Estimating Best Practices in the Front-End from the Asset Owner perspective

Shell Cost Estimating
experiences, challenges and suggestions

Edward Rademaker

10 October 2024

Agenda

- Introduction
- Project Estimating Experiences
    1. LNG Canada Project
    2. Prelude FLNG Project
    3. Petroleum Development Oman
- Estimating Challenges
- Developments in Shell with regards to Estimating
- Food for Thought

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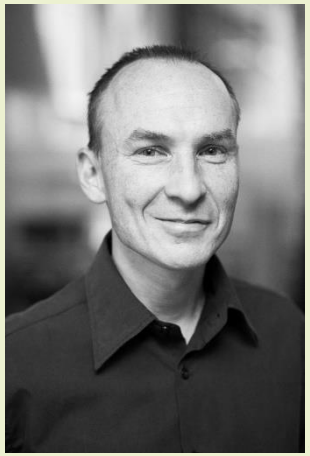
TU Delft



Shell Projects & Technology

Senior Cost
Estimating Engineer

NEBEST

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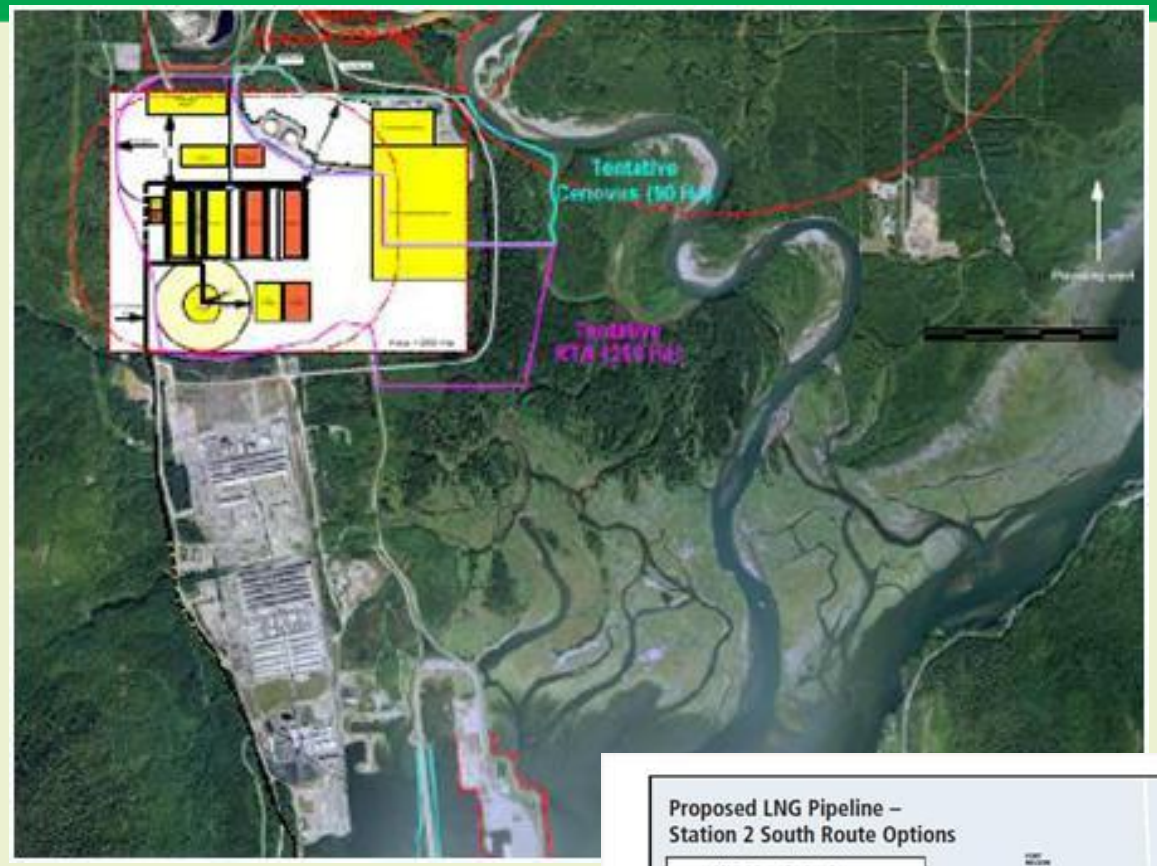
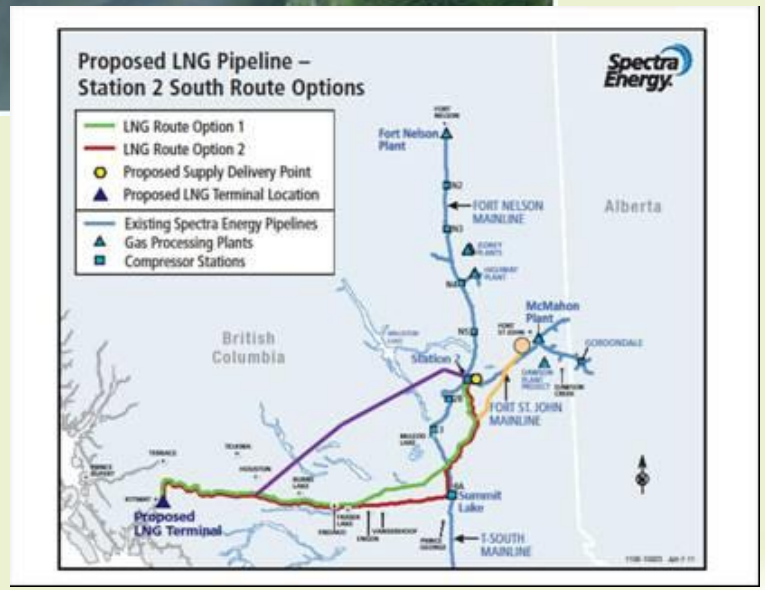
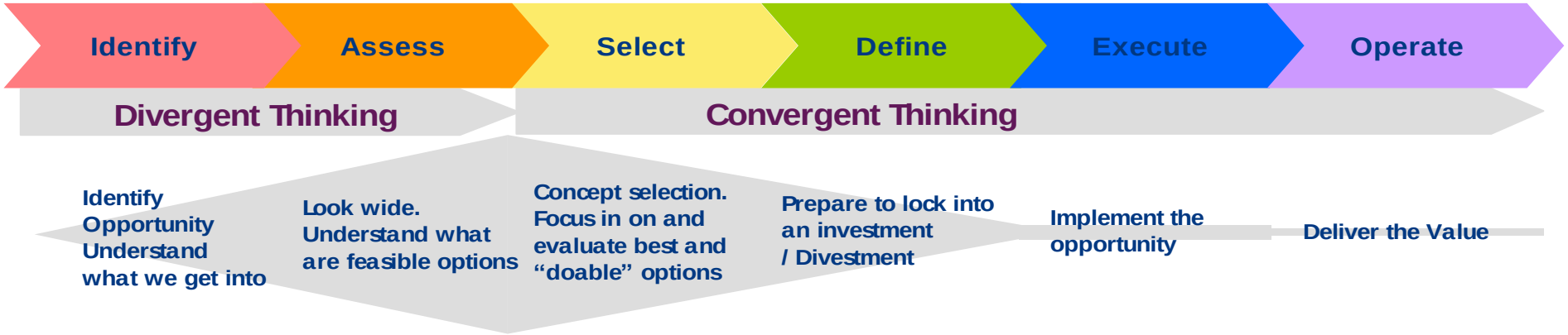
1. LNG Canada 2011

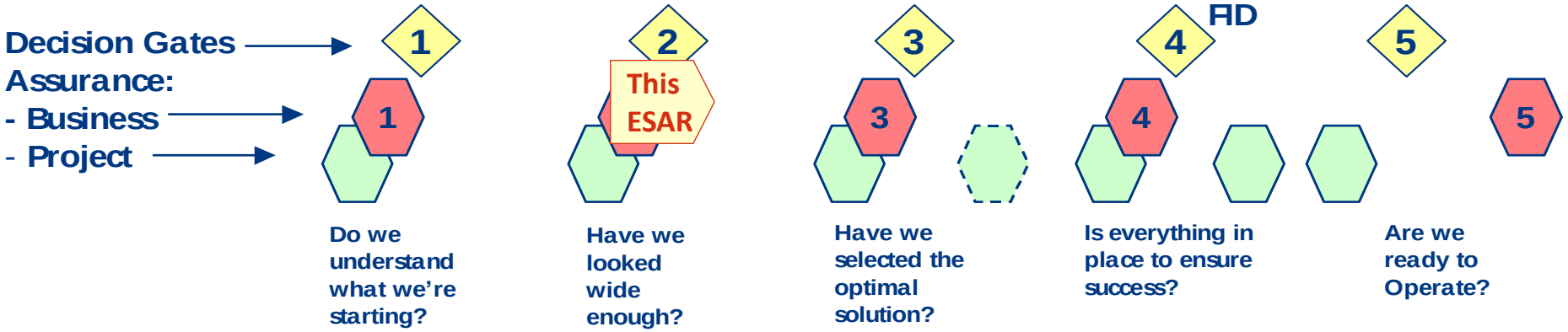
- Shell Decision Gate (DG) 2 – end of Assess phase [Type 1 – AACE Class 4]
- Estimate & Schedule Assurance Review & Value Assurance Review
- Technical risks:
  - Location of new LNG Plant only notionally known
  - Pipeline required to bring gas to the plant
  - Modular vs Stick-Built
  - Power options – grid?
- Non-Technical Risks
  - Ownership structure (JV) unknown
  - Support from local communities?
- Estimated using CapCo$t and IBIS-Calc





ORP Business & Project Assurance Overview





ORP: Opportunity Realization Process
ESAR: Estimate & Schedule Assurance Review
FID: Final Investment Decision

British Columbia - Kitimat

[Take an interactive tour through LNG Canada's facility - LNG]

2. Prelude FLNG*

- 2012-2015 Cost Engineer – Project Controls
- Execute Phase
  - Engineering at Technip in France (2012-2013)
  - Construction at Samsung Yard in Korea (2013-2015)

*) FLNG = Floating Liquefied Natural Gas

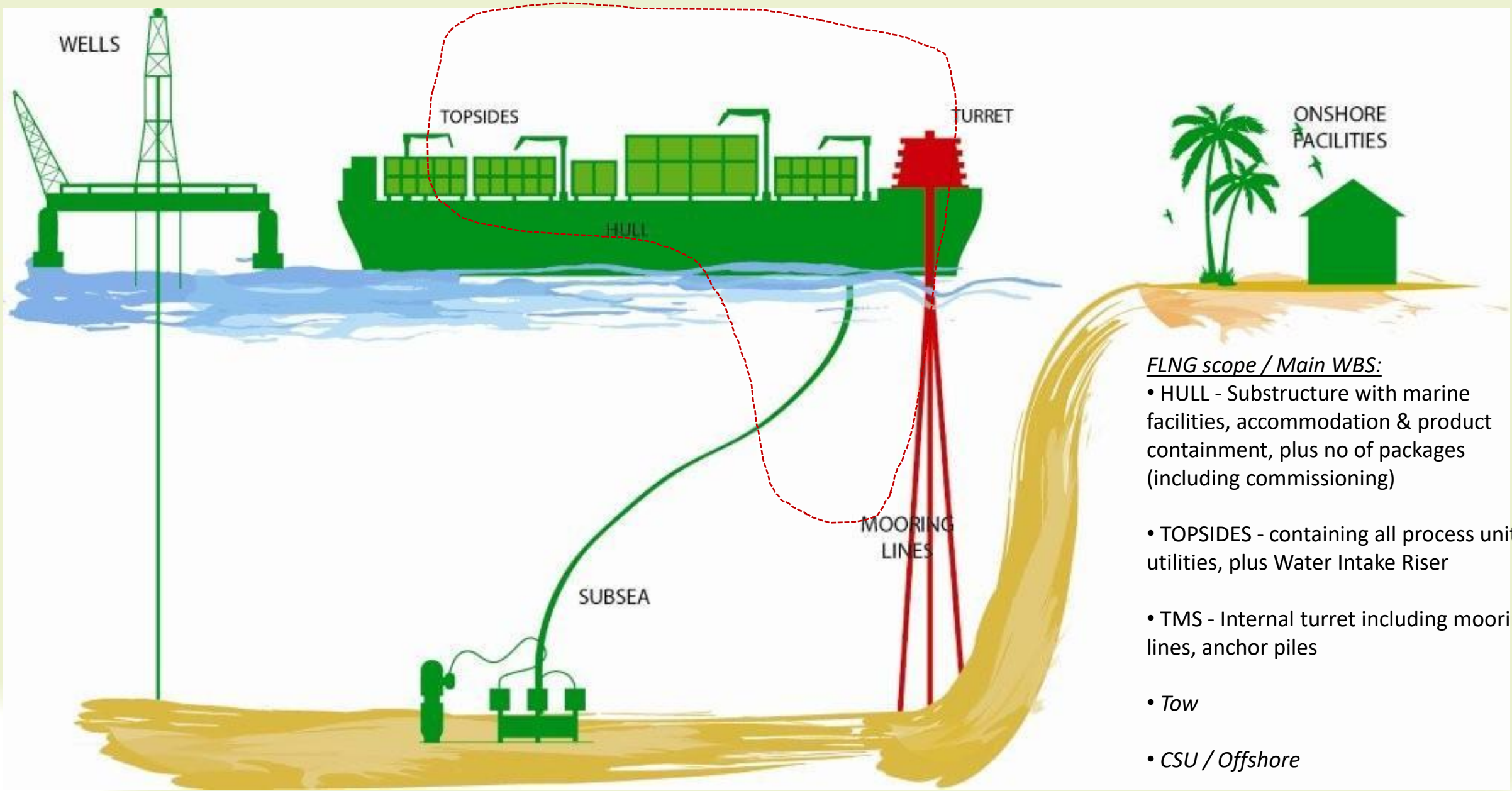
FPSO = Floating Production Storage and Offloading

PRELUDE FLNG: THE LARGEST FLOATING STRUCTURE EVER

The Prelude FLNG Facility:

- The Prelude FLNG Facility is 488m long, 74m wide, and has a weight of 600,000 tonnes when fully ballasted, making it the largest floating structure ever built
- Technip Samsung Consortium (TSC) was the main EPC Contractor. Engineering of Topsides, Procurement and Commissioning has been the responsibility of Technip (TPF). The entire hull, and Construction of the Topsides Modules is responsibility of Samsung Heavy Industries (SHI).
- Construction started in 2012 in SHI's Geoje Island shipyard in South Korea.
- Once constructed, and partly commissioned, the facility was towed to location off the coast of Australia, for further commissioning, hook-up and start-up (in 2018).
- Prelude FLNG Facility is now producing 3.6 million tonnes per annum (mtpa) of LNG, 1.3 mtpa of Condensate, and 0.4 mtpa of LPG.

PRELUDE ESTIMATE MAIN COMPONENTS



FLNG scope / Main WBS:

- HULL - Substructure with marine facilities, accommodation & product containment, plus no of packages (including commissioning)

- TOPSIDES - containing all process units & utilities, plus Water Intake Riser

- TMS - Internal turret including mooring lines, anchor piles

- *Tow*

- *CSU / Offshore*

3. Petroleum Development Oman (PDO)

Petroleum Development Oman LLC (PDO) is the leading exploration and production company in the Sultanate of Oman. We deliver the majority of the country's crude oil production and natural gas supply, but above all we focus on delivering excellence, growth and sustainable value creation within and well beyond our industry

www.pdo.co.om

The Company is owned by

60%	34%	4%	2%
THE GOVERNMENT OF OMAN	SHELL GROUP	TOTAL	PARTEX

- Producing more than 650,000 barrels of oil per day, including condensate and gas 1,200,000 barrels of oil equivalent per day
- > 13,000 active wells, 53 rigs, 28 production stations
- 30,500 km of pipelines and flowlines
- Capital Expenditure 5.5 billion USD/year
- Around 9,000 employees (90% Omani)
  - ~ 200 Shell Expats
- Oil North, Oil South, Gas Directorate

PDO Purpose: **Building a Sustainable and Low-Carbon Future to Maximise Value for Oman**

Cost Estimating in PDO

- Team of 9 (Senior) Cost Estimating Engineers in Function (UEAP), plus another 2 Cost Estimators in Project Delivery Organization (DLB)
- Responsible for the delivery of around 600 – 800 Cost Estimates every year:
  - Company Check-Bid Cost Estimates (to support award of Contracts)
  - Cost Estimates for Program-Build (yearly budgets, i.e. business planning)
  - Cost Estimates to support project phases, Decision Gates, Assurances
- Using a mix of Price Agreements, Cost Estimating Tool, Actual data from SAP, Simple Models, and Excel Templates to estimate the costs of PDO projects
- In-house Procedures and Guidelines (CP-233, GU-569)
- LEAN practices, Continuous Improvement Ideas, Standard Operating Procedures

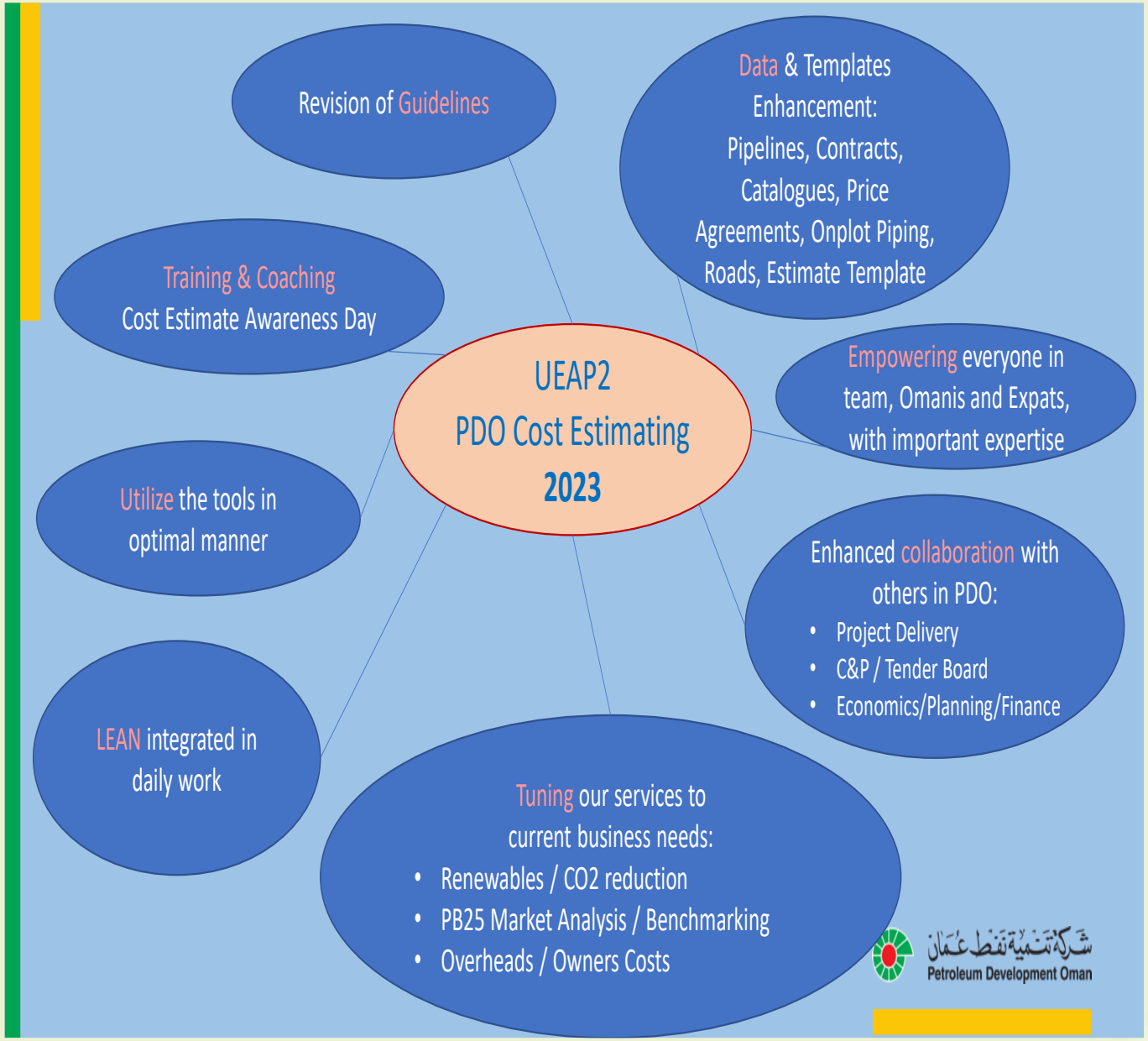
Lookback 2023

UEAP2 Mission

Continue to be recognized as the single source of truth when it comes to advise on costs of projects in PDO

- ***Maintain quality of our Cost Estimates, based on accurate and recent Data***
- ***Balance Delivery and Assurance Tasks***
- ***Continue to invest in skills and capability of team***

Petroleum Development Oman



Challenges in Shell World of Projects

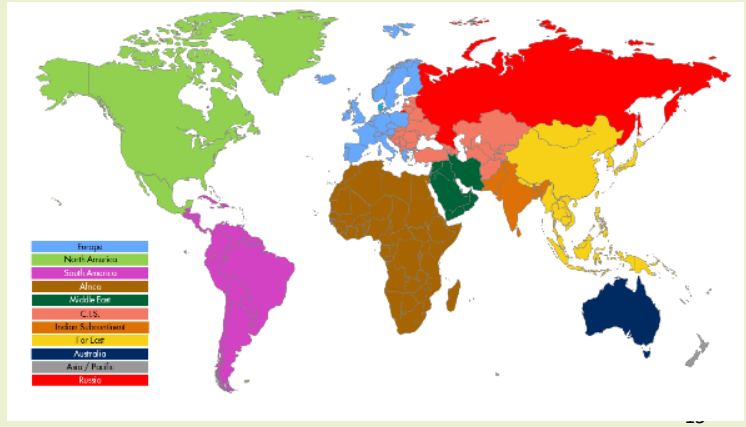
- Projects take looooooooooooooooooooooong, and are big
  - New people get involved along the way
  - Long before you can really learn from experiences, whole world has moved on
  - Different ventures, different countries, different contracting strategies, different offices
- How deep to be involved, technically
- New technologies, new markets are constantly being explored
- Owners Costs (Non-EPC costs)
- Non-Technical Risks
- Role of Cost Engineer is not as central as in Contractor organization
- Competition Law

Developments in Shell Estimating

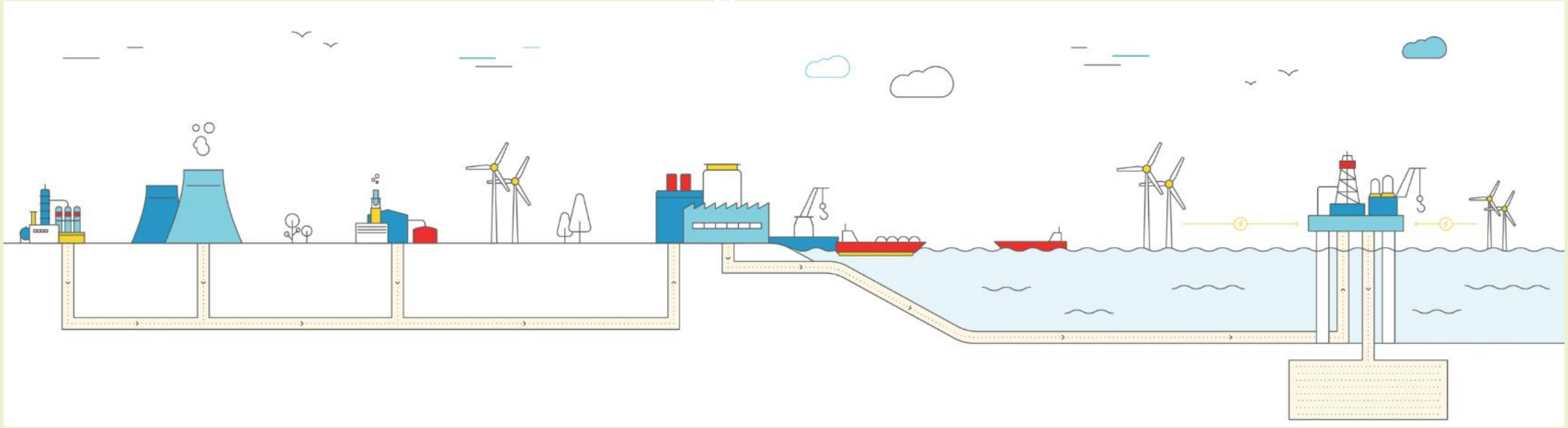
- New Technologies
  - Offshore Wind
  - Hydrogen
  - CCS (Carbon Capture Storage)
- More focus on benchmarking
- Cost Estimating tool access for Concept Engineers (Process Engineers)

Capital Cost Estimating Tool (CCET)

- CCET is the in-house **capital cost estimating software** within Shell P&T Project Services.
- CCET allows Cost Estimators to provide a **P50 "Money of the Day" (MOD) Full Project estimate** with an assigned accuracy range. This estimate is provided to economists for economic evaluations/ feasibility of a Capital Project.
- DCMT (Data Capture Metrics Team) collects data from actual projects, feeding back into the tool
- CCET estimates the cost of a Capital Project (Prospect) at the early stages of identification and assessment of the investment opportunity, well before detailed design or construction.
  - Subject to different technical scenario's.
  - Subject to different future market scenario's.
  - At different levels of accuracy and completeness of available data.
- Not only Cost Estimators validate and use the tool, also discipline and concept (process) engineers use the tool
- Various Archetypes have been built in CCET
- World Table functionality



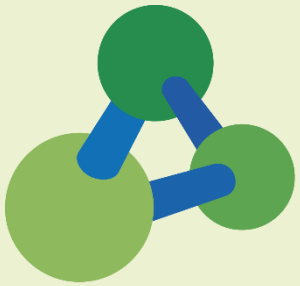
4. Shell Offshore Carbon Storage NL



5. Electrification of an LNG Plant in Australia

Food for thought

- In my view a mix of young people and experienced staff delivers best results
- Cost Engineering is not just Estimating: It includes Planning, Risk Analysis, Benchmarking, Project Management and Contracting & Procurement, and maybe some Economics or Finance. Learn these competences (e.g. by joining the DACE Certified Cost Engineer Course)
- Learn to play the corporate game – Be a player!
- The feedback loop is essential in any organization. Make sure that actual data feeds back into your estimating process. Connect the conceptual estimates (pre-DG3 with the actual execution)
- Find the right balance between volume/quantity/speed vs quality/assurance
- Where in the organization should the Estimating Team be?
- Encourage the Flexibility of Cost Engineers – they need to be able to adapt to new technologies, new markets, new strategies



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cost and value