Deepwater Conceptual Design and the Need for Integrated Thinking

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Agenda

Brief Xodus Introduction

Deepwater Background

Typical Field Development Issues

Industry Case Studies

An Integrated Approach

Summary

Xodus Introduction

- Established in 2005 in Aberdeen, 2007 in Perth
- Over 250 staff - 80 in Perth
- Offices in Aberdeen, London & Perth
- Provides integrated solutions
  - Development Planning,
  - Assurance, and
  - System Optimisation
- Comprises core divisions
  - Subsea
  - Integration Technology
  - Process and Facilities
  - Environment
  - Technical Safety and Risk

The Xodus vision is to be the premier integrated front end oil and gas consultancy in the world.

Xodus Introduction

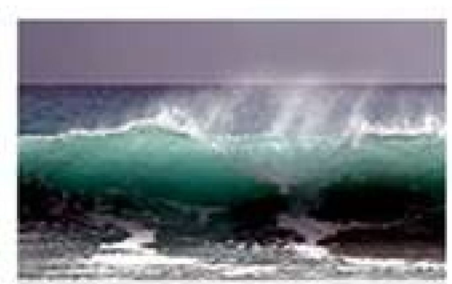
Aligning our consulting offering with client asset lifecycle needs:

Development Planning	Assurance	System Optimisation
• Geoscience & Reservoir Engineering • Appraisal Cost Estimates • Concept Screening • Integrated Asset Modeling • Concept Selection • Basis of Design • Risk Assessments	• FEED Activities • Execution Support • Risk management • Assurance programs	• Trouble shooting • Operational Support • Risk management • Debottlenecking • Real time monitoring and optimization


Subsea


Process & Facilities


Integration Technology


Environment


Technical Safety & Risk

Deepwater Background

Currently

- 33% of world oil & gas production is from offshore sources (Dr. R Sandrea)

- 25% of the US oil & gas production is from offshore sources (API)

- 25% of operator investment is in deepwater (>500 m WD) developments (EIA)

Deepwater Background

Forecast

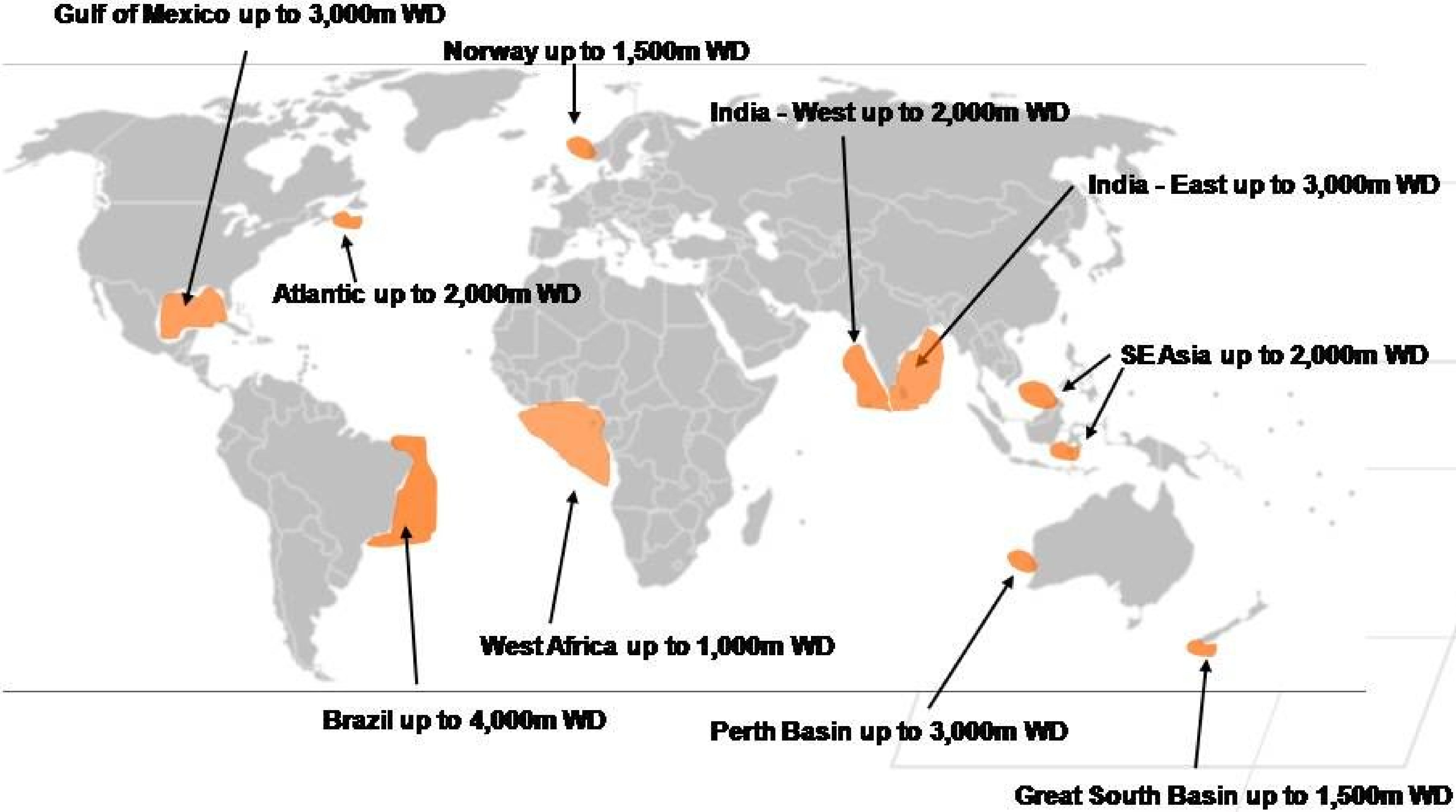
- ? % of world oil & gas production will be from offshore sources

- ? % of the US oil & gas production will be from offshore

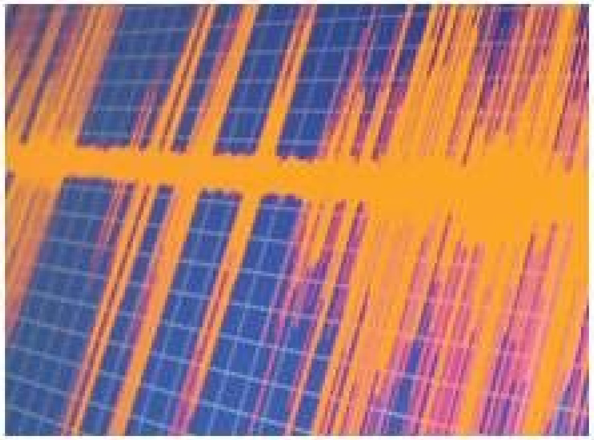
40 – 50 % by 2015 (EIA)

- 25% of operator investment will be in deepwater (>500 m WD) developments

Where is Deepwater?



What Has Enabled Deepwater?

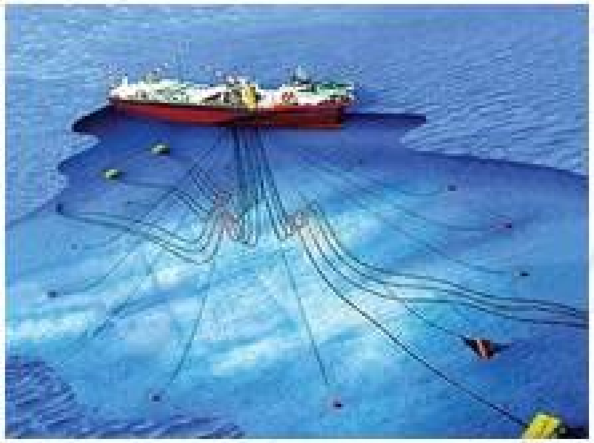


Exploration Technology

- 3-D Seismic Technology

Drilling Technology

- Directional & Horizontal Drilling
- Dynamic Positioning Systems



Substructure Technology

- Advanced Platform Design
- Advanced Mooring and Riser Design

Subsea Technology

- System capability

Typical Field Development Issues

Common issues for shallow water and deep water

- Recovery Uncertainty
- Type of facility
- Wells
- Facility location
- Fluid uncertainty
- Compression
- Existing infrastructure available?
- Flow assurance

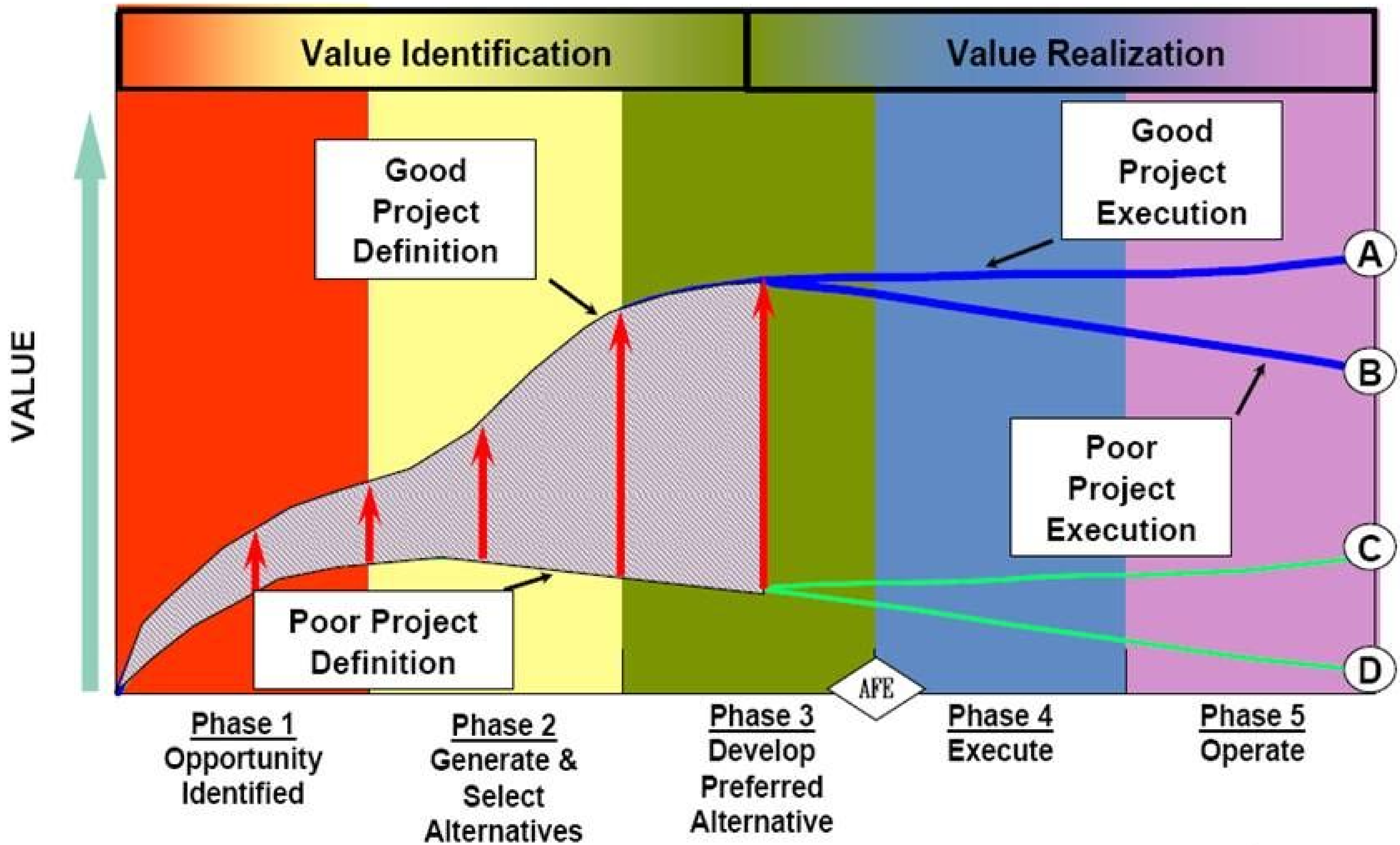
but……

May be predisposed to a solution for deep water

or

Not as many choices of potential solutions

What Do We Want to Achieve?



Why Is Deepwater Complex?
(or how could this encroach on the value?)

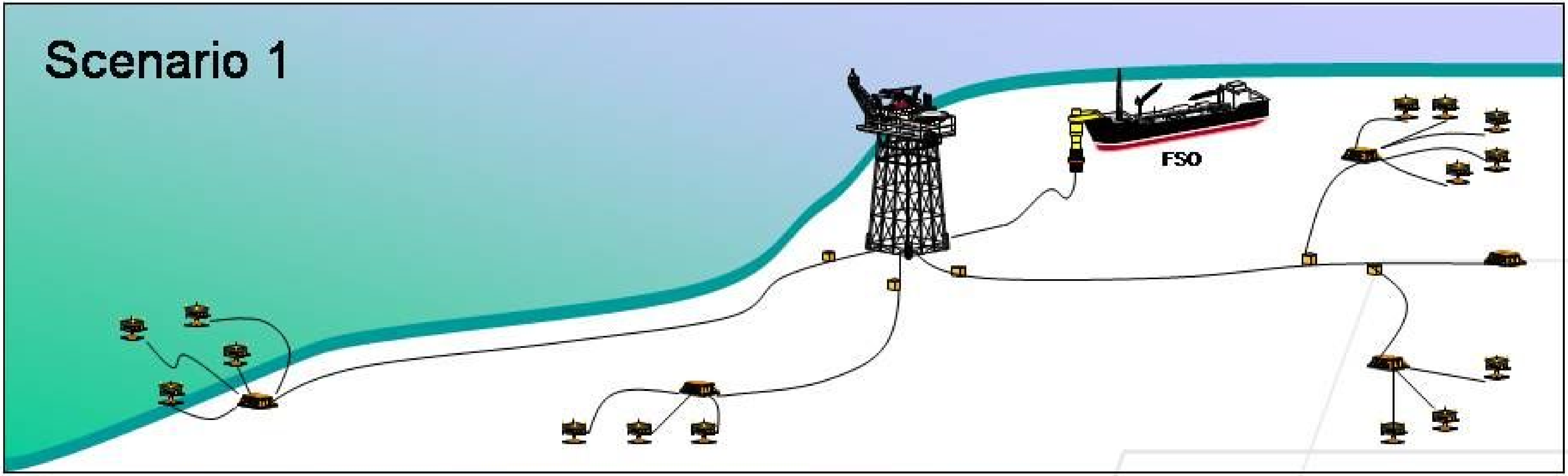
Uncertainties – Still very much a frontier

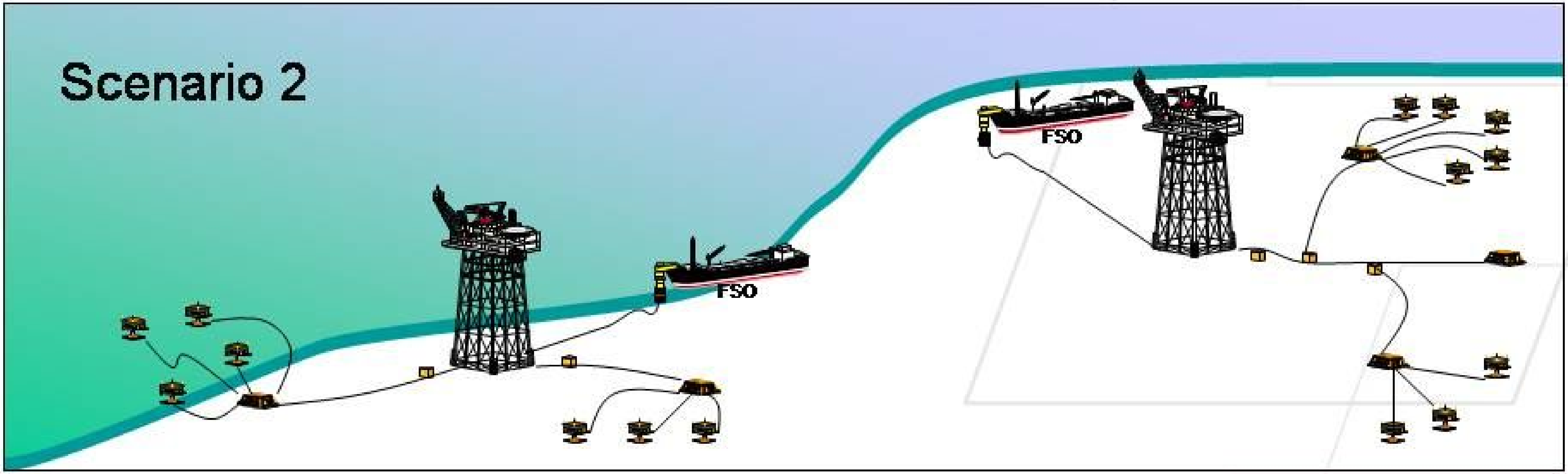
High Cost & High Risk Environment

Corporate capability may not be aligned for deepwater

Application of the technology that's required

Industry Case Study 1





Industry Case Study 1

Value (NPV) higher for Scenario 2 than Scenario 1

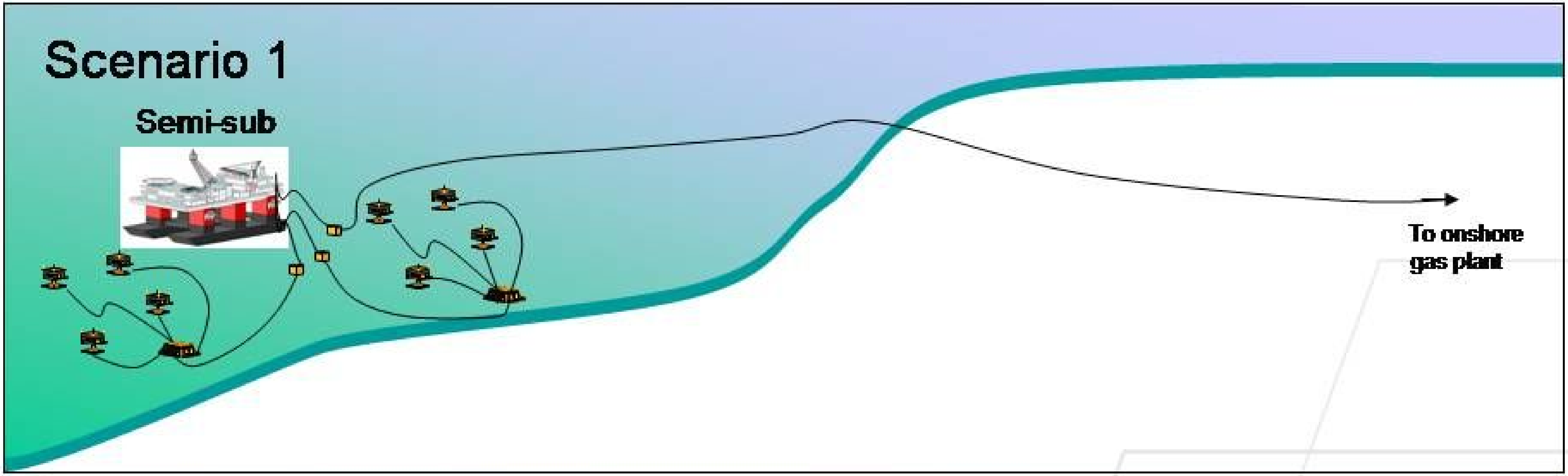
Other Issues that need to be considered

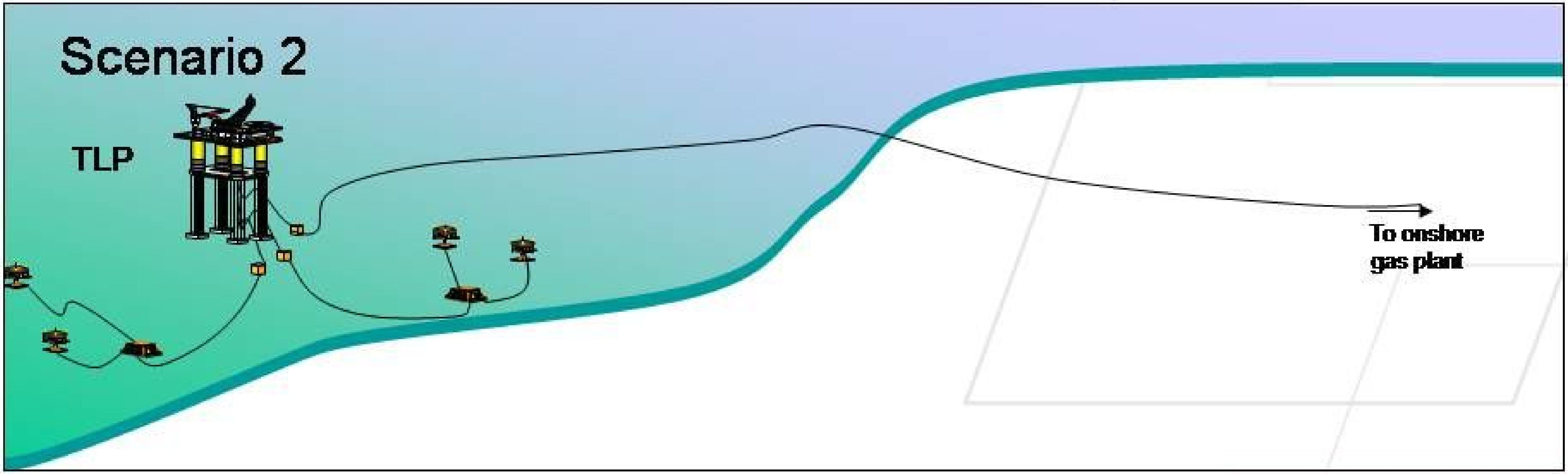
- Operations logistics

May not be final solution but….

- Provides significant insights (counter intuitive)
- Reached these insights sooner rather than later
- Enabled a different path of thinking

Industry Case Study 2





Industry Case Study 2

Similar Value (NPV)

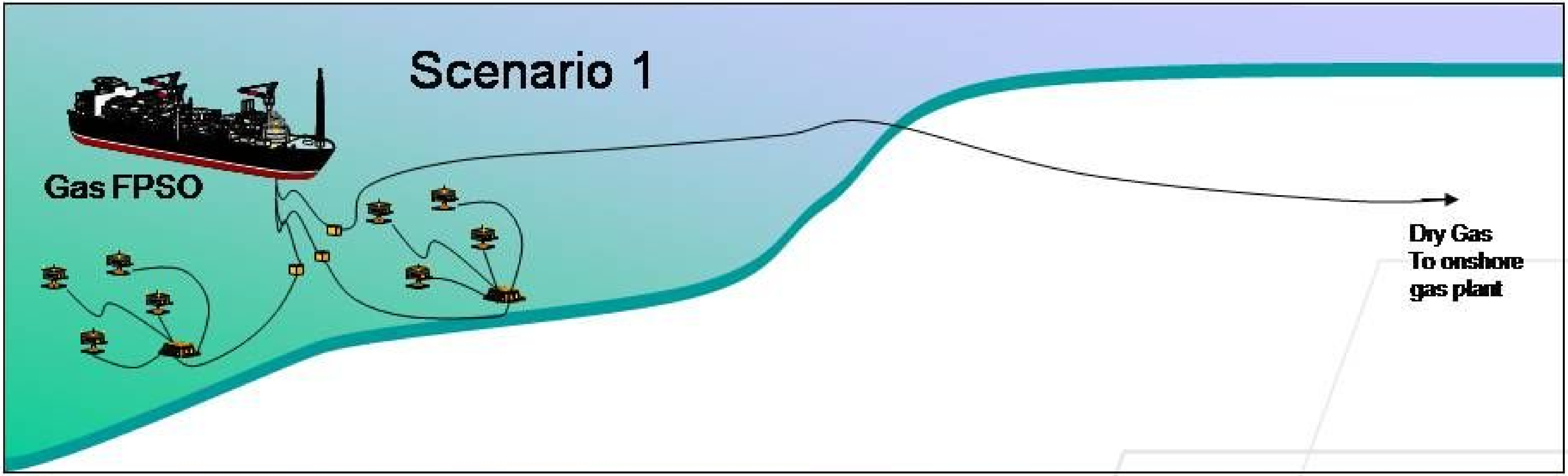
Points to highlight

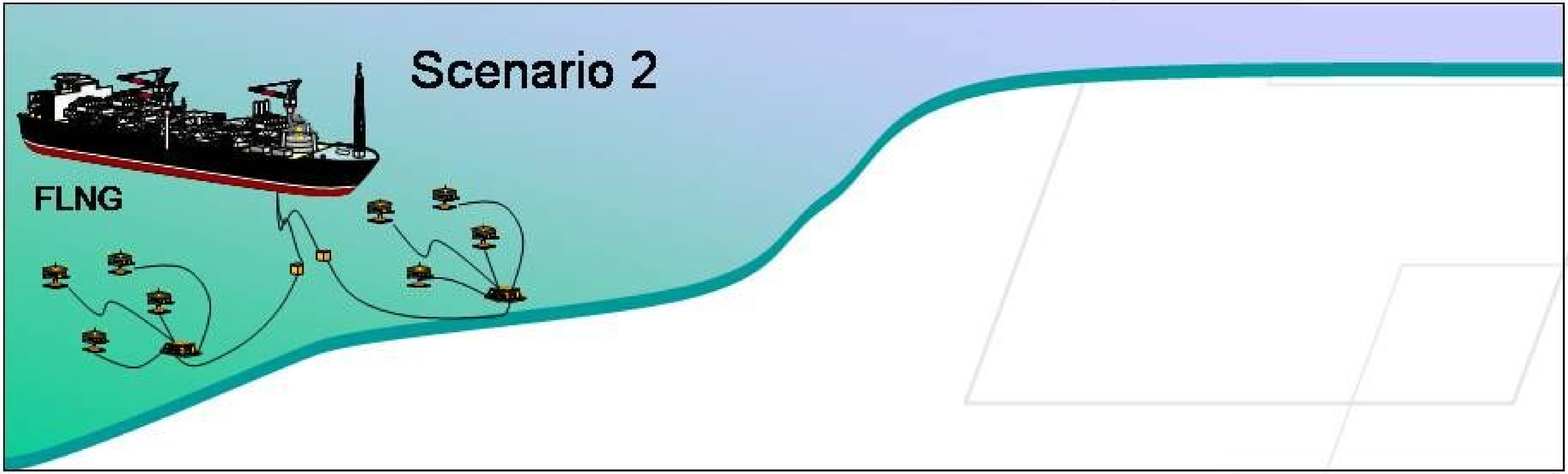
- Substructure type was not a differentiator
- Early insights related to:
  - flow assurance
  - rising and mooring constraints

May not be final solution but….

- Provides significant insights to kick-off other study areas
  - risers
  - flow assurance strategies
  - mooring / motion aspects
  - drilling / reservoir impact (dry wells vs subsea wells)

Industry Case Study 3





Industry Case Study 3

Value (NPV) higher for Scenario 2 than Scenario 1

Points to highlight

- Higher risk & uncertainty with FLNG
- FLNG capacity impacts value
- FLNG technology – early partnering for liquefaction process
- Gas FPSO – compression & export pipeline impacts value

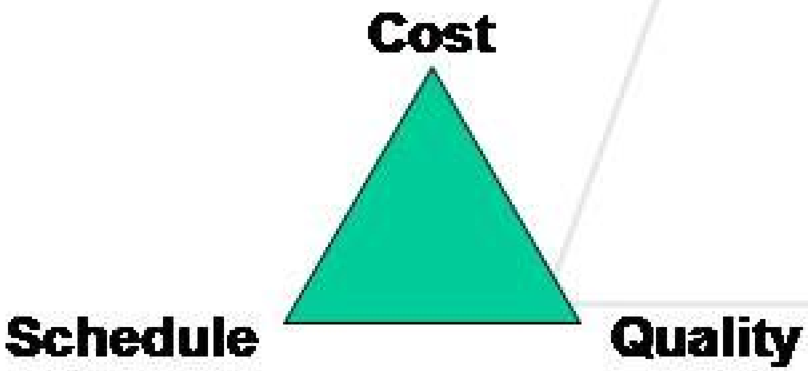
May not be final solution but….

- Provides significant insights to kick-off other study areas
  - Corporate understanding of FLNG market
    - how risk tolerant is the company
  - Schedule and time & effort commitment re: FLNG

Why An Integrated Approach?

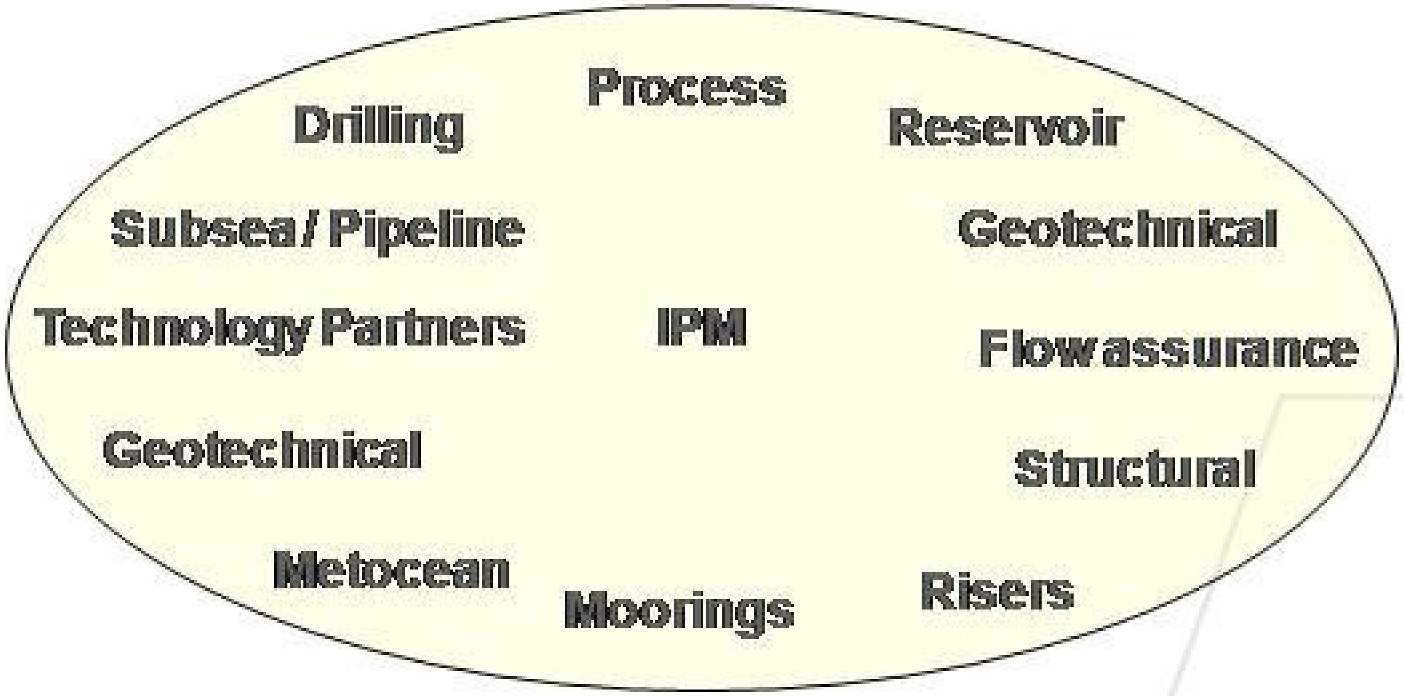
Better overall outcome

- We make more money or spend less money or both
- We meet the schedule
- We have a safer design, construction and operation
- Lesser degree of impact to the environment
- Higher probability of higher quality development



How We Achieve An Integrated Approach

Integration of <u>required</u> disciplines during Value Identification



Dependent on Development as to what disciplines and when

Sum is greater than the individual parts

What Does Integration Allow Us to Achieve

Improved Management of Risks and Uncertainties

- Earlier understanding of risks

Improved Decision Making Process

- Earlier knowledge of which issues drive outcomes

What Does Integration Allow Us to Achieve

Earlier engagement of applicable/necessary technology

- Allows for greater choice

Development of Corporate understanding and capability

- Access to skills within consultants and technology providers

Summary

Deepwater developments are complex

- Many unknowns with huge risks and costs

Integration during Value Identification allows achievement of:

- Improved Management of Risk and Uncertainties
- Improved Decision Making Process
- Earlier Engagement of Technology Providers
- Continued Development of Corporate Capability

Summary

There is no easy answer

Thomas Jefferson stated:

"Innovation is 1% inspiration & 99% perspiration"

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