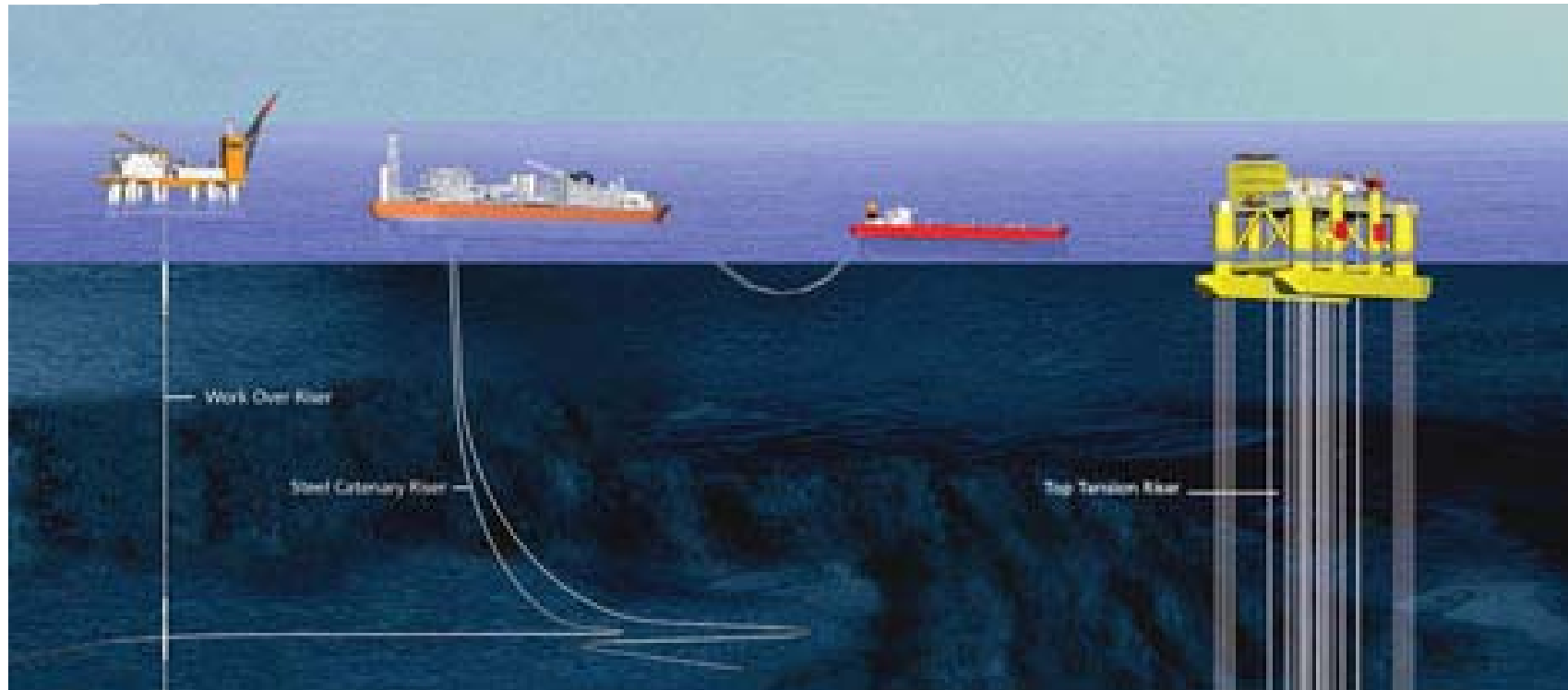




Importance of Riser and Pipeline Technology for O&G Production

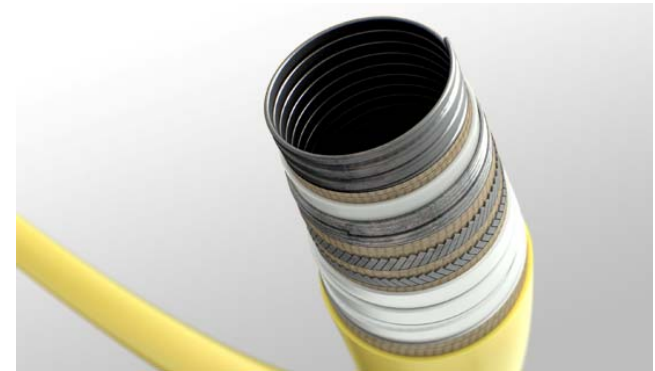
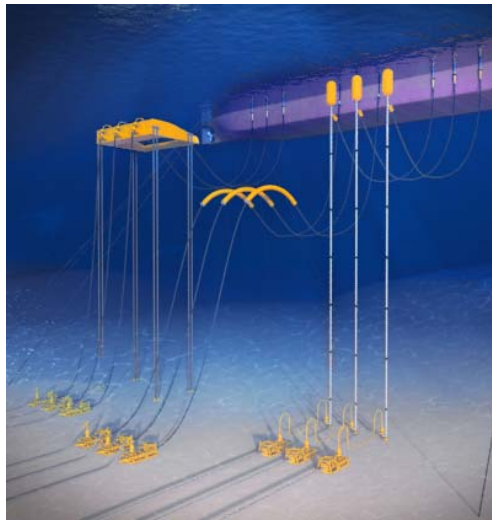
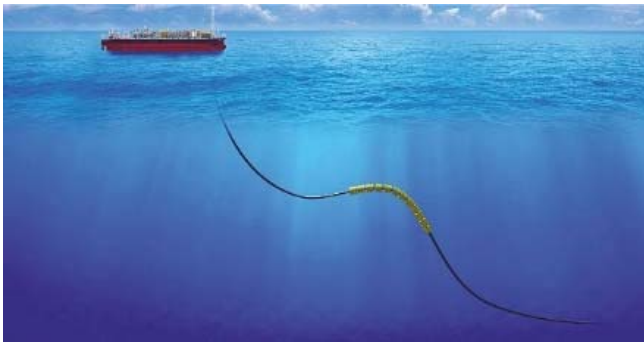


Carlos Alberto D. de Lemos

Lemoscad.cl@gmail.com

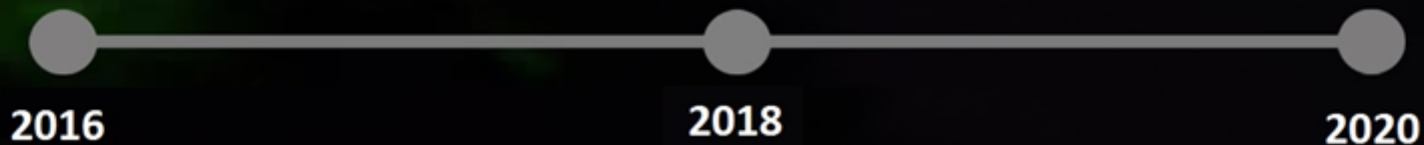
Lecture Contents

Overview of main technologies employed and challenges.



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what has changed?



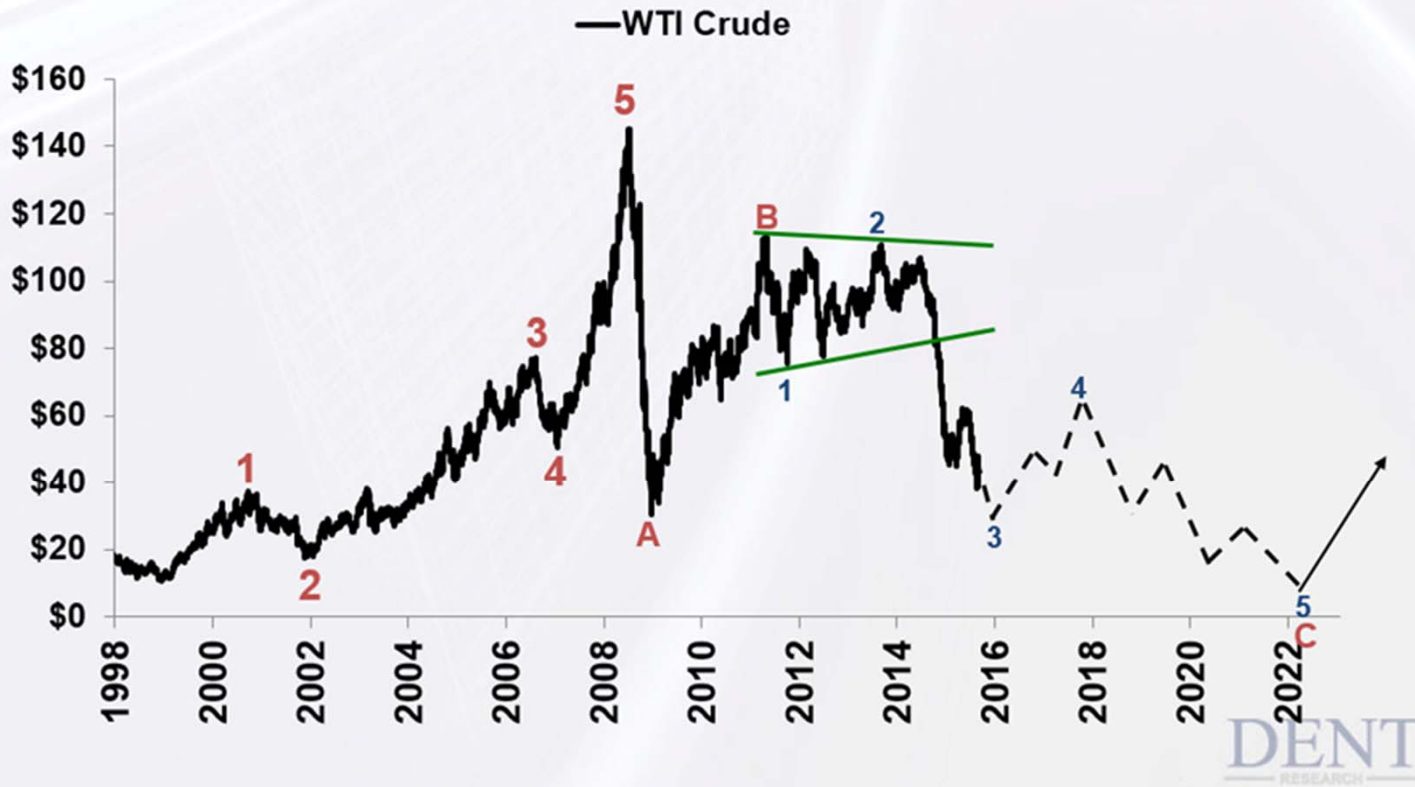
2016 - Falling oil prices: Who are the winners and losers?



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2016 – Oil Prices

Weak Demand and Oversupply
Crude Oil Will Be Down For Years



Source: HarryDent.com

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2016 – Great Question

Is it the correct time?



5p DAILY EXPRESS

ASTRONAUT TIM BLASTS OFF ON SIX-MONTH SPACE MISSION

EVERY SCHOOL IN LOS ANGELES SHUT AFTER TERRORIST 'BOMB THREAT'

OIL CRISIS WILL HIT PENSIONS

Millions could be forced to delay retirement

Super duper TV, now with Ne



2018 – Some recover on Oil Prices



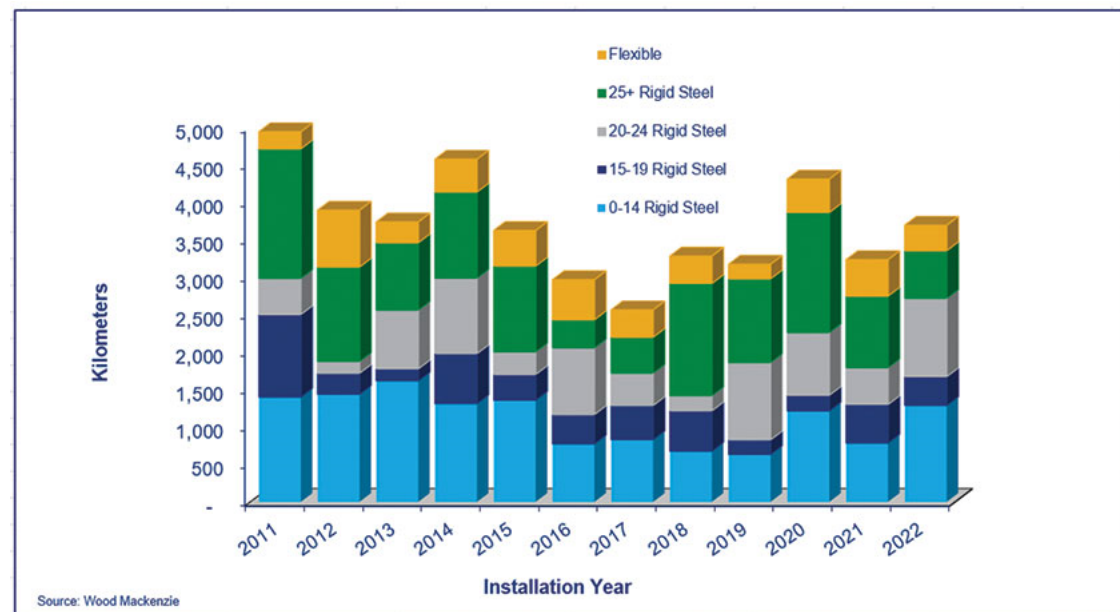
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GLOBAL DEEPWATER PIPELINE INSTALLATION TO FEEL EFFECTS OF PROJECT DELAYS IN 2017 & 2018

The global deepwater oil and gas market is **slowly recovering from the downturn** that significantly impacted operations

The supply chain has implemented fundamental and structural changes to the way deepwater reserves are developed. Industry players have worked together to reduce cycle time, increase efficiency, and innovate with a common goal of reducing the overall development cost of deepwater projects.

The pipeline recovery is attributed to increased long trunk lines and export pipeline activity.



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2020 – New Standard level?



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New Oil Crises and COVID 19 Impact



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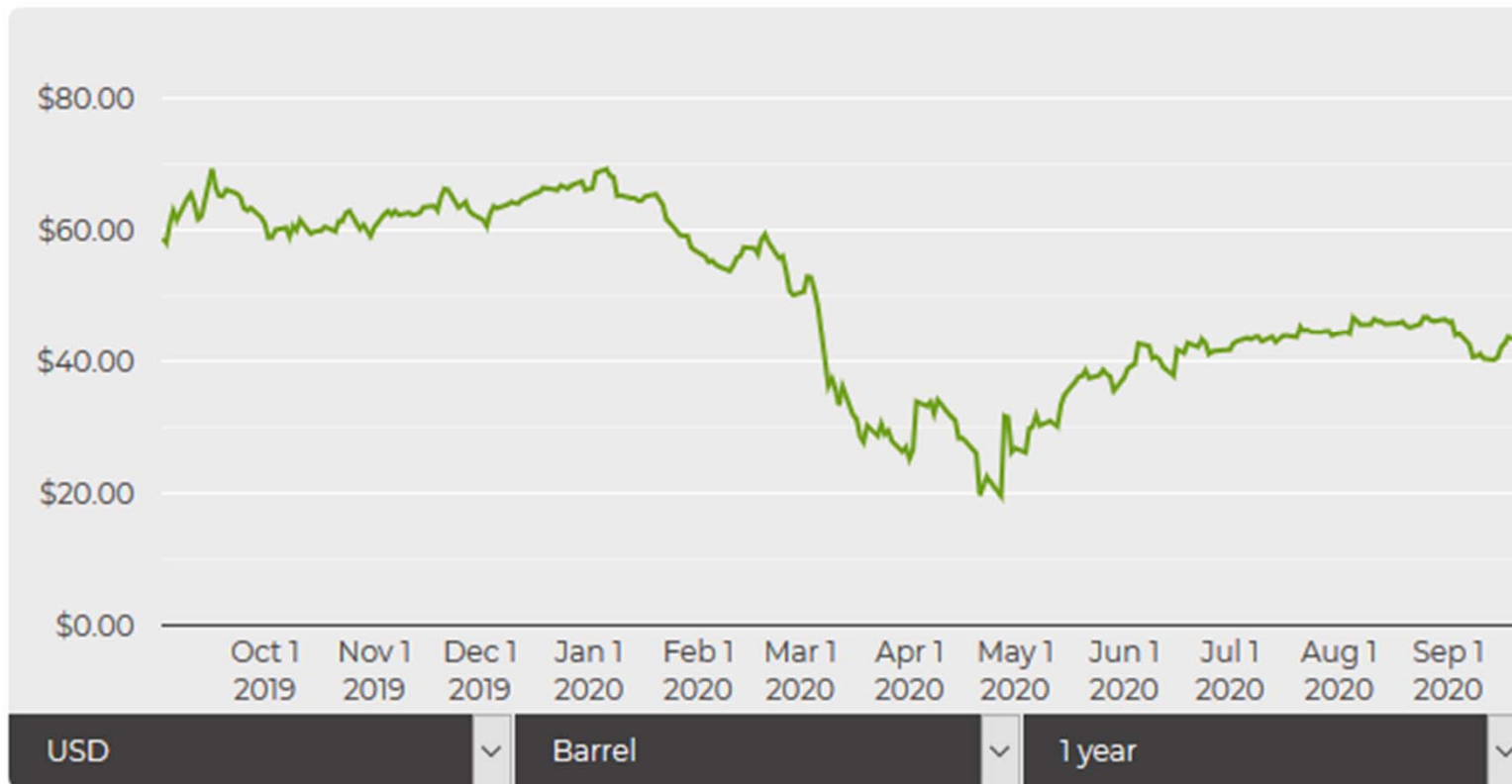
2020 – COVID IMPACT

1 Year Crude Oil Price

42.13 USD/bbl

52 weeks USD/bbl

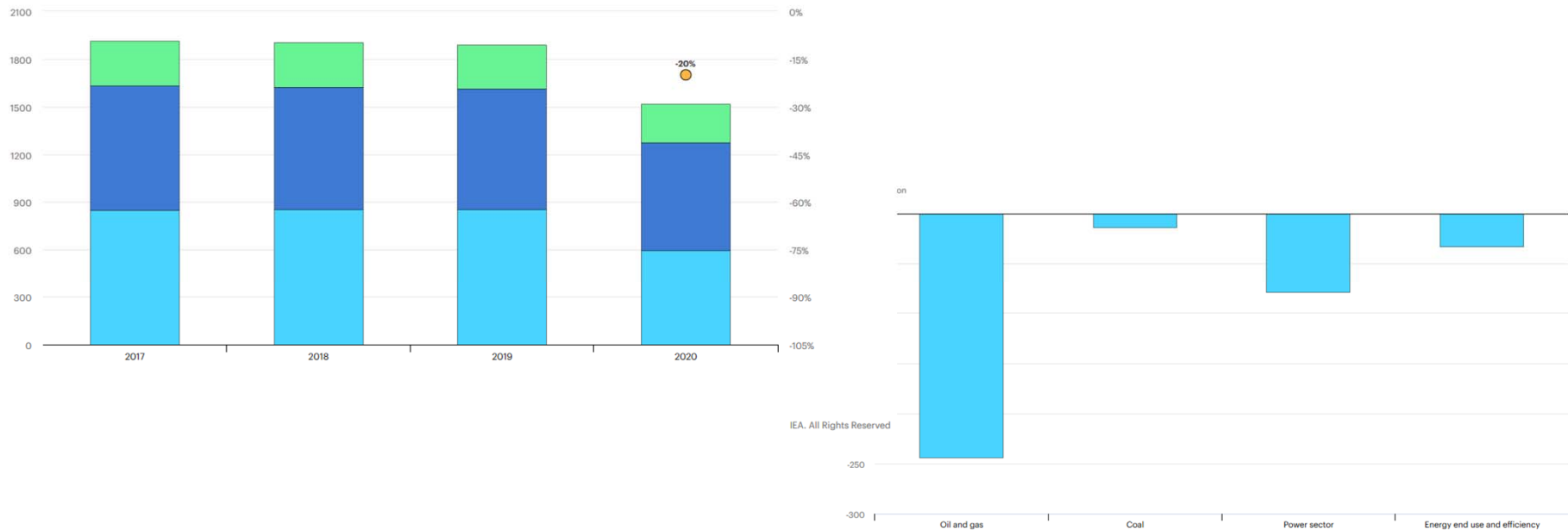
Low 19.61 | High 69.2



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Change on Expectations

- **Pre-crisis expectations of modest growth have turned into the largest fall in global energy investment**



WE KNOW. WE'VE SEEN IT BEFORE.

20 Years Crude Oil Price

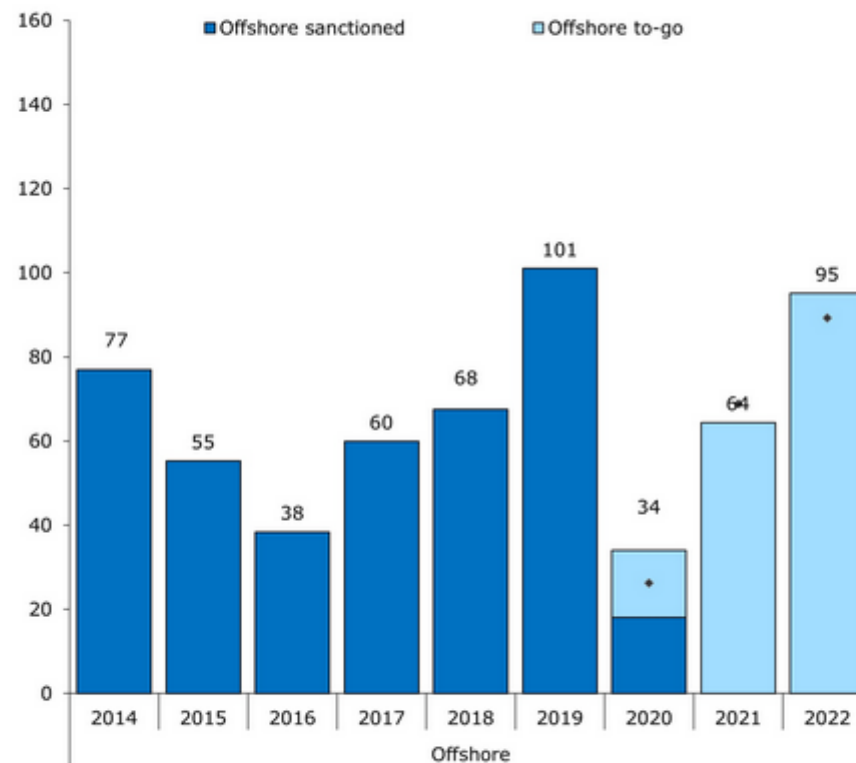
42.13 USD/bbl



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COVID-19 Impact

Global project sanctioning status and forecast from 2014 to 2022
Billion USD, by commitment year



*Commitments exclude supplier purchases

Source: Rystad Energy ServiceCube

What should we do?



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Knowledge and Innovation



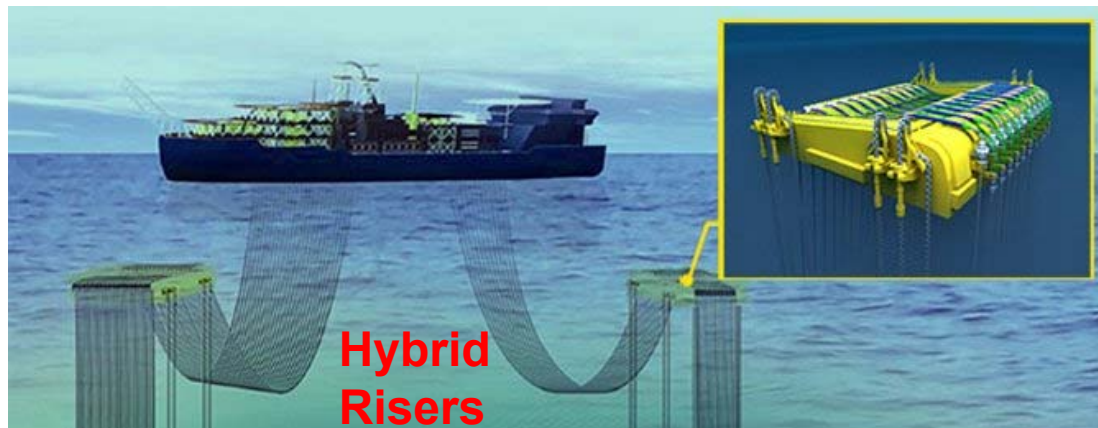
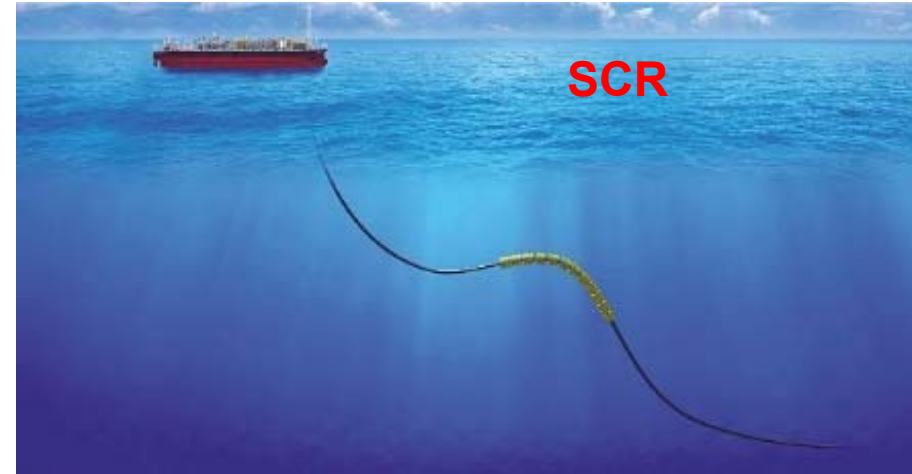
The source of wealth is something specifically human: **KNOWLEDGE**.

Knowledge applied to tasks we already know how to do is **PRODUCTIVITY**.

Knowledge applied to tasks that are new and different is **INNOVATION**.

~ Peter Drucker, "Managing for the Future: the 1990s and Beyond," 1992

Challenges of main technologies



Steel Pipeline Challenges

- Wall thickness design
- Installation challenges
- Flow Assurance - Prevention of Hydrates
- Free span assessment



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Wall thickness design

- High water depths can lead to a thick wall pipe that could limit installation capabilities
 - use of less conservative safety factors through technology qualification
- High external pressure means pipeline collapse failure mode governing wall thickness design
 - Enhancing Collapse Capacity of UOE Pipes



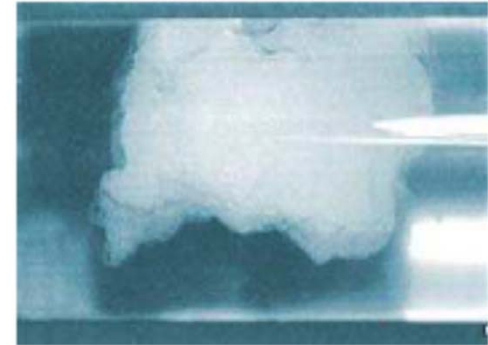
Installation challenges

- High strains coupled with high external water pressure with increased risks of local buckling and fracture
- High pipelay vessel tensioner capacity required. More stringent requirements to tensioner holding
- Ability to detect buckle and repair a wet buckle

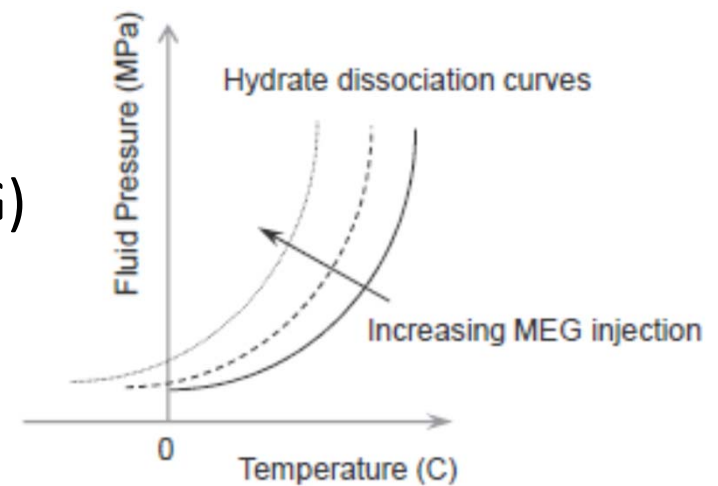


Flow Assurance

- Passive prevention systems
 - Insulation (coating, PiP, bundle)
- Active prevention systems
 - Injection of methanol/glycol (MEG)
 - Heating – electrical, circulation of hot water
- Reactive - Hydrate remediation
 - Depressurization
 - Injection of methanol/glycol (MEG)
 - Heating



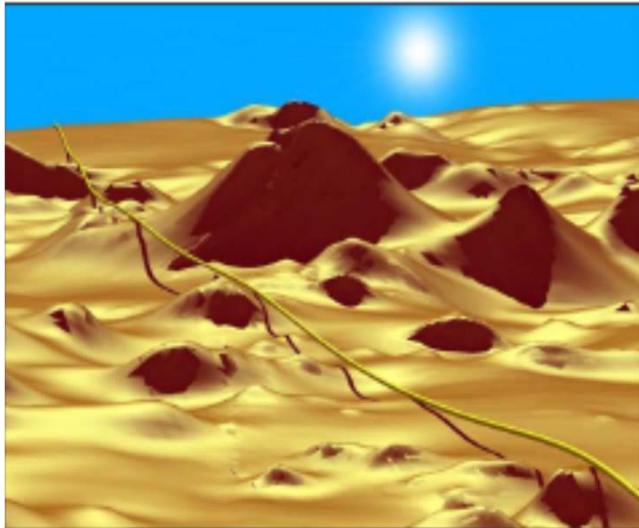
Source: www.ntnu.no



Example of a Hydrate formation curve

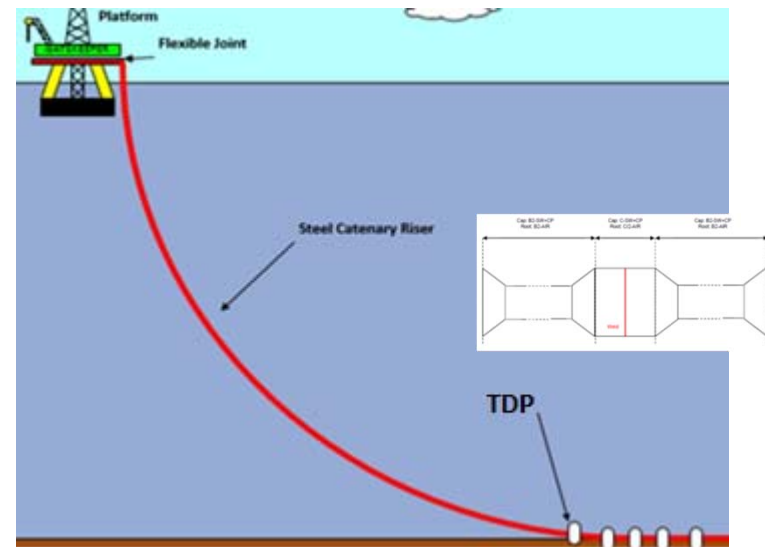
Free Span Assessment

- Advanced assessment of long freespans with multi-mode response can result in substantial cost saving in seabed intervention.

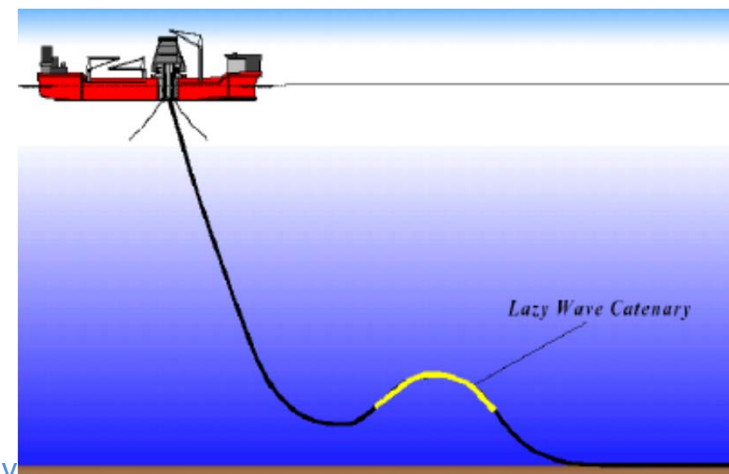


Steel Catenary Riser Challenges

- **Fatigue**
 - VIV
 - First order motions and loads
 - Clad (sour service)
 - Upset Ends in fatigue critical regions
 - Localized buckling Damping



SLWR – Steel Lazy Wave Riser
Optimization
Clashing issues



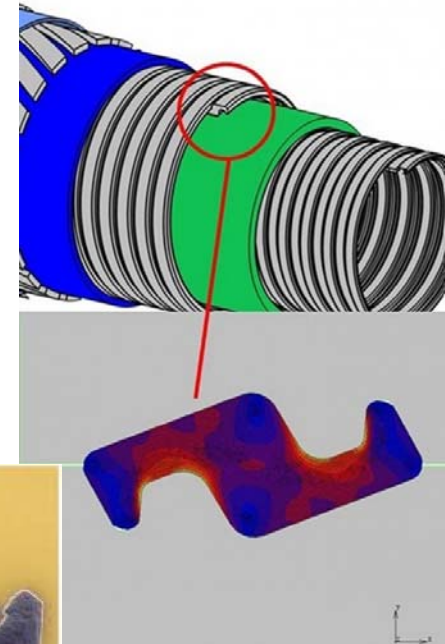
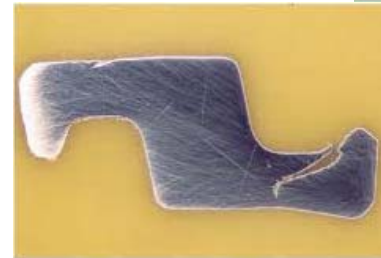
Flexible Riser Challenges

- **Fatigue (tensile and Pressure armors)**
 - Ultra deep water
 - High contaminants (CO₂ and H₂S)
 - Harsh environment
- **Integrity management**
 - Inspection and monitoring
 - SCC-CO₂ issues
- **New materials**
 - Composites
 - Specialized Polymers
 - Long term reliability
- **Design Methodologies**



Fatigue Validation (tensile and Pressure armors)

- Ultra deep water
- High contaminants (CO_2 and H_2S)
- Harsh environment
- Fretting fatigue



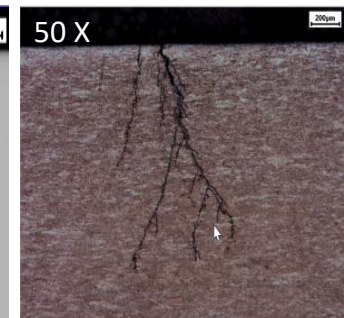
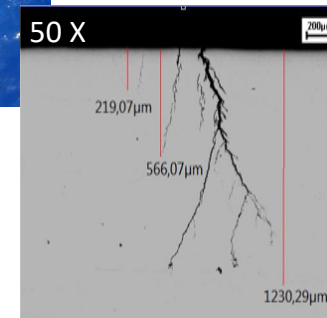
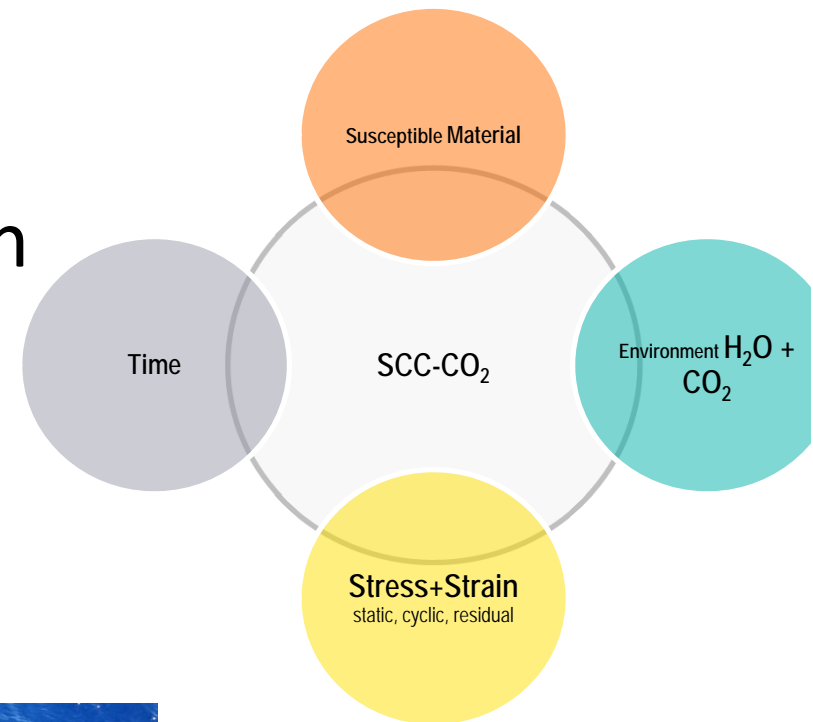
Integrity management



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SCC-CO₂

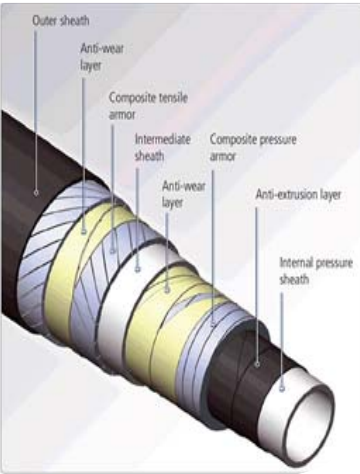
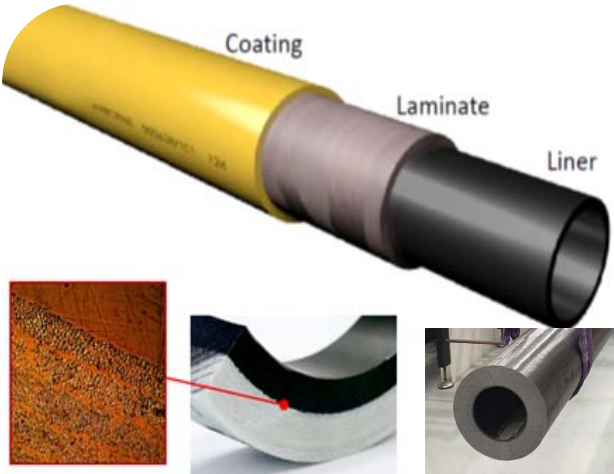
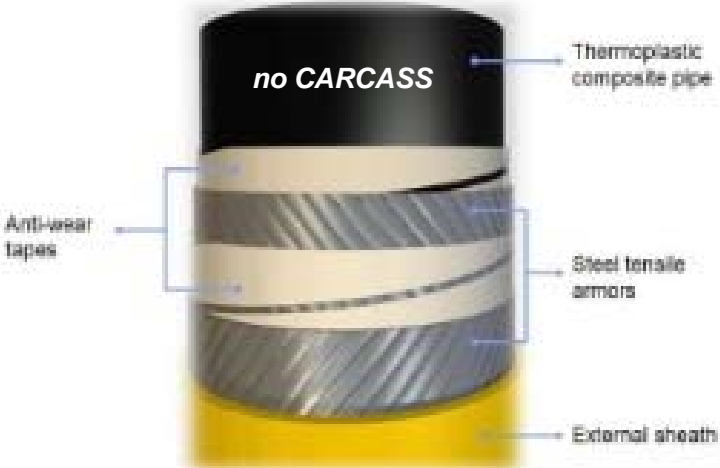
- Occurrence envelope
- Annulus flooding detection
- Service life evaluation
- Solutions



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New materials for Flexible Risers

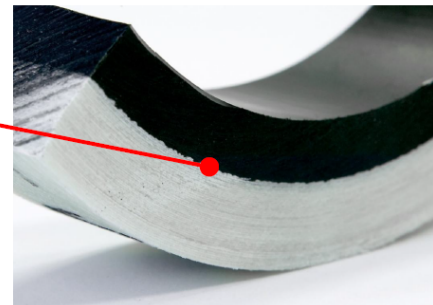
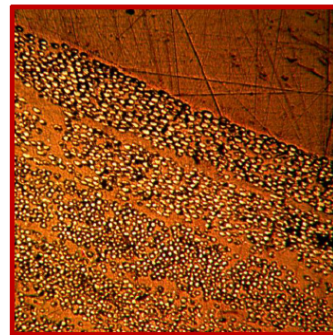
- Composites
- Specialized Polymers
- Long term reliability



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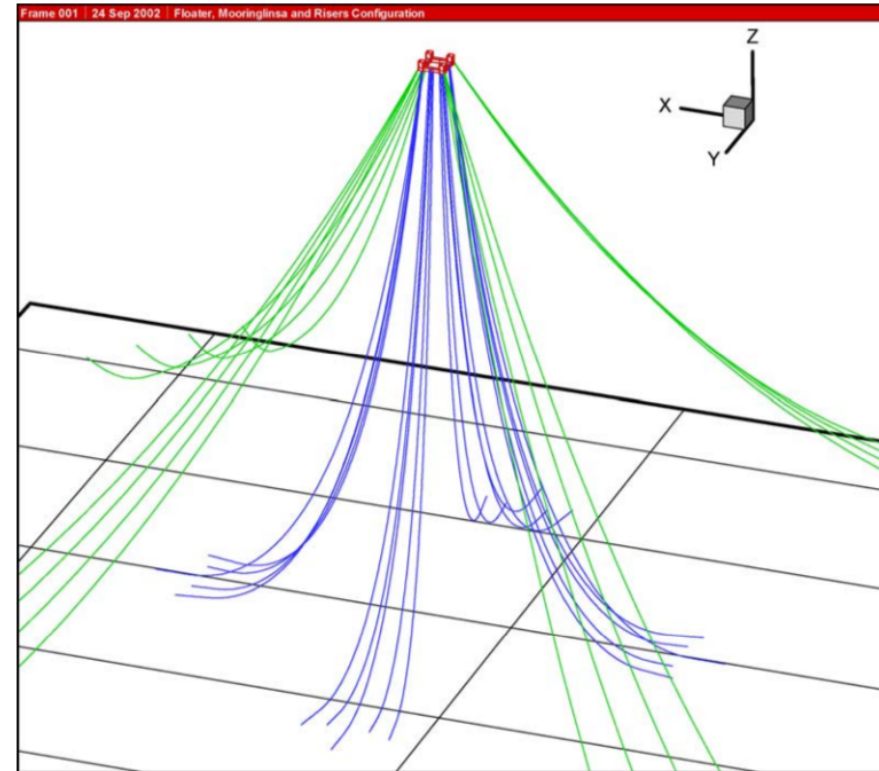
Composite Pipes

- Design methodologies
 - Safety factors
- Material degradation evaluation
- Crack growth (ECA?)
- Integrity management
- Long term behavior



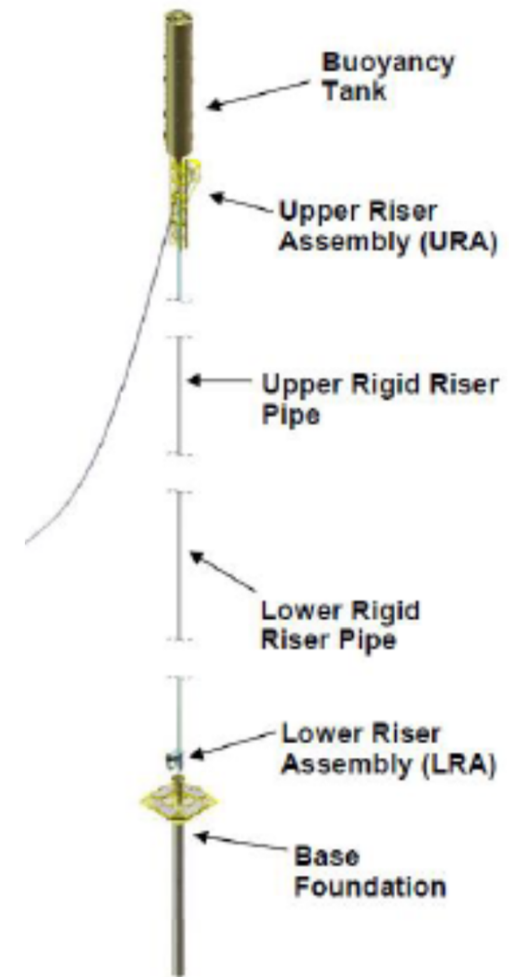
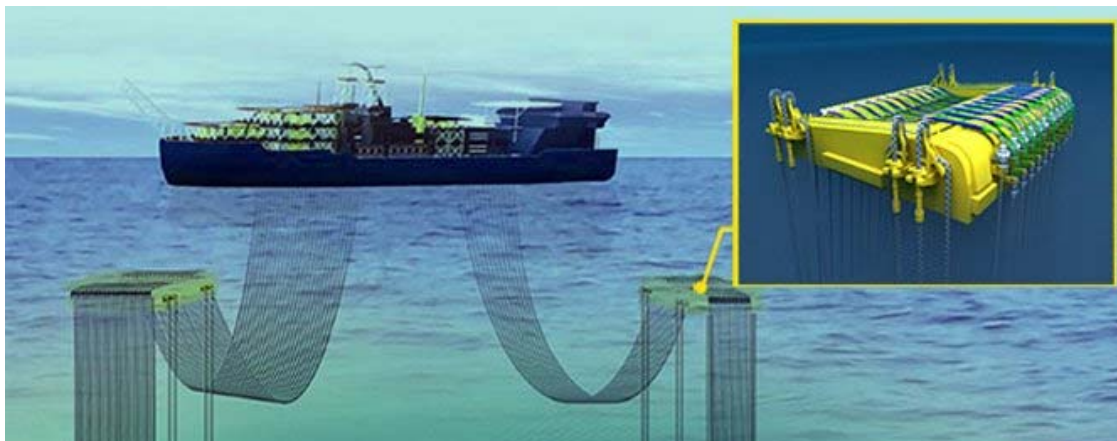
Design Methodologies

- **Coupled dynamic analysis of FPSO / moorings / risers**
- **Fatigue evaluation coupled with global dynamic (local/global)**



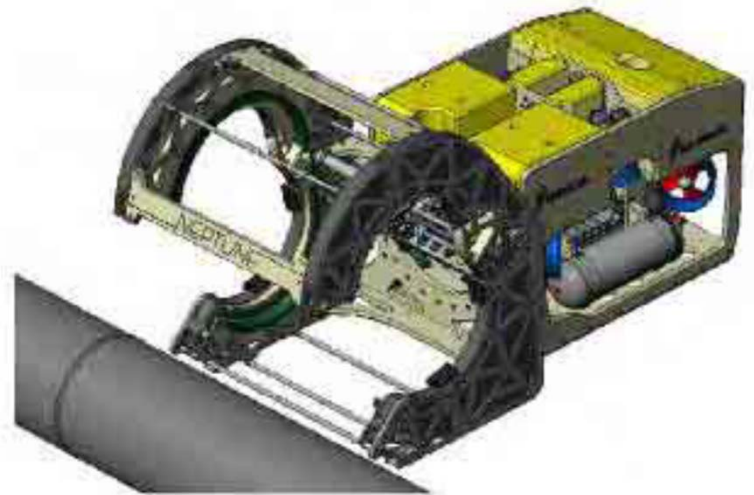
Hybrid Riser Challenges

- System design complexity
- Components design
- Clashing / Interference issues
- Installation challenges
 - Large components
 - Overall lift weight
- High CAPEX



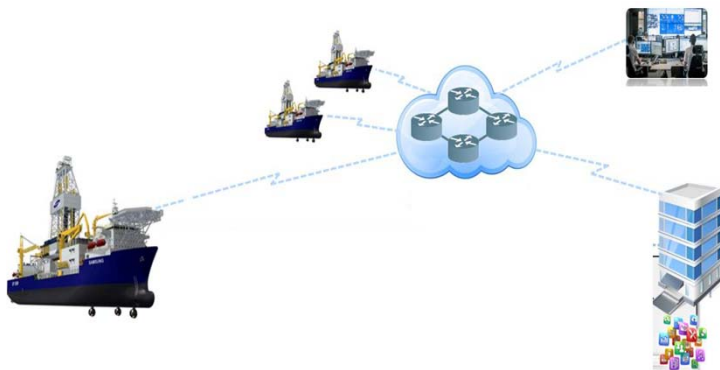
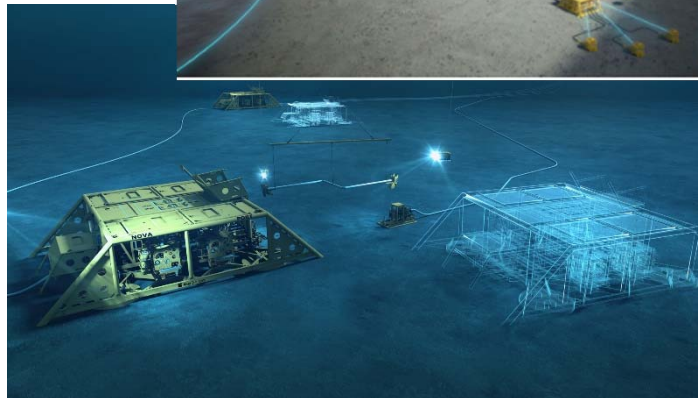
Integrity Management

- Real time monitoring of service conditions
- Annulus monitoring (flexible riser)
- Corrosion issues
- Accurate external inspection
- Feedback to the design
- Life cycle integrity
- Decommissioning



Subsea Digital Transformation

- Life Extension of Offshore Assets
- Integrity management
 - Automation
 - Big data
 - Cloud computing
 - Artificial intelligence
 - High performance computing
 - Machine learning
 - Digital Twin



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Importance of Riser and Pipeline Technology for O&G Production



Thanks!!!
Any Questions?

Carlos Alberto D. de Lemos

Lemoscad.cl@gmail.com