Association for Pioneers of Engineering and Technology

جمعية رواد الهندسة و التكنولوجيا

Value Engineering

Nasser El-Lakany

February 5th, 2014

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- Introduction to Value Engineering
- Value Engineering Methodology
- Final Thought

Imagination

is more important than

Knowledge

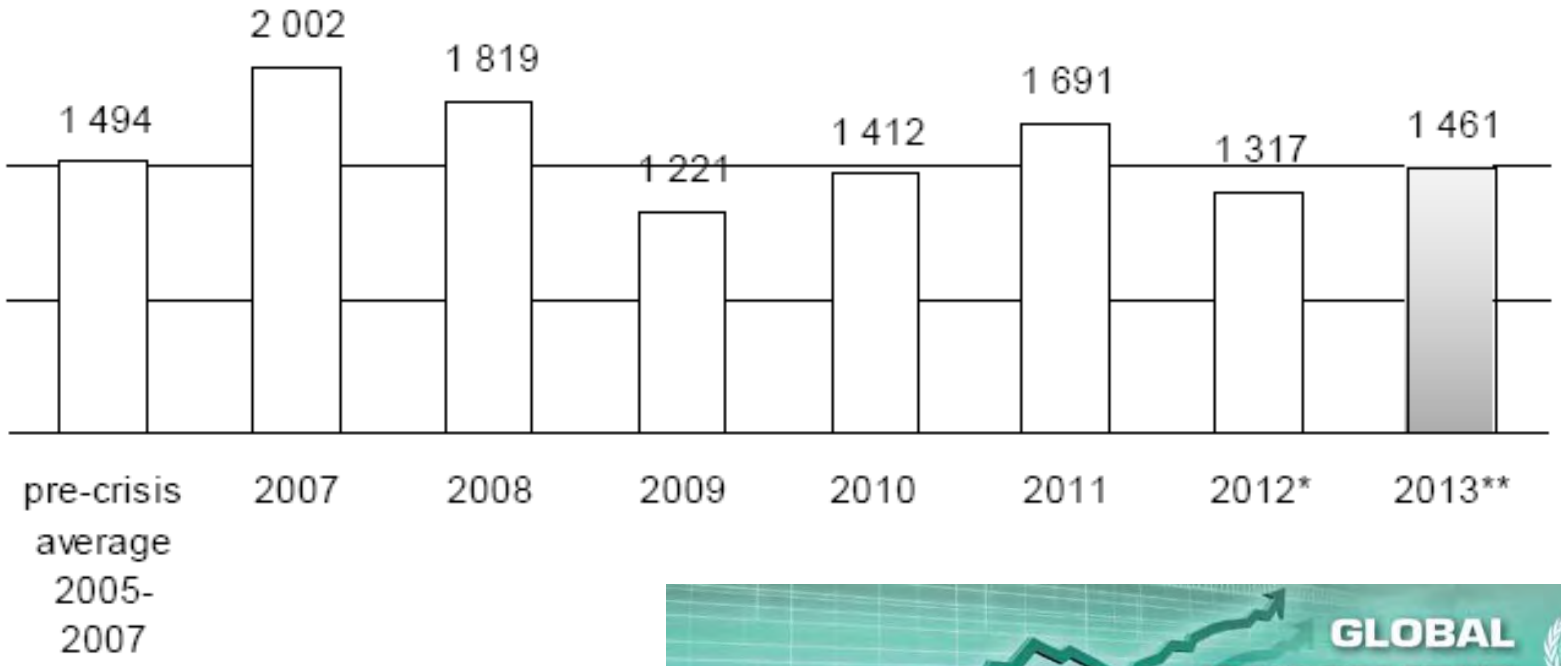
Albert Einstein

Introduction to Value Engineering

HIGHLIGHTS

- *Global foreign direct investment (FDI) inflows rose by 11% in 2013, to an estimated US$1.46 trillion – a level comparable to the pre-crisis average (figure 1) – reaching the upper range of UNCTAD's forecast.*

Figure 1. Global FDI inflows, average 2005–2007, 2007–2013
(Billions of US dollars)



Source: UNCTAD.
* Revised
** Preliminary estimates.

No. 15 28 January 2014

An Introduction

The Boosting Need for Value Engineering

In 2013, the world invested about **1.5 Trillions** of dollars for megaprojects / projects / services in various sectors.

If we consider only 5% waste in non-value adding elements of those projects, we'll end up with 75 Billions of dollars were misplaced.

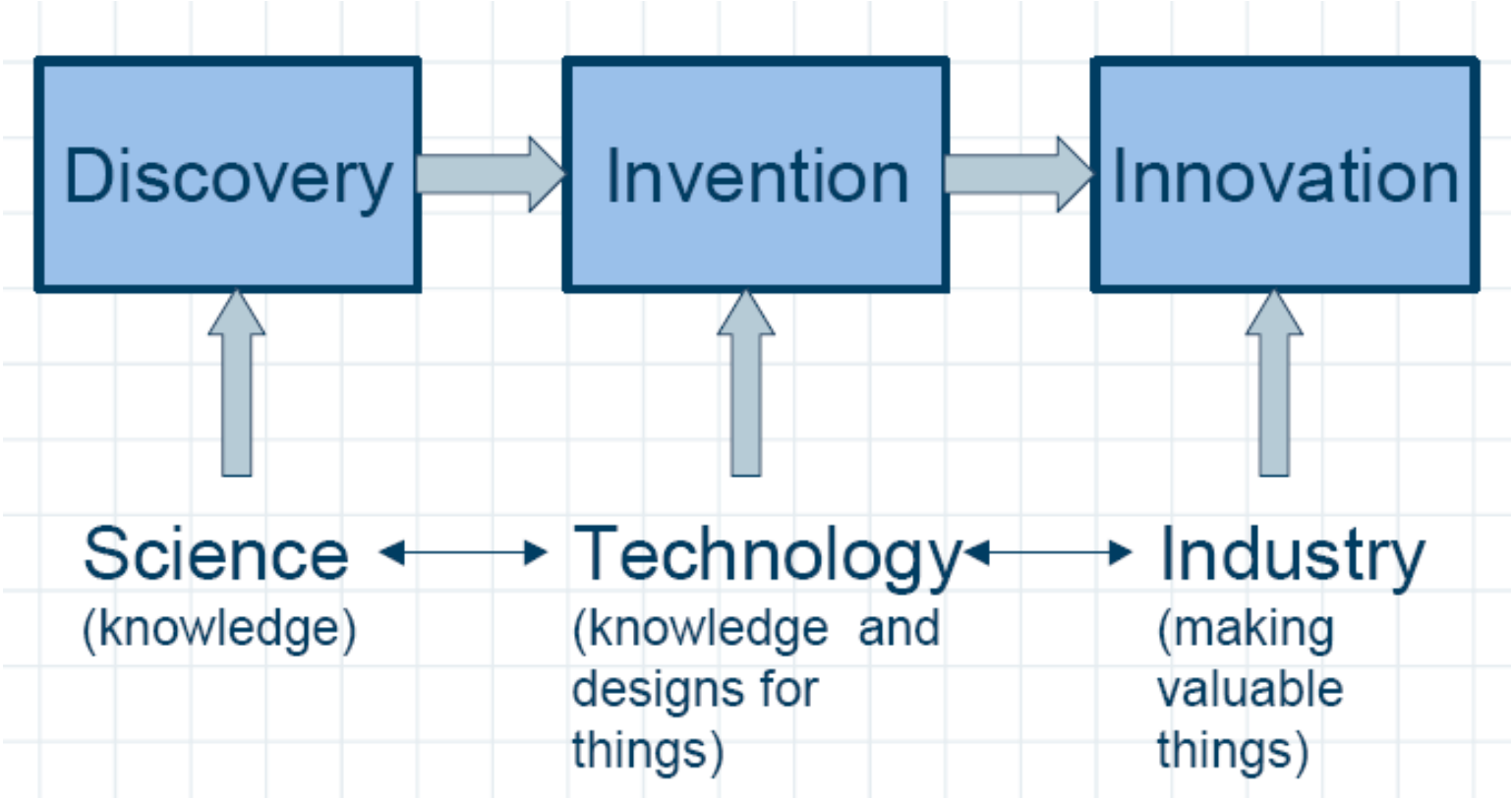
An Introduction

Industries Served By Value Engineering

- Oil and Gas
- Petrochemicals / Process
- Electrical Power Generation
- Nuclear
- Transportation
- Manufacturing
- Mining and Metals
- Telecommunications
- Environmental
- Pharmaceutical
- Health Care
- Commercial / Industrial / Institutional Facilities
- Etc.

An Introduction

It Is About Innovation …



An Introduction

Cost vs. Value

Cost is the amount of money required to obtain something.

Value is the usefulness or desirability of that thing.

An Introduction

Cost vs. Value

The value-based design maximizes the value while optimizing the cost.

An Introduction

Classical vs. Value-Based Design

Classical Design

- The designer is a lone individual / expert
- Focuses is on components of the system according to methods, standards, or state-of-the-art.

  What are they?
- Seeks to find best possible components within the constraints.
- Focuses on constrained optimality.

Value-Based Design

- The designer is a team engaged in collective effort
- Focus is on the system and its context. What is the system in its environment.

  How does it work?
- Elevates or abstracts systems to function-based models, and seeks to find the components that best perform the function wanted.
- Focuses on functional / economic value.

What is Value Engineering?

Value is defined as a fair return or equivalent in goods, services, or money for something exchanged.

SAVE International
The Value Society

What is Value Engineering?

Value is commonly represented by the relationship:

Value ≈ Function / Resources

where function is measured by the performance requirements of the customer and resources are measured in materials, labor, price, time, etc. required to accomplish that function.

What is Value Engineering?

What is Function?

The original intent or purpose that a product, service or process is expected to perform.

Function = Verb + Noun

Examples:

apply force, prevent corrosion, generate power, increase pressure, reduce temperature, stop flow, etc.

What is Value Engineering?

Value Engineering is

a systematic method

to improve the "value" of

product, process, procedure,

design, or service.

What is Value Engineering?

Value Engineering is more than:

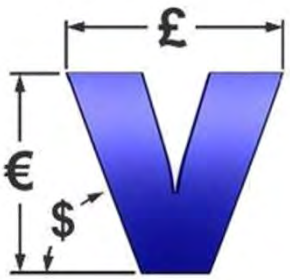
- A special look at some aspect of the project
- Cost reduction exercises
- Audits
- Project readiness reviews
- “Just good engineering”

What is Value Engineering?

Value Engineering mainly aims to increase the value of capital assets through supporting the project **value objectives** by:

- Selecting better technologies
- Simplifying processes
- Eliminating non-critical items
- Increasing reliability
- Optimizing costs
- Facilitating project execution

Typical Reasons for Poor Value



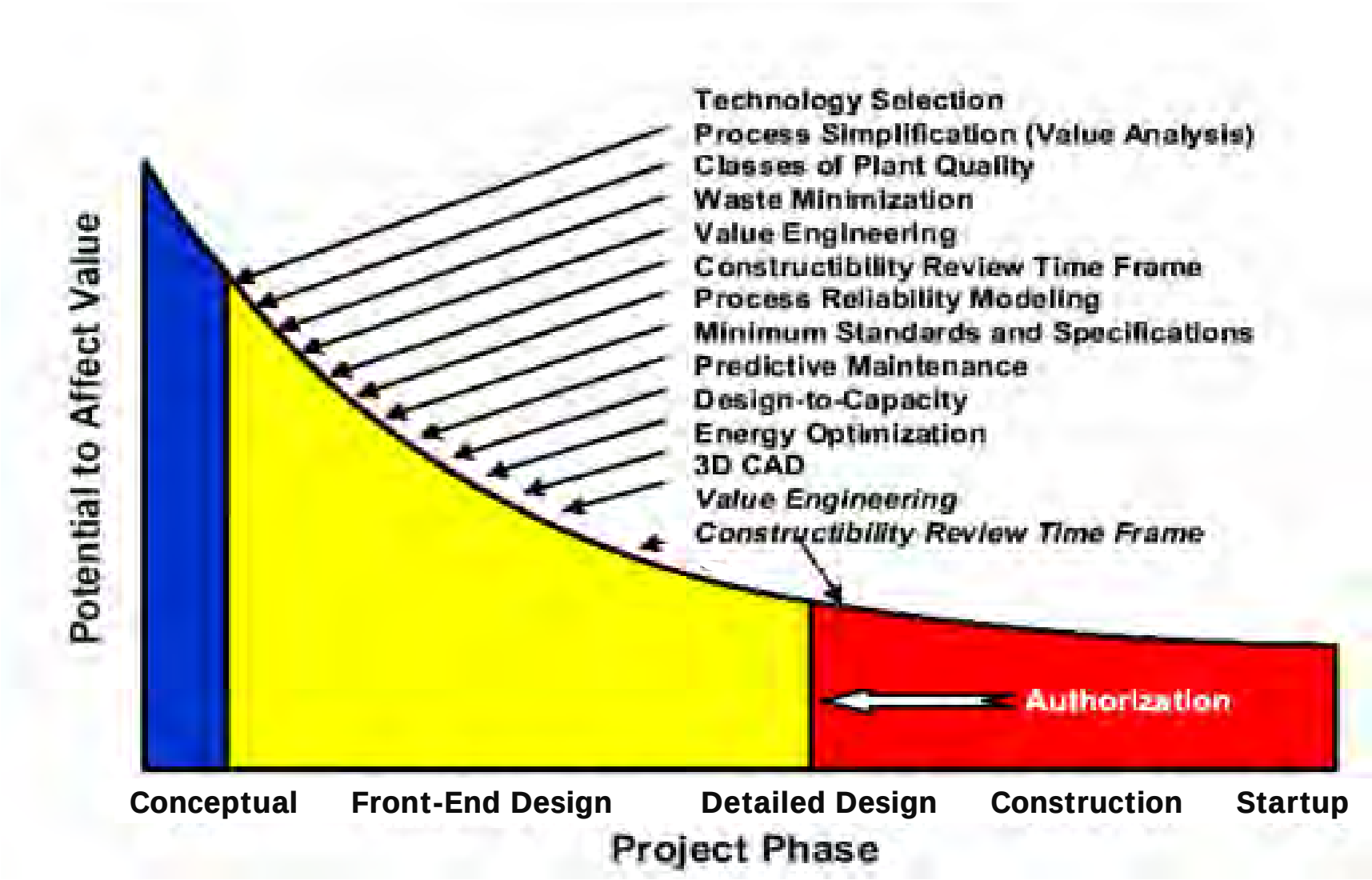
- ❑ Lack of information
- ❑ Habitual thinking
- ❑ Decisions based on wrong beliefs
- ❑ Reluctance to seek advice
- ❑ Negative attitudes
- ❑ Shortage of time
- ❑ Changing technology
- ❑ Lack of a yardstick for measuring value
- ❑ Outdated specifications
- ❑ Poor human relations

The Industry Approach (VIPs)

Value Improving Practices (VIPs)

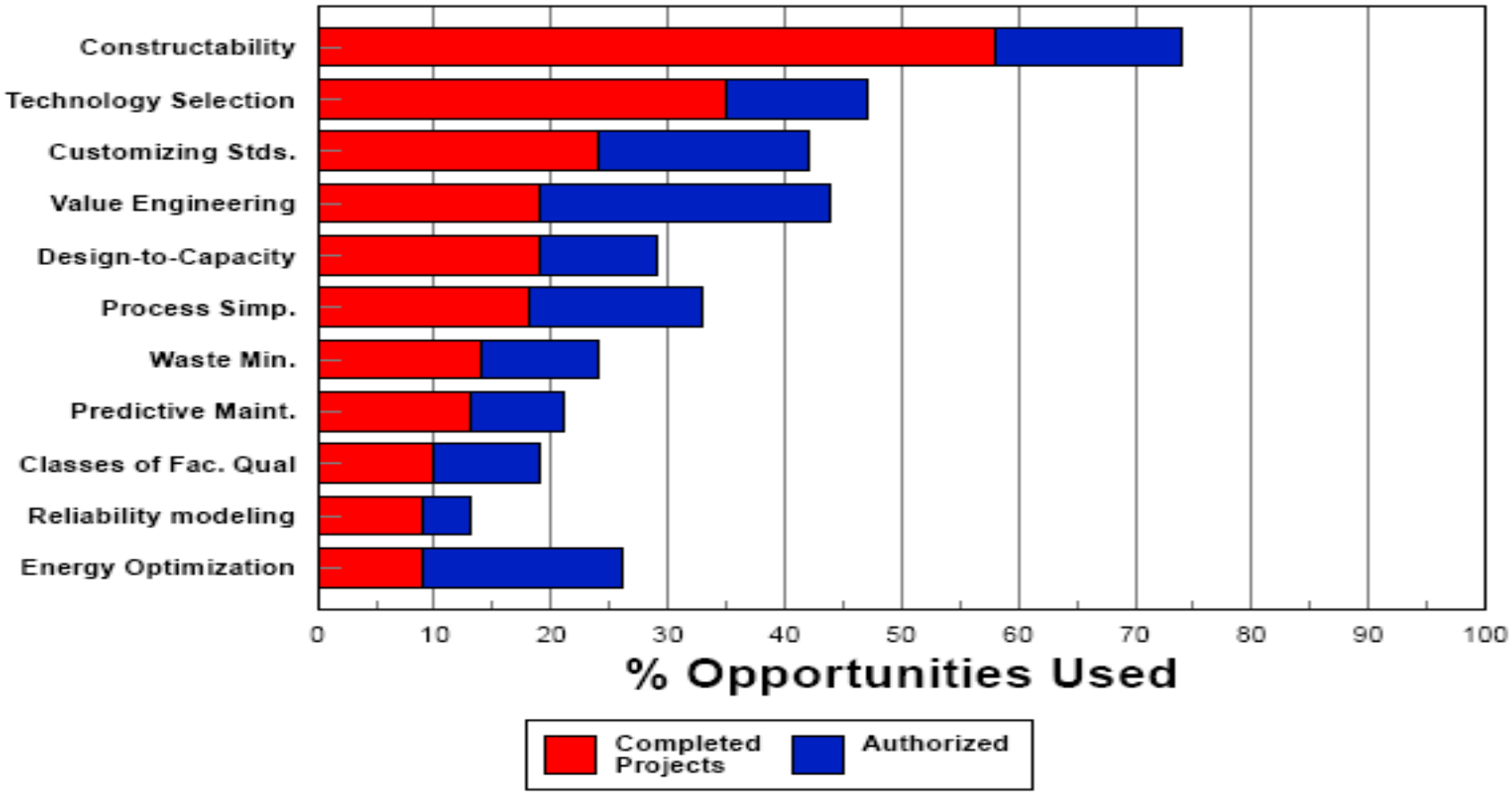
Measures of Value	Associated VIPS
Strategic Business Objectives	• Classes of Facility Quality • Technology Selection
Capital Cost *(Scope)*	• Process Simplification • Value Engineering • Design-to-Capacity • Customized Stds & Specs
Operating Cost *(Uptime, Utilities, and Maintenance)*	• Process Reliability Modeling • Predictive Maintenance • Energy Optimization • Waste Minimization
Execution Efficiency *(Cost and Schedule)*	• Constructability Reviews • 3D CAD

The Industry Approach (VIPs)



The Industry Approach (VIPs)

Which VIPs are Most Commonly Used



Value Engineering Methodology

Value Engineering Methodology

The **Value Methodology** **(VM)** is a systematic process used by a multidisciplinary team to improve the value of a project through the analysis of its functions.

- ❑ Value Analysis
- ❑ Value Engineering
- ❑ Value Management
- ❑ Value Control
- ❑ Value Improvement
- ❑ Value Assurance

Value Engineering Methodology

A **Value Study** is the formal application of a

value methodology to a project in order to

mprove its value.

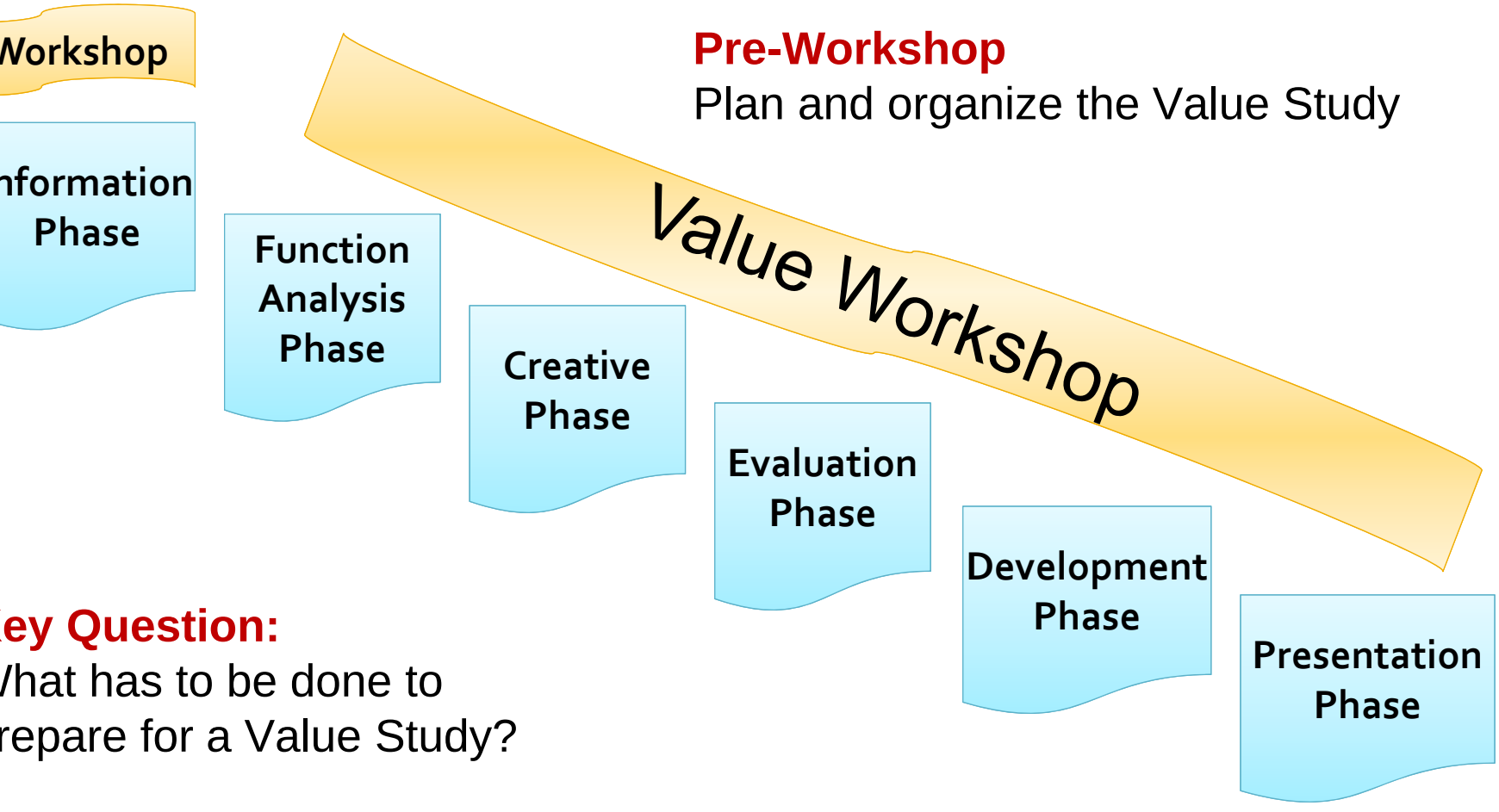
Value Engineering Methodology

Pre-Workshop (preparation)

Value Workshop (execution of the six-phase Job Plan)

Post-Workshop (documentation and implementation)

Value Engineering Methodology



Pre-Workshop
Plan and organize the Value Study

ey Question:
/hat has to be done to
repare for a Value Study?

Value Engineering Methodology

Workshop

Information Phase

Function Analysis Phase

Creative Phase

Evaluation Phase

Development Phase

Presentation Phase

Information Phase

The team reviews and defines the current conditions of the project and identifies the goals of the study.

Questions:

What is the current state/solution? (design)

What are the constraints/assumptions? (risk model)

Value Engineering Methodology

Workshop

Information Phase

Function Analysis Phase

Creative Phase

Evaluation Phase

Development Phase

Presentation Phase

Function Analysis Phase

The team defines the project functions.

The team reviews and analyzes those functions to determine which need improvement, elimination, or creation to meet the project's goals.

ain Technique:

- Function Analysis System Technique (FAST diagram)
- Value Index (Worth to Cost)

Value Engineering Methodology

Workshop

nformation Phase

Function Analysis Phase

Creative Phase

Evaluation Phase

Development Phase

Presentation Phase

Creative Phase

The team employs creative techniques to identify other ways to perform the project's function(s).

in Techniques:

Creative Thinking

Brainstorming

Value Engineering Methodology

Workshop

Information Phase

Function Analysis Phase

Creative Phase

Evaluation Phase

Development Phase

Presentation Phase

Evaluation Phase

The team follows a structured evaluation process to select those ideas that offer the potential for value improvement.

in Techniques:

Weighted Evaluation

80/20 Principle

Voting

Value Engineering Methodology

Workshop

nformation Phase

Function Analysis Phase

Creative Phase

Evaluation Phase

Development Phase

Presentation Phase

Development Phase

The team develops the selected ideas into alternatives (or proposals) with a sufficient level of documentation to allow decision making.

in Techniques:

Concepts Validation
Scenarios Development
Comparisons

Value Engineering Methodology

Workshop

Information Phase

Function Analysis Phase

Creative Phase

Evaluation Phase

Development Phase

Presentation Phase

Presentation Phase

The team leader develops a report and/or presentation that documents and conveys the adequacy of the alternative(s) developed and the associated value improvement opportunity.

ain Techniques

- Oral Presentation
- Written Report
- Answer Questions

Value Engineering Methodology

Workshop

nformation Phase

Function Analysis Phase

Creative Phase

Evaluation Phase

Development Phase

Presentation Phase

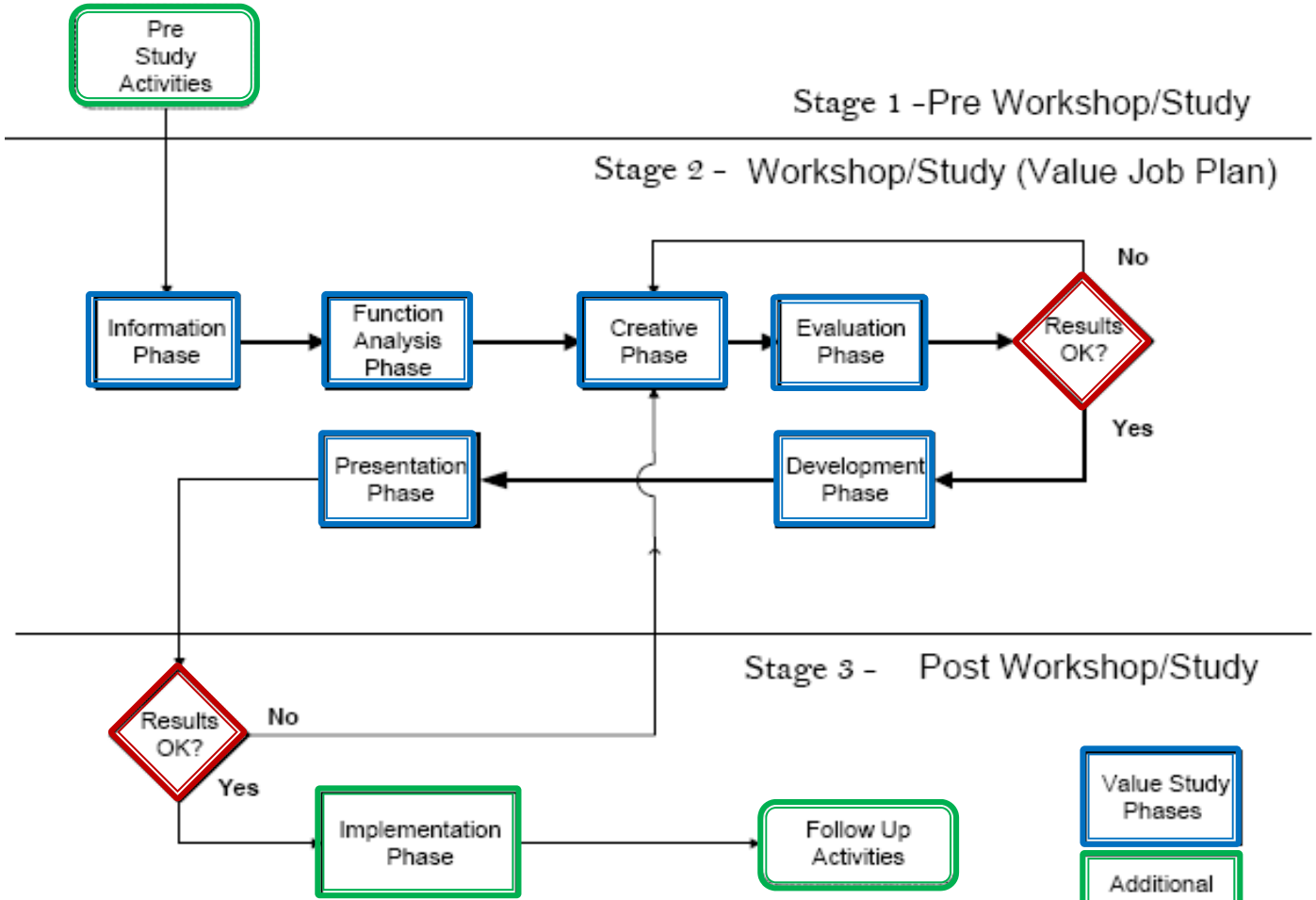
Post-Workshop

Ensure accepted value alternatives are implemented and that the benefits projected by the Value Study have been realized.

y Question:

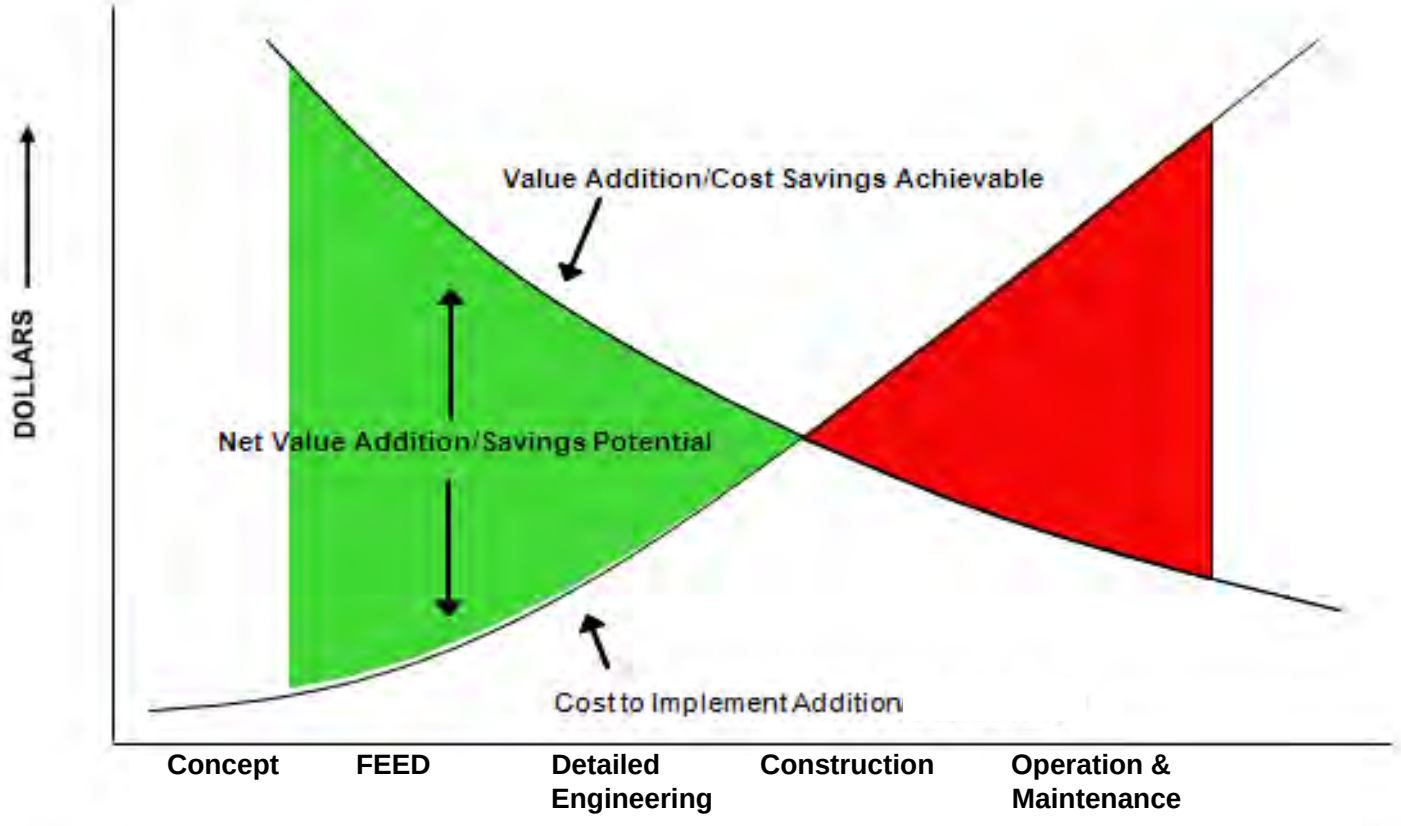
at are the solution changes, and how the project team manage them?

Value Engineering Methodology



Highlights

Timing for VE – Why is earlier better?



Highlights

Value Engineering Participants in Oil & Gas Projects

Multi-disciplined team members – process, rotating equipment, materials, and other disciplines with large cost impact.

Supporting team members – cost estimator, planner, construction specialist.

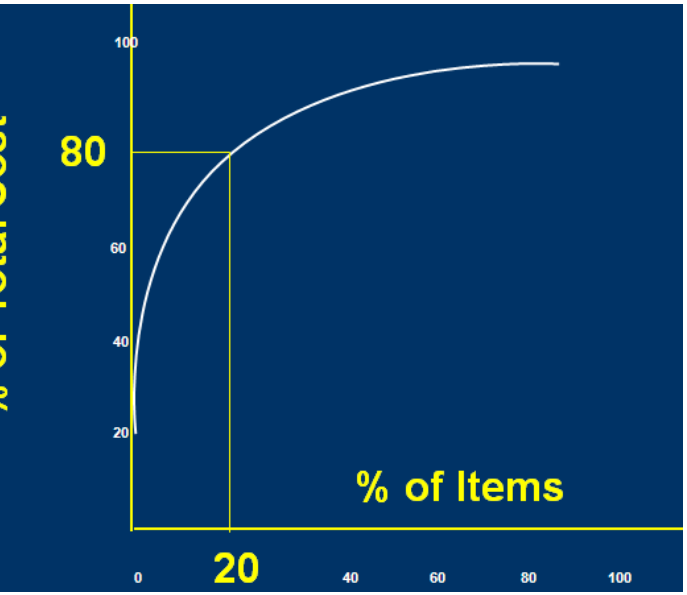
Facilitators – engineering management and project management.

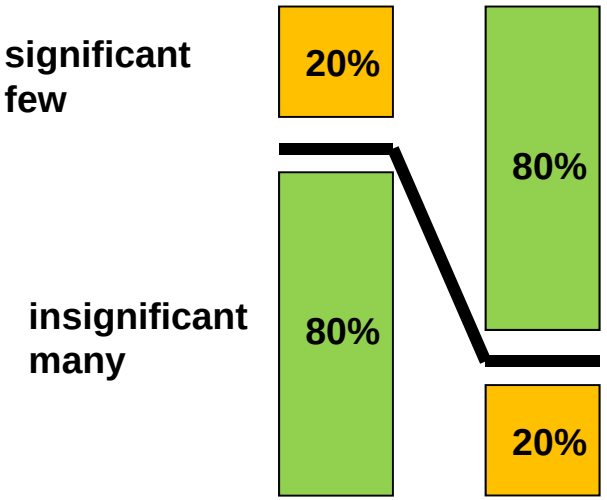
Operation Specialists – essential

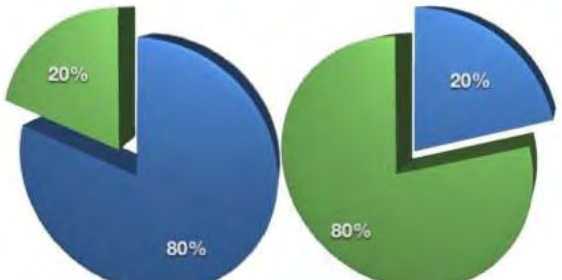
Highlights

areto's Rule

he 80/20 Principle







ue to limitations in time and resources in value
gineering exercises, the 80/20 Principle is

Highlights

Cost vs. Worth

ost is measured by the monetary value given for a quired function.

orth may be determined by the least cost to perform e required function.

orth, on the other hand, is assessed ing tools such as Need-Want-Desire.

Highlights

Cost vs. Worth

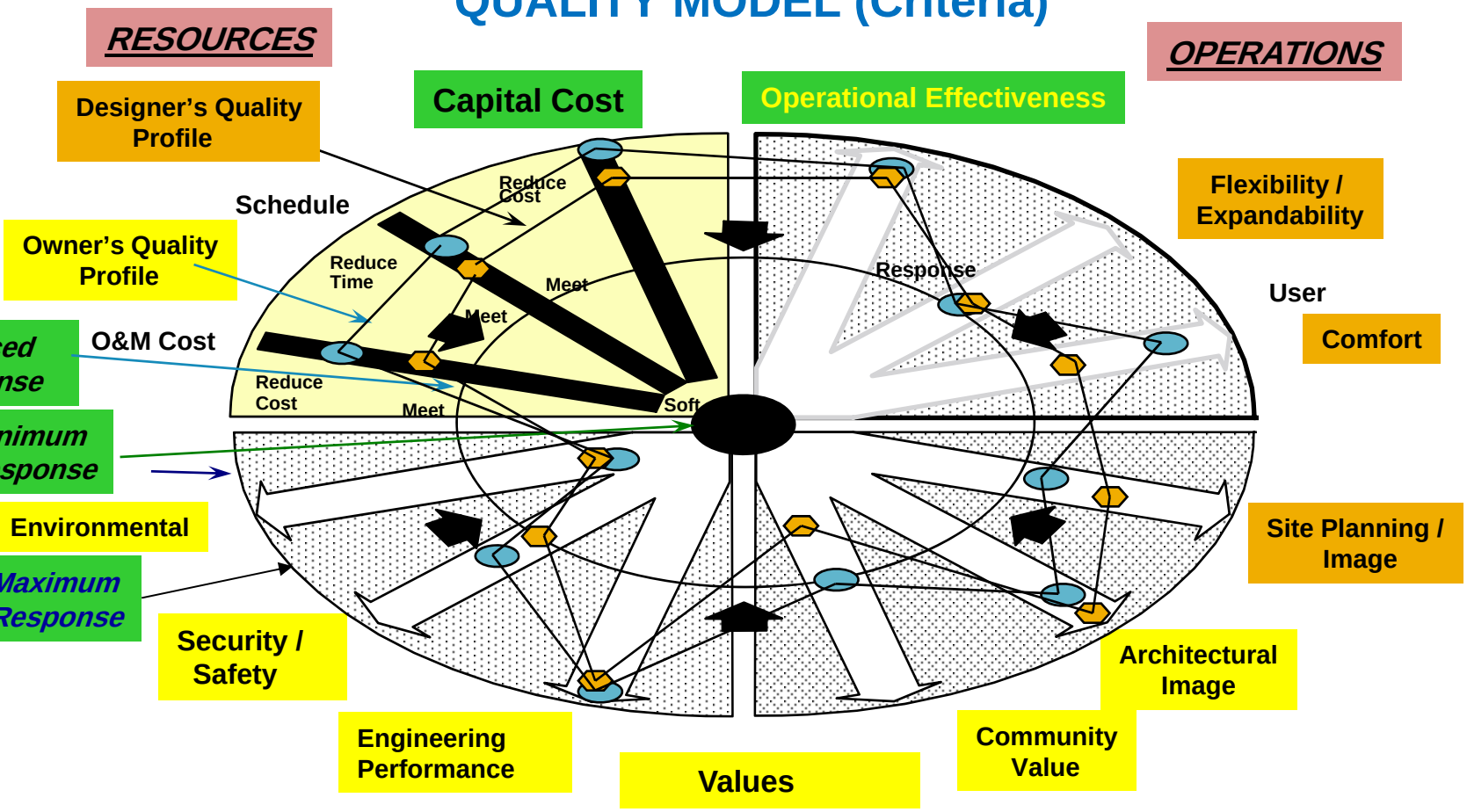
functional analysis, it is useful to introduce the

ost-worth ratio (value index) in order to help

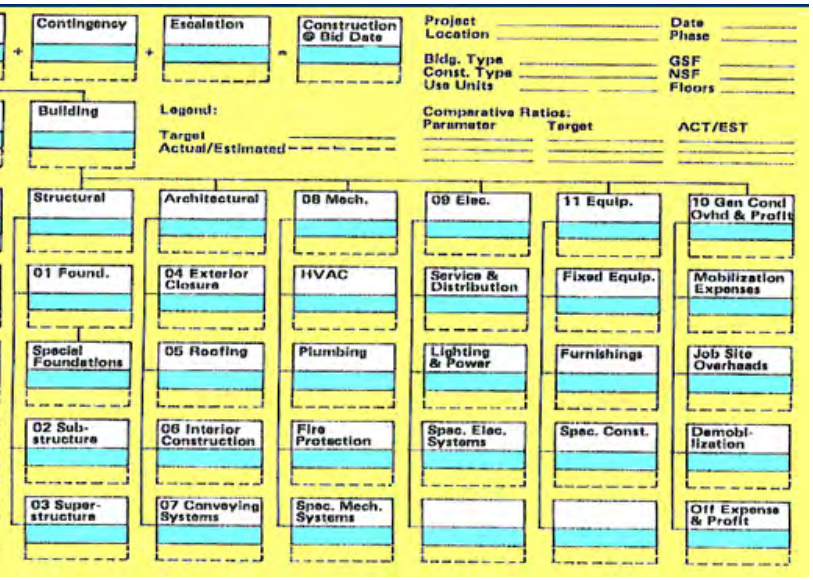
cusing on items with higher ratios.

Highlights

QUALITY MODEL (Criteria)

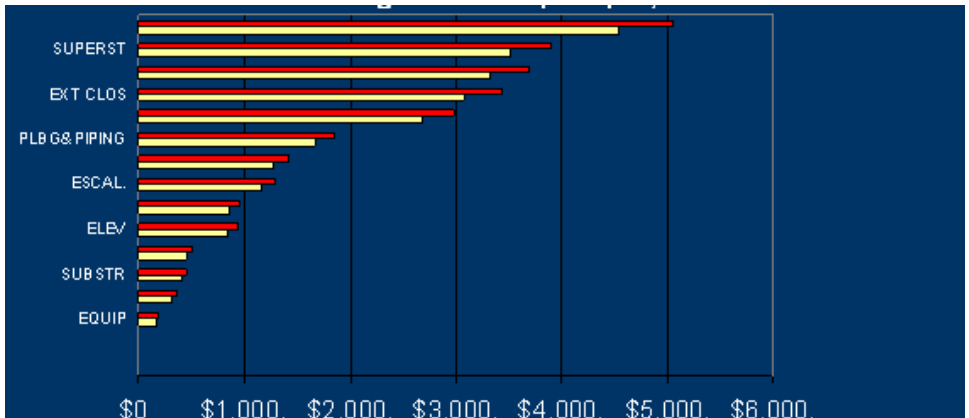


Highlights



Cost MODEL

FUNCTION COST-WORTH MODEL



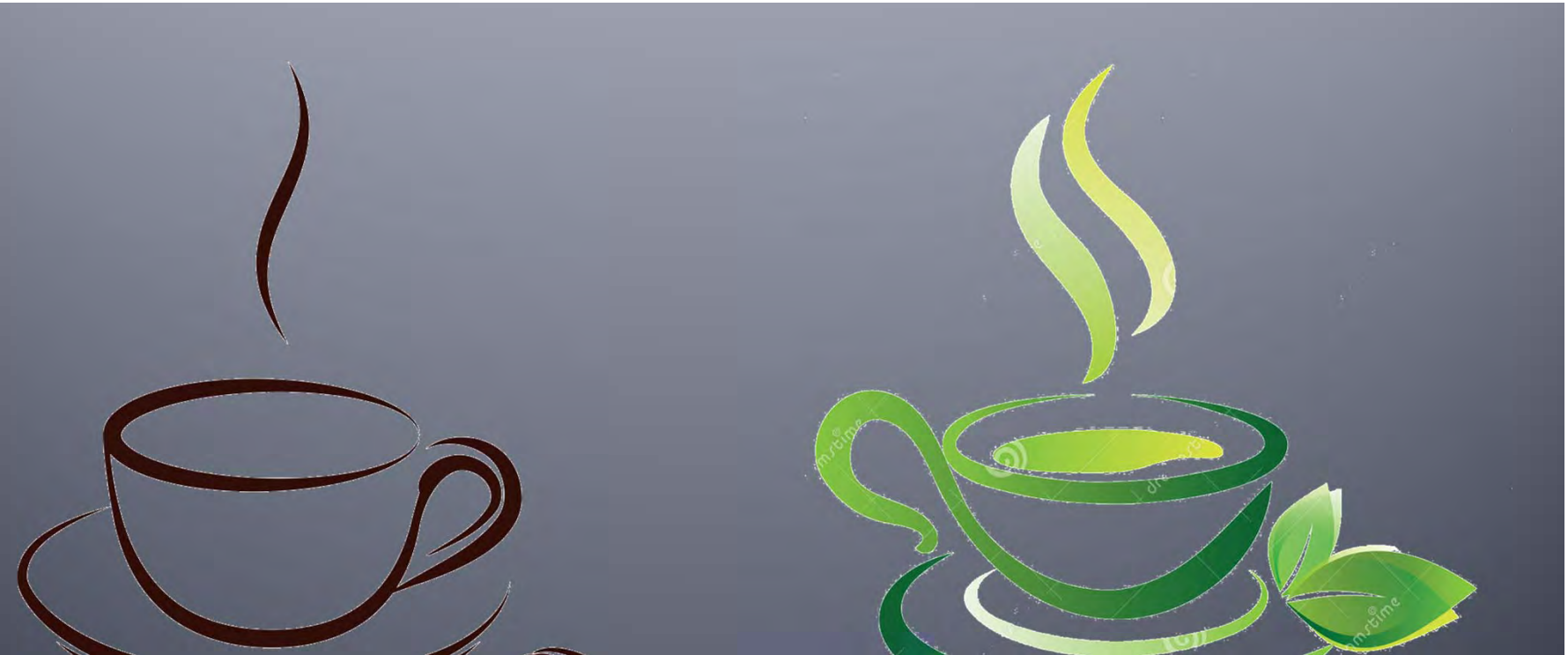
Highlights

wo essential tools and techniques used in

e Value Study are:

- Function Analysis System Technique (FAST diagram)
- Weighted Evaluation Template

Break



FAST Diagram

FUNCTION ANALYSIS

onent	Function Verb	Function Noun	P = Primary S = Secondary FUNCTION	Comment	Cost $	Worth $
/Worth Ratios = C/W					C	W

FAST Diagram

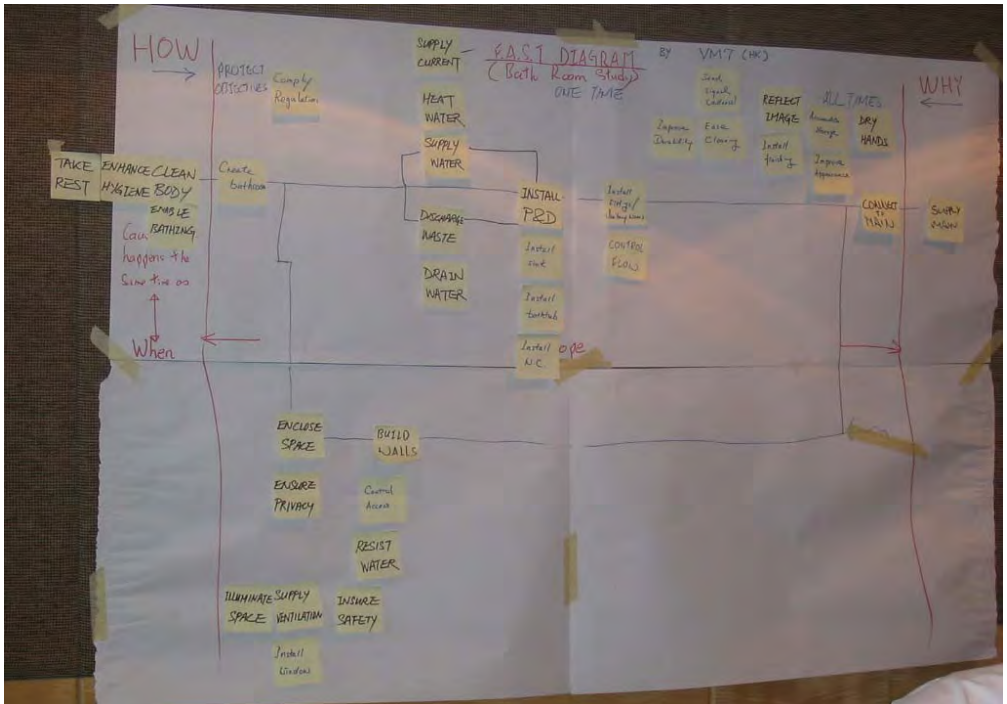
unction Analysis System Techniques (FAST):

function displaying

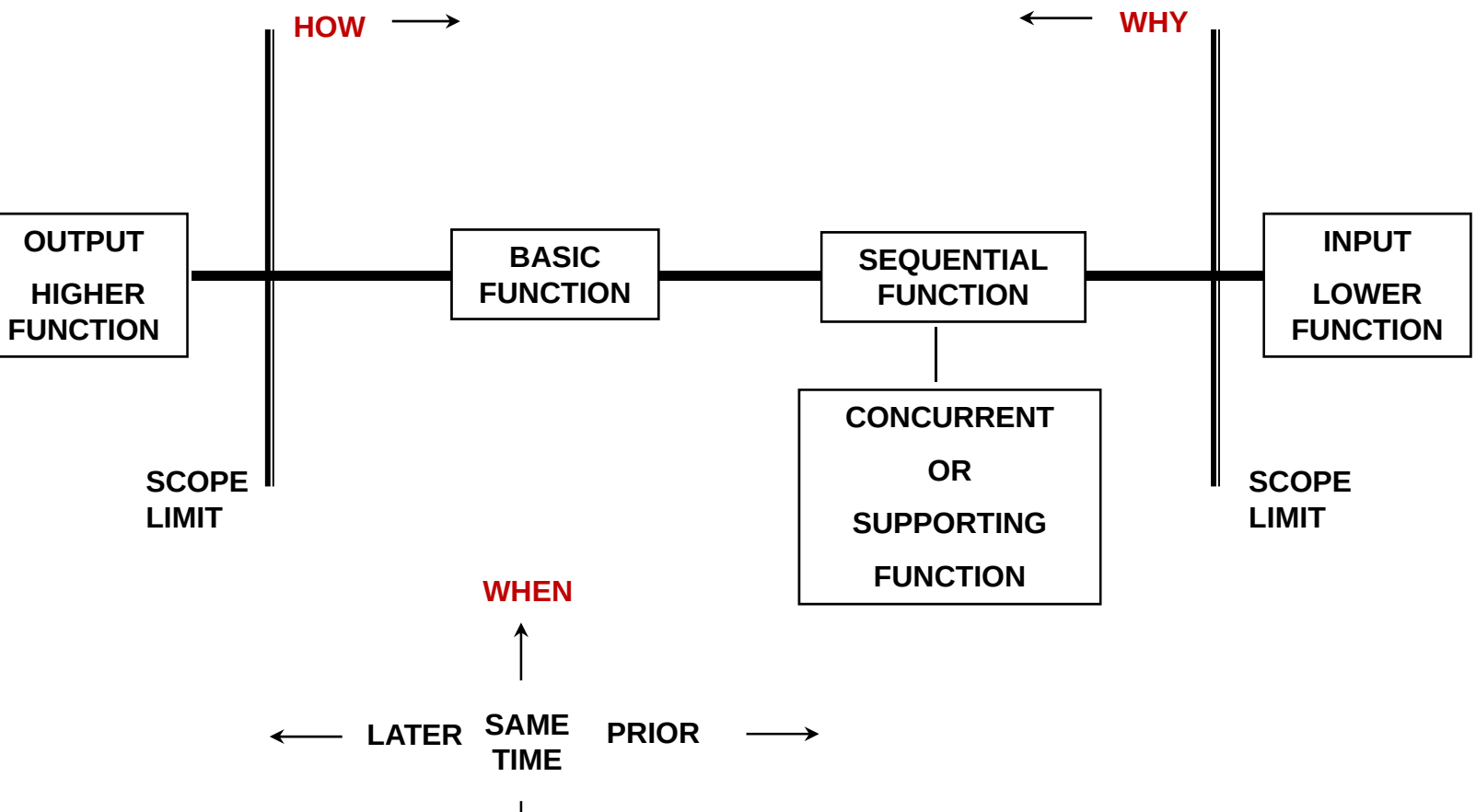
e interrelationship of

nctions to each other

a "**how-why**" logic.



FAST Diagram



Project Example

lan for field development in an oil and gas company

ned to increase the liquid handling capacity in order

sustain the crude production rate.

e to aging of the oilfield, water cut, which is currently

%, is being increased and expected to reach 30%

hin 7 years and 50% within 15 years.

Project Example

e conceptual studies adopted the approaches to
rease overall crude rate by artificial lifting for
covery improvement including water injection, gas lift,
d electrical submersible pumps.

e need to establish a project for the following
ilities was demonstrated :

Project Example

nstall new offshore flow stations contain oil/gas separators, pumps and transmission pipelines to onshore.

Expand onshore inlet separators' capacities to accommodate the ncreased production volumes.

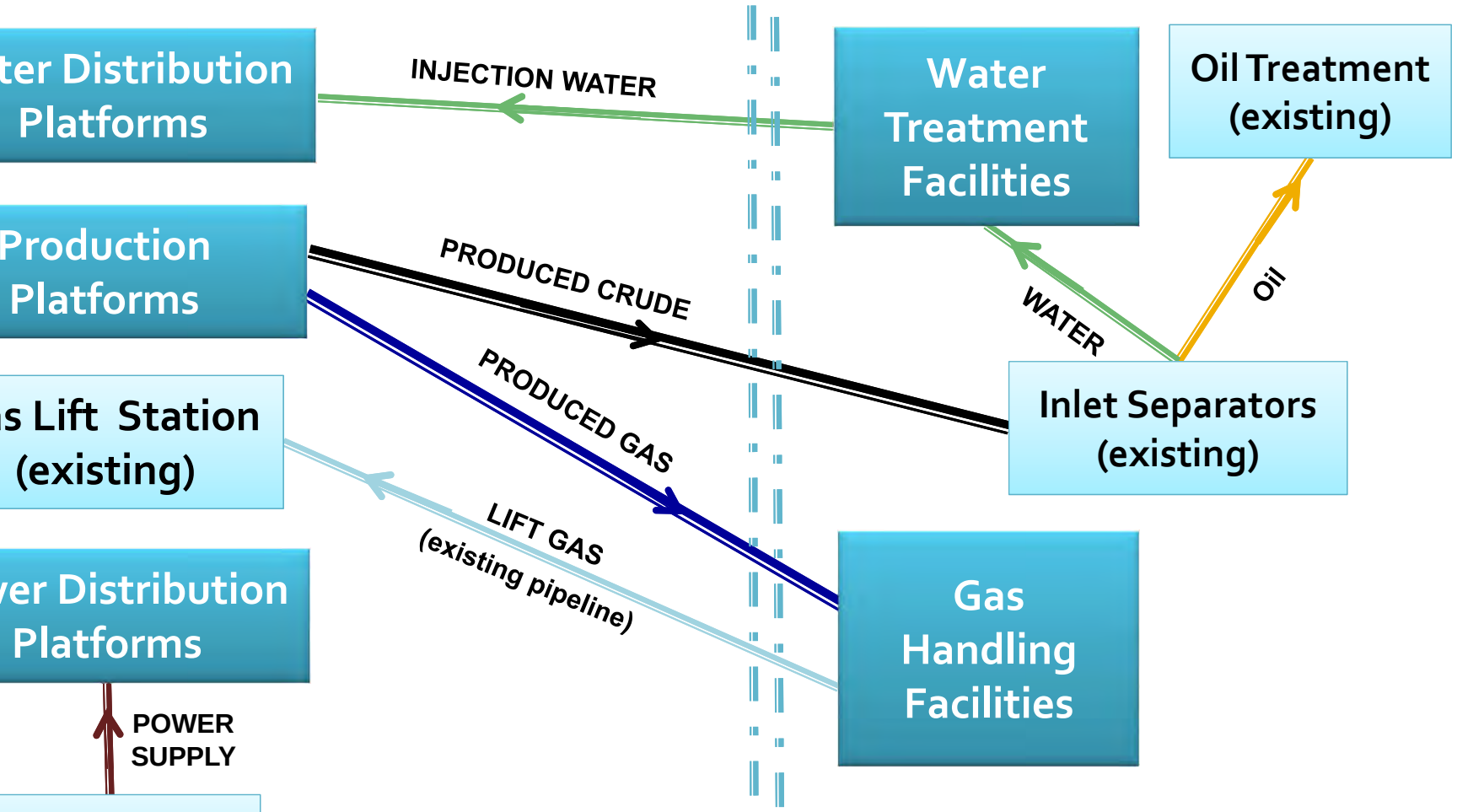
Expand the water treatment facilities to accommodate the ncreased water.

nstall water distribution platforms for injection of the treated water ncluding onshore injection pumps and submarine pipeline.

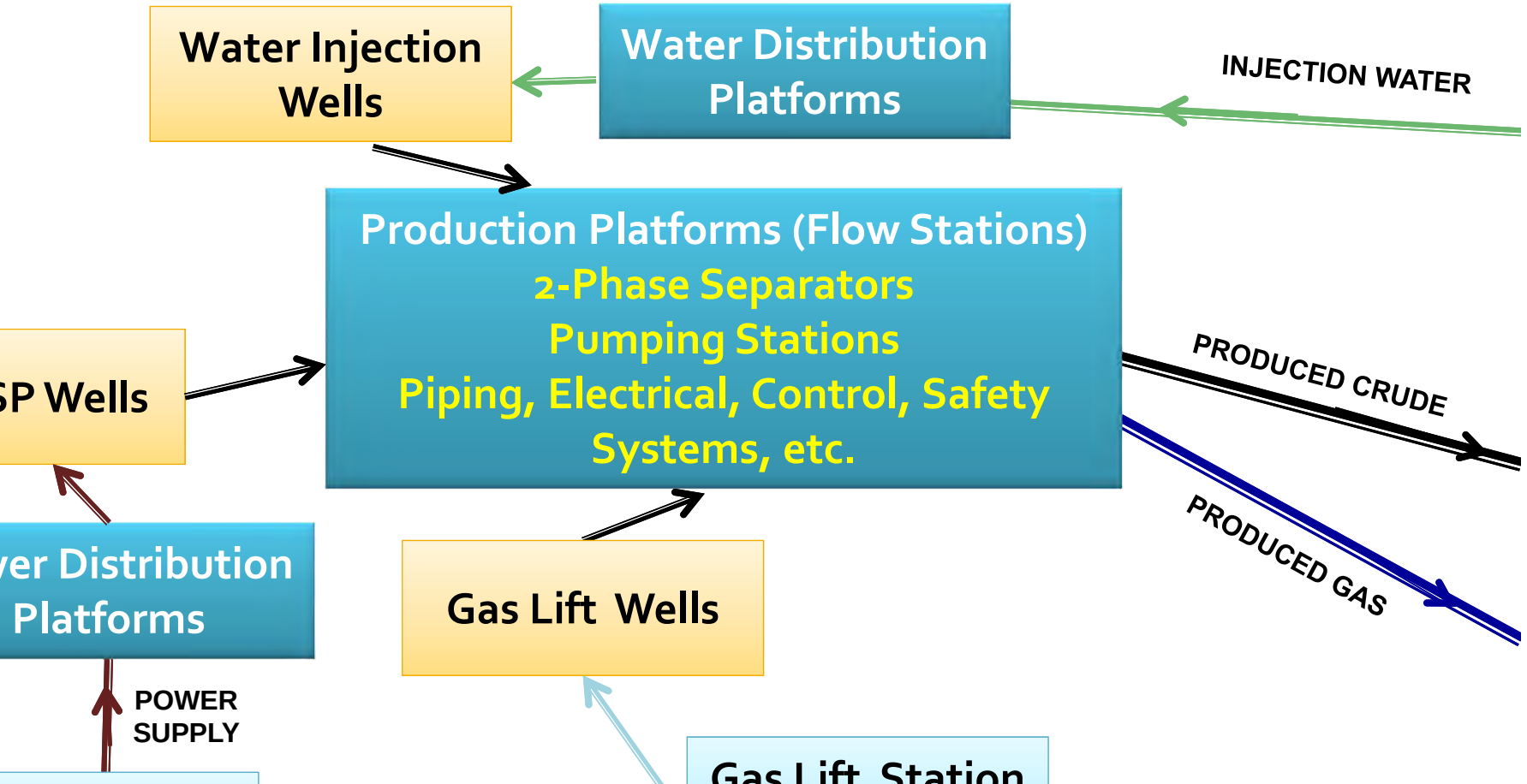
nstall onshore gas compressors for gas lift operations.

nstall new power distribution platforms and submarine cables to

Project Example



Project Example

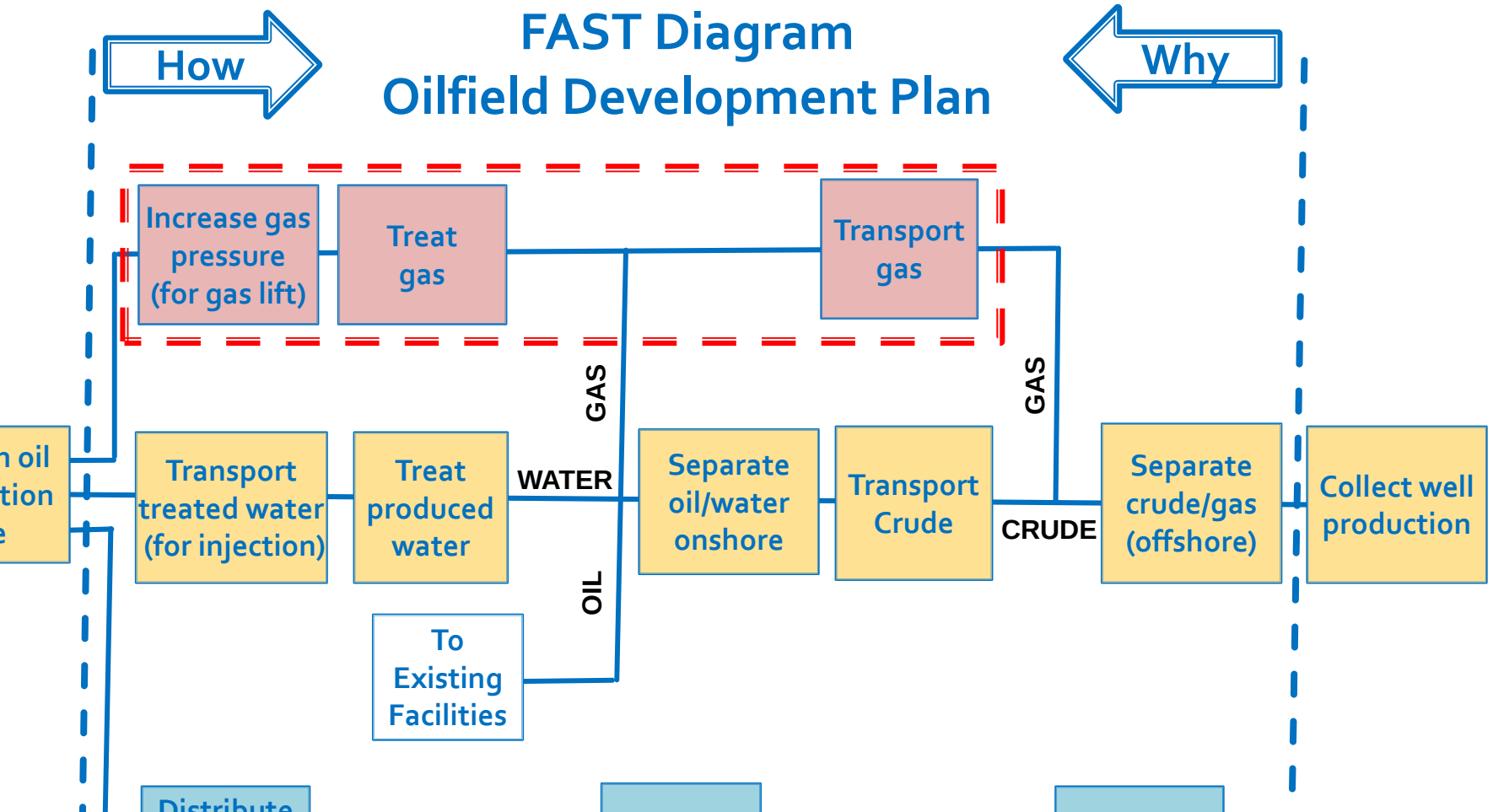


Project Example

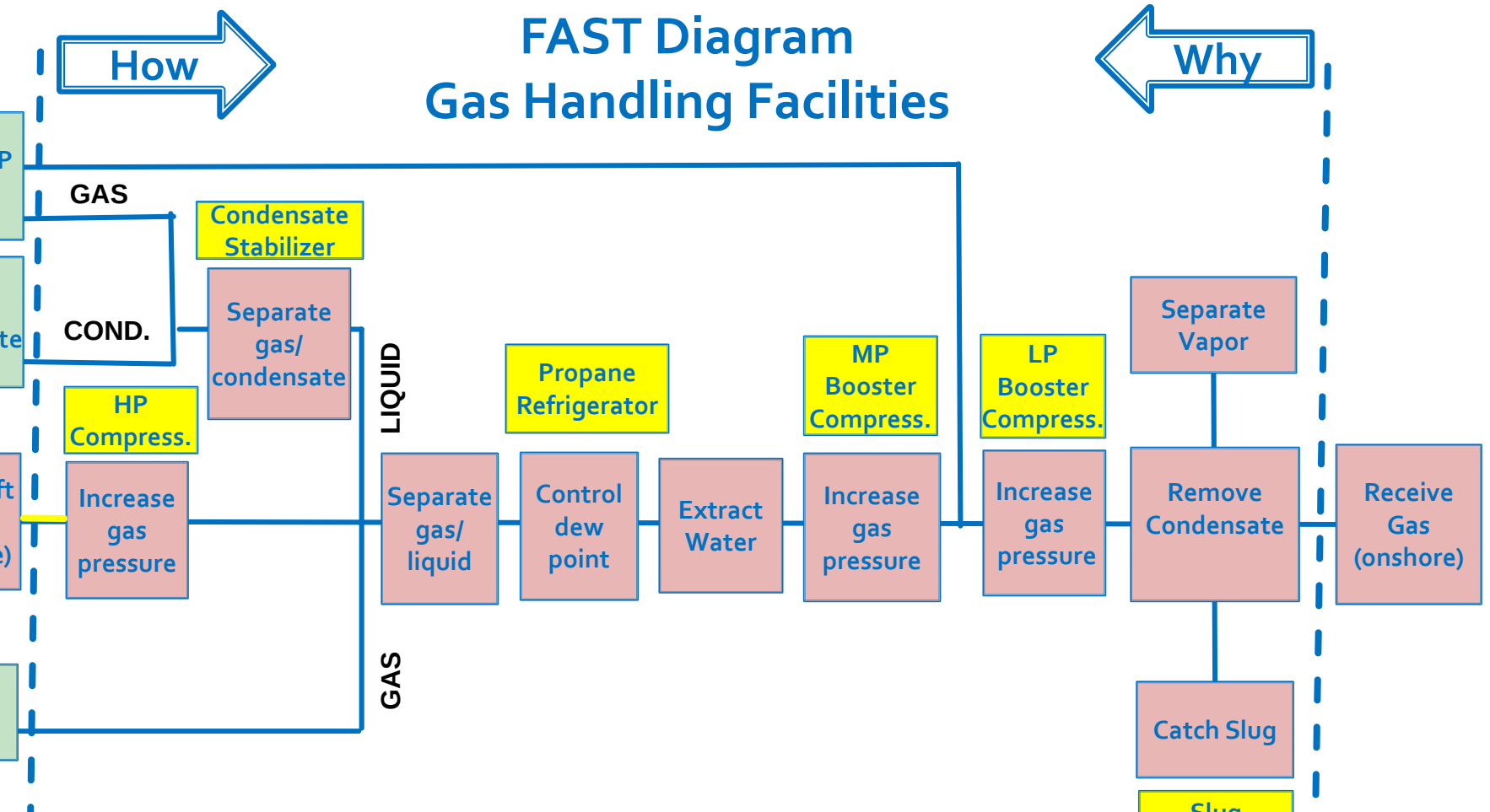
optimize **functionality** and **costs,** a Value Engineering
udy was initiated to take place with the following
rpose statement:

aximize project returns by eliminating non-value adding
ow-value adding components of the project and increase
pital effectiveness by minimizing the capital expenditure
quired to meet project objectives.”

Exercise


FAST Diagram
Oilfield Development Plan
How
Why
Increase gas pressure (for gas lift)
Treat gas
Transport gas
GAS
GAS
n oil
tion
e
Transport treated water (for injection)
Treat produced water
WATER
Separate oil/water onshore
Transport Crude
CRUDE
Separate crude/gas (offshore)
Collect well production
OIL
To Existing Facilities

Exercise


How
FAST Diagram
Gas Handling Facilities
Why
GAS
COND.
Condensate Stabilizer
Separate gas/ condensate
HP Compress.
Increase gas pressure
LIQUID
GAS
Separate gas/ liquid
Control dew point
Propane Refrigerator
Extract Water
MP Booster Compress.
Increase gas pressure
LP Booster Compress.
Increase gas pressure
Separate Vapor
Remove Condensate
Receive Gas (onshore)
Catch Slug

Project Example

pon completing the value engineering workshop,

e following results were presented:

Potential cost saving estimated at approximately **US$ 42 MM**

(Capex 28 MM and Opex 14 MM).

Optimized onshore and offshore facilities and operations.

Maximized availability of water treatment facilities.

Optimized expandability of water treatment facilities.

Maximized controllability of gas handling facilities.

Optimized plot area of gas handling facilities.

Project Example

on proceeding with implementation phase, a proven cost saving of

$ 34 MM (Capex US$ 24 MM and Opex US$ 10 MM) was justified.

following items were key potential output (only few listed):

Postpone two 12” interconnecting submarine pipelines.

Eliminate the MP compressors and adjust LP & HP compressors.

Change compressor drivers from gas turbines to 13.2 kV induction motors.

Utilize existing slug catcher.

Utilize existing 12” submarine gas pipeline in reverse flow.

Optimize sparing configuration of nutshell filters.

Eliminate the internal FBE coating for the 20” water injection pipeline.

FAST Diagram (RECAPPING)

Identify functions (verb + noun), not equipment.

Breakdown large complex problem into manageable pieces.

Use it as good basis for brainstorming.

Look for non-value adding steps;

Functions that you Do and then Undo:

- Cool off, then heat
- Solidify, then melt
- Let down, then re-pressure
- Dissolve, then dry

Observe value index.

Weighted Evaluation Technique

he weighted evaluation technique can be useful when
ere are a number of elements in the project criteria

e pre determined criteria for value may include:

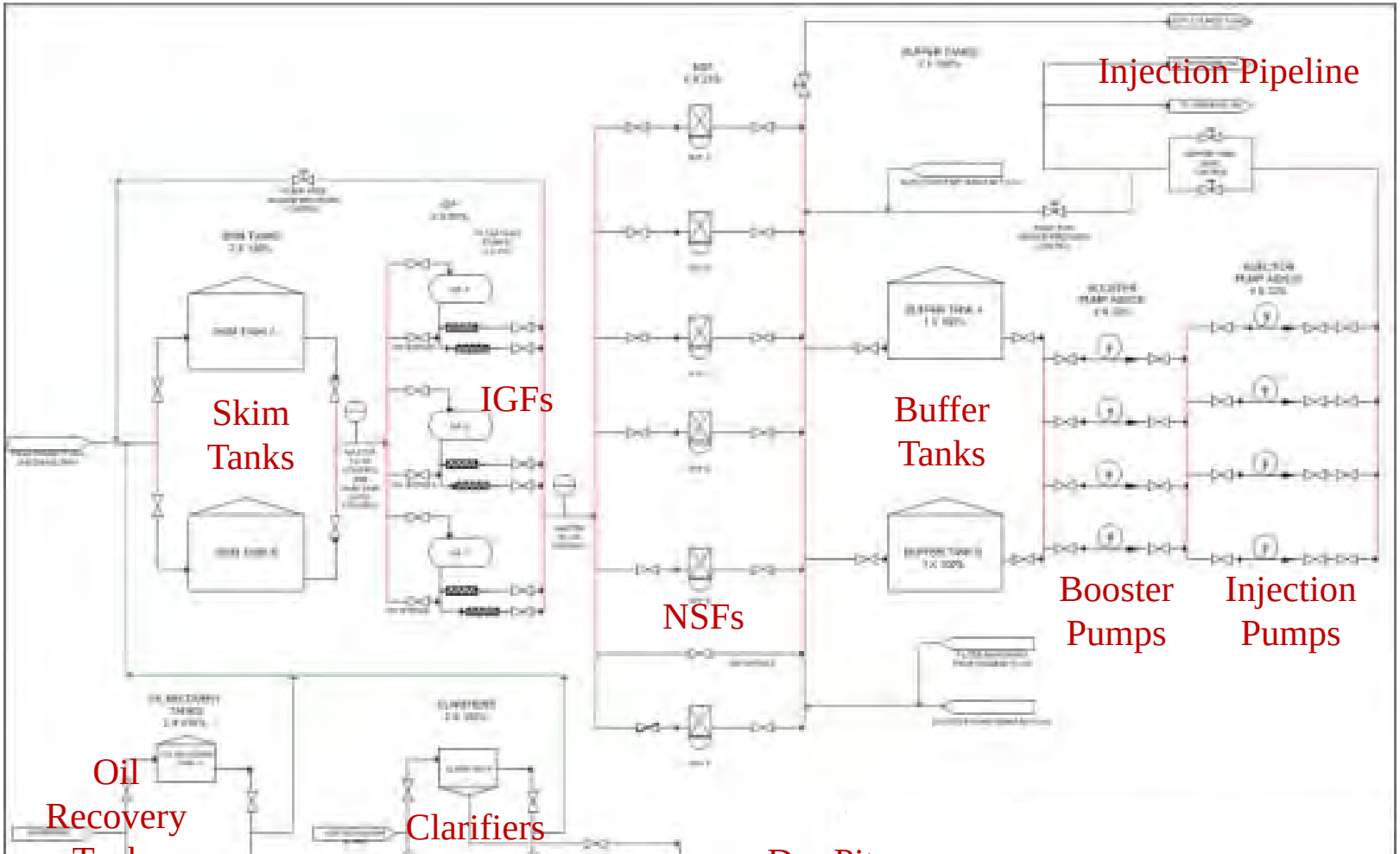
- Capex
- Opex
- Area-Space Utilization
- Execution Schedule
- Construction Effectiveness
- Operation Efficiency
- Ease of Operation
- Ease of Maintenance

Weighted Evaluation Technique

Two Main Steps to Conduct Weighted Evaluation

1	2
ompare and weight the criteria be used in the evaluation of eas/systems.	**Compare and rank the ideas** that were generated in the previous steps.
hat is the relative preference mong the criteria:	To which extent a criterion is satisfied by an idea/alternative:
4 = Major preference 3 = Medium preference 2 = Minor preference 1 = Equal preference	5 = Excellent 4 = Very Good 3 = Good 2 = Fair

Exercise


Injection Pipeline
Skim Tanks
IGFs
Buffer Tanks
NSFs
Booster Pumps
Injection Pumps
Oil Recovery
Clarifiers

Exercise

luate two alternatives for Water Treatment Facilities against four eria (CAPEX, OPEX, EXEC SCHEDULE, PLOT AREA)

(excellent CAPEX – fair OPEX – poor SCH – good AREA)

(good CAPEX – excellent OPEX – v. good SCH – fair AREA)

Consider that the most important criteria for this project is the CAPEX.
Both the OPEX and PLOT AREA are of the same importance.

Exercise

CRITERIA	A	B	C	D	E	F	G	H
apital cost								
perating cost								
Execution Schedule								
lot Area								
nt of importance (total raw score)								
	A	B	C	D	E	F	G	H

4 = Major preference
3 = Medium preference
2 = Minor preference
1 = Equal preference
0 = Beaten preference

5 = Excellent
4 = Very Good
3 = Good
2 = Fair
1 = Poor

IDEAS EVALUATION									
IDEA / OPTION / ALTERNATIVE	How well the idea/option/alternative fulfill the criterion?								TOTALS
lt 1 (Skim Tanks - IGFs - NSFs)									
lt 2 (Hydrocyclone - CPIs - IGFS)									

Final Thought

Critical Success Factors for VE

ethodology

systematically follow value engineering job plan.

rticipants

ensure right attitude, appropriate participants, awareness of ocess.

ming

be applied at the optimum time in the project and initiated in e front-end phase.

egration

be made a focused event and seen as an integral part of the

Critical Success Factors for VE

orkshop Facilitation

probe with right questions, use appropriate tools, manage
e process, maintain momentum of team, etc.

ocumentation

be fully documented.

anagement of Process

ensure clear objectives, timelines, follow-up actions, review
d feedback.

ecutive Support

be promoted and sponsored by senior management

Better – Cheaper – Faster – Safer

PROJECTS

Appropriate application of Value Engineering

at the Right Time

with the Right Participants

can help achieve

World-Class Project Performance.

THANK YOU