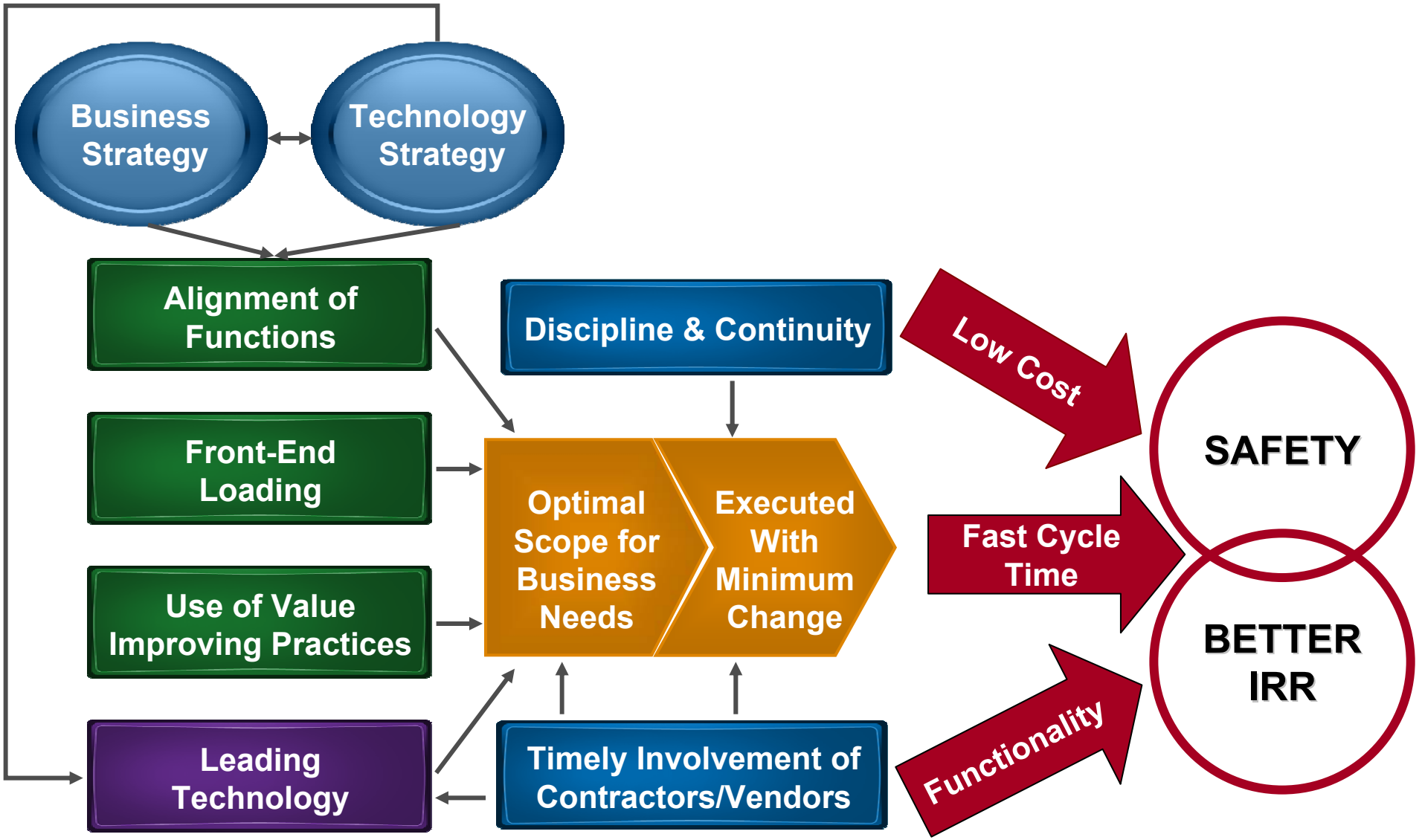
- *Conclusions*

Elements of Capital Effectiveness



Key Leading Indicators

Key Performance Indicators

Conclusions

- Do proper Front-End Loading – it pays
- Ensure you have a complete team that is familiar with the evaluation goals and the plan for implementing it
- Avoid changes in Principal Investigator
- Monitor progress
- Avoid scope and/or design changes

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