CSDM 2019 - PRELUDE
System Engineering to deliver first FLNG

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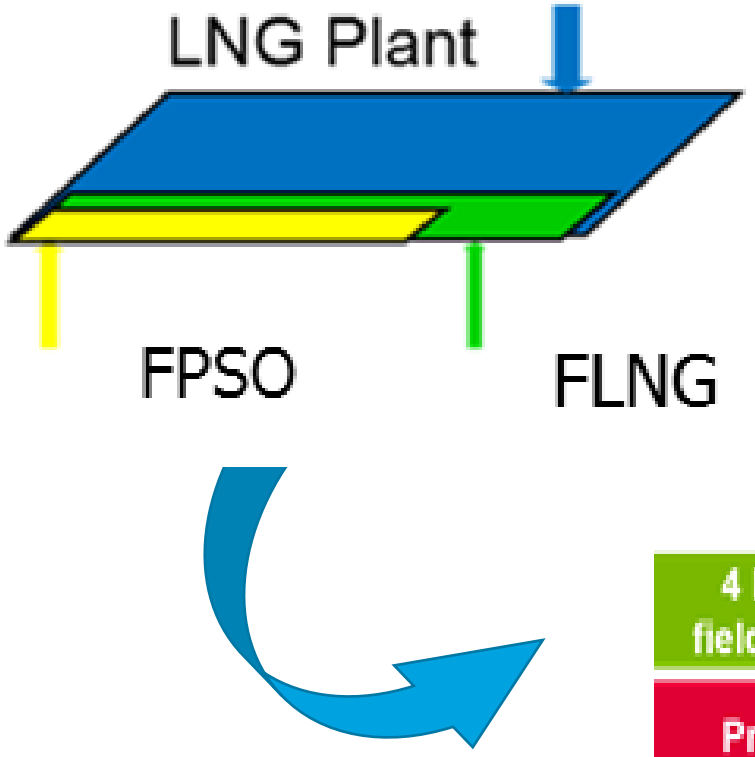
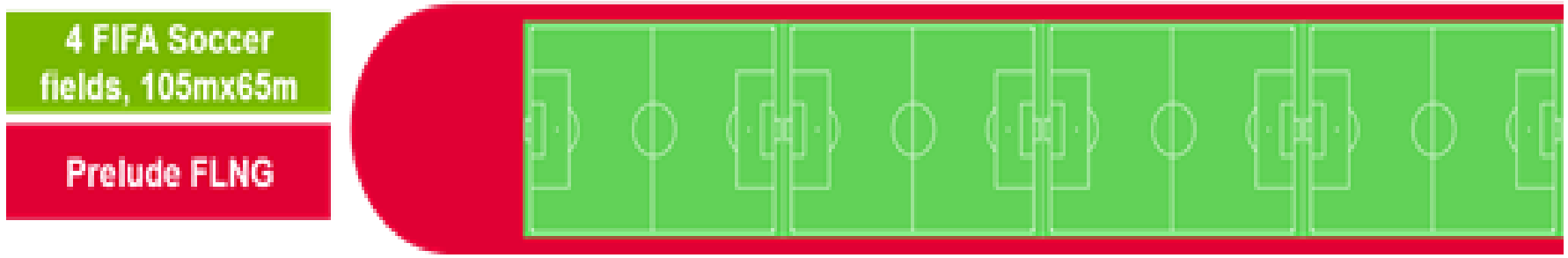
The Concept : a first of a kind
Build an Offshore version of an Onshore LNG facility !





Shell Prelude FLNG

How to manage complexity through system engineering

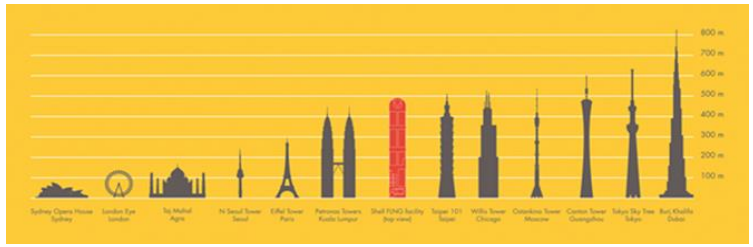
- **The largest floating facility ever built**
- **Gas treatment for liquefaction /Storage / off loading**
  - Length: 488 m. - Width: 74 m.(USS enterprise 351m)
  - Weight:
    - Steel: 260,000 tons
    - Displacement: ~600,000 tons
    - Topside 82000 tons
    - Cooling water : 50 000 m3/h sea water = 3mn to fill an Olympic swimming pool
- **200km from nearest land/design to resist to class 5 cyclone**
- **Up to 25 years on station**
- **Up to 250m water depth**
- **Safety: Goal Zero –(55mmh- 12 LTI– 4mmh off shore 1 LTI)**
- **Annual Production**
  - **3.6 Mtpa LNG capacity/1.3 Mtpa condensate/0.4 Mtpa LPG**

Turret Mooring System:

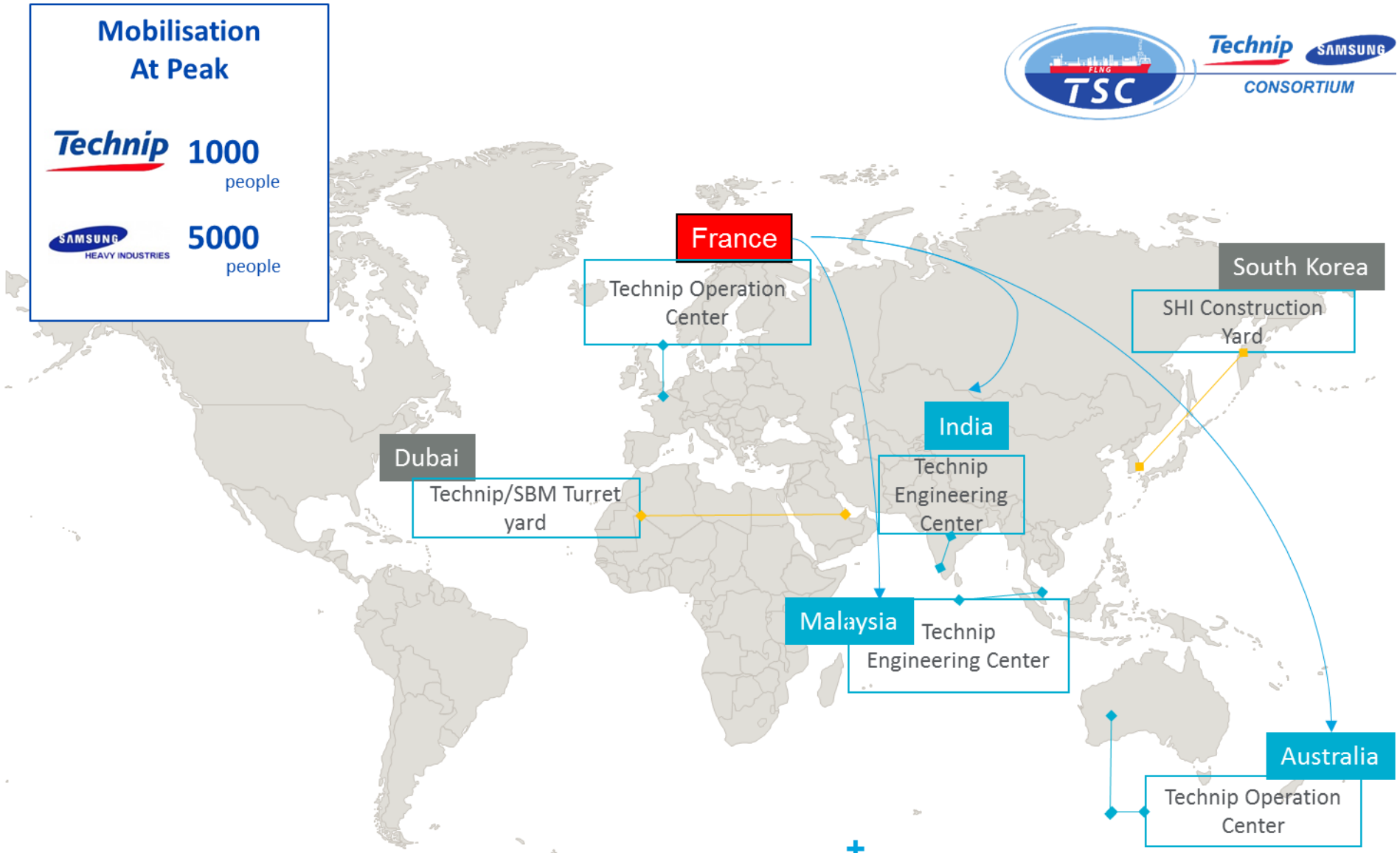
- 4 Production Risers
- Mooring Lines (4 x 4)
- Turret: 93 m height/ 12000 t

Topsides Modules:

- 14 modules
- Separation, Dehydration, Liquefaction, Boilers
- Associated utilities



A multi-center execution plan to manage risk & complexity



…due to multiple challenges…

Mechanical

- Offloading LNG between two vessels on the high seas
- Importing large quantities of high pressure feed gas on a floating facility
- Equipment and piping loads generated by motion (towing & in-place conditions)
- LNG tank sloshing over 25 years without dry docking
- Industrial Maturity vs. FLNG specifications

Process

- Gas processing facilities adapted to marine environment
- Compact design (weight and volume)
- Designing for motion compared to static onshore plant

Engineering

- Specific new challenges for Compliance to Australian regulation and Offshore safety design.

System Engineering
A Data Centric approach and breakdown structure management

❖ **Data Centric achieved through a unique master 3 D modelling operated from multi location**

- PDMS 3D architecture- digital Twin
- Single integrated commissioning system for marine and production/storage/offloading systems rationnel

❖ **Design breakdown / work breakdown/construction breakdown /system breakdown /cost Breakdown**

- To follow phases down to final delivery necessity to break systems

- Design phase
- Engineering phase
- Construction phase
- Commissioning phase
- Start up & operation phase

- Marine system
- Loading system
- Mooring system
- Process sytems
- Utility system
- Storage systems
- ……..

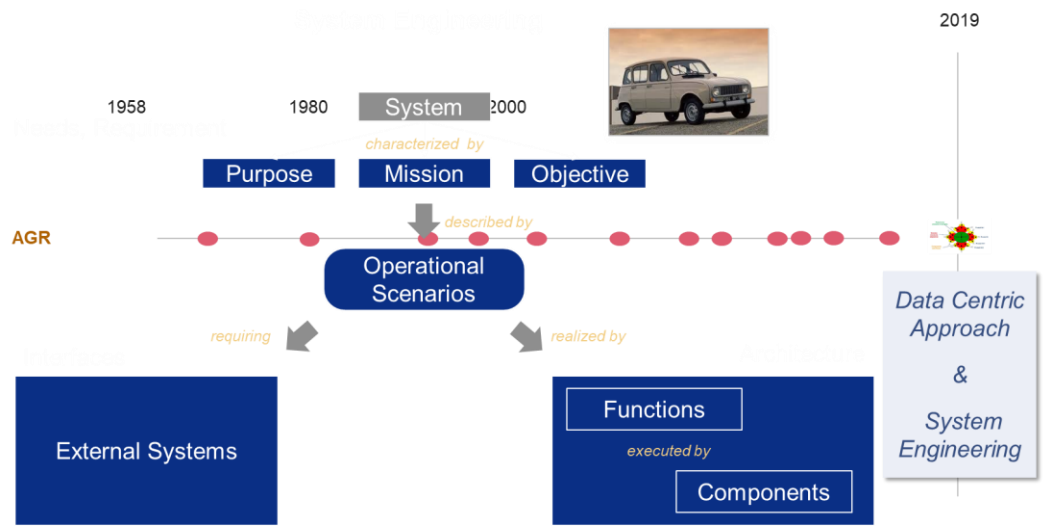
Lessons Learned & Success Factor

- Vision & value to goal zero sharing with customer
- Consortium mgt
- Pre com & com maximised before sail away .
- Novelty mgt into an EPC LS project
- Stress & fatigue excellence (piping & structural design)

- « Flawless Project Delivery program » implemented from design to start up.
- constructability of modularization (liftability, congestion, module density).
- Develop new design processes with multiple interdependences (blast, motion acceleration etc.)
- Customer intimacy build
- Sponsor ship
- Progressive conversion to derisk .

TECHNIPFMC & SYSTEM ENGINEERING

- **TechnipFMC is deploying System Engineering**
  - **in an agile way**
  - **in collaboration with other actors from the O&G supply chain**
  - **using digital transformation to accelerate implementation**



TECHNIPFMC IS ACTIVE IN THE INCOSE O&G WORKGROUP

Hosted at TECHNIPFMC premises

Organized with TechnipFMC, SHELL, Equinor and BP. One and half days of workshop on Digital Management of Requirements

40+ participant from the industry: Operators, OEMs, EPCs, Standard Bodies