A Prospective Evaluation of the Samarang Phase 2 Project

Prepared for
PETRONAS

Prepared by
Khanh Nguyen and Galvin Singh

December 2011

FINAL

IPA INDEPENDENT PROJECT ANALYSIS, INC.

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Prepared by Khanh Nguyen and Galvin Singh
Reviewed by Paul Barshop
Edited by Loren Farrar
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Preface

- **Members of PETRONAS-Schlumberger alliance project team supplied information in meetings on 11 and 12 October 2011 in Kuala Lumpur**

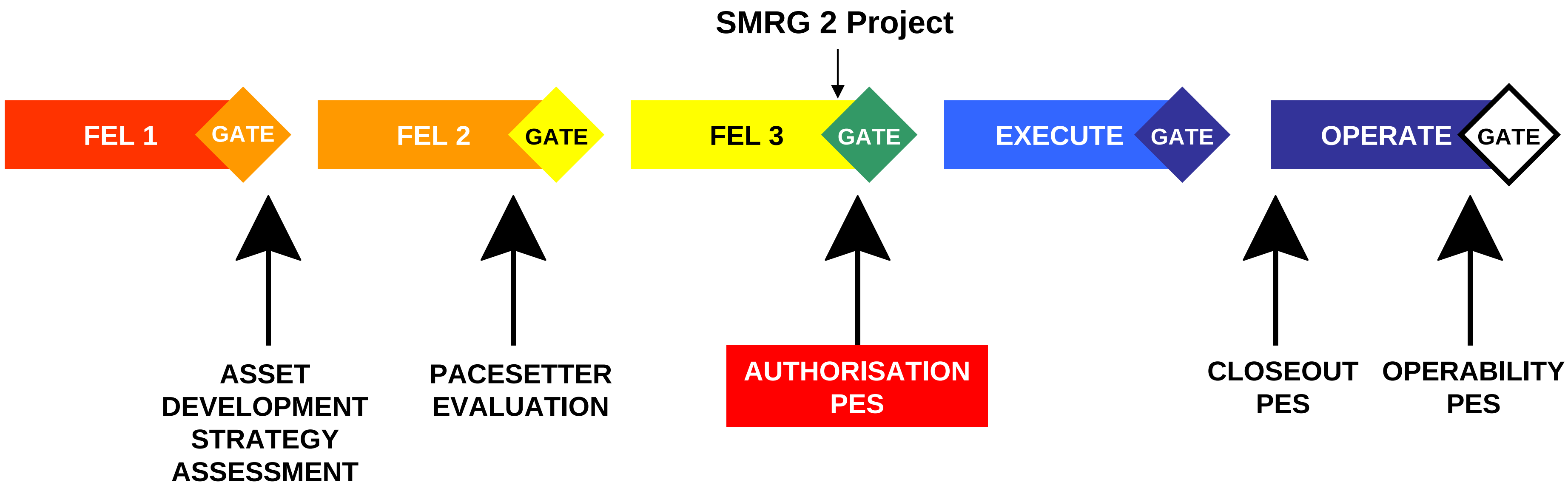
- **Although project team members provided information, interpretation and analysis are IPA's and do not necessarily reflect views of those interviewed**

- **For more information, contact**
  - **Khanh Nguyen at +65 9721 7964 or at knguyen@ipaglobal.com**
  - **Galvin Singh at +65 8223 7628 or at gsingh@ipaglobal.com**

Objectives of This Prospective Analysis

- **Provide feedback on Samarang Phase 2 (SMRG 2) Project status at sanction**
  - **Determine if Front-End Loading (FEL) and other drivers meet Best Practice**
  - **Identify gaps that may preclude project excellence**
- **Provide benchmarks of project cost and schedule expectations**
- **Share research to identify areas of risk and offer mitigation strategies**
- **Present recommendations for risk reduction and performance improvement**

When Does IPA Get Involved in Projects?



- **Pacesetter project evaluation to set targets, identify Best Practices, and quantify cost/schedule risks early**
- **Authorisation project evaluation when estimating data are available, support Decision Support Package for Development Stage**
- **Closeout after startup, but prior to team being reassigned**
- **Operability after first year of operation**

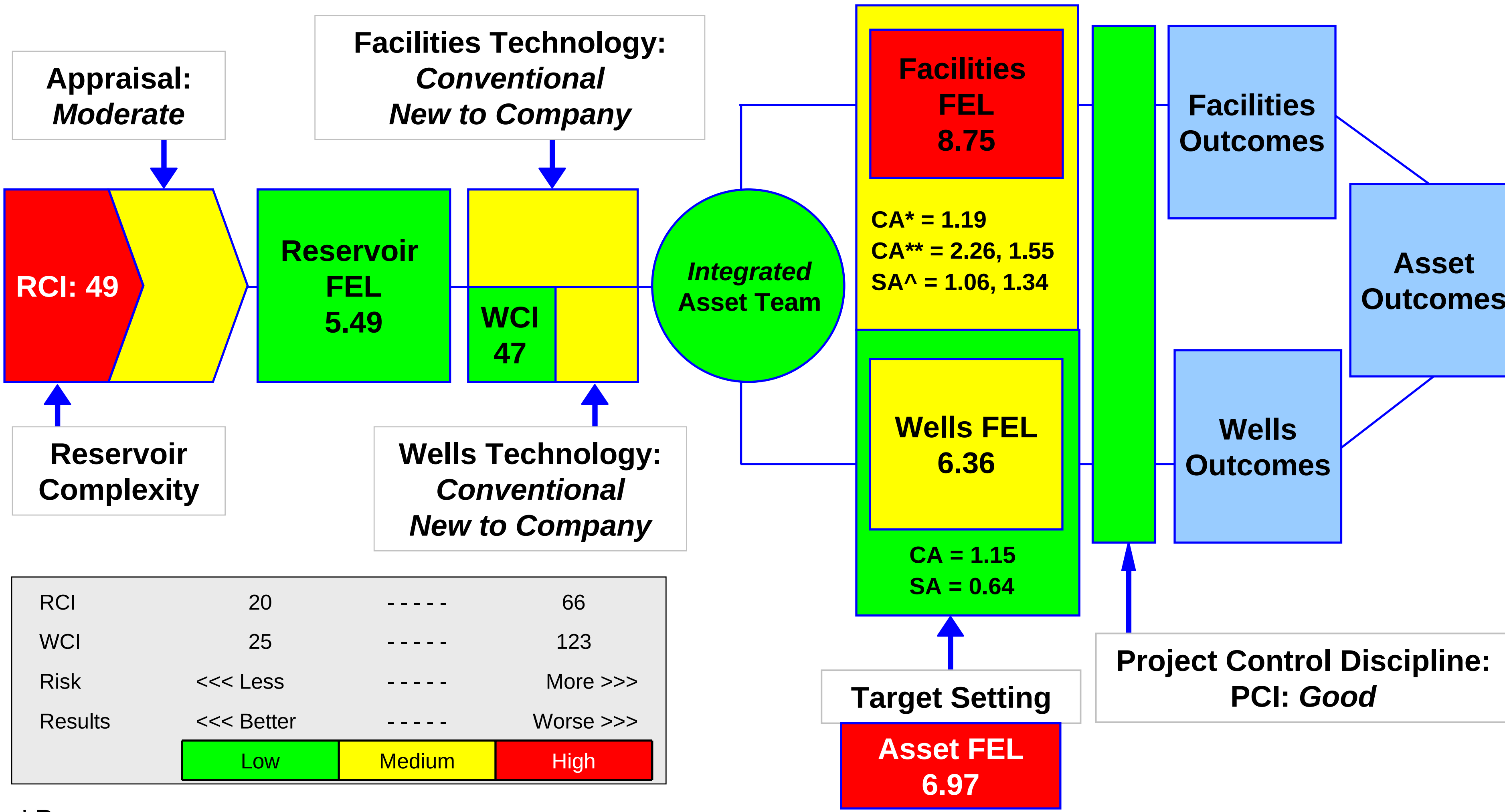
Outline

- ***Key Message***
- **Project Background**
- **Basis of Comparison**
- **Practices and Drivers**
- **Targeted Outcomes**
- **Conclusions**
- **Recommendations**

Key Message

- **SMRG 2 has an *Integrated* asset team and *Good* project control plans**
- **However, it is entering the sanction phase with significant gaps:**
  - **The viability of GASWAG has not been confirmed**
  - **FEED for the SMG-AA floatover concept and flexible pipelines are not yet done**
  - **Scope of wells campaign is not confirmed**
- **With these gaps, the current cost and schedule targets are unlikely to be achieved**
- **The team needs time for further definition work to deliver a successful project**

Summary of SMRG 2 Project (October 2011)



RCI	20	- - - - -	66
WCI	25	- - - - -	123
Risk	<<< Less	- - - - -	More >>>
Results	<<< Better	- - - - -	Worse >>>
	Low	Medium	High

*** Revamp scope**
**** 14-inch and 16-inch LP gas pipelines**
^ Based on 41- and 52-month execution durations
Note: SMG-AA, SMJT-AA, and SMW-B were not benchmarked

RCI = Reservoir Complexity Index
WCI = Wells Complexity Index
FEL = Front-End Loading

CA = Cost Aggressiveness
SA = Schedule Aggressiveness
PCI = Project Control Index

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Project Background (1)
Field History

- Samarang field is in South China Sea off coast of Sabah, East Malaysia, about 72 km northwest of Labuan Gas Terminal; field covers about 7 km X 2 km
- Samarang field discovered in 1972 by SM-1 well and was developed in phases—first oil achieved in June 1975
- Existing Samarang complex comprised of seven platforms (drilling, wellhead platforms, processing platforms, etc.)
- Shell was previous operator and relinquished concession to PCSB* in April 1995
- Current production license for Samarang field will expire in 2020

* PCSB = PETRONAS Carigali Sdn Bhd

Project Background (2)
Field History

- In late 1997, Samarang was upgraded as hub
  - Several offset fields (including Kinabalu, Samarang Kecil, and Sumandak) were tied in to Samarang facilities and shared export line to LCOT and LGAST*
- Total of 62 development wells drilled from 1975 to 1979 on SMDP-A, B and SMJT-C, D, and E platforms

* LCOT = Labuan Crude Oil Terminal and LGAST = Labuan Gas Terminal

Project Background (3)
Field History

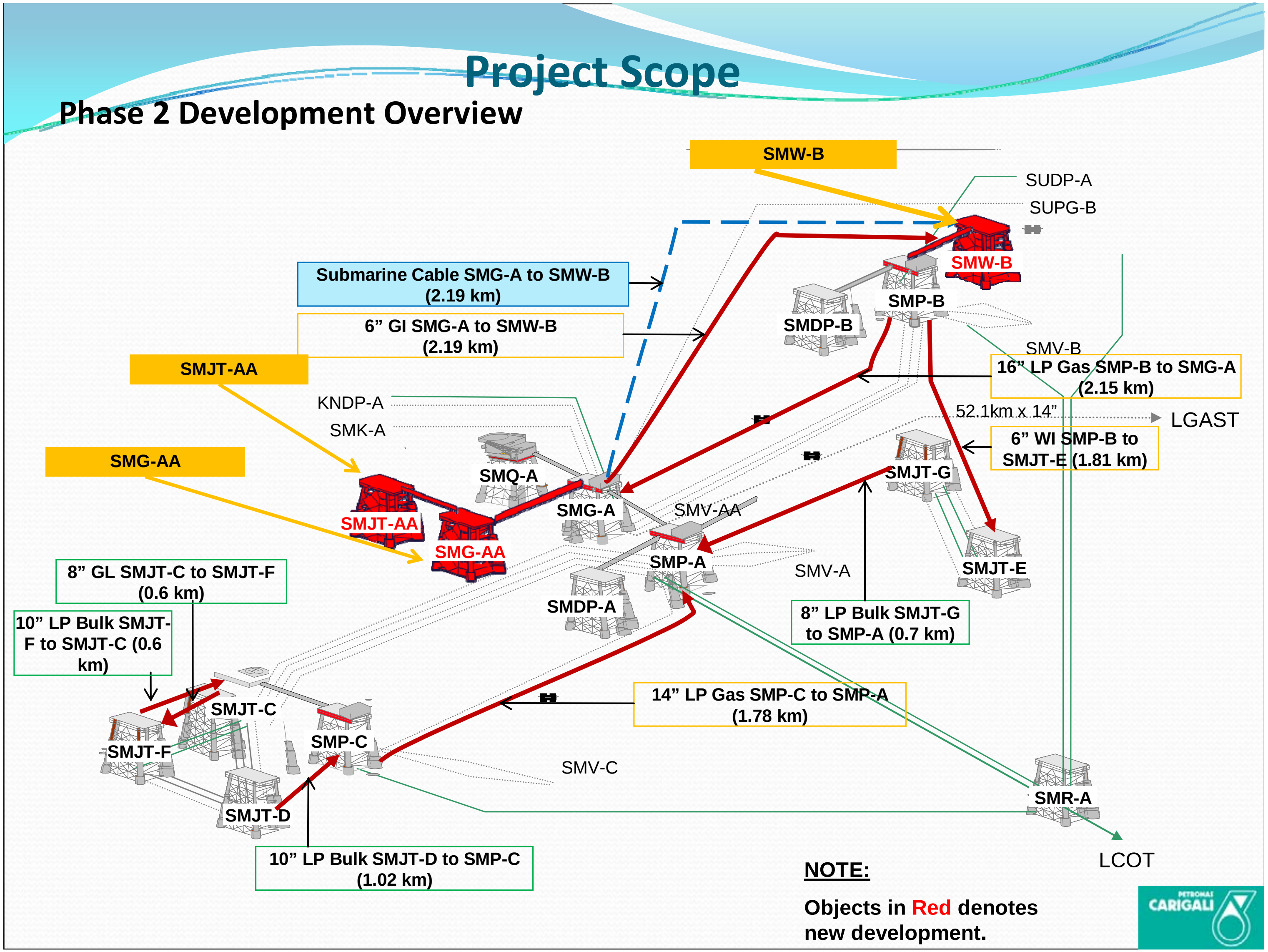
- **Field revisited several times since:**
  - **1986/87: 12 wells (SMJT-F, G) and 20 sidetracks on SMDP-A, B and SMJT-C, D, and E**
  - **1991/93: 27 sidetracks—3 were workovers and 2 were new wells on SMDP-A, B and SMJT-C, D, and F**
  - **1997/98: 3 sidetrack wells, 1x HHP gas, and 5 new wells in SMJT-D, F, and G**
  - **2002: 2 sidetracks (SM-52 and SM-57) and 1 recompletion (SM-42)**

Project Objectives
SMRG 2 Project

- **To maximise value from maturing Samarang field via implementation of enhanced oil recovery (EOR) – Gravity Assisted Simultaneous Water and Gas (GASWAG) scheme is planned**
- **Targeting total recovery of 44.7 million barrels (MMbbls) (to 2035)**
  - **23.7 MMbbls from infill and 21 MMbbls from EOR**
- **Total cost estimate of US$1.58 billion**
- **Target dates*:**
  - **First oil from infill drilling on 19 June 2013**
  - **First water injection on 25 September 2015**
  - **First gas injection on 19 November 2015**

*** Note that the team has committed to management to produce first oil on 4 January 2014, first water injection on 4 August 2016 and first gas injection on 16 October 2016**

Project Scope (1)
SMRG 2 Project



Source: Samarang Phase 2 Project Schedule Risk Analysis, 1 August 2010

Project Scope (2)
SMRG 2 Project

- **3 platforms:**
  - **SMG-AA compression platform**
  - **SMJT-AA drilling platform**
  - **SMW-B water injection platform**
- **8 infill pipelines**
- **1 submarine cable**
- **Brownfield work on 11 existing platforms**
  - **Platform upgrade, revisit, tie-in, and integrate operations (I/O)**
- **Drilling campaign**
  - **11 infill drilling wells**
  - **4 EOR, 5 water injection, and 4 gas injection wells**

Project History (1)
SMRG 2 Project

- **Field redevelopment concept endorsed in April 2009**
- **In 2009, project split into two phases**
  - **Phase 1: 5 infill wells to prove attic oil concept and gather data for EOR scope and reservoir management**
  - **Phase 2: complete field redevelopment**
- **Phase 1 sanctioned in May 2010 and achieved first oil on 31 July 2011**
- **More oil bearing sands found from Phase 1 wells data:**
  - **3 additional wells from SMJT-F platform planned to be drilled**
  - **Decision on spud date yet to be made**
- **Analysis of cores taken from Phase 1 completed, except for core flooding studies viable for EOR concept**

Project History (2)
SMRG 2 Project

- **Facilities FEED completed in April 2011**
  - **Modular concept for SMG-AA**
  - **Rigid pipelines**
- **In early September 2011, decision made to change to SMG-AA floatover and use flexible pipelines**
- **Project passed MR#5 on 28 September 2011**
- **Overall contracting strategy presented to decision review board in November 2011**
- **Team in process of preparing ITB packages**
- **Tier 1 sanction planned for February 2012 and Tier 2 sanction scheduled for October 2012***

*** Tier 1 sanction is fund approval for procurement and Tier 2 sanction is full-funds authorisation**

Project Execution Strategy (1)
SMRG 2 Project

- **EPCIC* to be used for SMG-AA platform**
  - **GMP** basis**
  - **Installation included because unconventional modular installation to be used for floatover**
  - **Possibility of using fabricators outside Malaysia being explored**
- **EPCC*** to be used for SMJT-AA and SMW-B**
  - **GMP basis**
  - **Modular installation based on Pan-Malaysia contract**** and to be managed centrally by PETRONAS**
- **EPC lump-sum to be used for brownfield work**

* EPCIC = Engineering, procurement, construction installation, and commissioning
** GMP = guaranteed maximum pricing
*** EPCC = engineering, procurement, construction, and commissioning
**** Pan-Malaysia allocates installation vessels and drilling rigs for all operators in Malaysia

Project Execution Strategy (2)
SMRG 2 Project

- EPCC lump-sum to be used for HUC*
- EPCC lump-sum to be used for conventional rigid pipelines
  - Different installation contractor will be used for flexible pipelines
- Drilling
  - Pan-Malaysia rig contracts to be used for rig and drilling services
  - Schlumberger alliance contracts to be used for other services
- Use of incentives being considered
  - Cost overrun borne by contractors and cost savings shared between PCSB and contractors
  - Schedule incentives considered, but structured yet to be decided

* HUC = hook-up and commissioning

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- **Key Message**
- **Project Background**
- ***Basis of Comparison***
- **Practices and Drivers**
- **Targeted Outcomes**
- **Conclusions**
- **Recommendations**

UIBC* 2010 Database: Basis for E&P Industry Averages

Characteristic	SMRG 2 Project	Dataset (432 projects)		
		Minimum	Median	Maximum
Year of Authorisation	2012	2002	2006	2010
Region	Asia	Asia 19%; North America, 15%; Europe, 22%; Africa, 14%; South America, 13%; Other, 17%		
Resource Promise Estimate (MMBOE)	44.7 (estimated)	<5	105	>3,000
Cost (^{2011}A$ millions)	1,575 (estimated)	<24	360	>7,300
Water Depth (m)	10, 50	2	100	>2,500

*** UIBC = Upstream Industry Benchmarking Consortium. The UIBC is a voluntary association of owner firms in the upstream petroleum industry that use IPA's quantitative benchmarking approach. The members exchange data, information, and metrics to improve the effectiveness of their project systems.**

Operators in IPA's E&P Benchmarking

Majors and Independents

Anadarko
Apache
BG Group
BHP Billiton
ConocoPhillips
Hess
INPEX
Marathon
Medco Energi
Nexen
Noble Energy
Pioneer
Santos
Sasol E&P
Talisman Energy
W&T Offshore
Woodside

National Oil Companies or Partial State Ownership

ADNOC
AIOC
CNOOC
ENI
Ecopetrol
Oman Oil
PDVSA
Petrobras
Petrochina
Petronas
PTTEP
Repsol
Saudi Aramco
Statoil

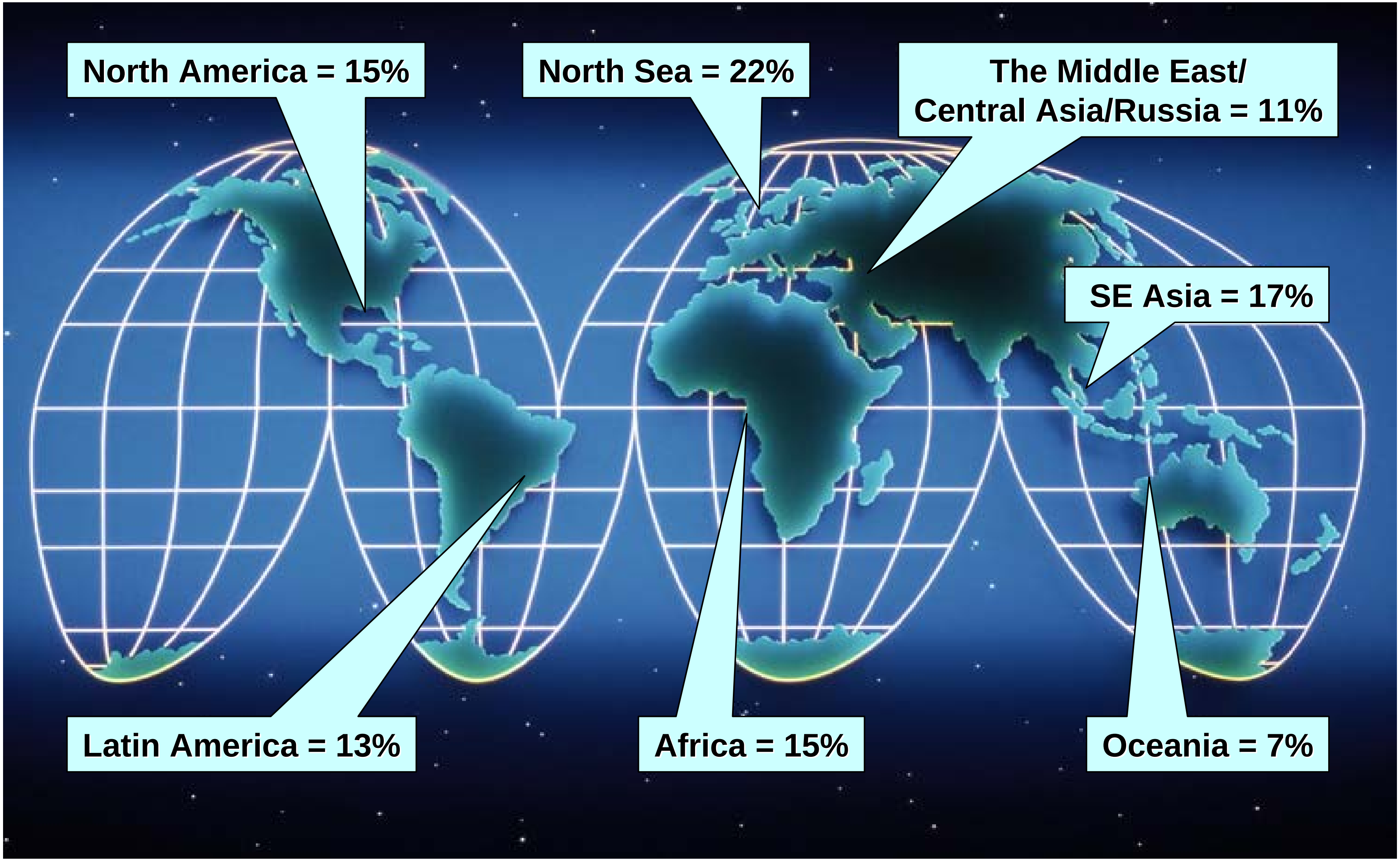
Super Majors

BP
Chevron
ExxonMobil
Shell
Total

* Company names in red indicate IBC and/or UIBC member companies

UIBC 2010 Database Is Global

432 Exploration and Production Projects



Basis of Comparison: Central Processing Dataset

Characteristics	SMG-AA	No of Projects	Asia (%)	Minimum	Median	Maximum
Year of Sanction	2012			1987	2002	2010
Jacket Weight (mT)*	841	117	27	82	2,150	>30,000
Jacket Fab Cost (^{2011}US$ millions)**	6	68	19	0.4	20	276
Topside Weight (mT)***	9,389					
Topside Fab Cost (^{2011}US$ millions)****	141	84	21	4	122	1,523

*** Comparison dataset based on similar water depth and topside operating weight**
**** Comparison dataset based on similar jacket weight**
***** Comparison dataset based on similar topside complexity; SMG-AA is outside comparison ranges, so it was not analysed**
****** Comparison dataset based on similar topside dry weight**

Basis of Comparison: Wellhead Platform Dataset

Characteristics	SMJT-AA SMW-B	No of Projects	Asia (%)	Minimum	Median	Maximum
Year of Sanction	2012			1990	2003	2010
Jacket Weight (mT)*	236 1,296	121	47	80	480	8,200
Jacket Fab Cost (^{2011}US$ millions)**	2 9	68	47	0.4	5	64
Topside Weight (mT)***	497 2,257					
Topside Fab Cost (^{2011}US$ millions)****	11 55	80	55	2	17	340

*** Comparison dataset based on similar water depth and topside operating weight**
**** Comparison dataset based on similar jacket weight**
***** Comparison dataset based on similar CxHy throughputs; SMJT-AA and SMW-B are outside comparison ranges, so they were not analysed**
****** Comparison dataset based on similar topside dry weight**

Basis of Comparison: Offshore Revamp Model

Characteristic	SMRG 2 Project	Dataset (143 projects)		
		Minimum	Median	Maximum
Year of Sanction	2012	1990	2001	2008
Region	Asia	Asia, 17%; GoM, 12%; Europe, 55%; Africa, 8%; Other, 8%		
Cost (^{2011}US$ millions)	248 (estimated)	0.2	41	748

Basis of Comparison: Pipeline Model

Characteristic	SMRG 2 Project	Dataset (108 projects)		
		Minimum	Median	Maximum
Year of Sanction	2012	1989	2000	2008
Region	Asia	Asia, 19%; GoM, 22%; Europe, 22%; Africa, 13%; South America, 16%; Middle East, 3%; Oceania, 5%		
Cost (^{2011}US$ millions)	147* (estimated)	3	59	>2,000
Pipeline Diameter (in)	6, 8, 10, 14, 16	4.5	14	45
Pipeline Length (km)	0.53 – 2.7	0.4	27.4	684
Water Depth (m)	10, 50	4.6	90	1,935

*** Excludes US$91 million of risers costs**

Basis of Comparison: Well Construction Model

Characteristic	SMRG 2 Project	Dataset (112 projects)		
		Minimum	Median	Maximum
Year of Authorisation	2012	1997	2004	2008
Region	Asia	Asia, 16%; North America, 19%; Europe, 33%; Africa, 13%; South America, 9%; Oceania, 10%		
Cost (^{2011}US$ millions)	407* (estimated)	4	150	1,600
Number of Wells	24	3	120	>2,500
Water Depth (m)	67 (average)	<10	120	>2,000
Program Duration (days)	680 (estimated)	12	240	>2,000

*** Excludes US$2.5 million of multi-phase flow meter costs and US$9.9 million of wells clean-up costs**

Basis of Comparison: Facilities Execution Model

Characteristic	SMRG 2 Project	Dataset (254 completed projects)		
		Minimum	Median	Maximum
Region	Asia	Asia, 15%; North America, 19%; Europe, 35%; Africa, 11%; South America, 11%; Other, 9%		
Cost (^{2011}US$ millions)	1,157* (estimated)	15	465	>11,000
Water Depth (m)	10, 50	2	126	>2,500
Resource Promise Estimate (MMBOE)	45	4	107	>3,200

*** Total costs of platforms, pipelines, and brownfield work**

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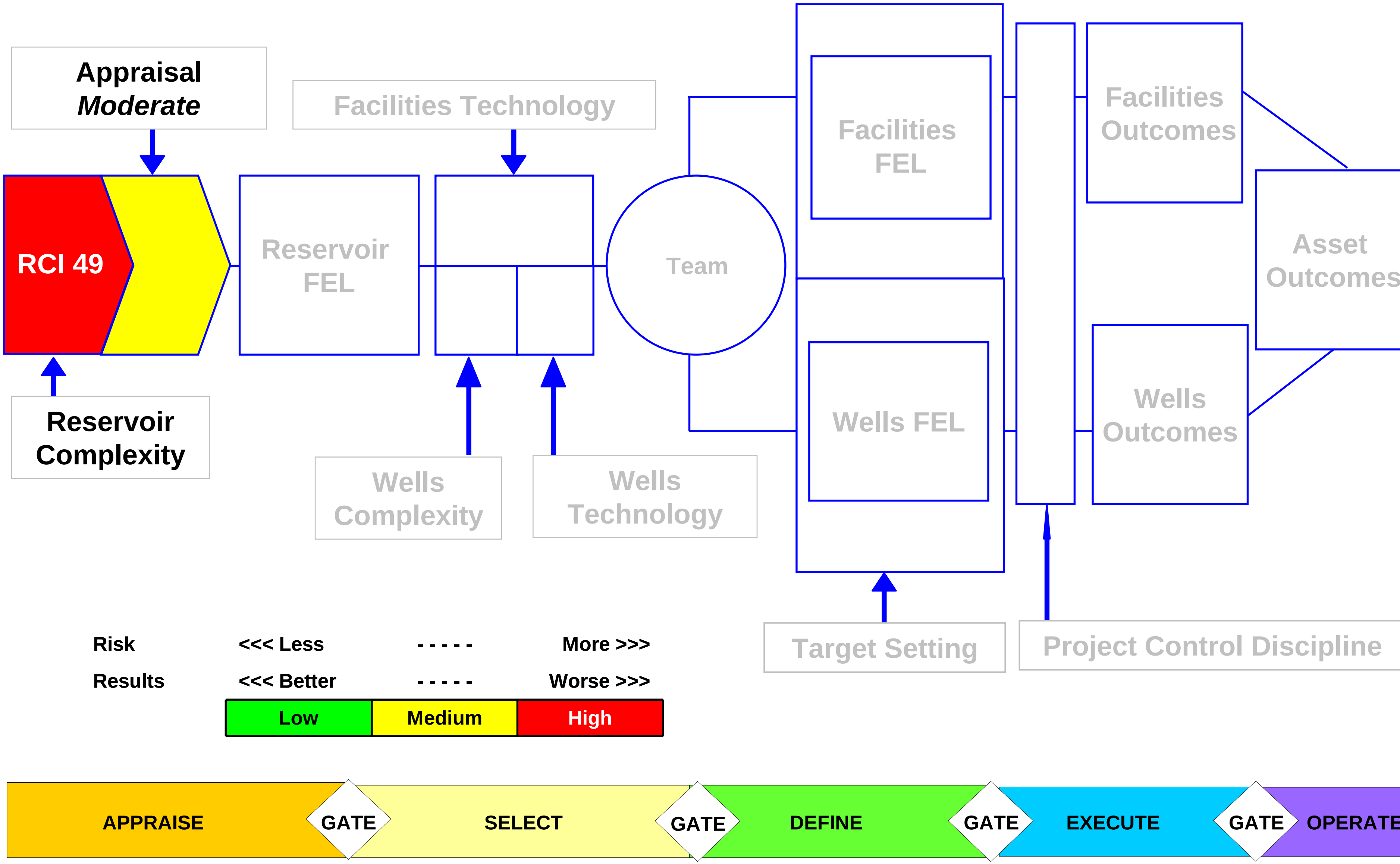
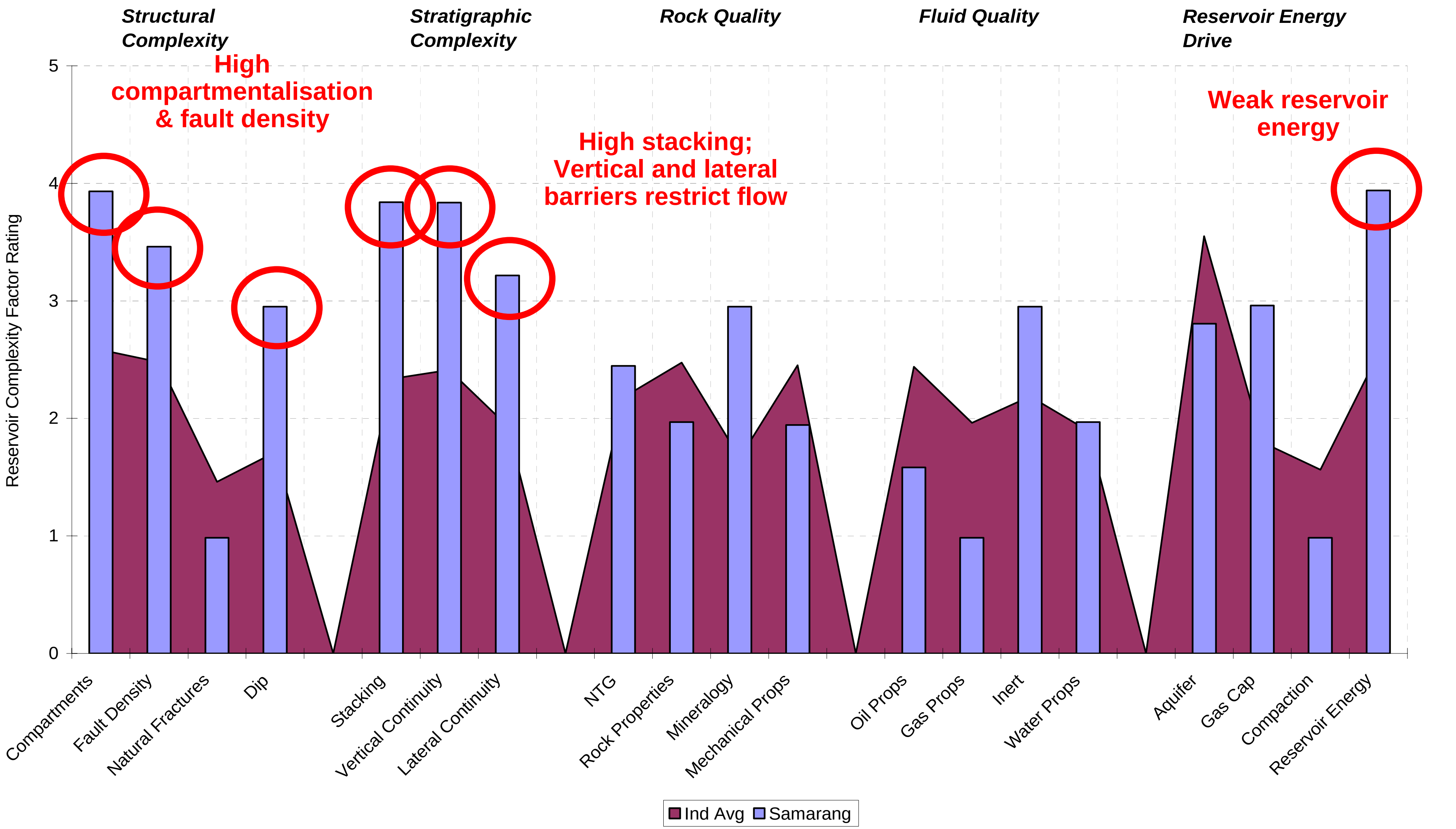
Drivers of Project Success

Reservoir Complexity and Appraisal Strategy



Complex Reservoir, RCI* = 49**



*** RCI = Reservoir Complexity Index**

**** RCI ratings for (EFGH), K, MN, and OPQ are 58, 44, 51, and 54, respectively; the overall RCI calculated using average weighted reserves**

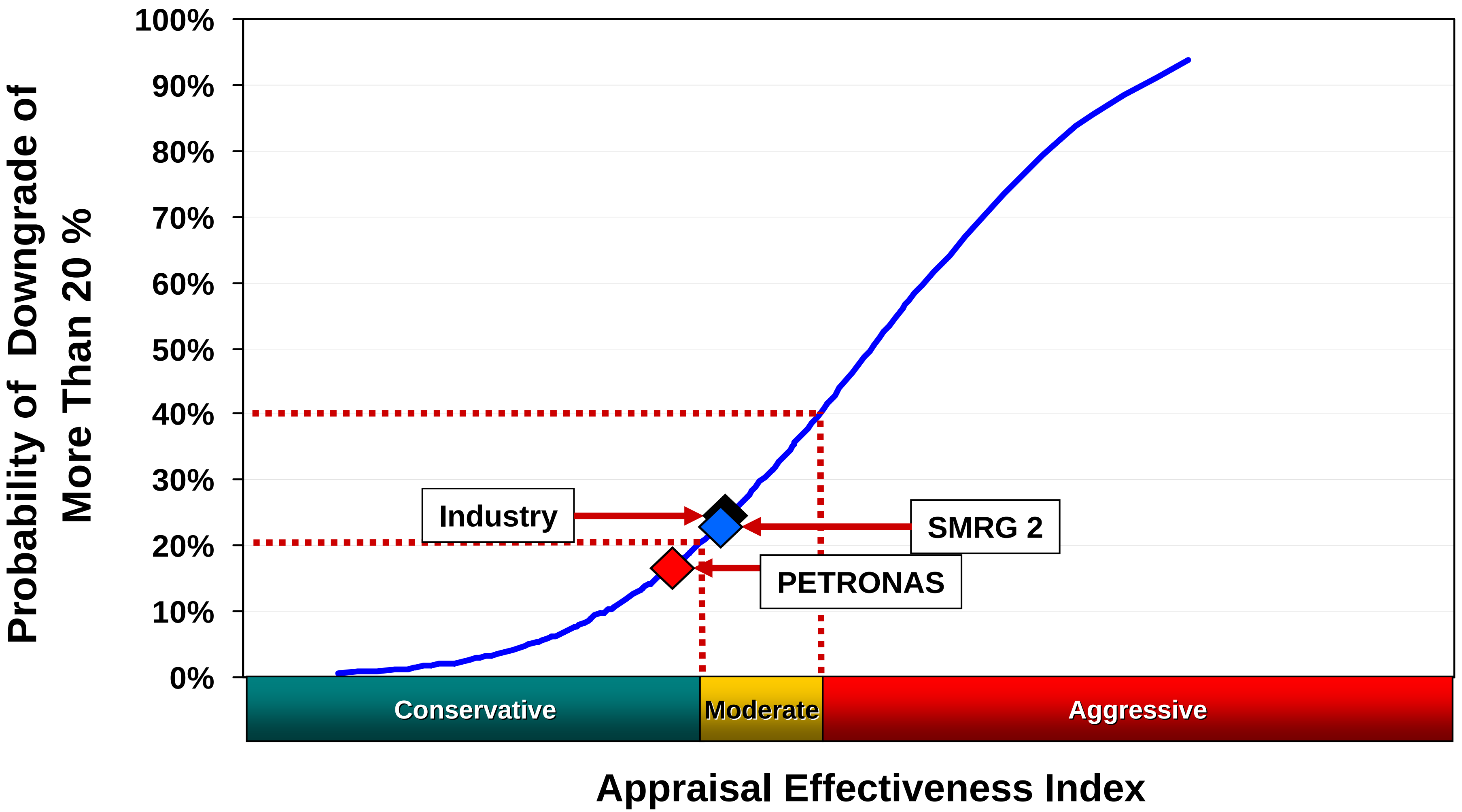
***** Industry RCI = 40 with standard deviation range from 32 to 48**

Appraisal Effectiveness (1)
Moderate *Appraisal*

- Reservoir is more complex than Industry (RCI = 49)
- Seismic with moderate quality
- Logs available in most key compartments
- Sidewall and conventional cores obtained in Phase 1
  - Awaiting core flooding studies for GASWAG concept
- Long production history with wells tested yearly
  - But fluid samples not gathered from all key compartments and fluid contacts uncertain, particularly East Flank
- Static and dynamic models available, but static model will be updated in November 2011 and dynamic model in April 2012

Appraisal Effectiveness (2)

Moderate Risk of Lower RPE Than Forecast



IPA Front-End Loading Index

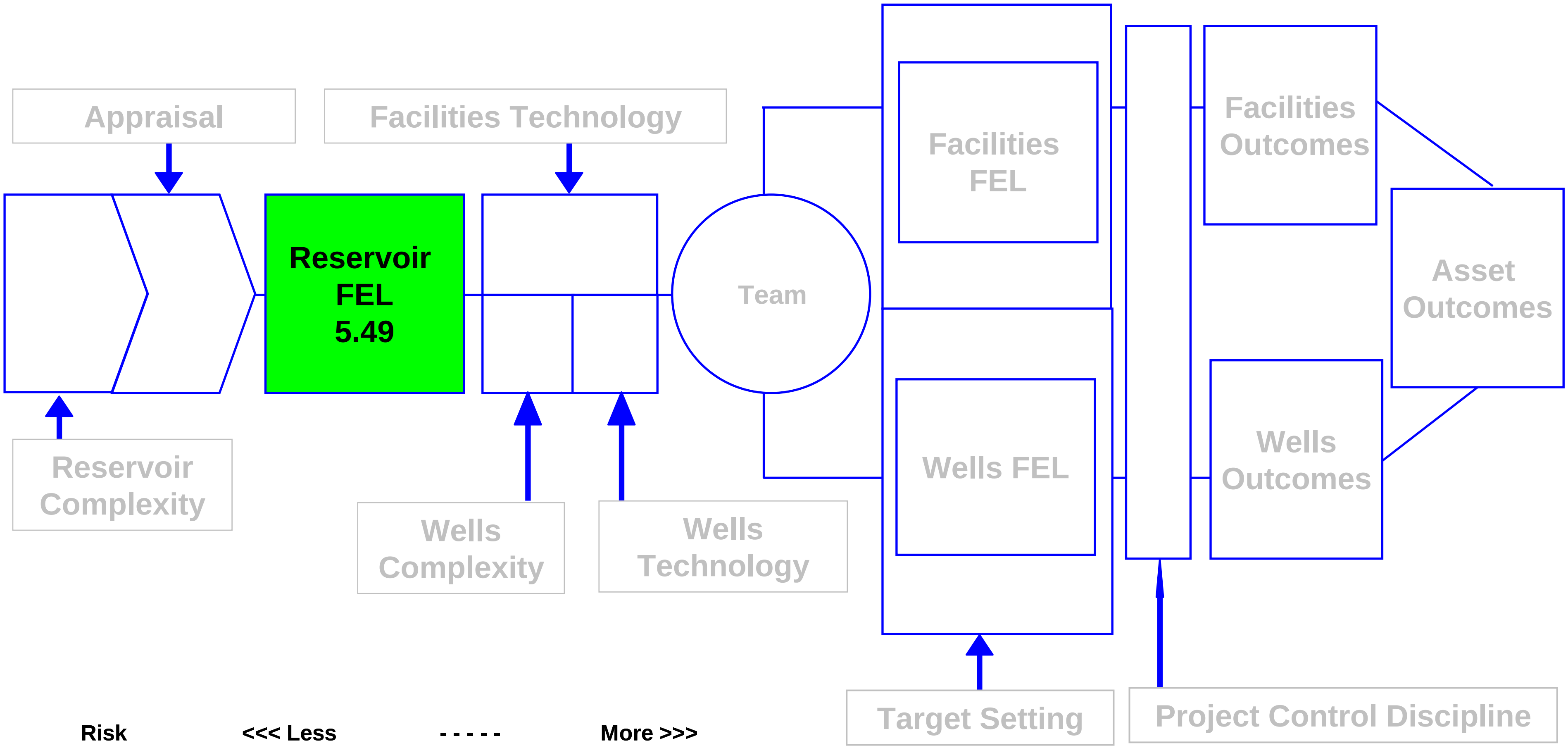
- **FEL is the process of defining a capital project to meet business objectives and minimise risk**

- **IPA evaluates key components of FEL work process before FID to quantify risks to achieving project goals**
  - **FEL Index considers specific project risks that must be thoroughly addressed in FEL process**

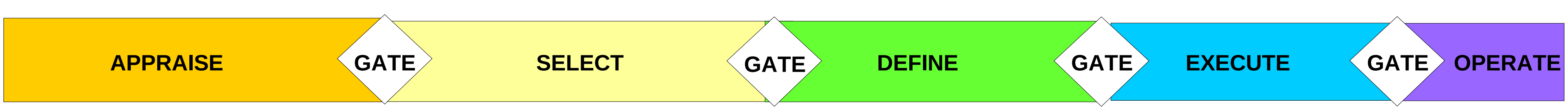
FEL Index is not an assessment of work by project team, but a project-specific risk indicator

Drivers of Project Success

Reservoir Front-End Loading



Risk	<<< Less	- - - - -	More >>>
Results	<<< Better	- - - - -	Worse >>>
	Low	Medium	High



Reservoir Front-End Loading

Inputs

- Seismic
- Logs
- Cores/SCAL
- Fluid Properties
- Well & Reservoir Tests
- Pressures
- Production History Analogs

Constraints

- Regulatory/ Environmental
- Timing
- Budget
- Appraisal Strategy
- Operating Constraints
- Technology/Tolerance for Risk
- Business Commercial Strategy Issues
- Joint Operating Agreement Issues

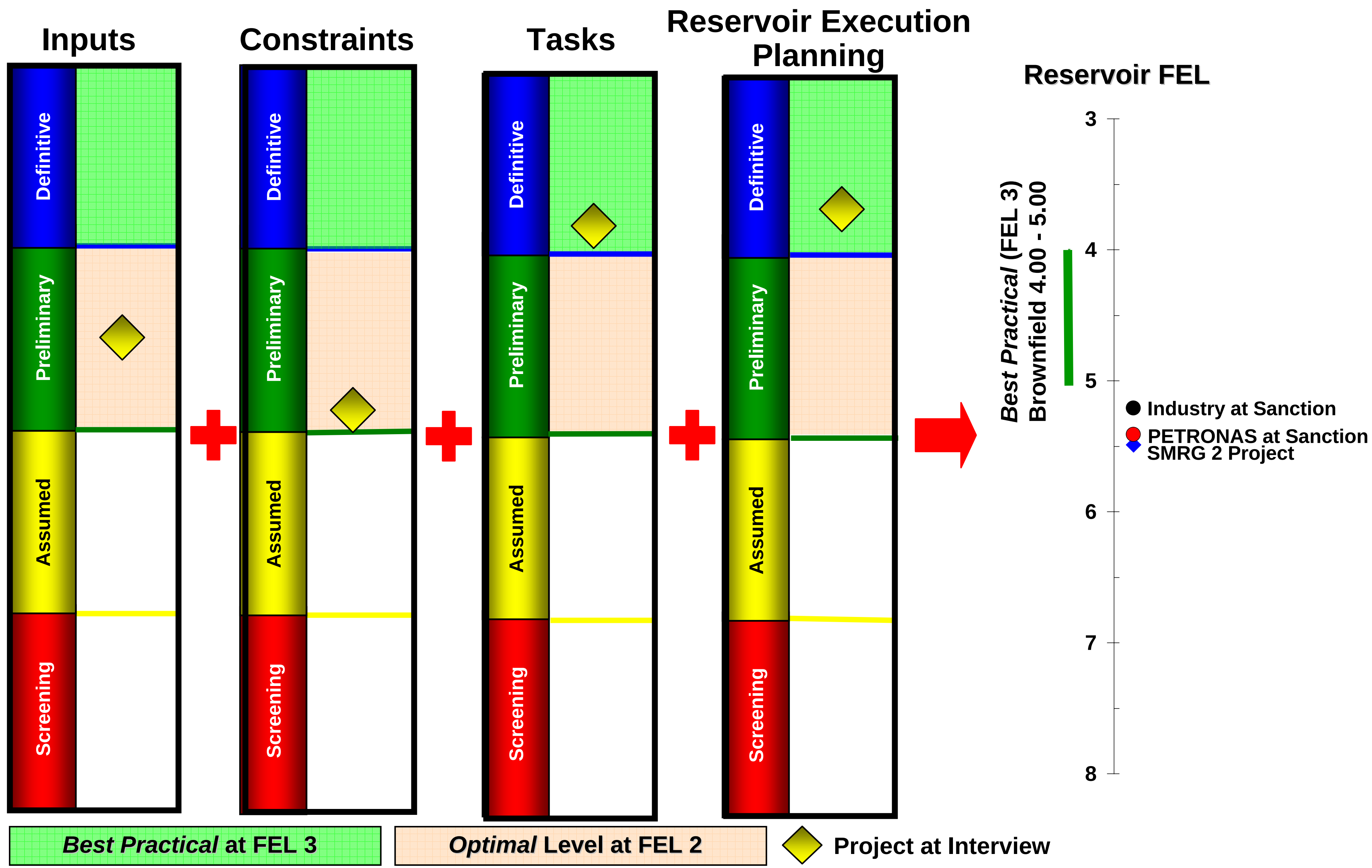
Tasks

- Interpret Seismic
- Develop Maps and Geologic Model
- Integrate Wells Team
- Characterise Fluids
- Complete Reservoir Design Basis
- Understand Drive Mechanism
- Define Compartments
- Predict Production Profiles and Reserves
- Complete Risk and Uncertainty Analysis

Execution Planning

- Subsurface Team Interactions
- Schedule Development
- Plans/Documents Completed
- Controls in Place

Reservoir FEL by Component



Reservoir FEL Status (1)
SMRG 2 Project

Inputs – *Preliminary* (*Best Practical* is *Definitive*)

- **Seismic data available, but navigation files inconsistent or missing**
- **Cores taken in 1970s, but sample eroded with time**
  - **Recent cores taken from Phase 1 to provide characteristics of shallow, intermediate, and deeper sands**
  - **Awaiting core flooding analysis for EOR concept**
- **Pressure measurements**
  - **Sporadic over the last 5 years**
  - **Collection of more pressure data planned as part of FDP**

Reservoir FEL Status (2)
SMRG 2 Project

Inputs – *Preliminary* (*Best Practical* is *Definitive*) (con't)

- **Long production history, but not for East Flank**
- **2 injectivity tests done to date, but only for water injection**
  - **Injectivity tests are crucial to project because GASWAG will be used**

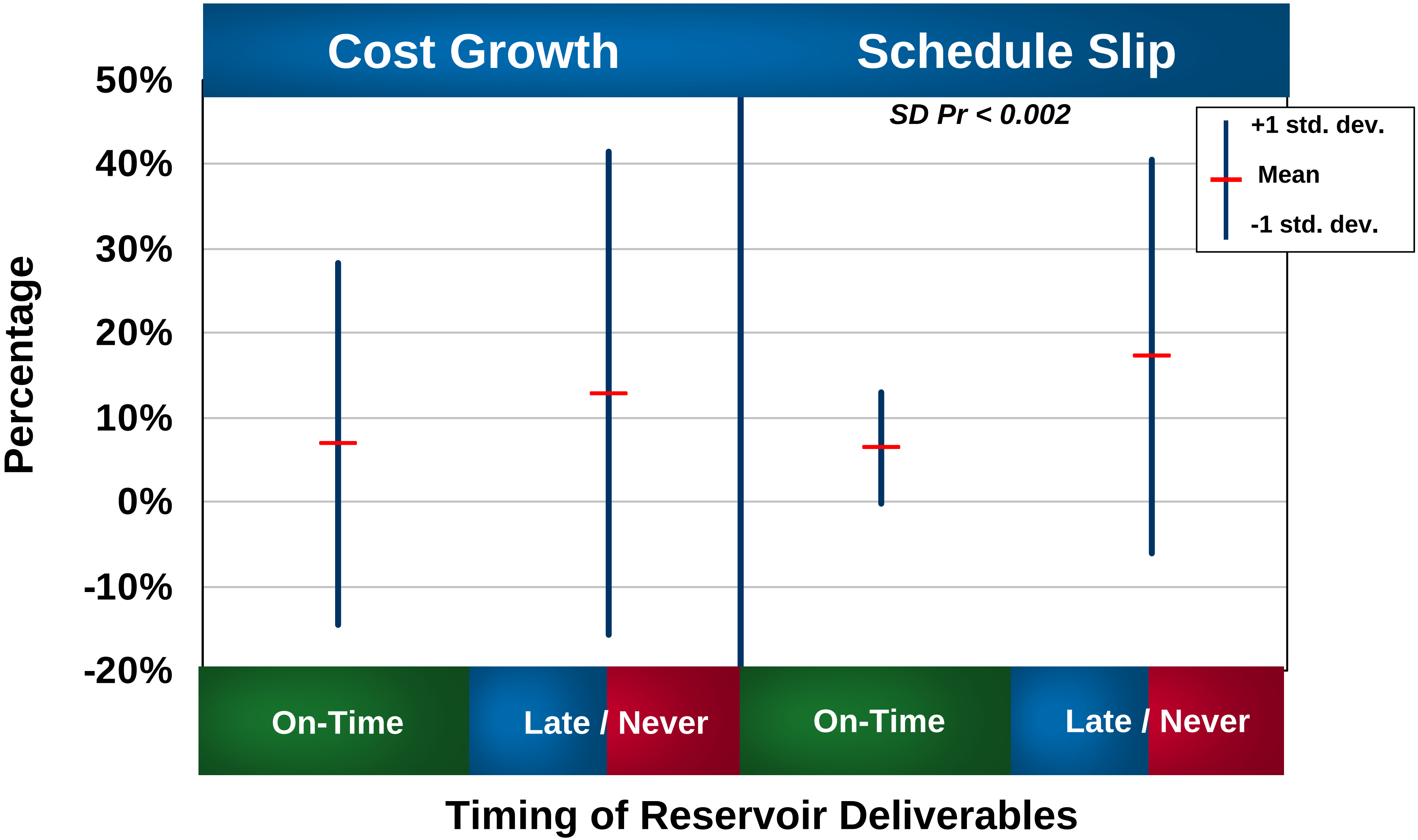
Reservoir FEL Status (3)
SMRG 2 Project

Constraints – *Preliminary* (*Best Practical* is *Definitive*)

- **First full-scale implementation of GASWAG**
  - **GASWAG has not been piloted in Samarang field**
  - **Detailed plan in place to monitor EOR performance well by well so appropriate mitigation can be developed**
- **Result of core flooding studies expected only after ITB issue*– risk of scope changes (SMG-AA gas compressor and gas injection wells) and disruption to ITB process**
- **Sufficient sources of gas supply to SMG-AA**
  - **Preliminary identify, but plan not yet developed**

*** Tier 1 sanction scheduled for February and October 2012, but studies expected in March 2012 and scenario assumptions to be updated in February 2013**

Late Confirmation of GASWAG Viability May Impact SMRG 2 Facility Predictability



Source: Neeraj Nandurdikar, Erin Mofford, and Jason Walker "*Stage-Gate Processes - Should They Be Deliverable Focused or Flow of Information Focused?*", UIBC 2011

Reservoir FEL Status (4)
SMRG 2 Project

Tasks – *Definitive* (*Best Practical*)

- **3D simulations performed with data matching**
  - **Static model to be updated in November 2011 and dynamic model in April 2012**
- **Drive mechanisms and rock properties understood and confirmed**
- **Risk and uncertainties analysis conducted**
- **Surface and bottomhole location and well path finalised and agreed to**
- **Production profile peer reviewed, but update required if 3 additional wells included**

Reservoir FEL Status (5)
SMRG 2 Project

Execution Planning – *Definitive* (*Best Practical*)

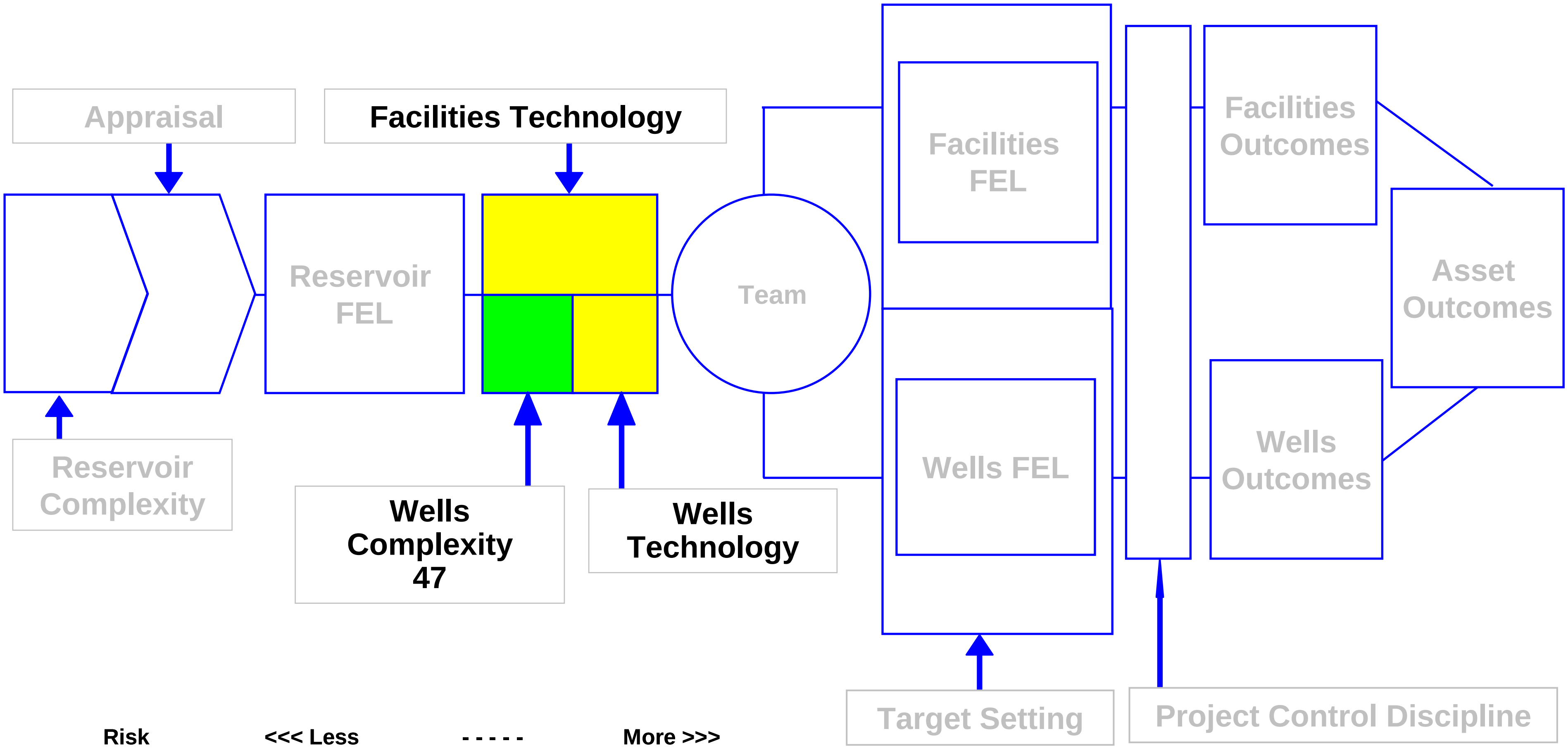
- **Subsurface team interactions**
  - **Team in place with Schlumberger and PCSB well integrated**
  - **Roles and responsibilities defined and well understood**
  - **Risks identified, reviewed, and being tracked in risk register**
  - **Reservoir evaluation activity schedule developed, but not yet fully integrated into overall project schedule**

Reservoir FEL Status (6)
SMRG 2 Project

Execution Planning – *Definitive* (*Best Practical*)

- **Plans and documents**
  - FDP develop in detail
  - Facilities Design Basis Memorandum peer reviewed
  - Data acquisition, surveillance, and integrated management plans well developed
- **Controls**
  - Management of change plan; management team in place
  - Measurable definition of success for GASWAG
    - > Success measures defined
    - > Plan in place to monitor performance of EOR well by well

Drivers of Project Success
Facilities and Wells Technology/Complexity

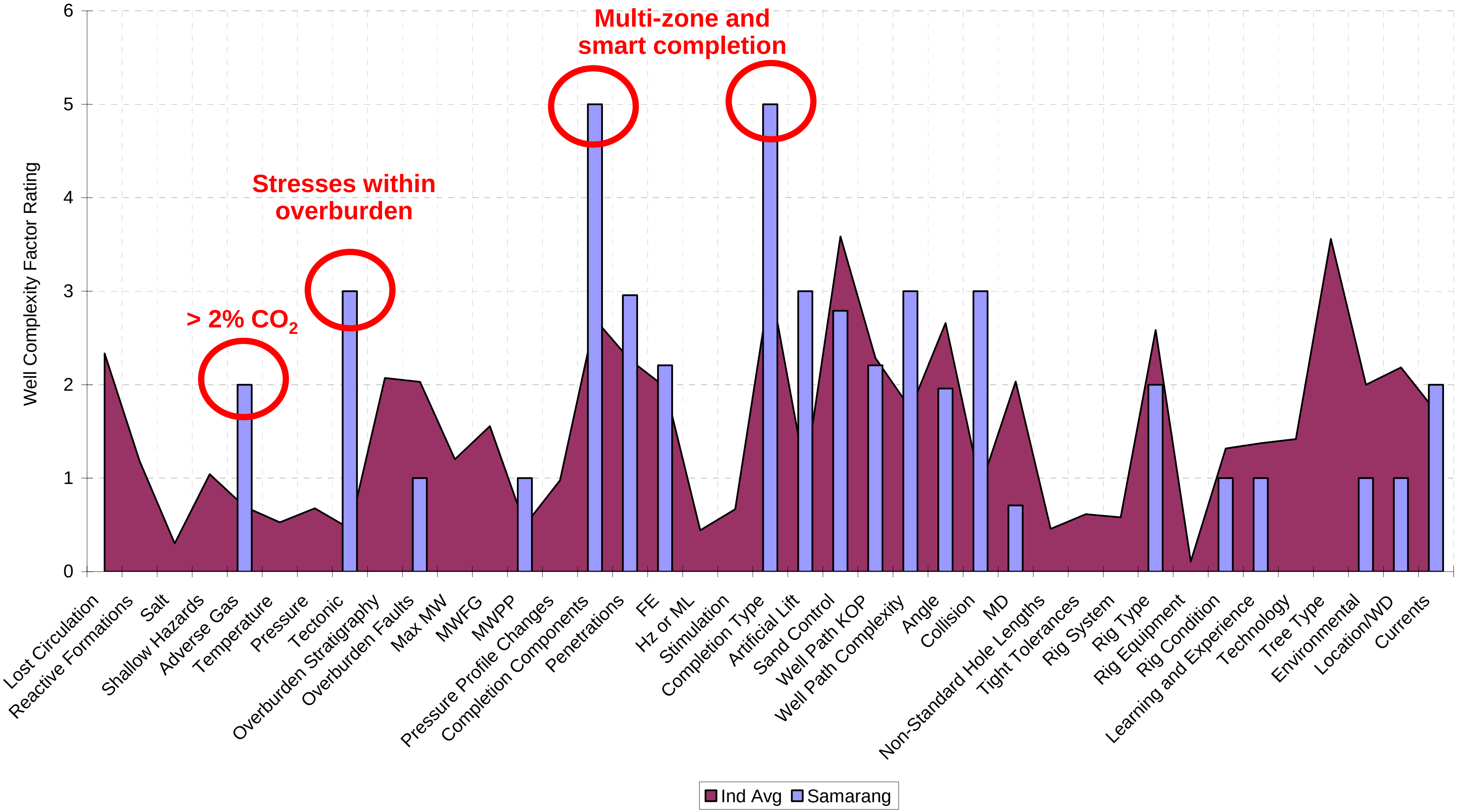


Risk	<<< Less	- - - - -	More >>>
Results	<<< Better	- - - - -	Worse >>>
	Low	Medium	High

APPRAISE | GATE | SELECT | GATE | DEFINE | GATE | EXECUTE | GATE | OPERATE

Well Complexity

Less Complex Than Industry With WCI of 47*



*** WCI = Well Complexity Index; Industry WCI = 53 with standard deviation range from 42 to 65**

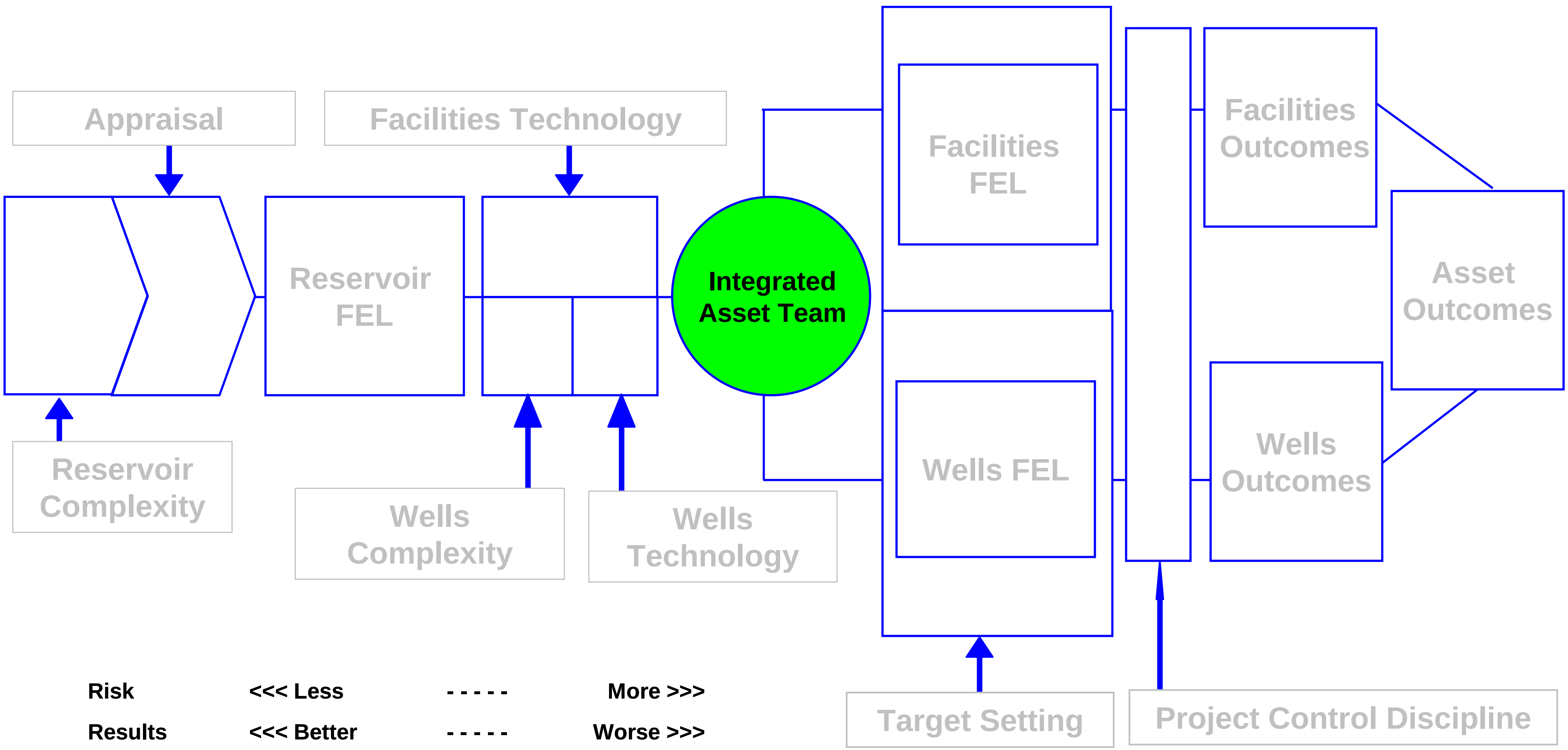
Wells and Facilities Technology

SMRG 2 Project

- **Facilities technology**
  - **Floatover installation (SMG-AA)—new to PCSB**
  - **Integrated operations—new to PCSB**
  - **Flexible pipelines—new to team**
- **Wells technology**
  - **Slot recovery and smart completion*—new to PCSB**
  - **OH completions with standalone screen and swell packers—new to Samarang**

*** Downhole pressure gauges, interval control devices, temperature sensors, etc.**

Drivers of Project Success
Fully Integrated Asset Team



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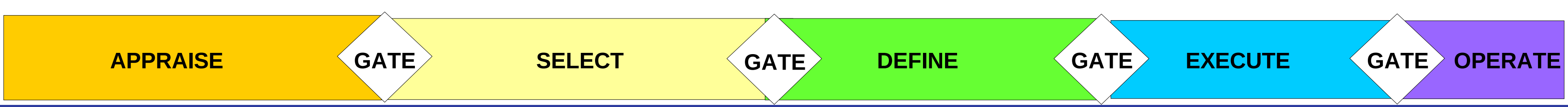
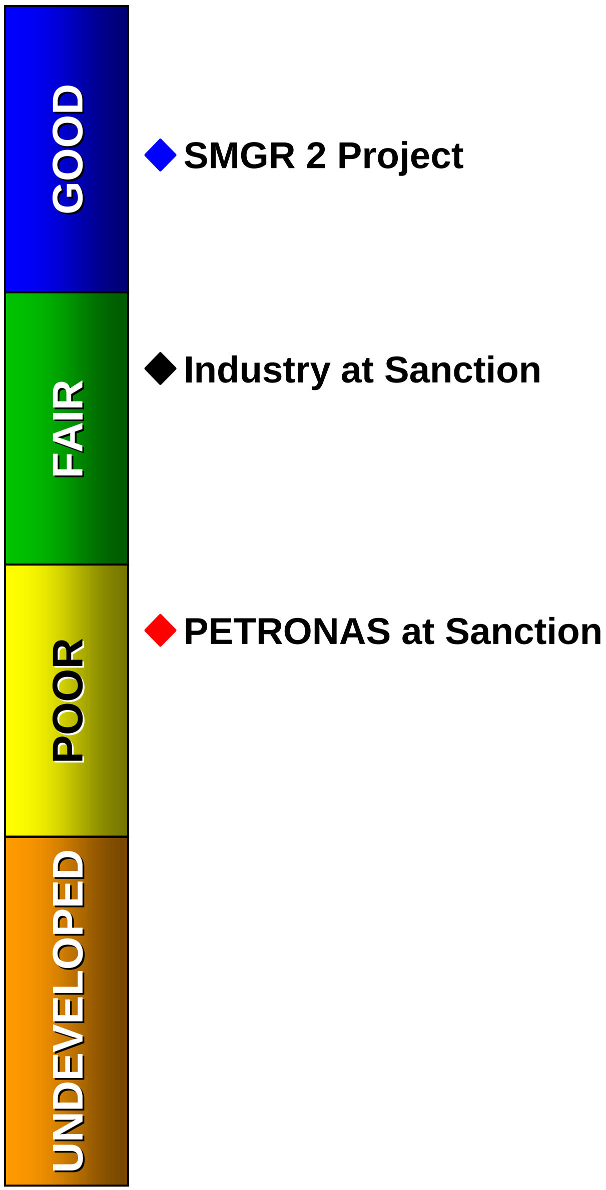


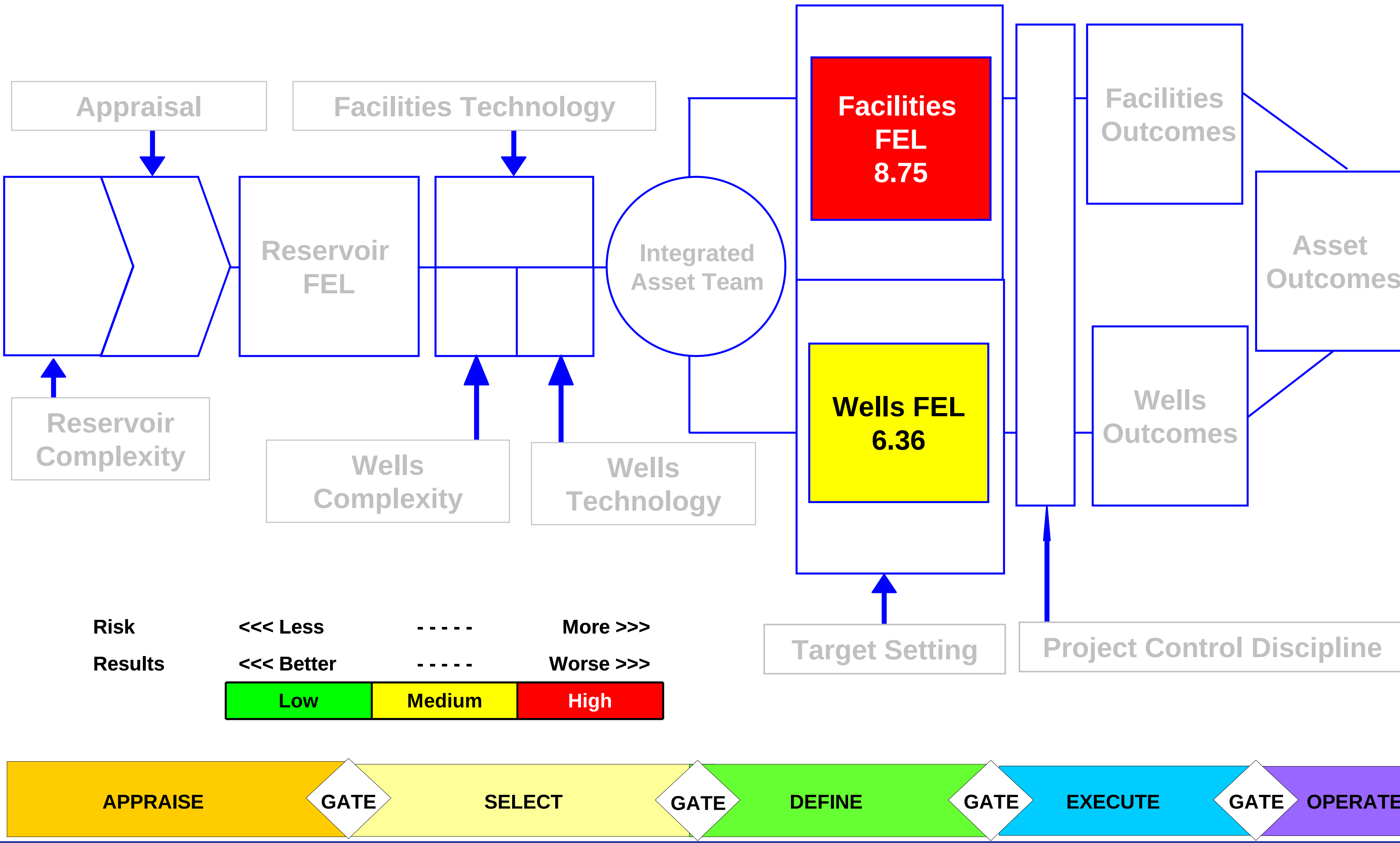
Team Integration and Team Development Index
Integrated Team and *Good* TDI



- ☑ ***Project objectives defined and aligned with business objectives***
  - **Objectives understood by project team**
- ☑ ***All functions that can influence project outcomes present on the team***
  - **Organisational charts for FEED and execution phases developed**
- ☑ ***Team roles and responsibilities defined, understood, and documented***
  - **Succession planning to be developed for all key team members**
- ☑ ***Risk register set up for use by various functions***
  - **Major tasks and issues identified and monitored and mitigation plans in place**
- ☑ ***PETRONAS Project Management System process being followed***

Drivers of Project Success

Facilities and Wells FEL



Well Construction Front-End Loading

Scope of Work

- Offset Wells
- Commercial
- Well Objectives
- Scope of Work
- Location Survey
- Metocean Data
- All Needed Technical Inputs

Regulatory HSE

- Permitting
- Preliminary Safety Management Plan
- Hazid Analysis
- Company Policies
- Waste Management

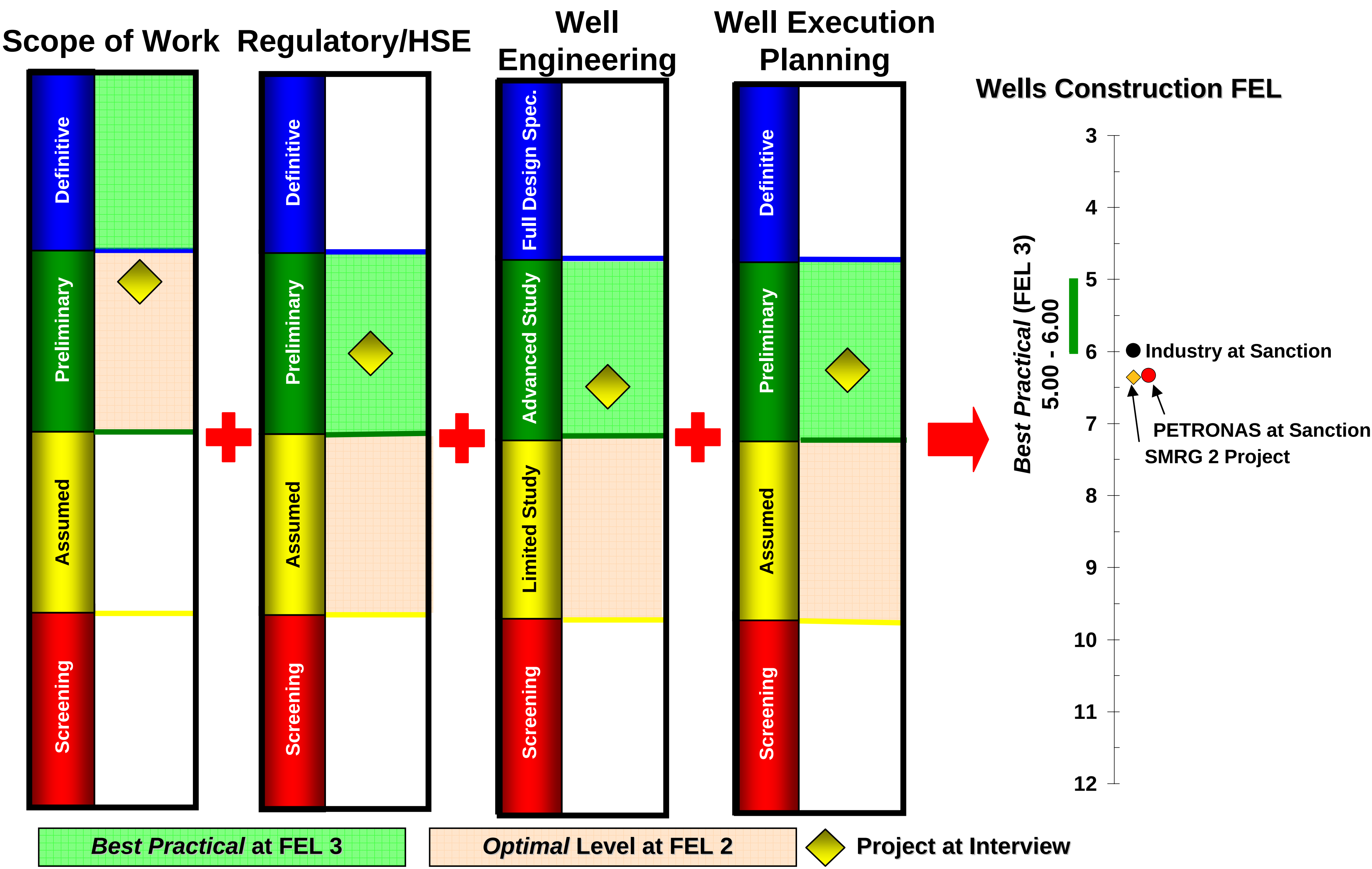
Well Engineering

- Casing Design
- Completion and Stimulation Plans
- Certify Rig
- Certify Equipment
- Long-Lead Items Identification
- Scenario and Option Planning
- Peer Review
- Stakeholder Buy-in

Execution Planning

- Contracting Strategy
- Team Composition
- Procurement Plan
- Secured Rig
- Logistics
- Schedule Estimate including Concurrent Ops, SIMOPs, etc.
- Detailed Well Plan to Achieve Objectives
- Program Cost Estimate

Well Construction FEL by Component



Wells FEL Status (1)
SMRG 2 Project

Scope of Work – *Preliminary* (*Best Practical* is *Definitive*)

- **Soil boring data available for new platform locations**
- **Soil boring data for infill drilling conducted around 30 years ago. Further discussion with drilling contractor to confirm the need for new soil boring data**
  - **No issue is anticipated because platforms have been revisited numerous of times**
- **Drilling program, timing, and phasing defined and agreed to for 24 wells, but not for 3 additional wells**
  - **Timing to execute these wells can impact on Phase 2 subsurface and drilling scope of work and program**
- **Development, reservoir depletion, and surveillance plans defined**

Wells FEL Status (2)
SMRG 2 Project

Regulatory/HSE – *Preliminary* (*Best Practical*)

- **Permit requirements for drilling identified**
- **Import and export requirements for equipment and materials known and plans in place**
- **HSE requirements and drilling hazards identified**
  - **Permission to dump water-based mud to sea obtained**
- **Rig Naga-3 preliminary assigned but not confirmed**
  - **Rig-specific HAZOP review not yet done**

Wells FEL Status (3)

SMRG 2 Project

Engineering – *Advanced Study* (*Best Practical*)

- **Well proposal prepared with agreed to targets, depths, trajectories, formation evaluations, and completions**
- **Drilling basis of design reviewed by subsurface team**
- **Drilling risks, complexity, and difficulties assessed**
  - **DWOP* and CWOP** to be conducted before spud**
- **Drilling equipment list preliminary defined**
- **Drilling plan to be signed off on a few months before spud**
- **Individual well programs available after the detailed design phase**

* DWOP = Drilling Wells on Paper
** CWOP = Completing Wells on Paper

Wells FEL Status (4)

SMRG 2 Project

Planning – *Preliminary* (*Best Practical*)

- **Full team in place, including completion engineers with swell packer and smart completion experience**
- **Existing PCSB drilling contracts being used**
  - **Some contracts like completion equipment required to be renewed**
- **Long-lead items identified, but not finalised**
- **SISO* developed for each platform**

* SISO = specific instructions for SIMOPs

Wells FEL Status (5)

SMRG 2 Project

Planning – *Preliminary* (*Best Practical*) (con't)

- **Rig Naga-3 preliminary assigned, but could be changed**
  - **Possibility of additional rig for EOR drilling**
- **Well costs estimated, but AFEs will not be prepared until few months before spud**
- **Drilling schedule at milestone level and integrated into overall project schedule**

Facilities Front-End Loading

Project Specific Factors

- Soils and Surveying
- Permit Requirements
- Concession Terms
- Import/Export Terms
- Community Relations
- Security
- Offshore Persons on Board Requirements
- Support and Logistics
- Local Content
- Local Labour
- HSE for Operations
- HSE for Fabrication, Transport, and Installation
- Yard Availability

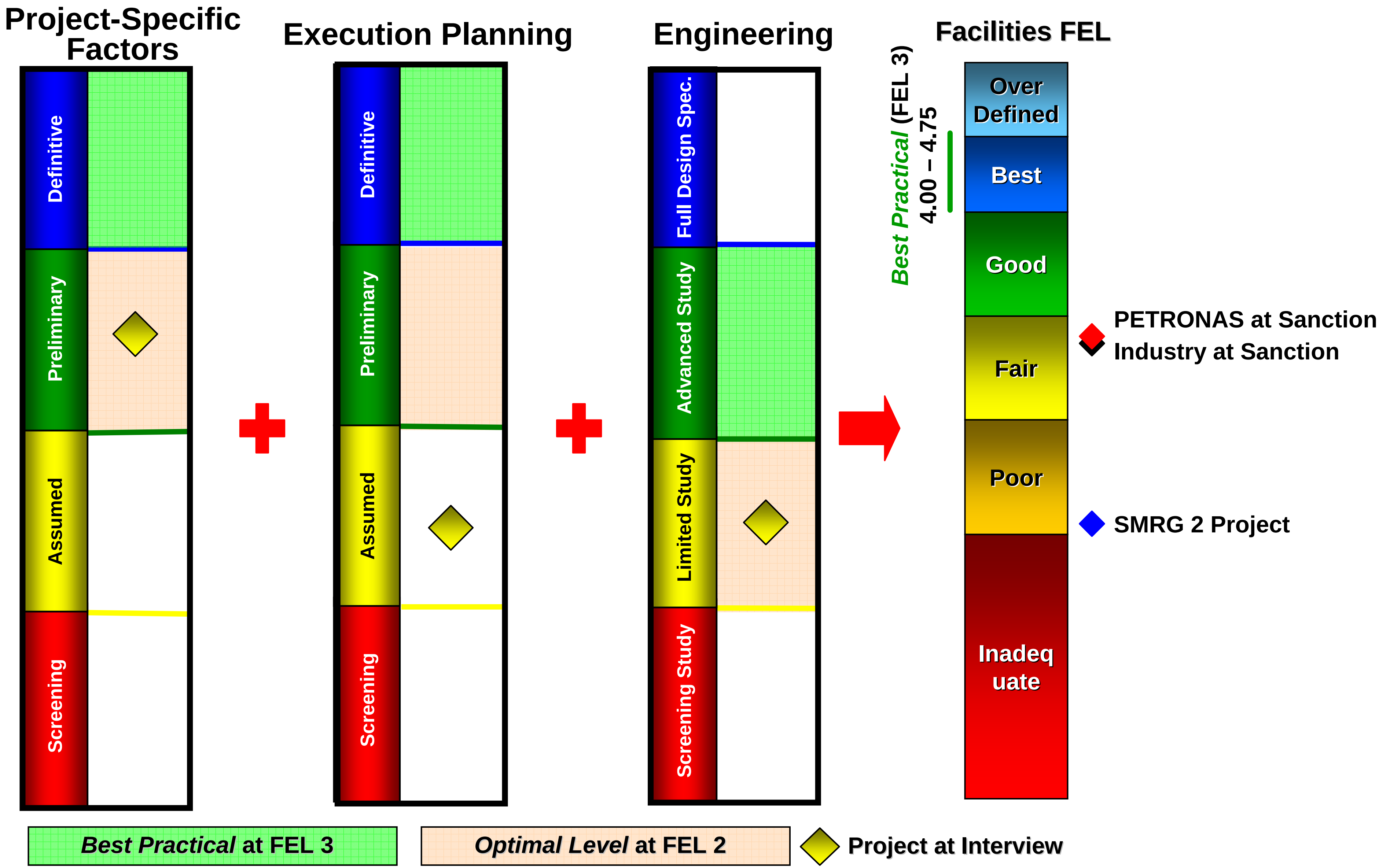
Execution Planning

- Contracting Strategy
- Team Participants & Roles
- Integrated Schedule
  - Critical-path Items
  - Identification of Shutdown for Tie-ins
  - Resources
  - Overtime
- Plans
  - Commissioning
  - Startup
  - Operation
  - Well Construction
  - Quality Assurance
- Cost and Schedule Controls

Engineering

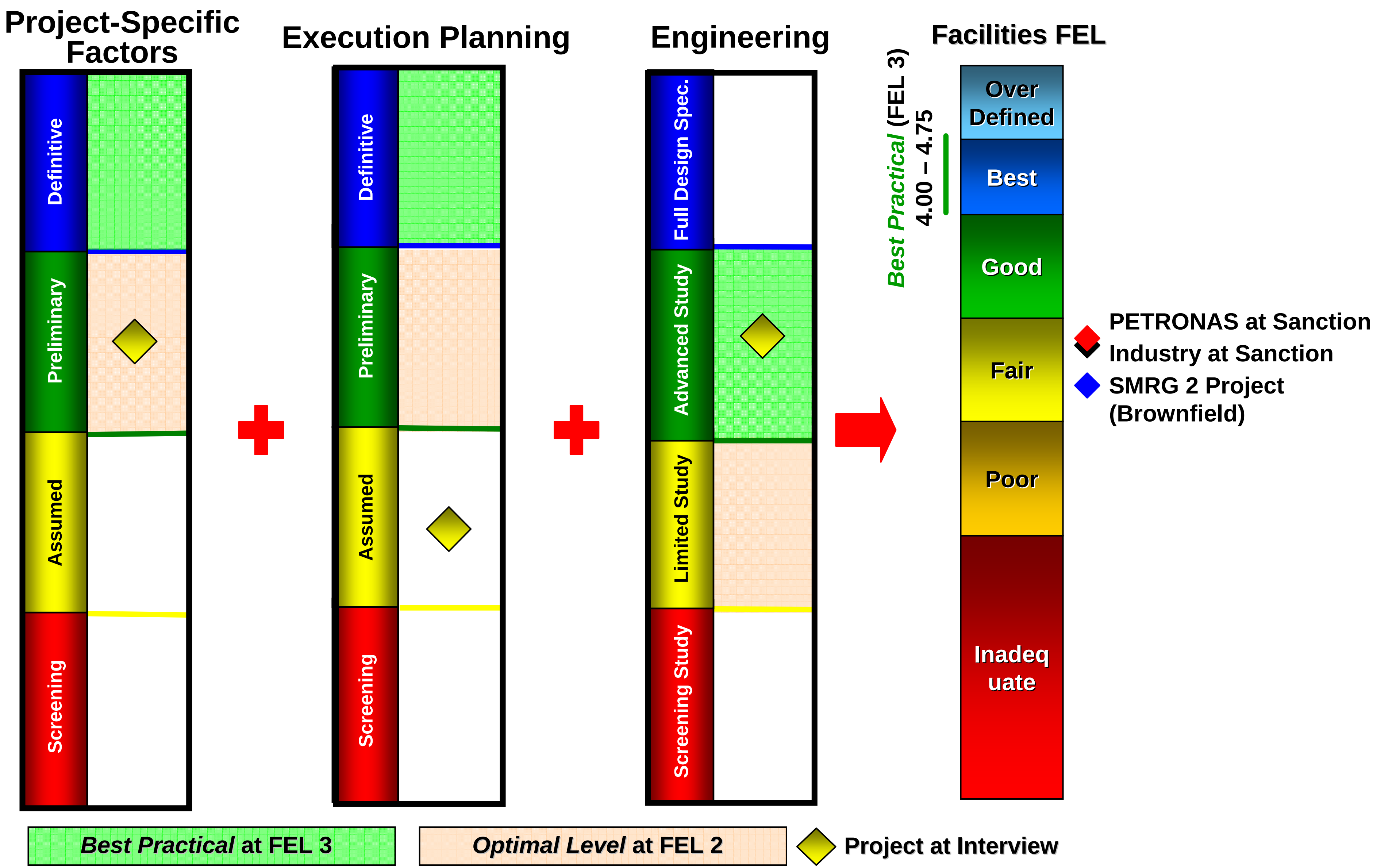
- Engineering Tasks
  - Fluid Definition
  - Detailed Scope
  - PFDs
  - H&MBs
  - Preliminary P&IDs
  - One-line Elec. Diagrams
  - Major Equipment Specifications
  - Cost Estimate
- Participation/Buy-in of:
  - Operations
  - Maintenance
  - Business
  - Subsurface

Offshore Facilitates FEL by Component
Overall for Greenfield and Brownfield

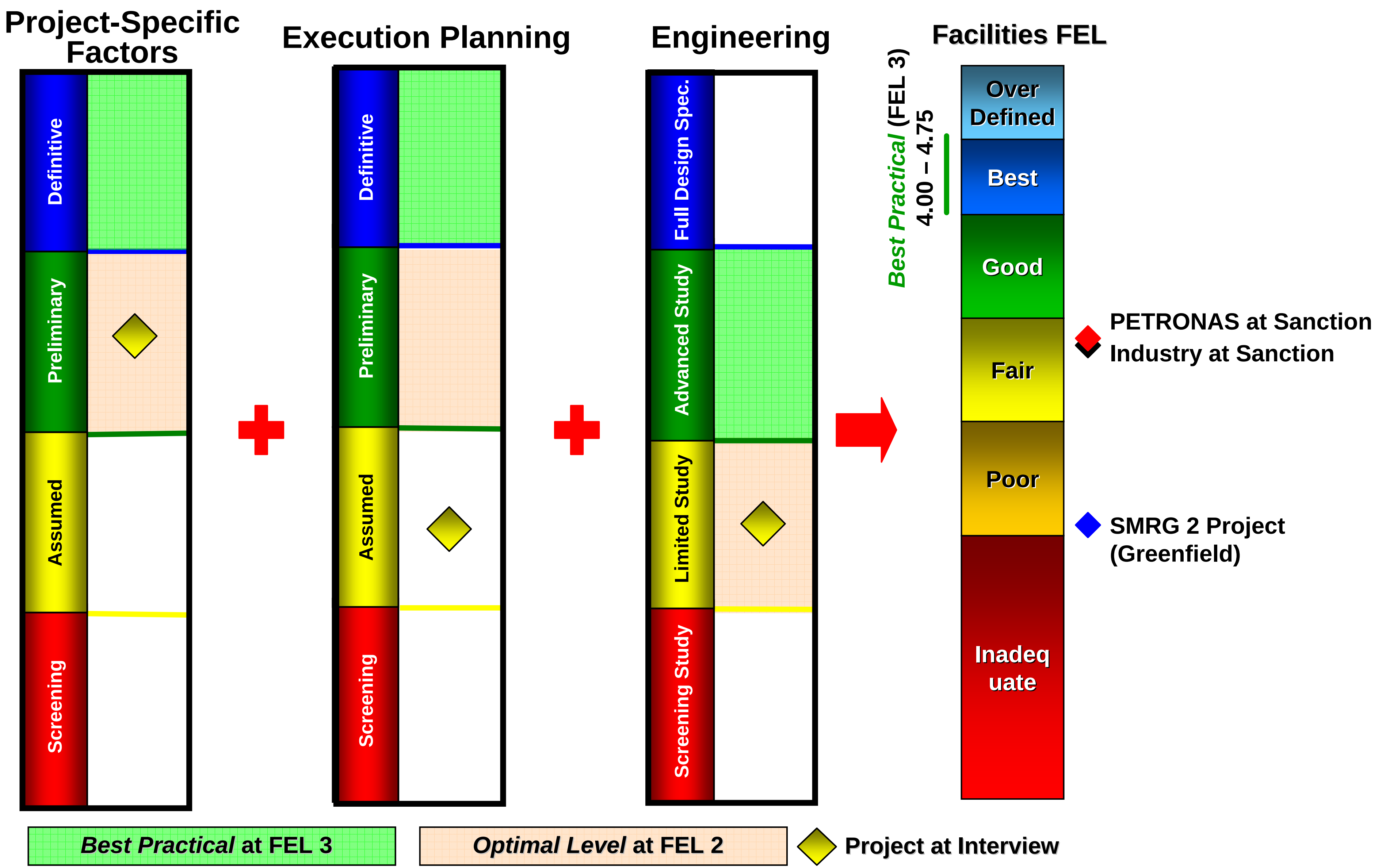


Offshore Facilitates FEL by Component

Brownfield



Offshore Facilitates FEL by Component
Greenfield



Facilities FEL Status (1)

SMRG 2 Project

Project-Specific Factors – *Preliminary* (*Best Practical Definitive*)

- **Soils, metocean, and surveying data available**
- **EIA for Samarang field approved**
  - **Plan to submit supplementary EIA for three new platforms in place**
- **Local content known and understood**
- **People on board planned with floatel to be used**
- **HAZOP review and Quantitative Risk Assessment conducted in April 2011**
- **Yard and barge availability uncertainty (greenfield only)**
  - **HSE for yard, transportation, and installation not developed**

Facilities FEL Status (2)

SMRG 2 Project

Overall Execution Planning – *Assumed* (*Best Practical* is *Definitive*)

- **Schedule for shutdown, brownfield, and work pack reviewed and agreed to with operations**
- **Detailed shutdown requirements defined in SISO**
- **Monthly management interface meeting being held**
- **HUC sequences developed**
- **Project execution plan developed**

Facilities FEL Status (3)

SMRG 2 Project

Overall Execution Planning – *Assumed* (*Best Practical* is *Definitive*) (con't)

- **Contracting strategy**
  - **In process of being finalised and approved***
  - **Information on availability and capability of Malaysia and foreign yards lacking**
    - > **Market survey not yet carried out****
  - **Possibility of using yard outside Malaysia, not a common strategy for Malaysian projects**
    - > **Uncertainties such as forex risk and legal requirements not yet addressed**

During feedback session with team on 12 December 2011, team informed that:
***Contracting strategy was approved on 10 November 2011. Contracting to yard outside Malaysia is permitted if potential candidate Malaysian yards are not available to take work**
**** Local yard assessment has been conducted**

Facilities FEL Status (4)
SMRG 2 Project

Overall Execution Planning – *Assumed* (*Best Practical Definitive*) (con't)

- **Schedule development**
  - **Low execution activities for project of this size**
  - **Not fully integrated or resource or cost loaded**
  - **Critical path exists, but it is weak and does not run through all phases**
  - **No details on pipeline execution except for installation milestone dates**
  - **Availability of yard and barge assumed and not included in schedule risk analysis**

Facilities FEL Status (5)

SMRG 2 Project

Brownfield Engineering – *Advanced Study* (*Best Practical*)

- **FEED completed for platform upgrading scope, including structural integrity review**
  - **Site visits conducted to verify proposed locations and as-built drawings**
  - **Laser scanning and 3D modelling done for parts of platform where work will take place**
- **Detailed engineering started for infill/tie-in scope**
- **17 percent of I/O FEED completed, but not a major concern because of small cost**
- **P&IDs reviewed by operations**

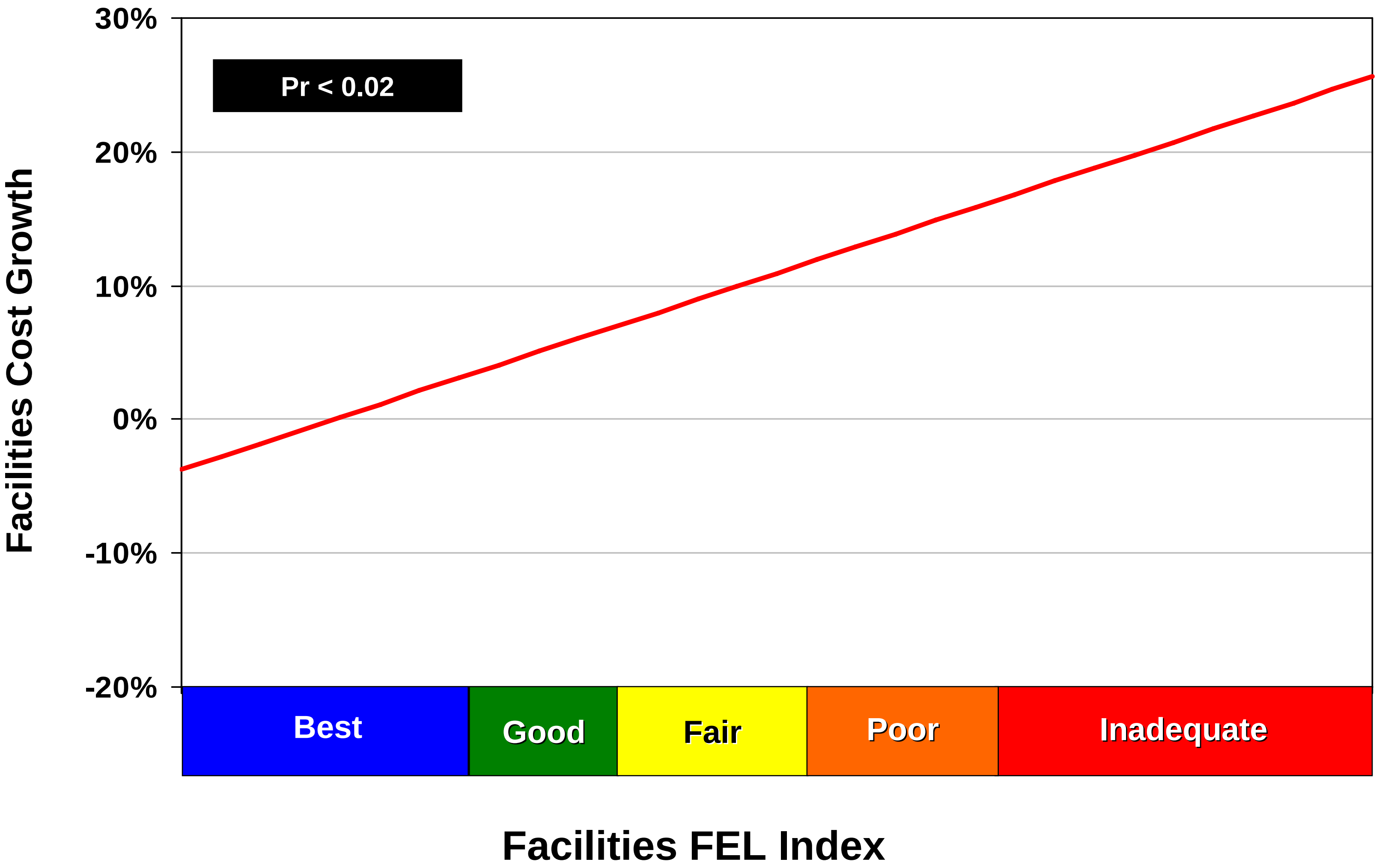
Facilities FEL Status (6)

SMRG 2 Project

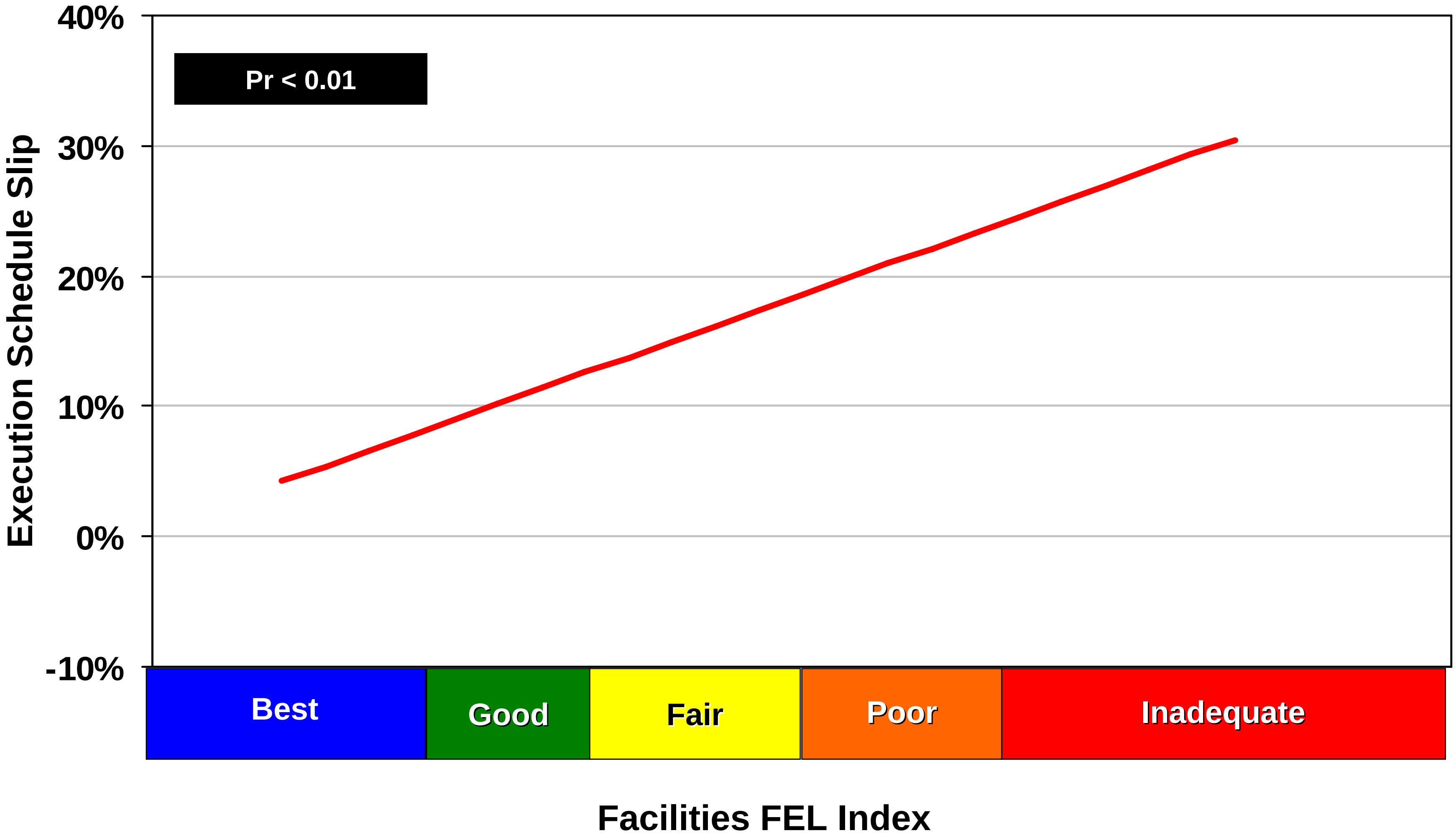
Greenfield Engineering – *Limited Study* (*Best Practical* is *Advanced Study*)

- **SMJT-AA and SMW-B**
  - **FEED completed with jacket weights, deck loads, and P&IDs approved by operations**
- **SMG-AA**
  - **FEED completed for modular, but not floatover concept**
  - **Structural configuration, jacket weights, and deck loads planned to be finalised during detailed engineering**
  - **Cost estimate not based on engineering**
    - **Structural and piping procurement adjustment based on benchmarking of other projects**
    - **Estimate incorporate input and guidance from CTE**

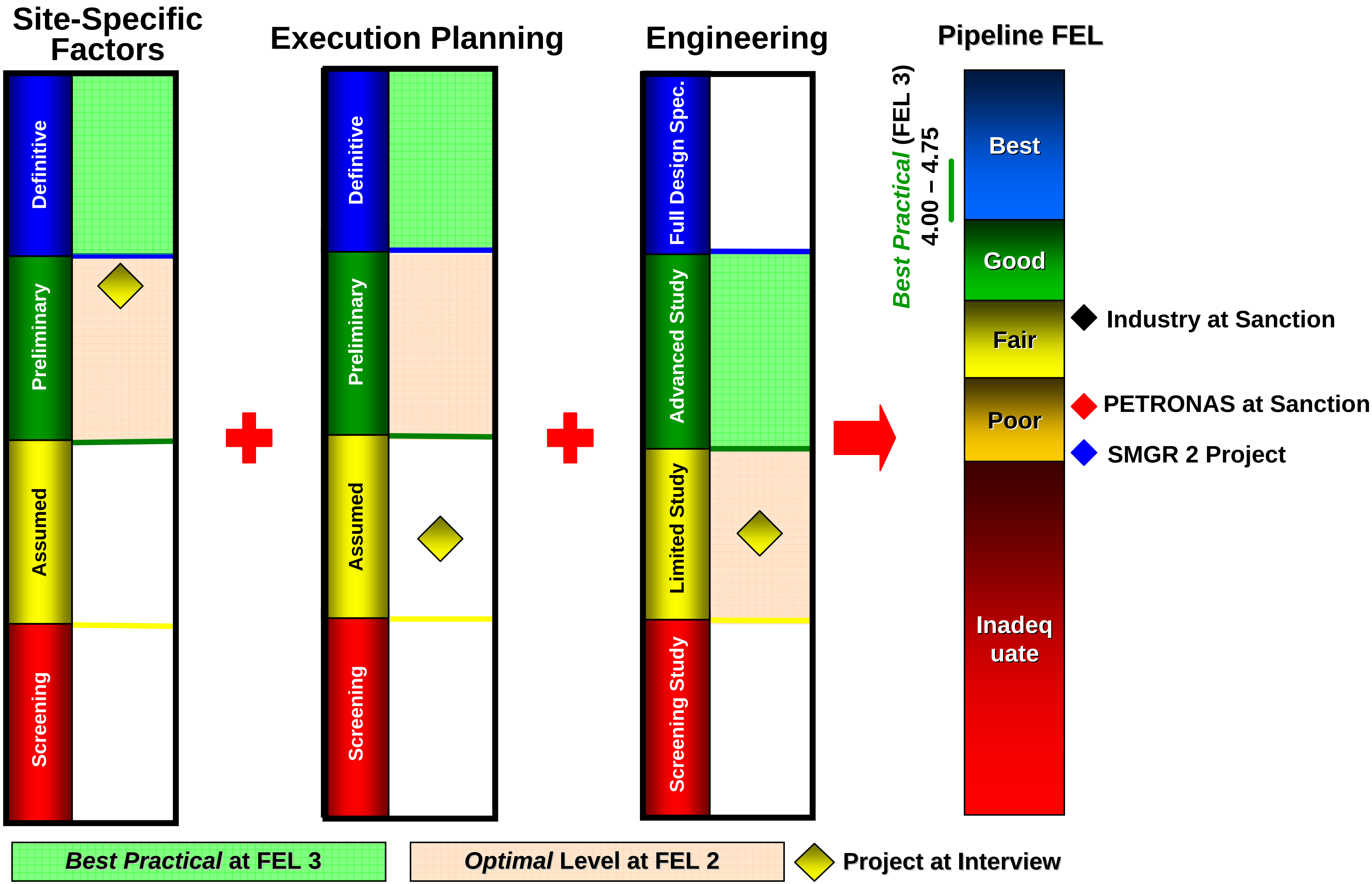
Facilities FEL Drives Facilities Cost Growth



Facilities FEL Drives Schedule Slip



Offshore Facilities FEL by Component
Pipelines



Pipeline FEL Status (1)

SMRG 2 Project

Site-Specific Factors – *Preliminary* (*Best Practical* is *Definitive*)

- **Route and soil boring survey conducted in 2009**
  - **Route survey planned for November 2011 to confirm 2009 findings**
- **No right of way or community issues**
- **HAZOP review conducted in April 2011, but only for rigid pipelines**
  - **HAZOP review for flexible pipelines planned to be conducted**
- **Environmental permit submitted as part of the facilities EIA**

Pipeline FEL Status (2)

SMRG 2 Project

Execution Planning – *Assumed* (*Best Practical* is *Definitive*)

- **See overall Facilities execution planning for further details**

Engineering – *Limited Study* (*Best Practical* is *Advanced Study*)

- **FEED completed for rigid pipelines but not for flexible pipelines**
  - **Waiting for decision on awarding FEED contract**

Asset FEL Components

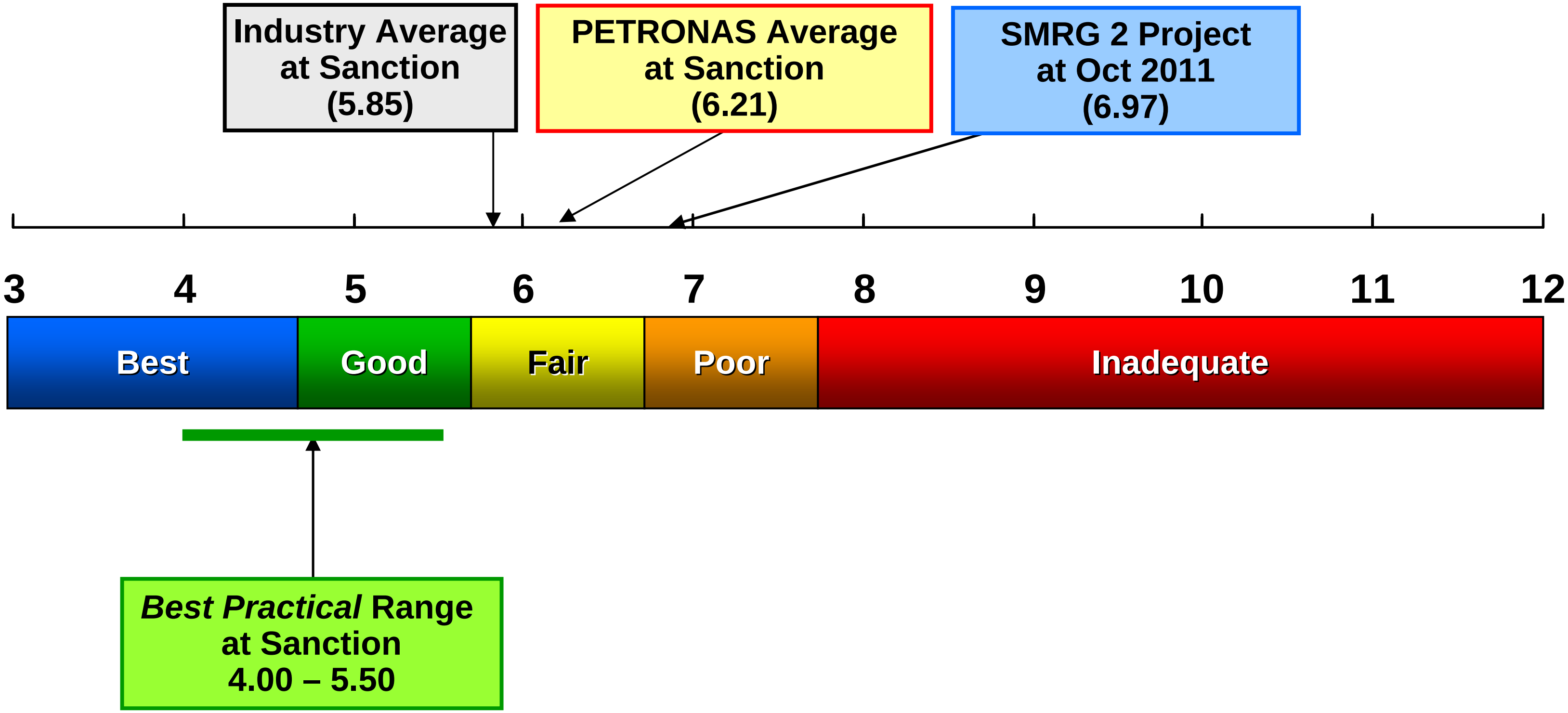
Reservoir FEL + **Facilities FEL** + **Wells FEL** → **Asset FEL**

- Inputs
- Constraints
- Tasks
- Planning

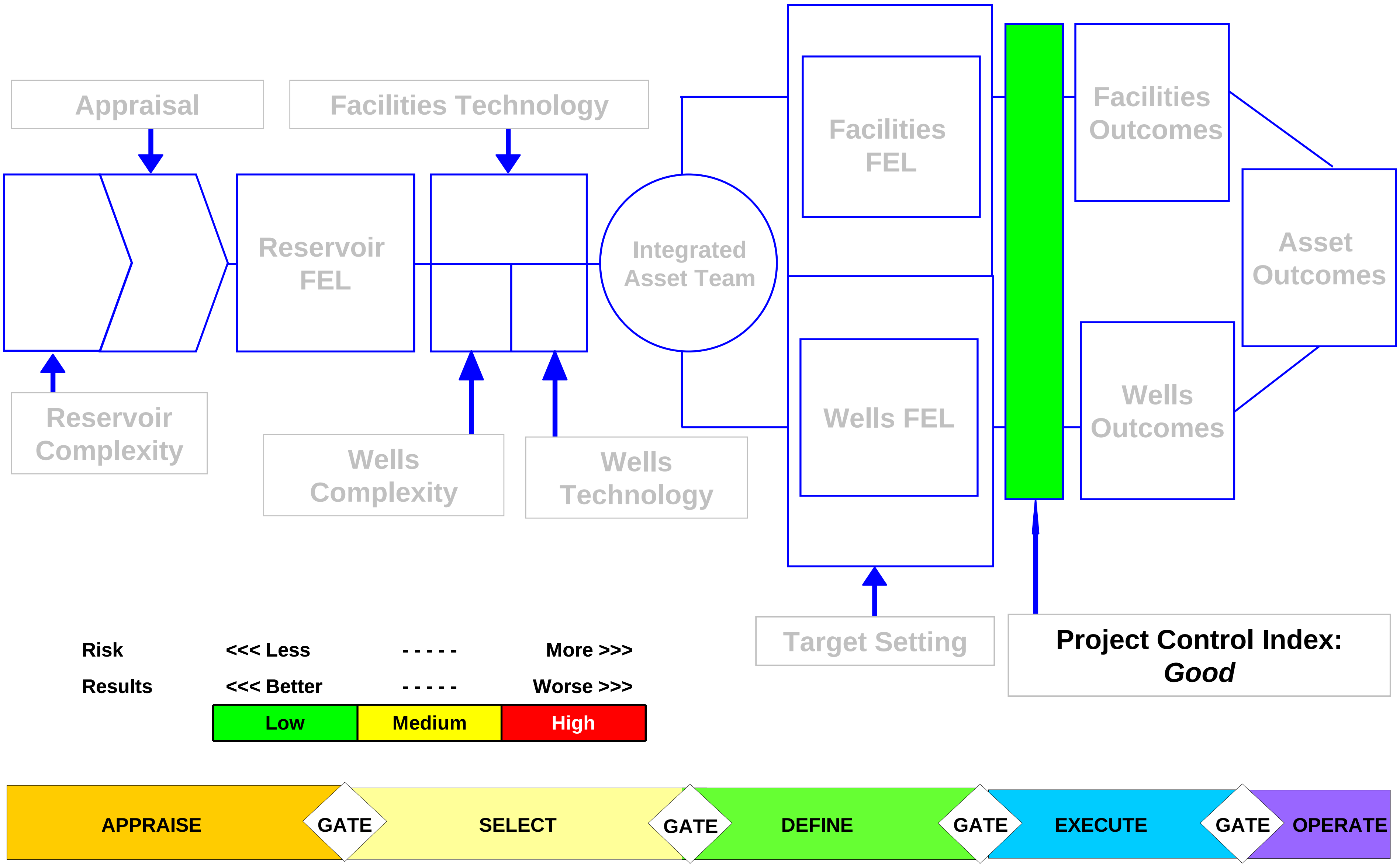
- Site Factors
- Engineering
- Planning

- Scope of Work
- Regulatory
- Engineering
- Planning

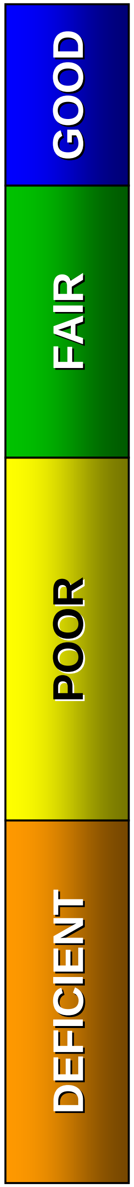
Asset FEL Is Outside *Best Practical* Range



Drivers of Project Success
Project Control Discipline



Planned Project Control Index (PCI) Is Better Than Industry



◆ SMRG 2 Project

◆ Industry at Sanction

◆ PETRONAS at Sanction

☑ ***Project estimate quantitatively validated as part of PPMS milestones***

- **Estimates peer reviewed by committee involving multi-disciplinary team that followed structured processes**

☑ ***Physical progressing***

- **Team plans to use earned value as basis of tracking for all accounts**

☑ ***Planned detail and frequency of progress reporting***

- **Discipline-level reports to be issued biweekly or monthly**

☑ ***Project control specialist assigned***

- **Owner project service resourcing in place**

Summary of Drivers and Practices (1)

- **Reservoirs are complex with *Moderate* appraisal strategies**

- **GASWAG yet piloted in the field and recognised as a risk**

- **Reservoir, Wells, and Facilities FEL Indices are outside *Best Practical* range**
  - **Time constraints on firming EOR concept**
  - **Wells definition lacking, which is expected given that first spud date is 2 years away**
  - **Incomplete SMG-AA FEED undermines cost estimate**
  - **Uncertainties in platform contracting strategy and lack of detailed execution schedule undermine execution planning**

Summary of Drivers and Practices (2)

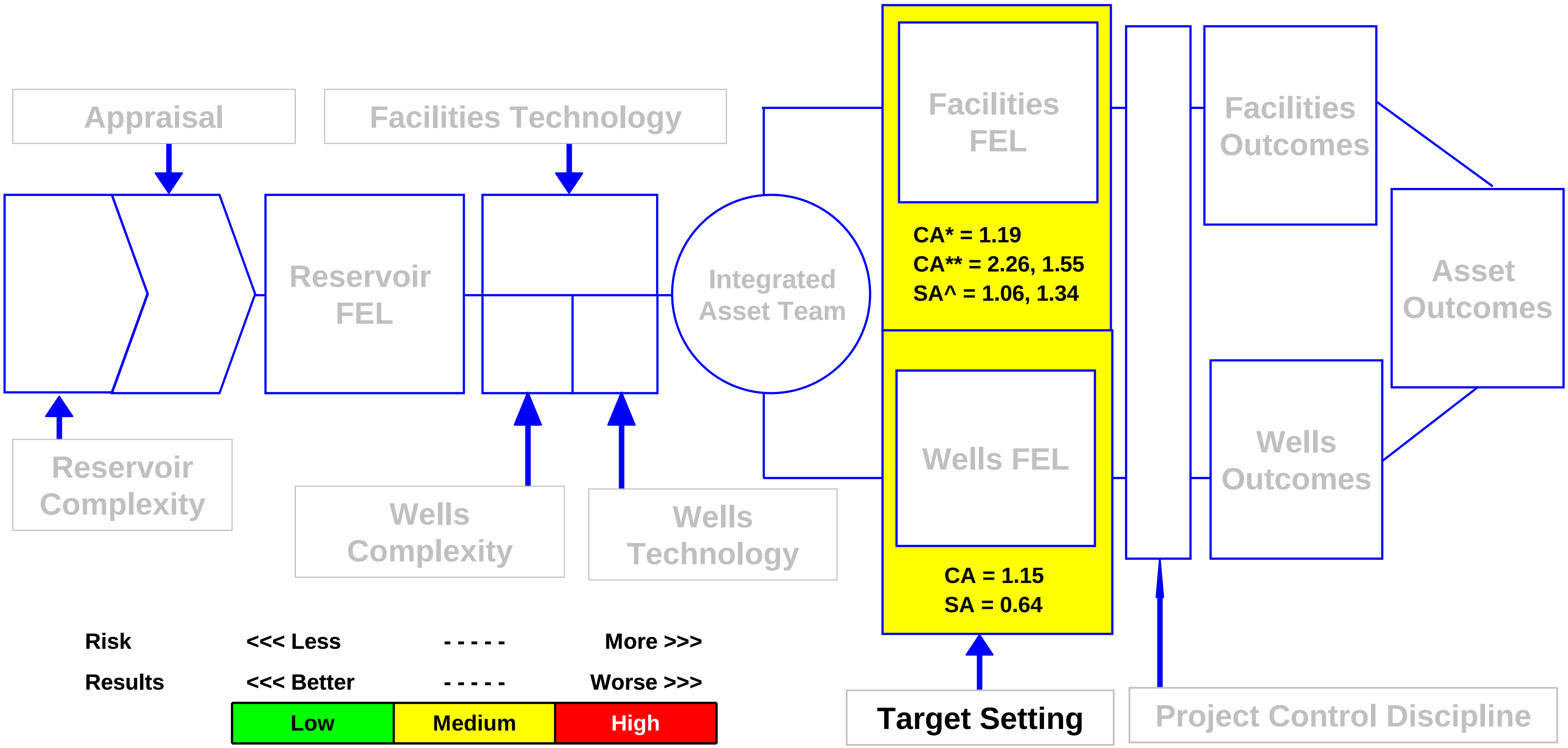
- ***Integrated* asset team and *Good* TDI**
  - **Good team development is a precursor for achieving *Best Practical* Facilities FEL***
  - **Not the case for SMRG 2 Project, which has *Poor* Facilities FEL**
    - **Driven mainly by time constraint to complete facilities definition, confirm execution strategy, and refine execution planning**
- **Project control plans are well developed**

*** Source: Fred Biery, *Enhancing Team Effectiveness to Improve Project Outcomes*, IPA, IBC 2001, March 2001**

Outline

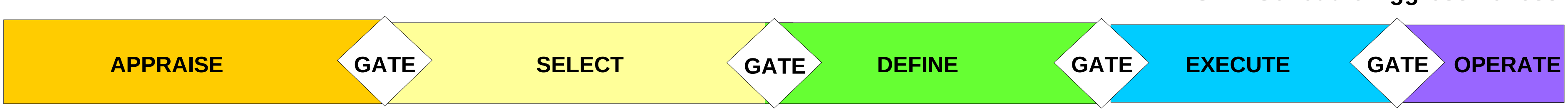
- **Key Message**
- **Project Background**
- **Basis of Comparison**
- **Practices and Drivers**
- ***Targeted Outcomes***
- **Conclusions**
- **Recommendations**

Drivers of Project Success
Planned Outcomes



* Revamp scope
** 14-inch and 16-inch LP gas pipelines
^ Based on 41- and 52-month execution durations
Note: SMG-AA, SMJT-AA, and SMW-B were not benchmarked

CA = Cost Aggressiveness
SA = Schedule Aggressiveness

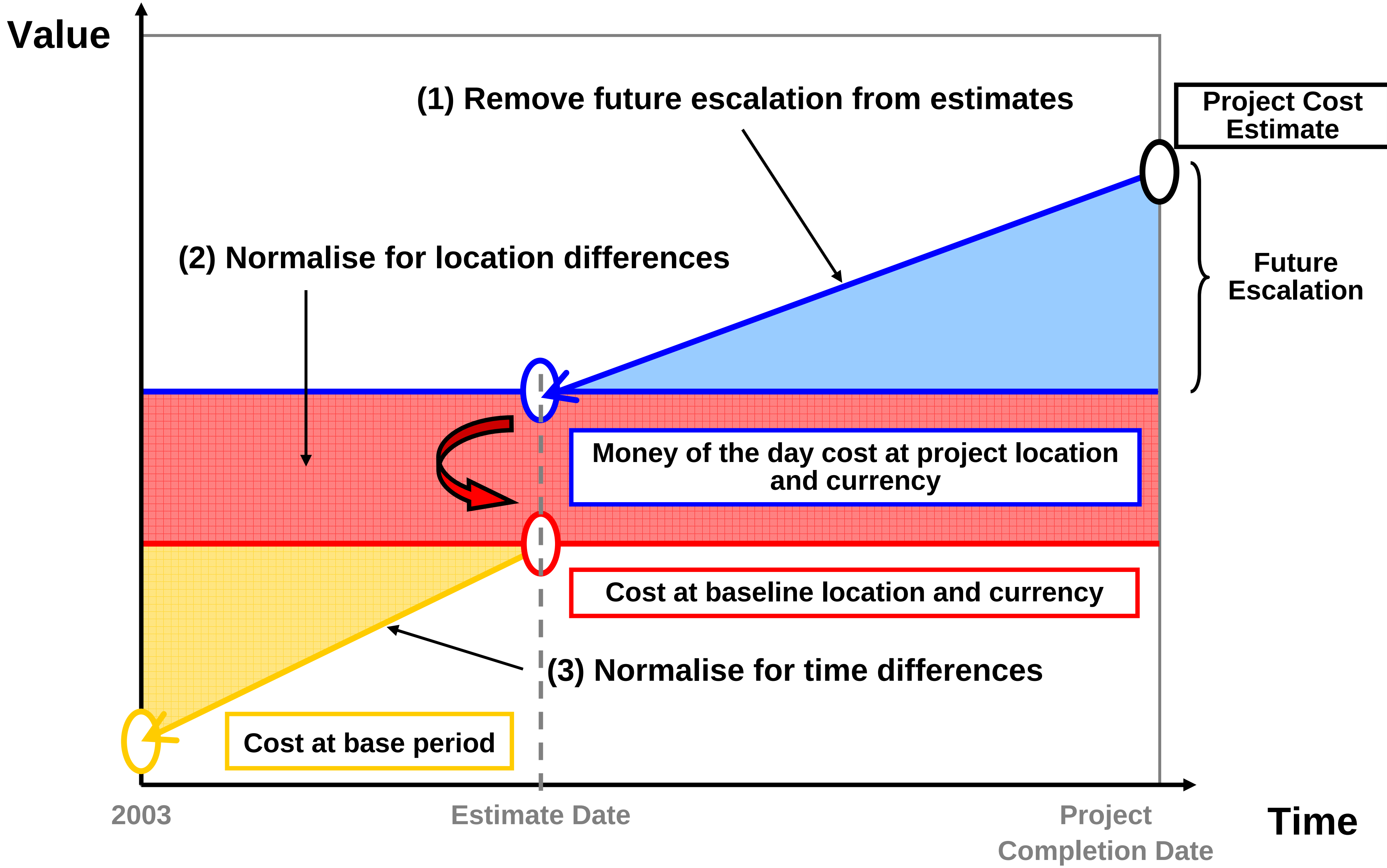


Cost Estimate Adjustment Methodology

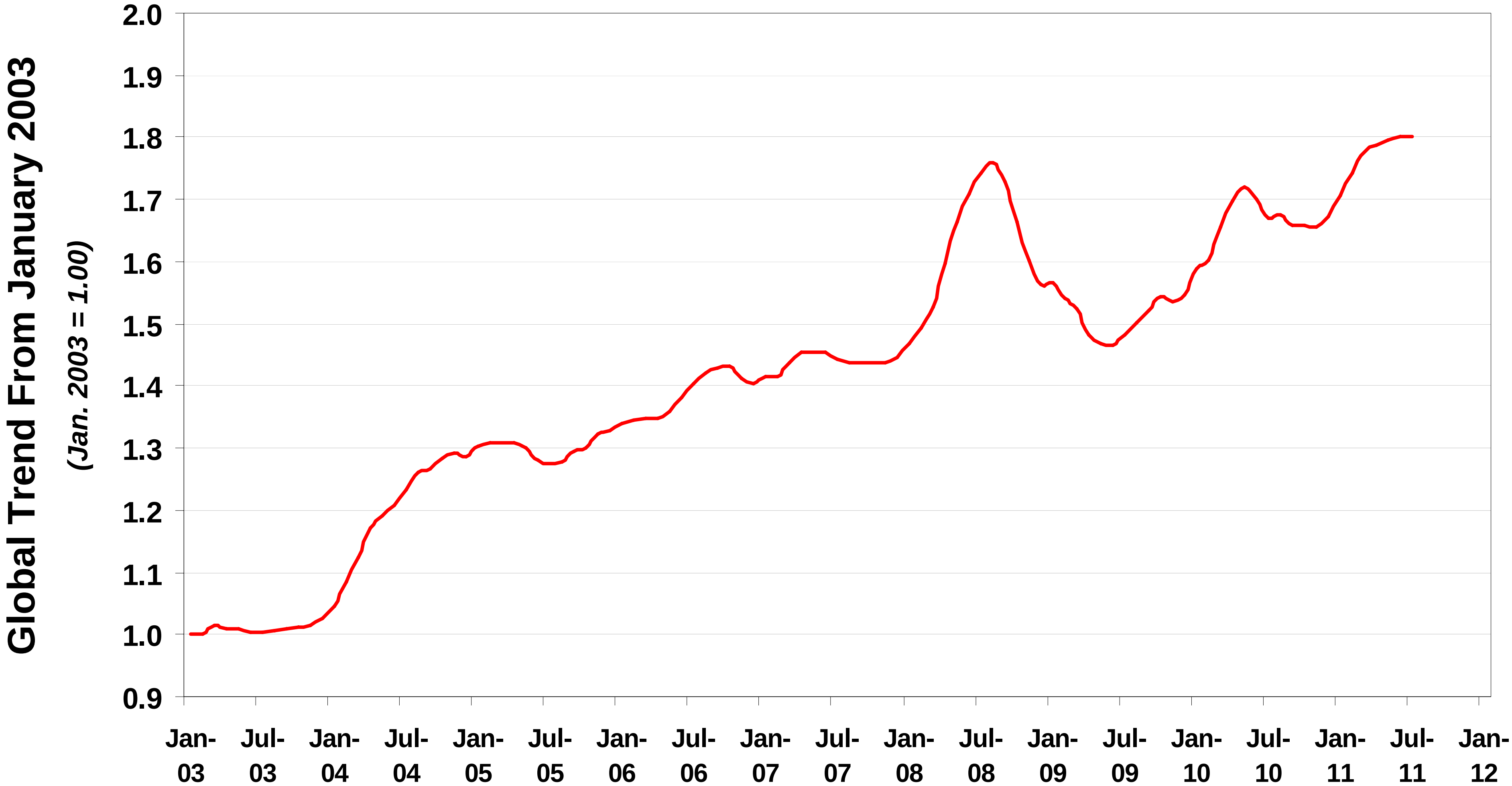
- IPA adjusts line by line using provided cost breakdowns
  - Foreign exchange done using monthly average exchange rate
  - Costs de-escalated to constant date
- Estimates adjusted based on date of estimate
- IPA assumes:
  - Prices reflect estimate date
  - Contingency is broken out
  - Escalation is excluded from cost analysis
- When contingency and escalation are in line items, IPA adjustments and benchmarks are less accurate

How Does IPA Normalise Costs?

Three Steps



Bulk Materials Escalation
Fabricated Pipe



Cost escalation trends are displayed in US dollars

Cost Estimate Breakdown

Overall SMRG 2 Project

Component	SMG-AA	SMJT-AA	SMW-B	Bridge	Cable	Pipelines	Risers	Brownfield	Wells	TOTAL
FEL 2 & 3	4.6	1.4	2.7	2.0		2.4		12.1		25.2
Detailed Engineering	16.4	1.5	3.0	1.0		3.2		3.0		28.1
Project Management	35.7	6.9	19.9	1.1	1.3	23.0		24.1	7.6	119.6
Fabrication	149.4	11.3	67.8	4.9		5.1	1.6	49.6		289.7
Multi-phase Flow Meters		2.5								2.5
T&I	54.0	27.6	41.0	0.2		65.1	75.6	8.3		271.8
Non-wells Activities									14.6	14.6
Drilling									165.1	165.1
Formation Evaluation									25.9	25.9
Completion									125.2	125.2
Wells cleanup									9.9	9.9
HUC	45.3	8.2	35.7	0.0		21.6		109.4		220.3
Others	9.2	3.7	5.6	0.2	9.9	5.2		5.5	2.0	41.4
Contingency	53.5	10.7	29.9	1.6	1.9	21.4	13.1	36.0	67.3	235.4
Without Wells Clean-up									407.7	
Total	**368.3**	**73.8**	**205.6**	**11.0**	**13.0**	**147.0**	**90.4**	**248.1**	**417.7**	**1,574.8**

Represents costs used in analysis for brownfield and well construction cost analysis

SMG-AA Platform Cost Analysis
Methodology

- **Processing platform model**
  - **Accounts for topside complexity (separation units, compressors, pumps, etc.), maximum wave height of design, water depth, and number of platform legs**
  - **Not used to benchmark SMG-AA because model does not include compression platform as large as SMG-AA**
- **Topside and jacket weight and costs**
  - **Jacket weight accounts for topside operating weight, water depth, and maximum wave height**
  - **Topside weight takes into account topside complexity and compression characteristic**
    - > **SMG-AA is outside dataset range**
  - **Jacket and topside cost for given jacket and topside weights**

SMJ-AA and SMW-B Platform Cost Analysis
Methodology

- **Wellhead platform model**
  - **Accounts for CxHy throughput per slot, maximum wave height of design, water depth, number of platform legs, manned platform, and rig support (drilling and workover)**
  - **Not used to benchmark SMJ-AA and SMW-B because injection function not considered in model**
- **Topside and jacket weights and costs**
  - **Jacket weight accounts for effect of topside operating weight, water depth, and maximum wave height**
  - **Topside weight accounts for CxHy throughput, number of slots, manned, and rig support (drilling and workover)**
    - > **SMJT-AA and SMW-B not analysed because injection function not in dataset**
  - **Jacket and topside cost for given jacket and topside weight**

Cost Estimate Breakdown
SMRG 2 Project Platforms

Component	SMG-AA	SMJT-AA	SMW-B
Office	**56.8**	**9.7**	**25.6**
FEL 3	4.6	1.4	2.7
Detailed Engineering	16.4	1.5	3.0
Project Management	35.7	6.9	19.9
Fabrication - Substructure	8.1	2.9	13.2
Jacket*	6.1	1.8	8.6
Piles	2.0	1.1	4.5
Anodes	0.1	0.1	0.1
Fabrication - Topside	141.3	10.9	54.6
T&I	54.0	27.6	41.0
HUC	45.3	8.2	35.7
Others	9.2	3.7	5.6
Contingency	53.5	10.7	29.9
TOTAL	**368.3**	**73.8**	**205.6**

Represents costs used in the analysis

*** Jacket fabrication cost includes coating cost**

Platform Cost Analysis
Results

- **Analysis based on topside and jacket weights and costs**

Component	Unit	Compression Platform		Wellhead Platform		Wellhead Platform	
		SMG-AA	Asia	SMJT-AA	Asia	SMW-B	Asia
Jacket Weight	mT	841	712	236	171	1,296	1,172
Jacket Fabrication Cost	US millions	6	7	2	2	9	8
Topside Fabrication Cost	US millions	141	237	11	11	55	47

- **Compared with other similar projects in Asia:**
  - **Jacket weights of SMG-AA and SMW-B are comparable to average, but SMJT-AA jacket is heavier**
  - **Jacket fabrication cost of all platforms is industry average**
  - **Topside cost for SMJT-AA and SMW-B is comparable with average, but SMG-AA is significantly lower**

Pipeline Cost Analysis
Methodology

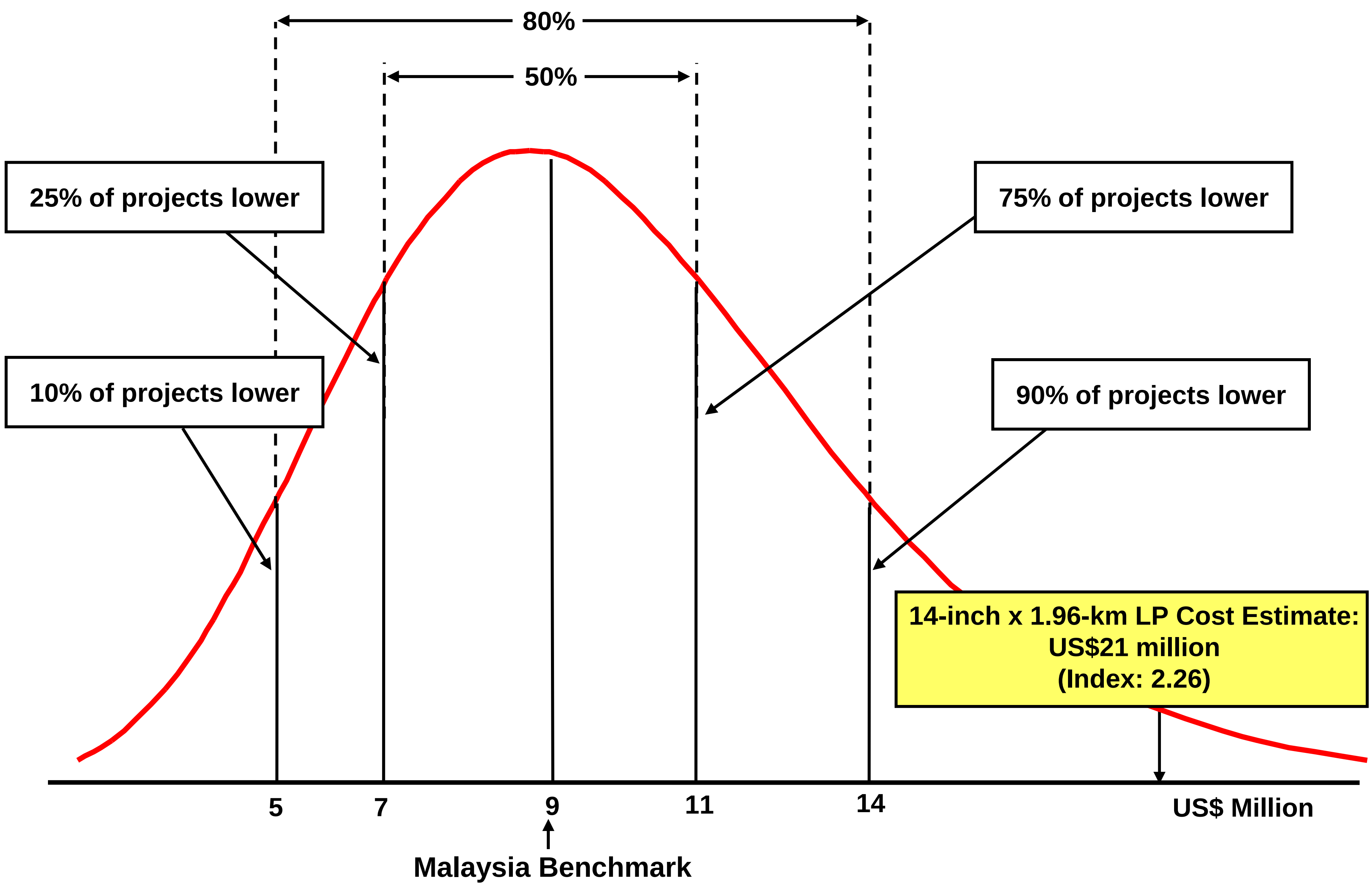
- **Pipeline cost model accounts for cost effects of:**
  - **Pipeline diameter**
  - **Pipeline length**
  - **Water depth**
  - **Excludes riser costs**
- **Model only applicable for 14-inch x 1.96-km and 16-inch x 2-km pipelines**
- **Other pipelines with in x km outside the minimum model range are not benchmarked**

Cost Estimate Breakdown
14-inch x 1.96-km and 16-inch x 2-km Pipelines

Component	14-inch x 1.96-km		16-inch x 2-km	
	Pipeline	Riser	Pipeline	Riser
Project Cost	3.8		4.0	
FEL 3	0.3		0.3	
Detailed Engineering	0.4		0.4	
Project Management	3.1		3.3	
Fabrication	0.8	0.2	1.0	0.2
T&I	9.6	9.5	11.0	9.5
HUC	2.7		2.7	
Others	0.7		0.8	
Contingency	3.0	1.6	3.3	
TOTAL	**20.7**	**11.3**	**22.8**	**9.7**

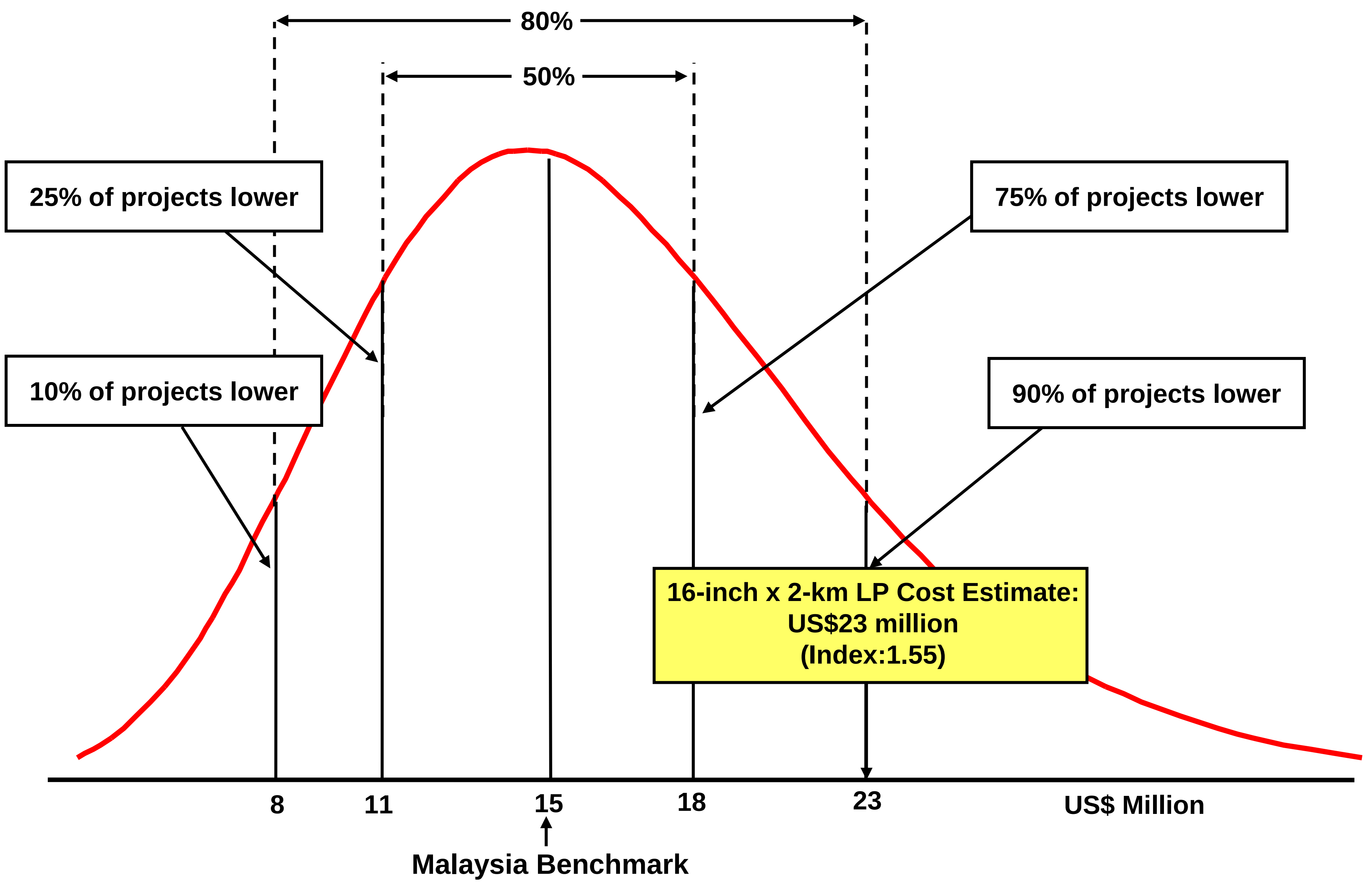
Represents costs used in the analysis

Pipeline Cost Analysis
14-inch x 1.96-km LP SMP-C to SMP-A



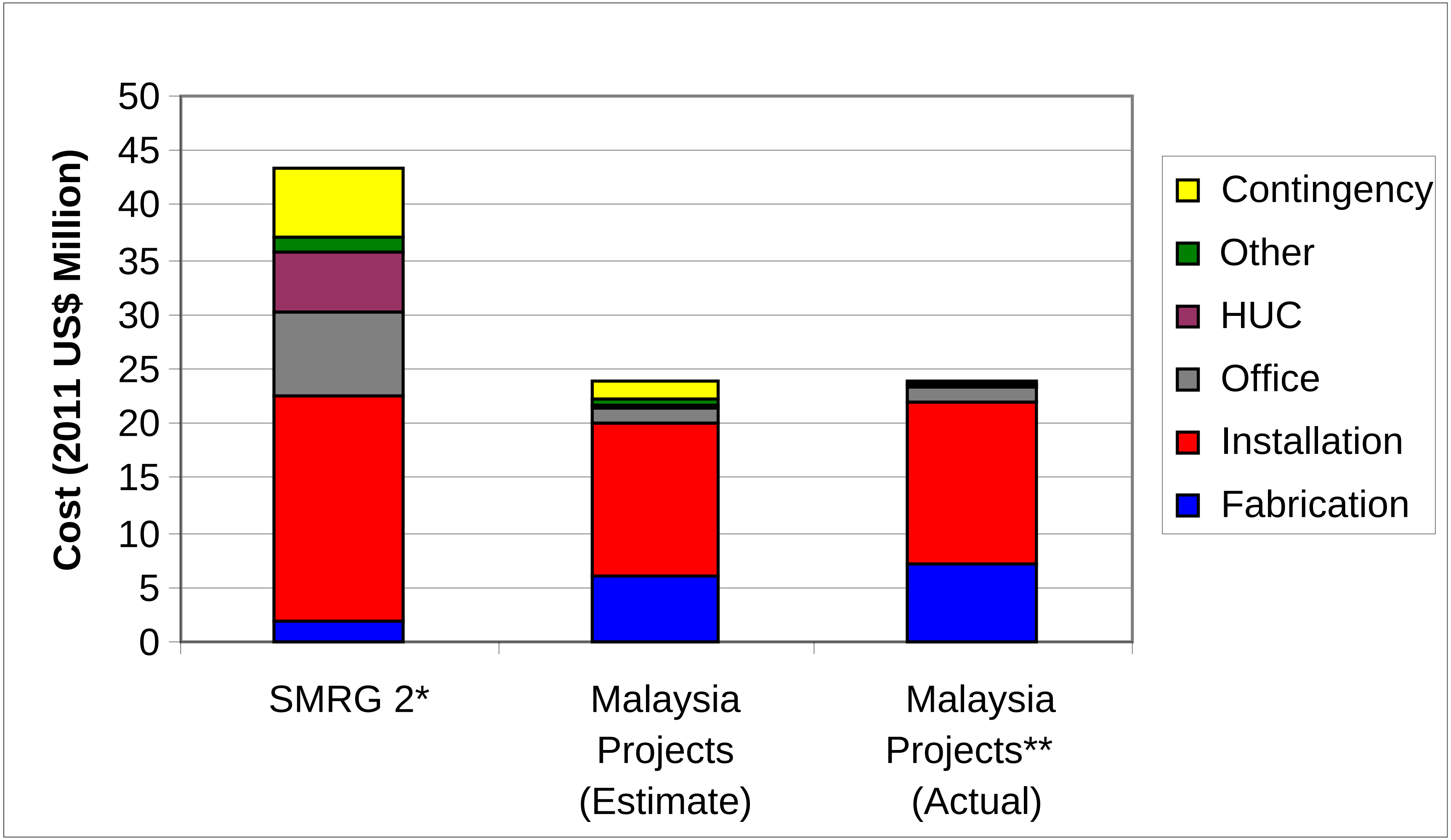
Pipeline Cost Analysis

16-inch x 2-km LP SMP-B to SMG-A



Pipelines Cost Analysis

Estimated Costs Are Mixed Compared With Malaysia Projects



* SMRG 2 Project total covers costs of 2 pipelines

** Malaysia projects (actual) cost based on 3 projects

Pipelines Cost Analysis
Results

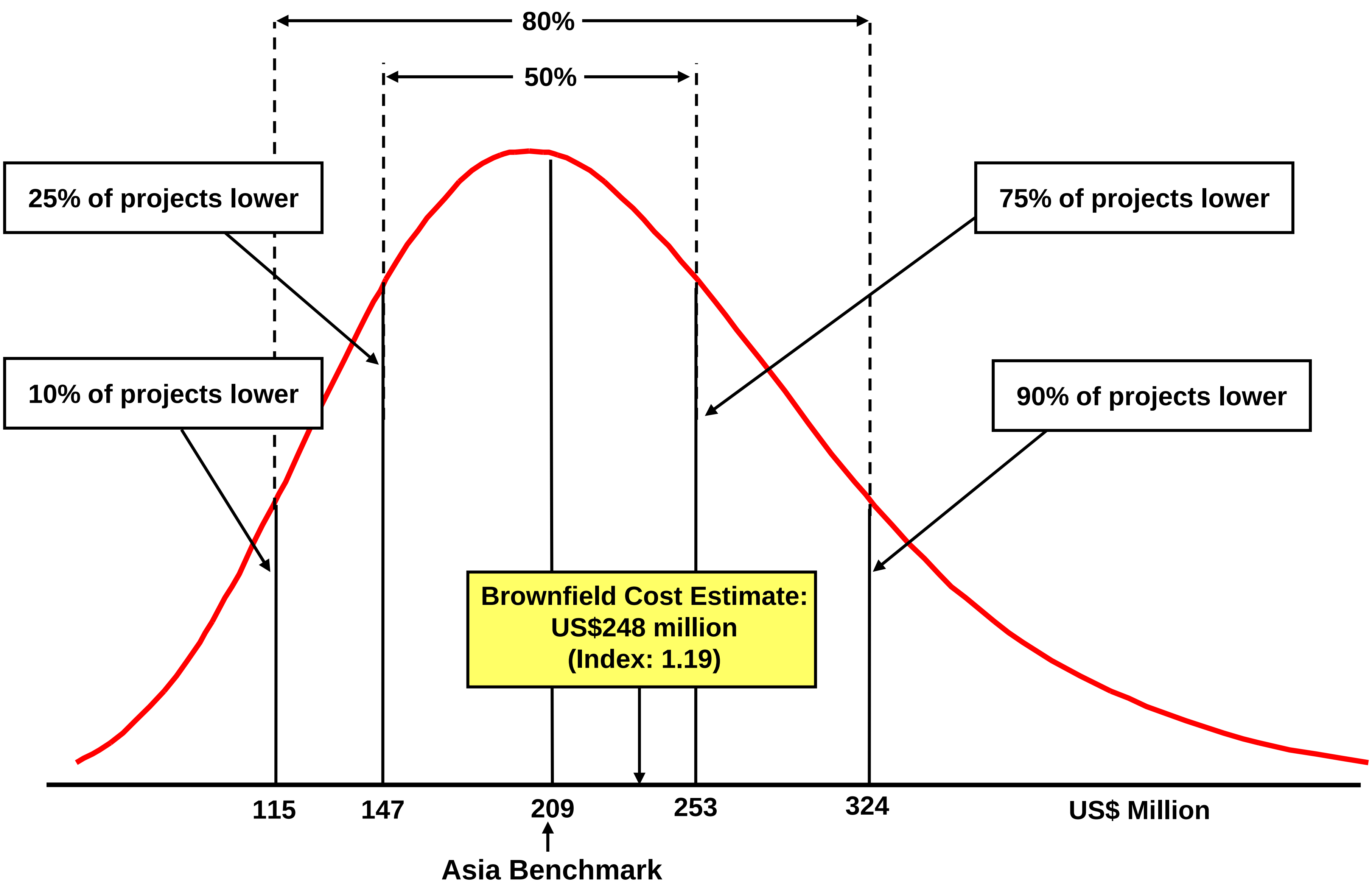
- **Compared with Malaysia projects:**
  - **Estimated cost for 14-inch x 1.96-km is two times more expensive than average**
  - **Estimated cost for 16-inch x 2-km is 55 percent more expensive than average**

- **Based on benchmark, analysis of component costs shows that, except for fabrication cost, all other costs, including contingency estimates, are higher than that for similar Malaysia projects**

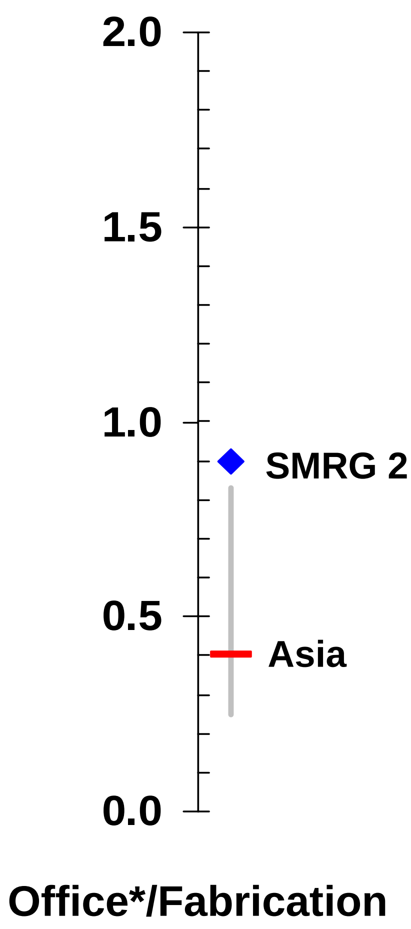
Brownfield Cost Analysis
Methodology

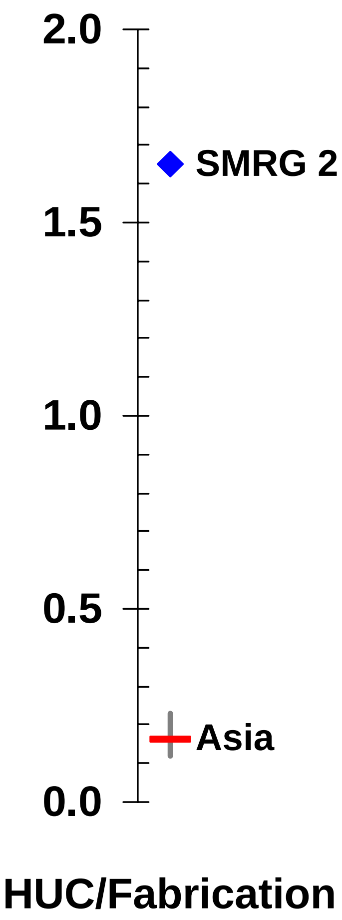
- **Brownfield cost model accounts for cost effects of:**
  - **Total bulk materials and equipment cost, including onshore and offshore fabrication**
  - **Use of a floatel (as a proxy for project complexity)**

Brownfield Cost Analysis
SMRG 2 Project



Brownfield Cost Analysis
Office and HUC Costs Look High





Note: The grey lines represent the interquartile range
*** Office cost is the sum of FEL, detailed engineering, and project management costs**
Also note: 17 percent contingency was added to estimates

Brownfield Cost Analysis
Conservative Estimate Driven by High HUC Cost

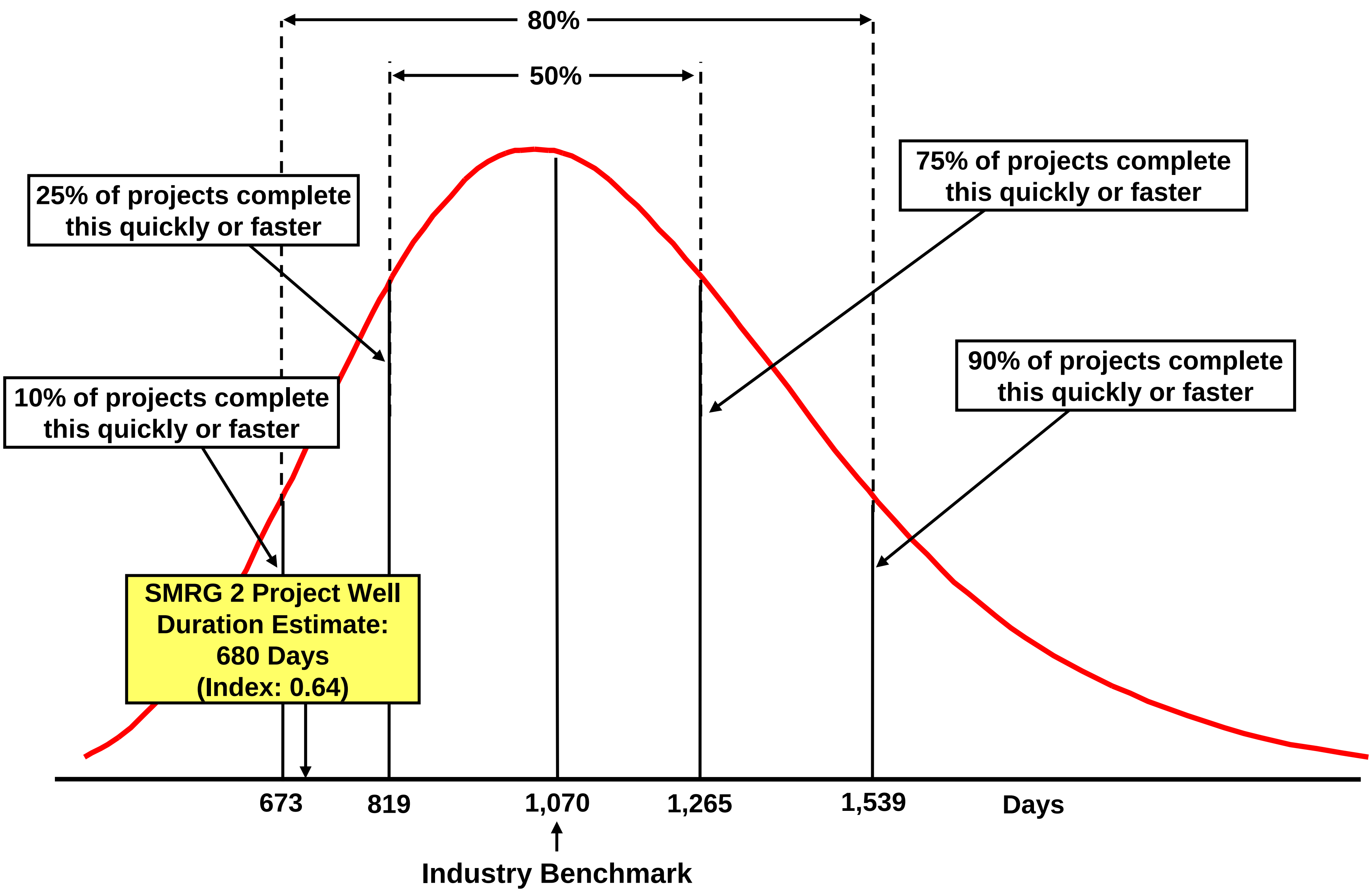
- Brownfield estimate is about 20 percent higher than Asia average
- Further analysis based on cost per total fabrication
  - Office cost is more than twice the Asia average
  - HUC cost is 10 times higher than Asia average*
    - > Significant hook-up scope: pre- and post-drilling, platform upgrading, and integration operations
    - > Low productivity due to weather and ocean conditions

* Comparison with other PETRONAS projects cannot be carried out due to the lack of PETRONAS projects with HUC costs

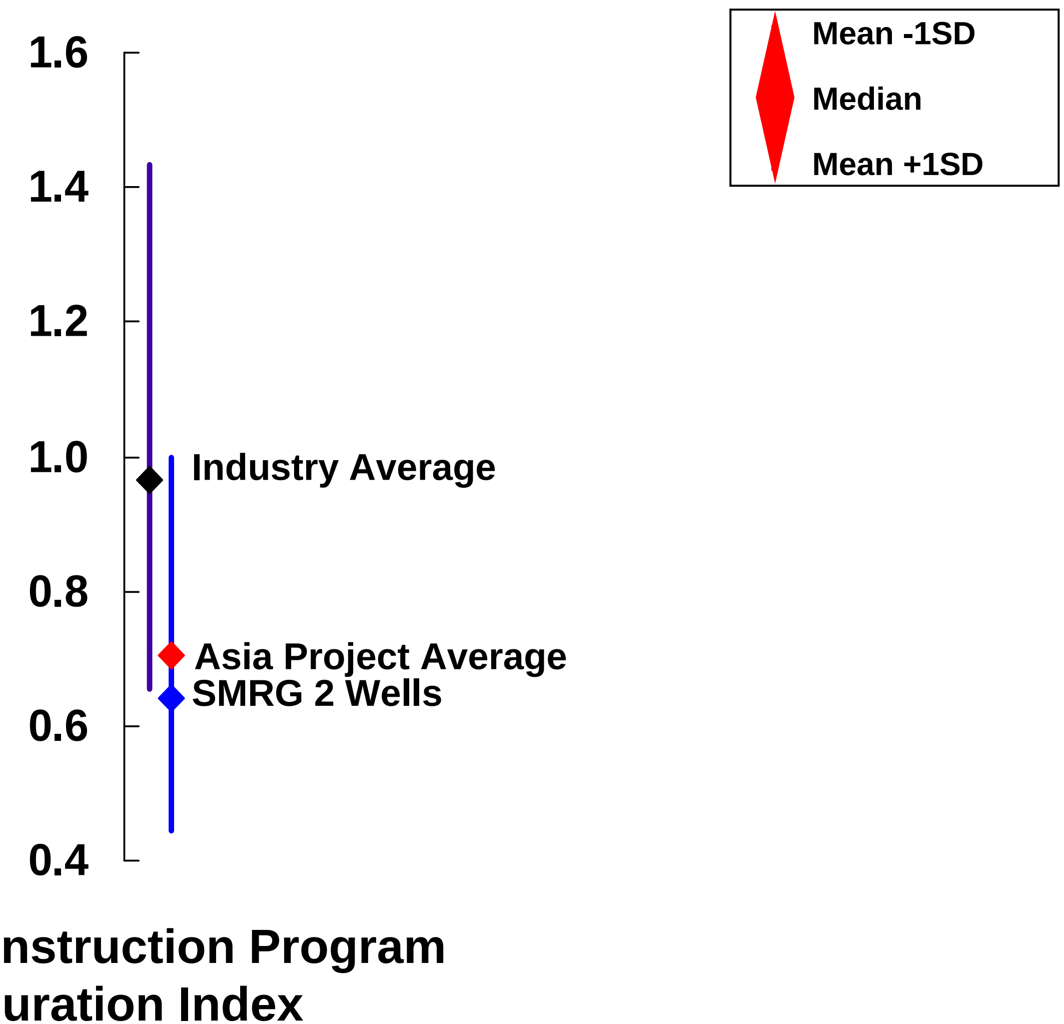
Well Construction Duration and Cost Analysis
Methodology

- **Wells construction duration benchmark built from benchmarks for drilling and completion**
  - **Drilling duration model considers drilled footage, complexity of casing design, well path complexity, and batch drilling**
  - **Completion duration model considers completion depth, tree type complexity, batch drilling, and completion complexity (multi-zone, multi-lateral, sand control, etc.)**
- **Wells construction cost benchmark mainly built from duration benchmark with water depth as additional factor**

Well Construction Duration Analysis
SMRG 2 Project



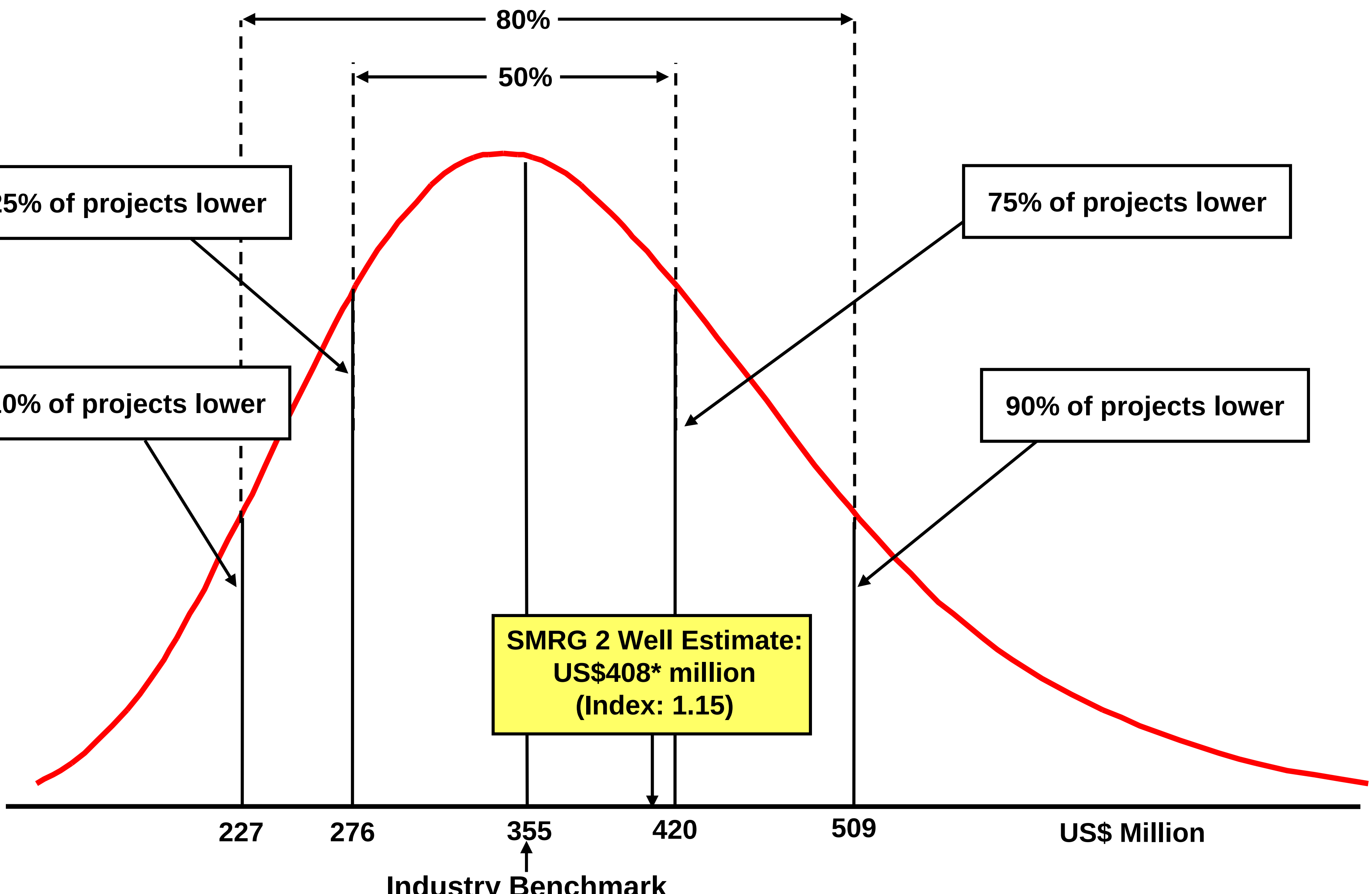
Well Construction Duration Analysis
In line With Asia Average



Wells Schedule Analysis
In Line With Asia Average

- **Planned well construction duration is 35 percent faster than Industry**
- **Wells executed in Asia are 30 percent faster on average than Industry**
  - **SMRG 2 Project well construction duration is in line with Asia average**

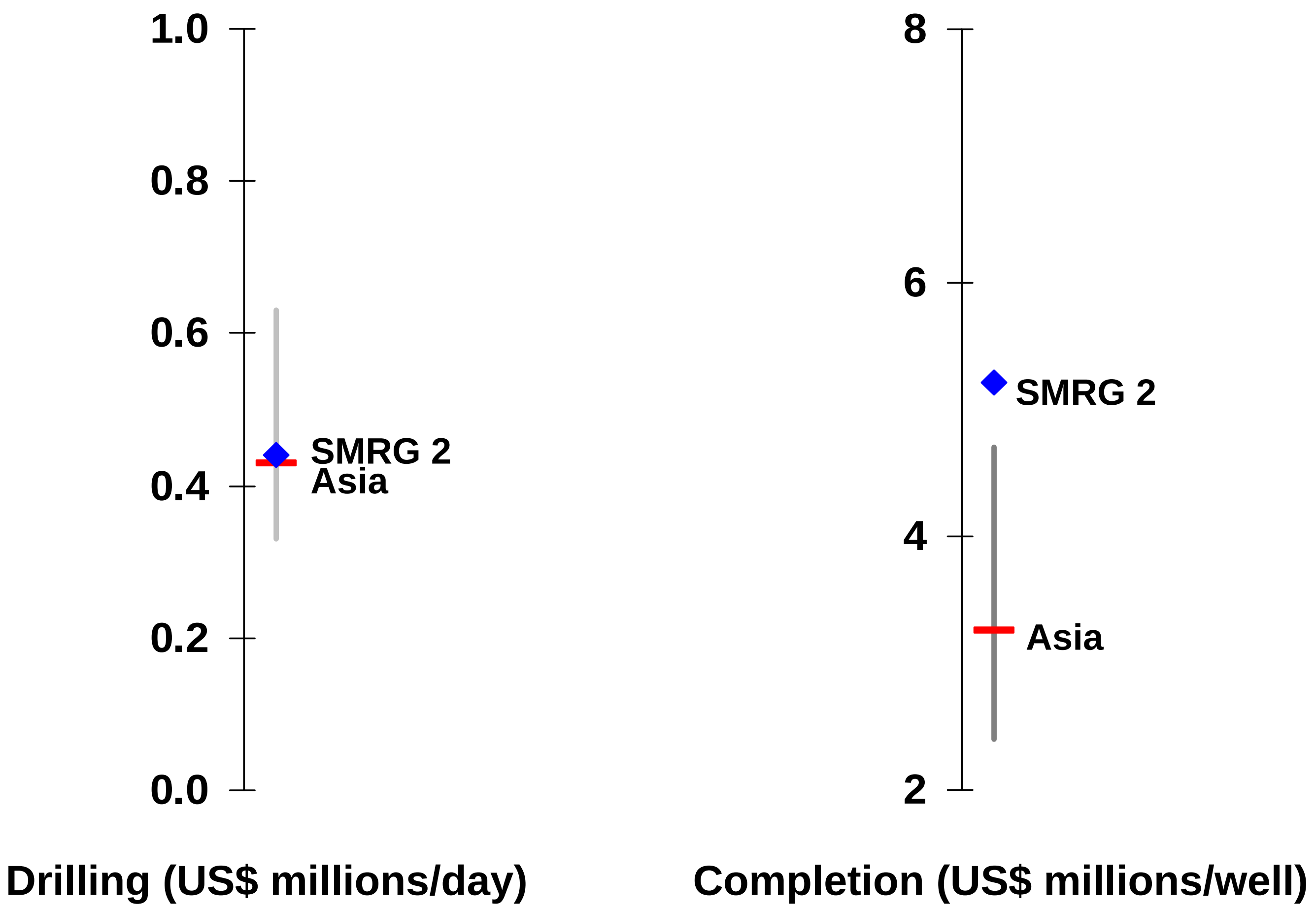
Well Construction Cost Analysis
SMRG 2 Project



* Exclude well clean-up cost

Well Construction Cost Analysis*

Completion Cost Looks Higher Than Industry



Note: The grey lines represent interquartile range

***Only projects with multi-zone completions with sand control were included. Well model does not control for smart well completion (downhole pressure gauges, interval control devices, temperature sensors, etc.) and 13Cr tubing**

Well Construction Cost Competitiveness
Completion Cost Looks High

- **Well construction cost estimate is about 15 percent higher than industry average**
- **Further analysis show that high cost driven by high completion cost rather than duration or drilling cost**
  > **Drilling cost per day and well construction duration in line with Asia averages**

  > **Completion cost per well about 60 percent higher than Asia average**

  >> **High completion cost due to expensive completion components such as SMART wells and 13Cr tubing***

*** Completion model only controls for completion depth, dry tree completion, sand control, drilling sequence (batch or sequential), multi-zone, type of wells (producer or injector), and multi-lateral**

SMRG 2 Project Planned Schedule

Activity	Start	Finish	Duration (Months)
FEL 3 (Modular)	01-Apr-10	06-Oct-11	18
Tier 1 Sanction	**08-Feb-12**		
Tier 2 Sanction	**17-Oct-12**		
Tendering (Prebid, Bid, Evaluate, Award)	20-Jul-11	24-Dec-12	17
Detail Engineering			
Tie-in	12-Nov-10	28-Sep-11	11
Brownfield, SMG-AA, SMW-B and SMJT-AA	20-Jun-12	08-May-14	23
Procurement (prebid, bid, evaluate, award, manufacture and deliver)	22-Sep-11	06-Aug-14	34
Fabrication / Construction including load-out and sea fastening	04-Mar-12	22-May-15	39
Transportation and Installation			
SMW-B	02-Apr-14	03-May-14	1
SMJT-AA	09-Apr-15	06-May-15	1
SMG-AA	02-Mar-15	18-Apr-15	2
Pipelines	29-May-14	30-May-15	12
Wells			
Infill Drilling	15-Apr-13	21-Feb-14	10
EOR Drilling	16-Nov-14	01-Oct-15	11
Hook-up and Commissioning	18-Jan-13	16-Feb-16	37
Infill Drilling First Oil	**19-Jun-13**		
First Water Injection	**25-Sep-15**		
First Gas Injection	**19-Nov-15**		
Execution Duration (start of Detailed Engineering to First Gas Injection)*	**20-Jun-12**	**19-Nov-15**	**41**

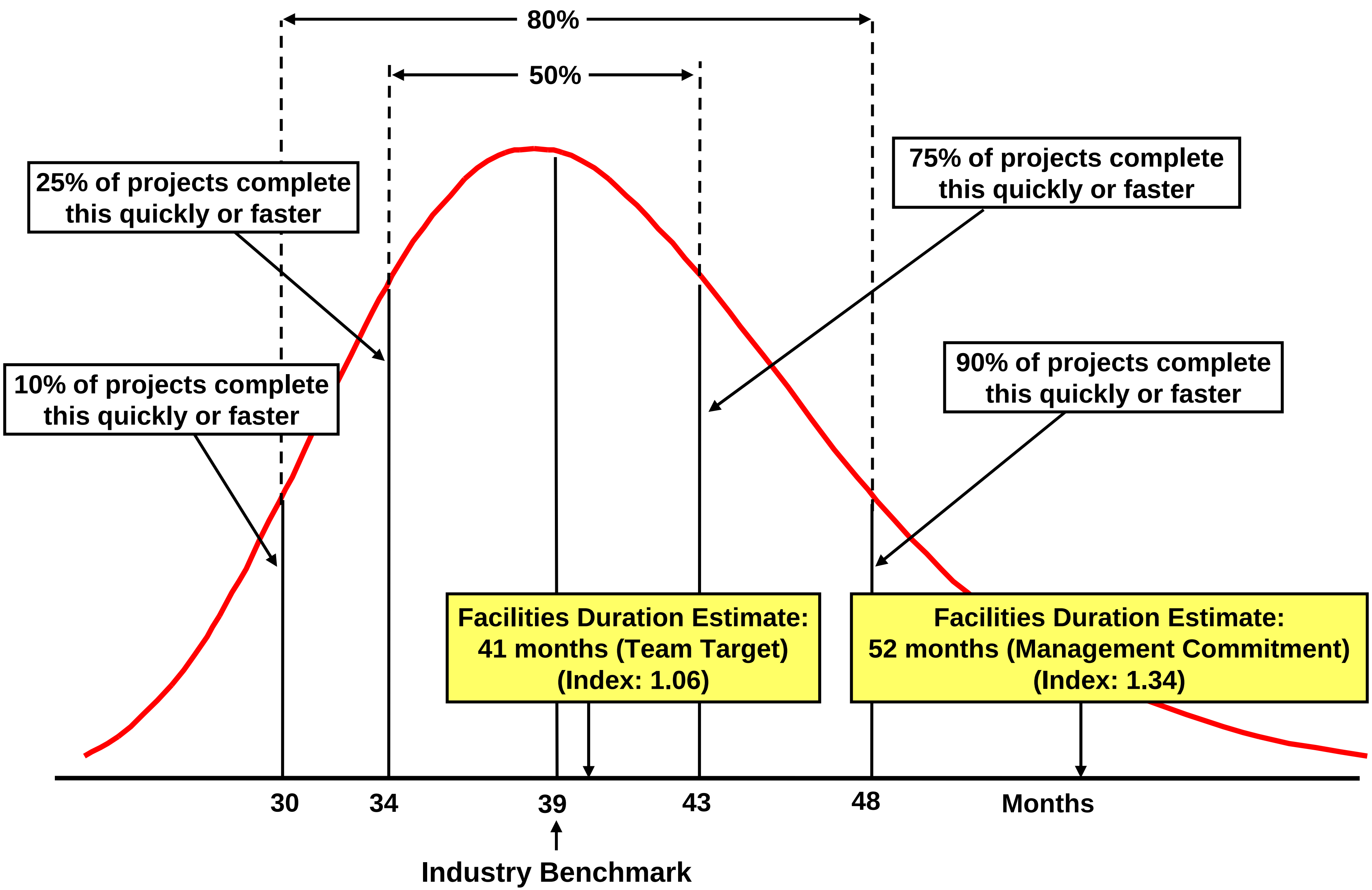
Represents duration used in analysis

*** Start of detailed engineering for brownfield scope (platform upgrading) used for analysis rather than tie-in because of simple scope**

Facilities Duration Analysis
Methodology

- **Facilities execution schedule benchmarks are:**
  - **Size based, not concept-specific or regional**
  - **Assumes industry average overlap of engineering and fabrication**
  - **Weather window considered**
  - **Effect of revamp scope on duration included**
- **SMRG 2 facilities duration calculated from detailed engineering for brownfield scope (platform upgrading) to first gas injection**
  - **Management has committed to one duration, while the team is targeting a different duration**
  - **Both dates included in analysis**

Facilities Execution Duration Analysis
SMRG 2 Project



Facilities Execution Duration Analysis
In Line With Industry

- **Planned facilities execution duration targeted by team is 41 months**
  - **– First gas injection planned for 19 November 2015**
  - **> Duration is in line with Industry**
- **Planned facilities execution duration committed to management is 52 months**
  - **– First gas injection planned for 16 October 2016**
  - **– Duration is 34 percent slower than industry average**
- **Uncertainty around yard and barge availability should be considered**

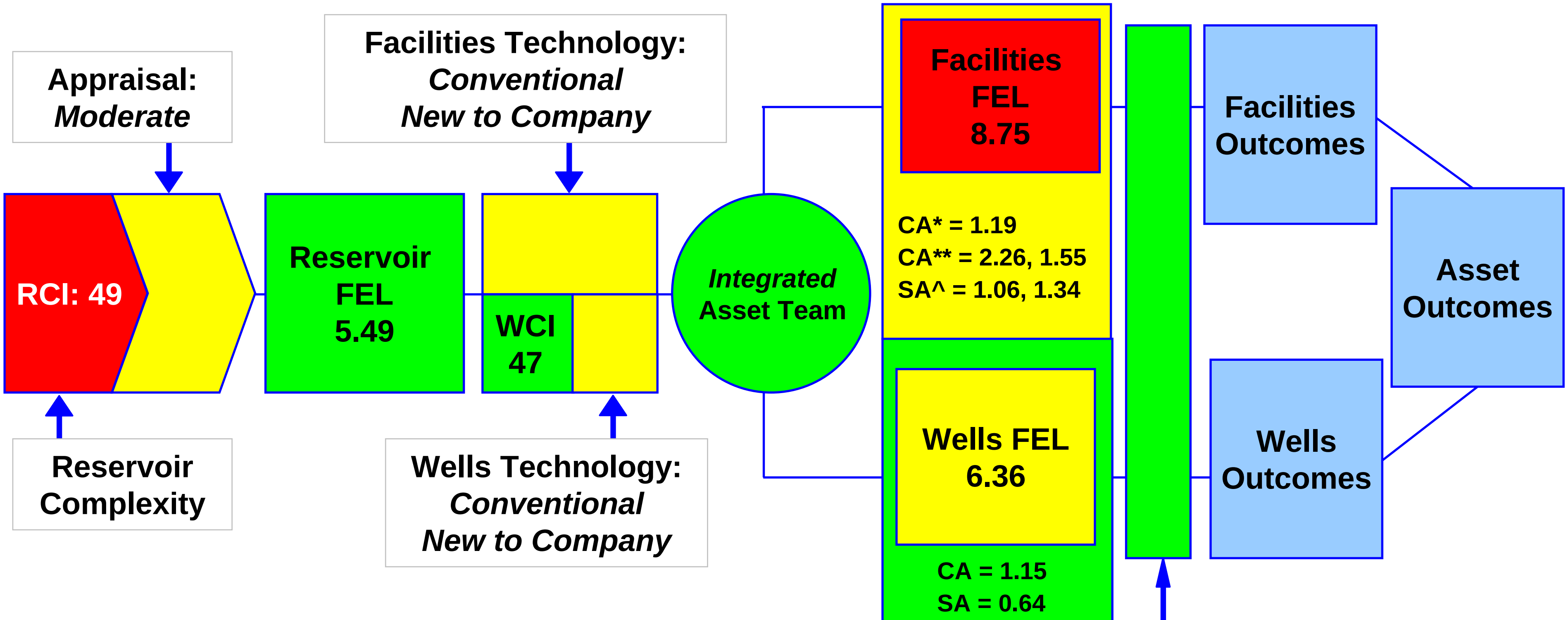
Summary of Targets

- Brownfield cost is conservative compared with Asia average with high HUC cost
- Pipeline cost is conservative with high T&I, HUC, and contingency costs compared with Malaysia projects
- Well construction cost is conservative, whilst the planned duration is comparable with Asia average
  - Drilling cost per day is average, but completion cost per well is high
- Facilities execution schedule targeted by team is industry average
- Facilities execution schedule committed to management is conservative

Outline

- Key Message
- Project Background
- Basis of Comparison
- Practices and Drivers
- Targeted Outcomes
- *Conclusions*
- Recommendations

Summary of SMRG 2 Project (October 2011)



RCI	20	- - - - -	66
WCI	25	- - - - -	123
Risk	<<< Less	- - - - -	More >>>
Results	<<< Better	- - - - -	Worse >>>
	Low	Medium	High

*** Revamp scope**
**** 14-inch and 16-inch LP gas pipelines**
^ Based on 41- and 52-month execution durations
Note: SMG-AA, SMJT-AA, and SMW-B were not benchmarked

RCI = Reservoir Complexity Index
WCI = Wells Complexity Index
FEL = Front-End Loading
CA = Cost Aggressiveness
SA = Schedule Aggressiveness
PCI = Project Control Index

Conclusions (1)

- **SMRG 2 has a complex reservoir and is planning to implement GASWAG, which has not been piloted in the Samarang field**

- ***Moderate* appraisal strategy emphasises the remaining risks and uncertainty in RPE particularly for EOR and East Flank**

- **The project team is fully-staffed and functionally integrated**

- ***Good* Reservoir FEL masks important constraints on the project:**
  - **Timing of data to confirm GASWAG viability**
  - **Gas supply source during operations**

Conclusions (2)

- **Significant gaps remain in the facilities scope:**
  - **FEED and updated cost estimate for floatover concept, flexible pipelines**
  - **Uncertainties in yard and barge availability**
  - **Lack of a detailed schedule for execution**
- **Wells FEL is outside *Best Practical* range but there is time for further work before spud:**
  - **Lack of firmly contracted rigs**
  - **Execution timing for the additional three wells not yet determined**

Conclusions (3)

- **With these gaps, the project runs the risk of setting unrealistic cost and schedule targets**
  - **Planned execution schedule targeted by the project team is industry average but this could be at risk due to uncertainty in the execution planning**
  - **Cost estimate for pipelines look high but will be revised for flexible pipelines**
- **The team recognises these gaps but will require time and effort to close them**

Outline

- **Key Message**
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- **Conclusions**
- ***Recommendations***

Postpone ITB for SMG-AA

- Team waiting for results from core flooding analysis to confirm viability of GASWAG
- Analysis results could affect SMG-AA platform design
  - If gas compression scope is not be needed, platform size and configuration may change significantly
- Incorporating such changes during ITB process (which has started) likely to be disruptive and lengthen the process
- IPA research shows that late reservoir basic data for increase the risk of facilities schedule slip

Complete Floatover FEED Prior to SMG-AA ITB

- Current plan is to include FEED as part of EPCIC contract
- Main driver is to meet sanctioned target date
- However, this strategy likely to attract risk premium from contractor because there is more uncertainty around the design

Improve Schedule Definition

- Develop detailed pipelines schedule and incorporate it in the overall project schedule
- Provide greater details on engineering and construction
- Update schedule once contracting strategy is finalised
- Include availability of yard and barge in schedule risk analysis

Ensure Sufficient Gas Will Be Supplied

- **Identify and profile source of supplied gas to ensure gas supply for compression adequately covers expected economic life**
- **Track progress of project(s) in region that can affect gas supplied to LGAST and SMRG 2 Project**
- **Develop mitigation plan if source gas is not sufficient**
- **Maintain regular contact with PMU* on status of source gas**

*** PMU = PETRONAS Management Unit**

Gather Lessons Learnt From International PCSB Projects

- **If fabrication done outside Malaysia, team should:**
  - **Gather lessons learnt from international PCSB projects on the following:**
    - > **Yard capability and safety record**
    - > **Performance track record of the yard with international PCSB projects**
    - > **Risks associated with transportation, custom requirements, etc.**
  - **Develop appropriate mitigation plans**
  - **Incorporate identified risks into schedule and cost estimate**

Finalise the Plan to Execute the Additional 3 Wells

- **Make a decision regarding when the additional 3 wells will be executed so team has sufficient time to define:**
  - **Well scope of work, including location risks and timing**
  - **Well design, including drilling plan, drilling risks, and cost estimates**
  - **Well execution planning, including depletion plan, procurement, simultaneous interface plan, monitoring plan, rig plan, etc.**

Appendix A: Interviewees

Name	Position
Chik Adnan	Project Manager
Hendry Majinun	Head of Operations
Walter Chia	Senior Structural Engineer
Chao Zhao Neal	Senior Drilling Engineer
Eliff M Mazlan	Senior Electric Engineer
Mohd Norfisyah Alifiah	SRE
Rasim Yildiz	Head of Production Technology
Suhir Che Selia	Senior Project Engineer
Sebastien Batiot	Geologist
Javier Farinez	Integrated Operation Leader
Luca Vizzini	Technical Manager

Name	Position
Roslina Misman	Head of Facilities
Aizuddin Che Mansor	Contract Administrator
Sarah Harris	Senior Inst Engineer
Norashikin Ramli	Safety Engineer
Tengku Mohd Shahru Haslan	Pipeline Engineer
Jorge Maldonado	Reservoir Engineer
Mimi Azura Shuhaimi	Resource Study Manager
Haakon Roed	Wells Team Leader
Nik Mohd Fakrul Fidzrie	Project Engineer
Mehran Jahangiri	Plan and Schedule

Independent Project Analysis, Inc.

Khanh Nguyen - knguyen@ipaglobal.com

Galvin Singh - gsingh@ipaglobal.com

#03-07 Creative Resource

31 International Business Park

Singapore 609921

+65 6567-2201

Prospective Evaluation of the Samarang Phase 2 Project

Prepared for
PETRONAS

Prepared by
Khanh Nguyen and Galvin Singh

December 2011

FINAL

IPA INDEPENDENT PROJECT ANALYSIS, INC.