



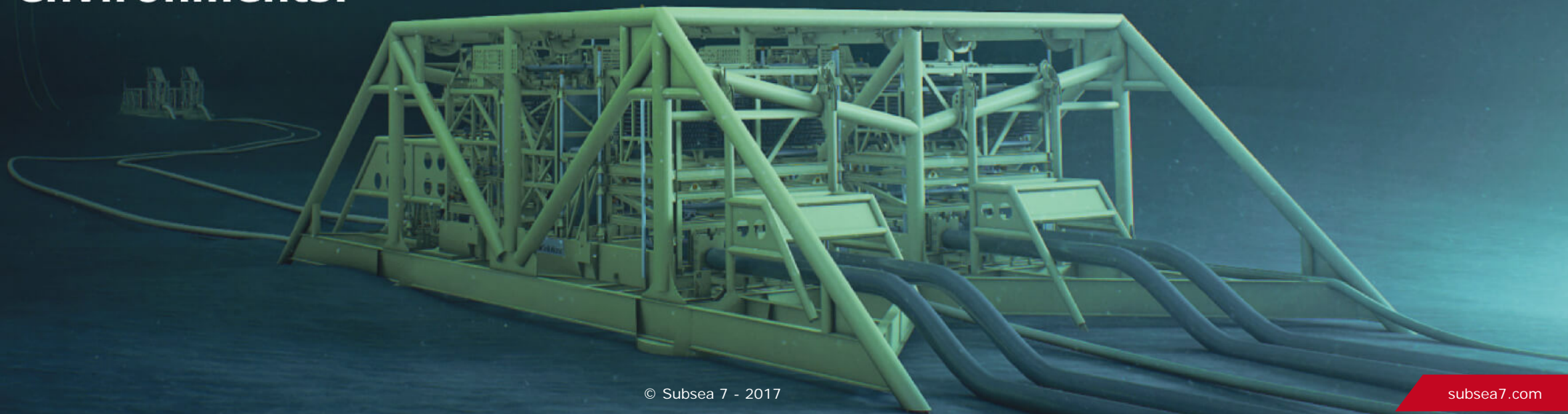
Innovation and Technology

12 October 2017

# WHO WE ARE

One of the **world's leading** global contractors in **seabed-to-surface** engineering, construction and services.

**Cost-effective** technical solutions enabling delivery of **complex projects** in all water depths and **challenging offshore environments.**



# OUR VISION

To be acknowledged **by our clients**, our people, and our shareholders, as the **leading strategic partner** in **seabed-to-surface** engineering, construction and services.





# CORE VALUES

**SAFETY**

**INTEGRITY**

**INNOVATION**

**PERFORMANCE**

**COLLABORATION**

# OUR DIFFERENTIATORS



## PEOPLE

Project delivery based on our expertise and know-how



## TECHNOLOGY

Delivering market-driven and cost-effective solutions



## ASSETS

A diverse fleet of vessels and strategically positioned global assets



## ALLIANCES & PARTNERSHIPS

Collaborating to deliver optimal field development solutions



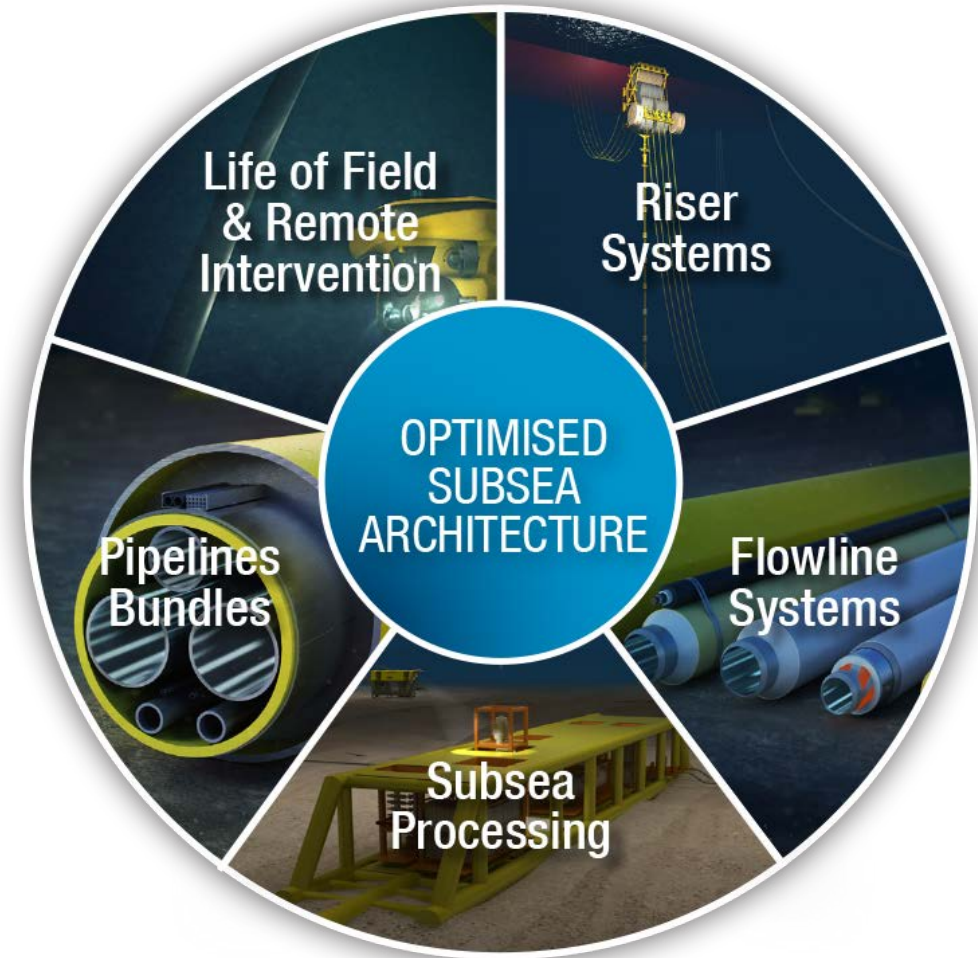
## LOCAL PRESENCE

Building local business and embedding local capability

# Our Strategic Technology Programmes

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- Business driven technology solutions to address industry wide challenges
- Client-centric innovation
- Cost-efficient and commercially relevant outcomes

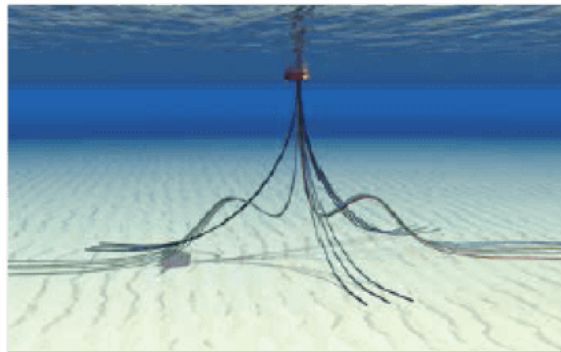
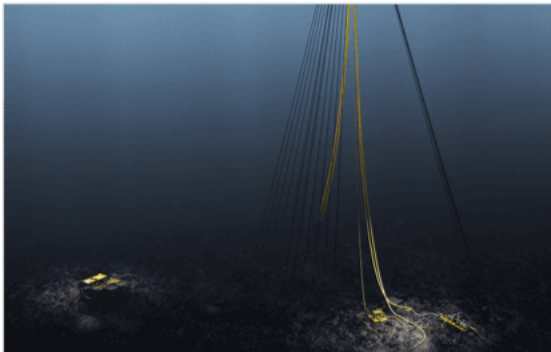




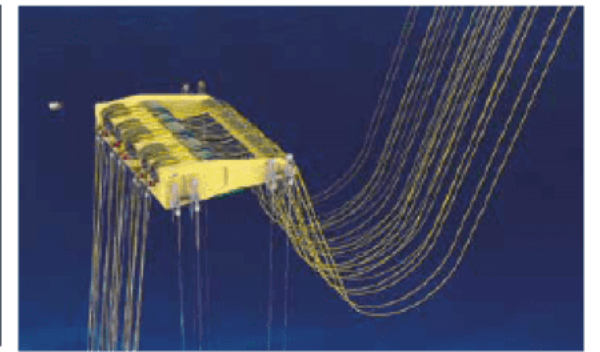
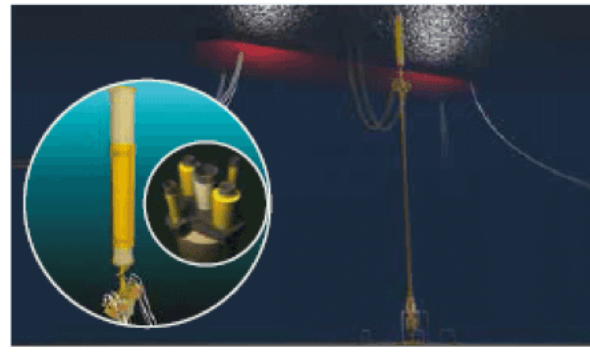
# A LEADER IN **DEEPWATER RISER SYSTEMS**

- **Cost-efficient** solutions
- Uniquely **wide portfolio** of riser solutions allowing optimised concept selection for each project
- **Strong track-record**, including large EPCI projects
- Optimised riser integration into field development
- **Improved** flow and integrity **performance**

## Coupled Systems



## Un-Coupled Systems



# FLOWLINE SYSTEMS

**Developing portfolio of high performance and cost-efficient flowline solutions to enable optimum field architecture.**

- Active heating systems - Electrically Heat Traced Flowline Pipe-in-Pipe (EHTF PiP) with most energy efficient system in market
- Longer tie-backs
- PiP with industry leading thermal performance
- Enable more cost efficient solutions
- Integration of continuous health monitoring
- Non-Destructive Testing (NDT)
- Field Joint Coating (FJC)





# ... SUBSEA PROCESSING

**Integrating compact subsea processing systems into our solutions.**

- Integration of subsea processing functions by providers into standardised and modularised transport and installation system
- Towed Production System as technology platform for carrying processing plants
- Small plants or subsea production solutions replacing platforms
- Short or long distance tie-backs in shallow and deep waters

# BUNDLES

**Enhancing Pipeline Bundle technology solutions for global market. Developing towed production systems.**

- Multiple flowlines packaged inside a carrier pipe
- Terminates with towhead structures (manifolds)
- Fabricated on-shore in a single length
- Towed to site by CDTM  
(Controlled Depth Tow Method)





# ... LIFE OF FIELD & REMOTE INTERVENTION

**Developing technology to support integrated Life of Field services and products across the field lifecycle.**

- Exploration
- Development
- Production uptime
- Production enhancement
- Production intelligence
- Surveillance



# Subsea Integration Alliance technology proposition



# Subsea Integration Alliance technology focus



## OneSubsea

- Production Systems
- Processing Systems
- Services
- Control Systems
- Integrated Solutions

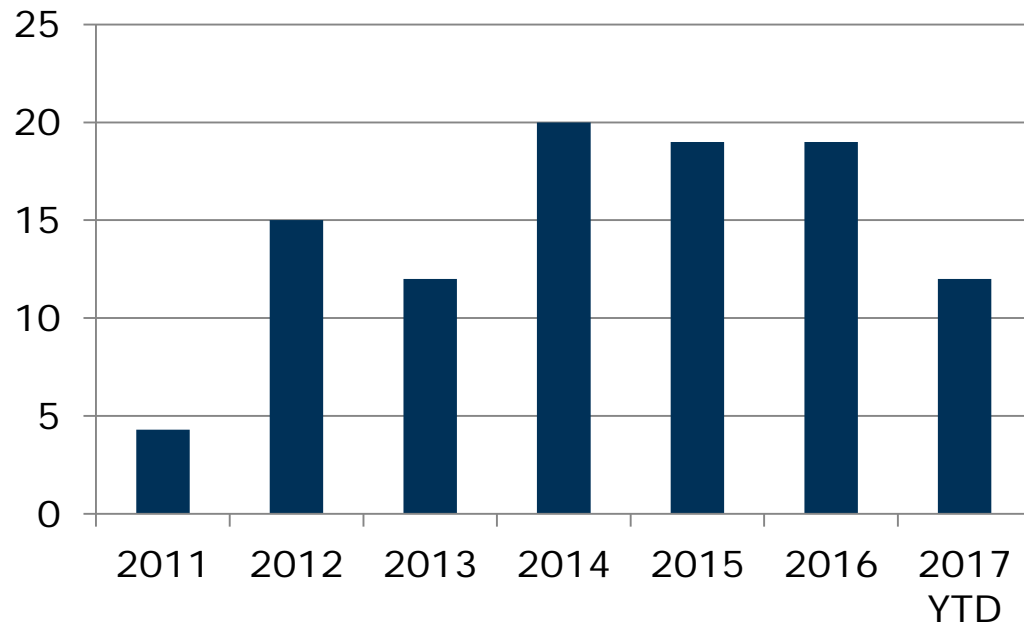
## Subsea 7

- Riser Systems
- Flowline Systems
- Bundles
- Subsea Processing
- Life of Field

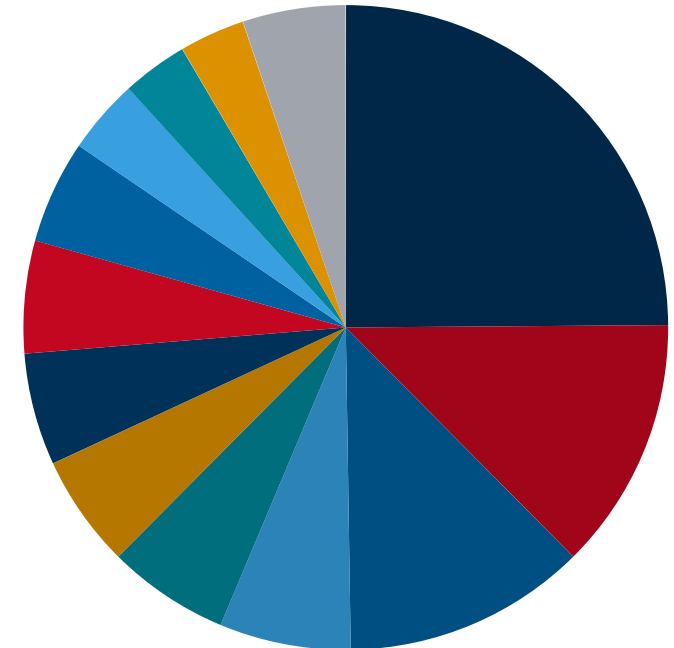
# Proprietary technology and Intellectual Property (IP)

- Subsea 7 has over **750** granted and pending patents contained in ~**170** patent families

Patents filed by Subsea 7, by year



Subsea 7 IP by category



- Rigid pipelines
- Riser designs
- i-Tech
- Structures
- Swagelining
- Welding/Materials
- Offshore Resources
- Flow Assurance
- Lifting/Rigging/Construction
- Bundles
- Geotechnics
- Flexibles/Umbilicals



# CREATING VALUE THROUGH INNOVATION & TECHNOLOGY

**Capturing decades of experience and creating new step-changes for the future.**

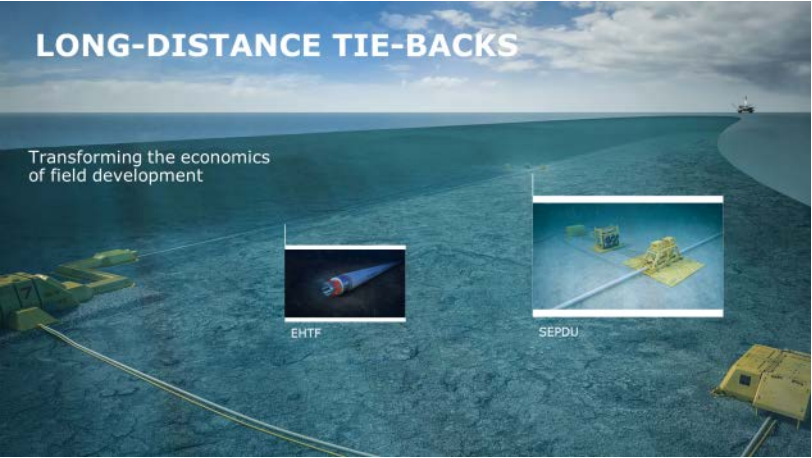
- Solutions that reduce CAPEX costs related to subsea field developments
- Enabling increased recovery rates
- Increasing value extracted from existing field infrastructure
- Enabling development of complex reservoirs
- Integration of continuous health monitoring
- Lowering OPEX costs of subsea operations



# Latest key technology development areas

### LONG-DISTANCE TIE-BACKS

Transforming the economics of field development



EHTF

SEPDU

This slide illustrates long-distance tie-back technology. It features a 3D rendering of an offshore oil field with a long pipeline connecting two platforms. Two inset images show specific components: EHTF (External Heat Transfer Fluid) and SEPDU (Subsea Energy Production Unit).

### PIPELINE BUNDLES & TOWED PRODUCTION SYSTEMS

Enabling the next generation of subsea architecture



Pipeline Bundle

STARBOARD


subsea 7

STARBOARD

This slide shows pipeline bundles and towed production systems. It includes a 3D rendering of a subsea production system with a pipeline bundle. The subsea structure is labeled with 'STARBOARD' and 'subsea 7'. An inset image shows a 'Pipeline Bundle'.

### DEVELOPING COST-EFFICIENT PIPELINE MATERIALS

Reducing field development costs



High Strength Steels

Corrosion resistant alloy

Polymer-liner

Composites

This slide displays four different types of pipeline materials: High Strength Steels, Corrosion resistant alloy, Polymer-liner, and Composites.

### DEVELOPING THE FUTURE OF IRM THROUGH INNOVATION

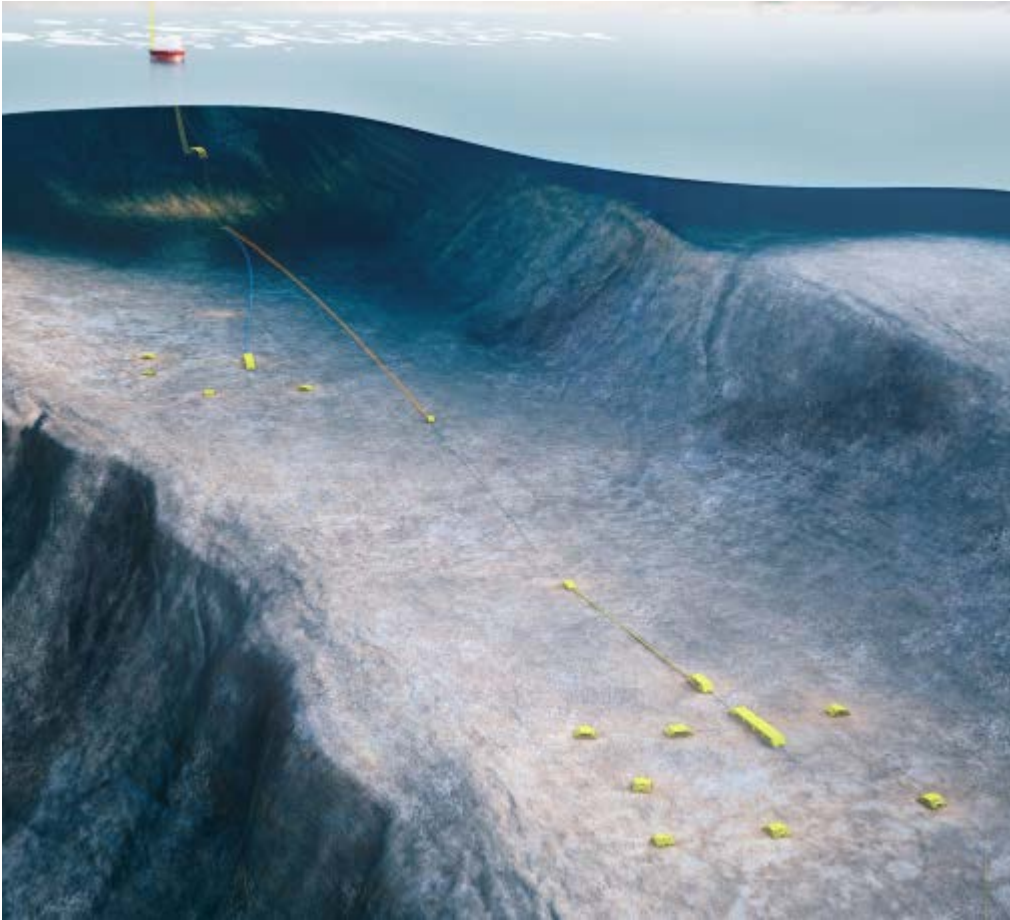
i-Tech Services a leading Life of Field Partner



This slide illustrates the future of IRM (Intelligent Risk Management) through innovation. It features a 3D rendering of an offshore oil field with a subsea production system.

## Long-distance tie-backs

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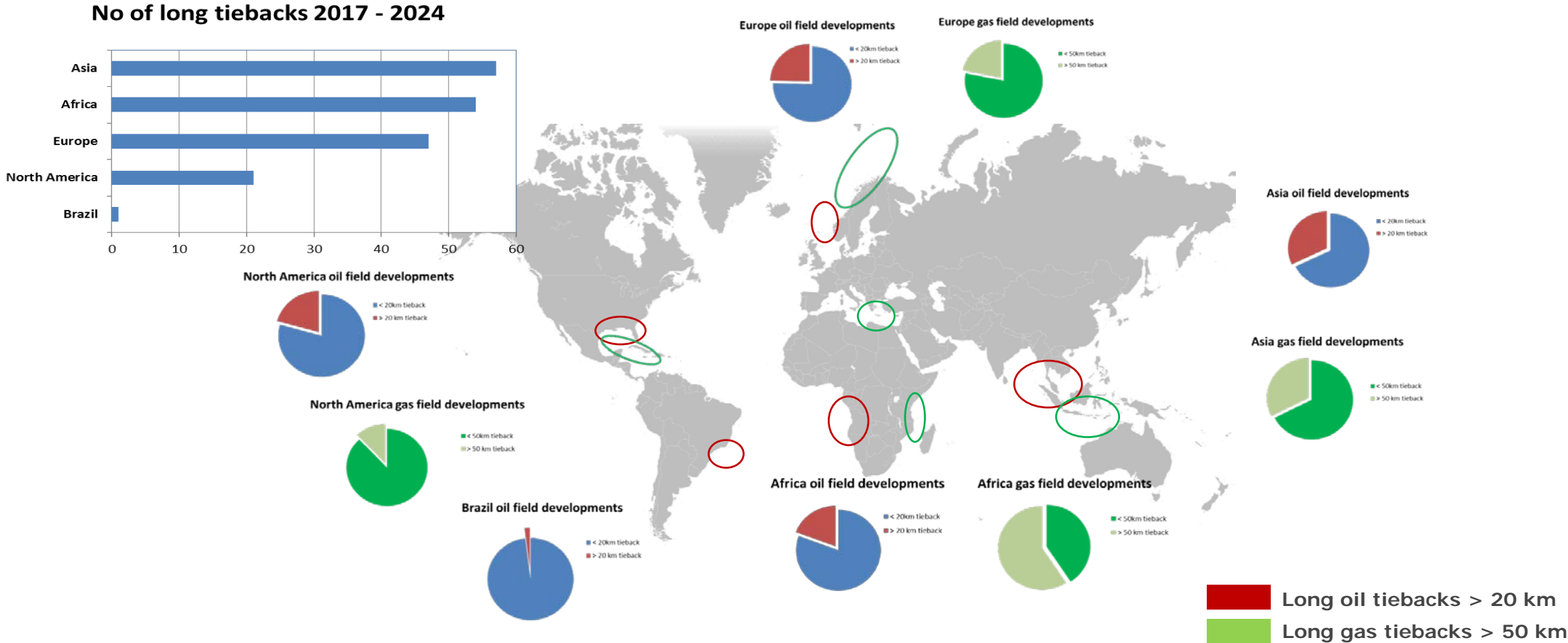


An increasing number of offshore oil and gas developments can be made viable with **long-distance tie-backs** by eliminating the need to add expensive topside facilities



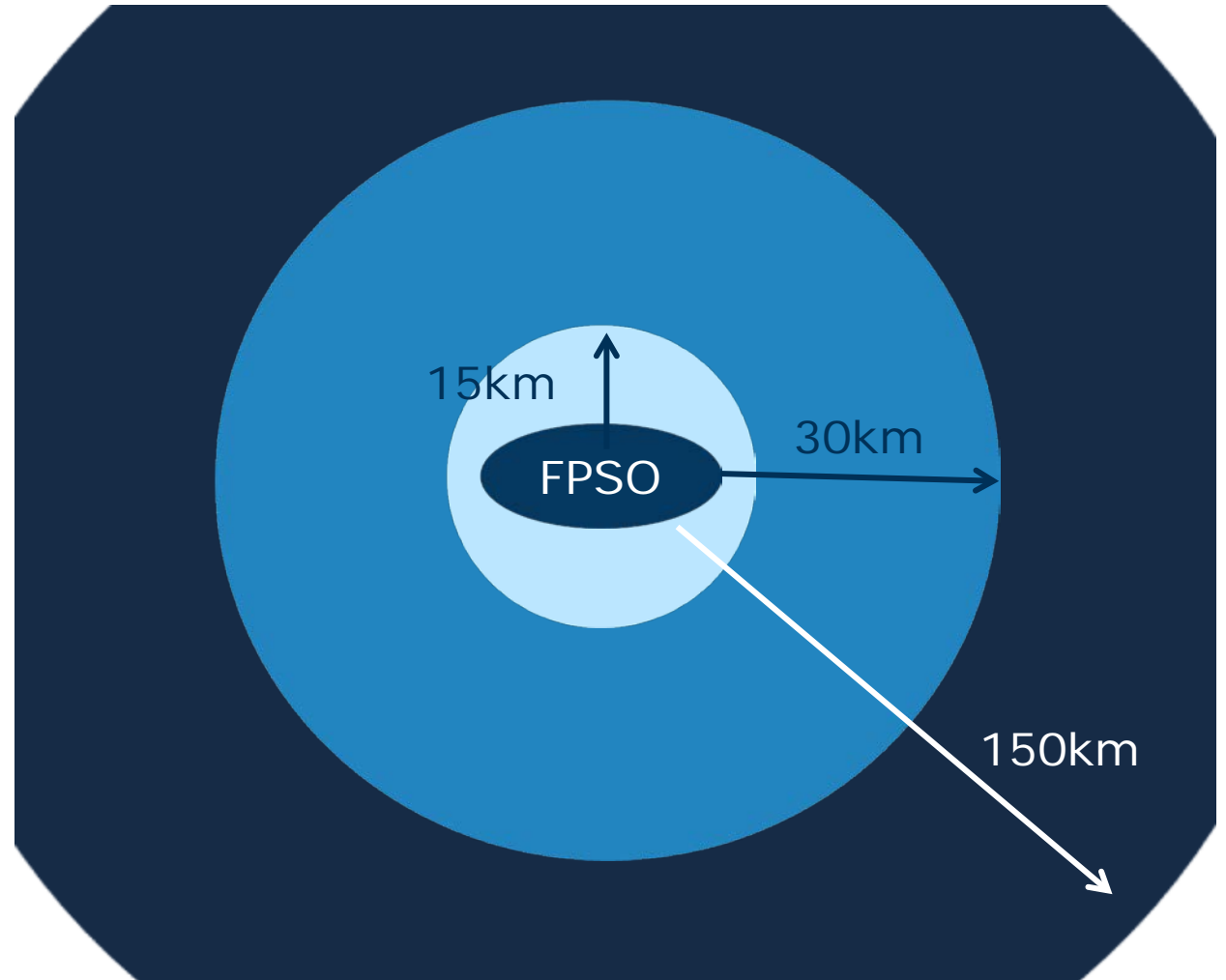
# Long-distance tie-backs

Over 20% of near to medium term development concepts are "long"



## Long-distance tie-backs

- Our aim is to provide operators with solutions that can tie-back remote fields to existing facilities over longer distances
- A typical 15km tie-back today reaches an area  $\sim 700\text{km}^2$
- A future 150km tie-back would reach an area **100 times larger**:  $\sim 70,000\text{km}^2$



# Long-distance tie-backs

Main challenges are Flow Assurance



Waxing occurs when oil cools and solidifies in the pipeline



Hydrates form at high pressures and low temperatures



## Long-distance tie-backs

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- Temperature reduction as the fluid is transported longer distances may lead to wax deposits on the pipe wall and hydrate formations during operating or reset conditions
- Our technology addresses this in three different ways:

### Active heating



### Subsea processing



### Cold flow systems

## Long-distance tie-backs

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### Active heating

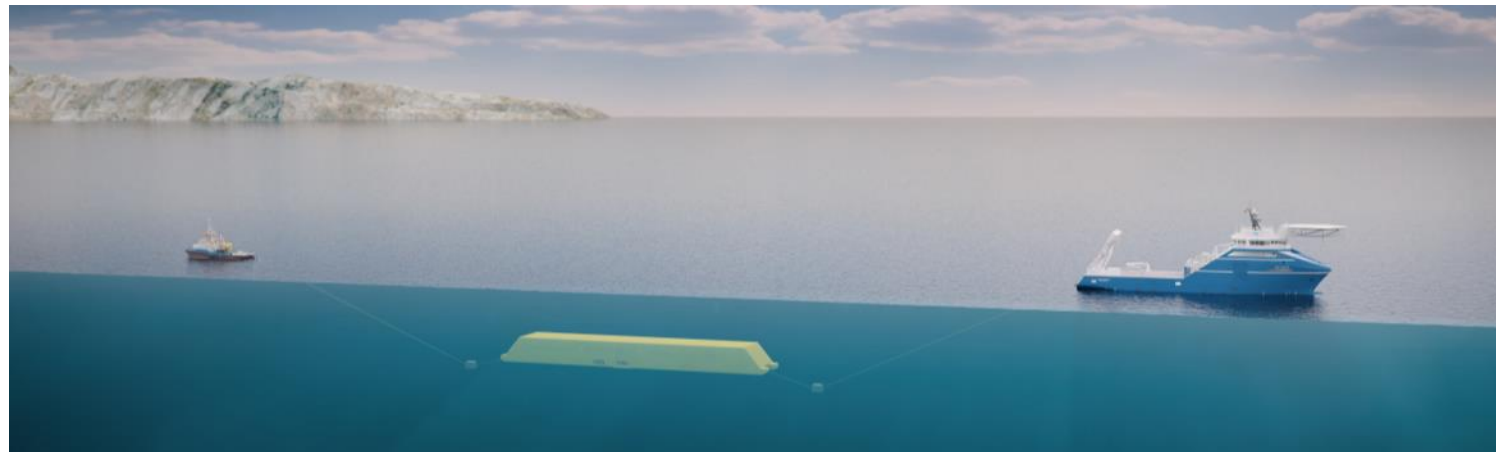
- Subsea 7 is the only contractor with all three active heating technologies:
  - Direct electrical heating (DEH)
  - Electrically Heat traced flowline (EHTF) and
  - Hot water circulation in a Pipeline Bundle
- Topside power generation limits the length of pipeline that can be heated
- Our EHTF technology, developed with manufacturer ITP Interpipe, is one of the most efficient active heating systems available in the market today
- EHTF pipeline will be installed by reel-lay, using *Seven Oceans* and our new-build reel-lay vessel due to join the fleet in 2020.

# Long-distance tie-backs

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## Subsea processing

- Moving topside processing facilities to the seabed
- Subsea separation, seabed pumping and gas boosting
- Subsea Integration Alliance, with OneSubsea, brings market-leading capability
- Subsea 7 is using tow-lay installation techniques to support subsea processing.



**Subsea** Integration Alliance  
OneSubsea & Subsea 7





## Long-distance tie-backs

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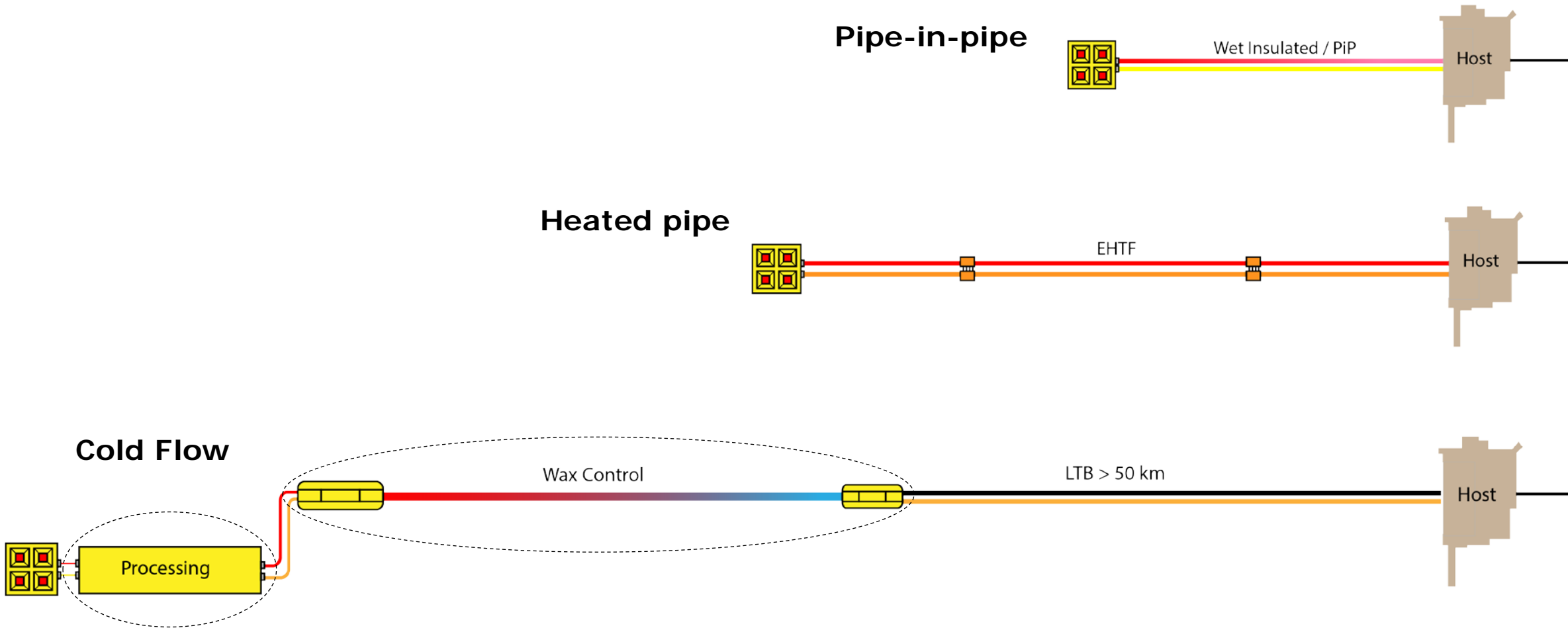
### Cold flow systems

- Flow assurance for very long-distance tie-backs
- Maintain production at ambient sea water temperatures
- Wax Control Unit (WCU) based on Bundle and Pipe-in-pipe technology
- Waxing is controlled by the WCU to localise wax deposition
- Subsea 7 is currently developing and qualifying the WCU as part of a larger development programme supported by the Norwegian Research Council

Wax Control Unit



# Long-distance tie-backs



## Long-distance tie-backs

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Recent Subsea 7 projects with active heating:

- The world's first implementation of reeled CRA-lined carbon steel pipe with DEH active heating on the **Maria project for Wintershall**, offshore Norway
- The deepest DEH system implemented to date on **Chevron's Lianzi Project**, offshore Angola, 43km long and 1070m water depth.

Tenders and prospects with active heating and long-distance tie-backs

- Aker BP, Snaad, Norway, 21kms of EHTF
- Total, Garantiana, Norway, 52kms of DEH
- CNR, Kossipo, Ivory Coast, 15kms of EHTF
- VNG, Pil&Bue (Fenja), Norway, 67kms of EHTF



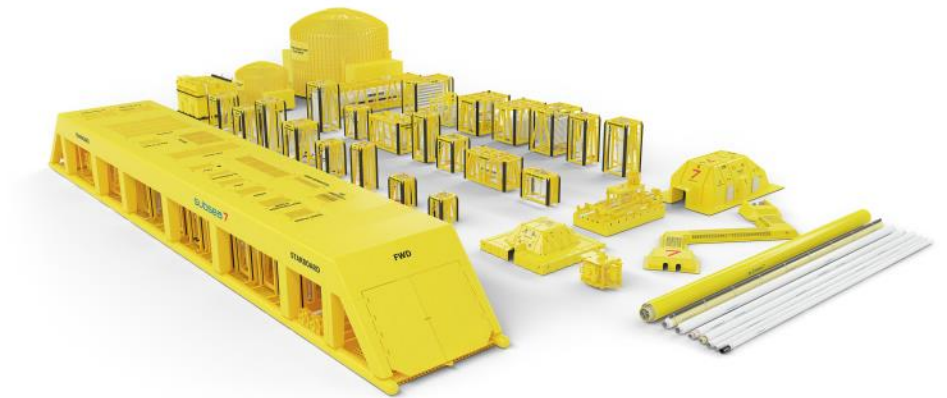
## Pipeline Bundles and towed production systems

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### **Pipeline Bundles**

Flowlines, injection lines and control umbilicals within a rigid, large-diameter carrier pipe



### **Towed production systems**

Cost-effective installation of equipment within a modular platform

## Pipeline Bundles and Towed Production Systems

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Multiple flowlines packaged inside a carrier pipe providing significant cost reductions compared to other pipe lay installation methods.



# Pipeline Bundles and Towed Production Systems

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Terminates with towhead structures (manifolds)





# Pipeline Bundles and Towed Production Systems

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Fabricated on-shore in a single length



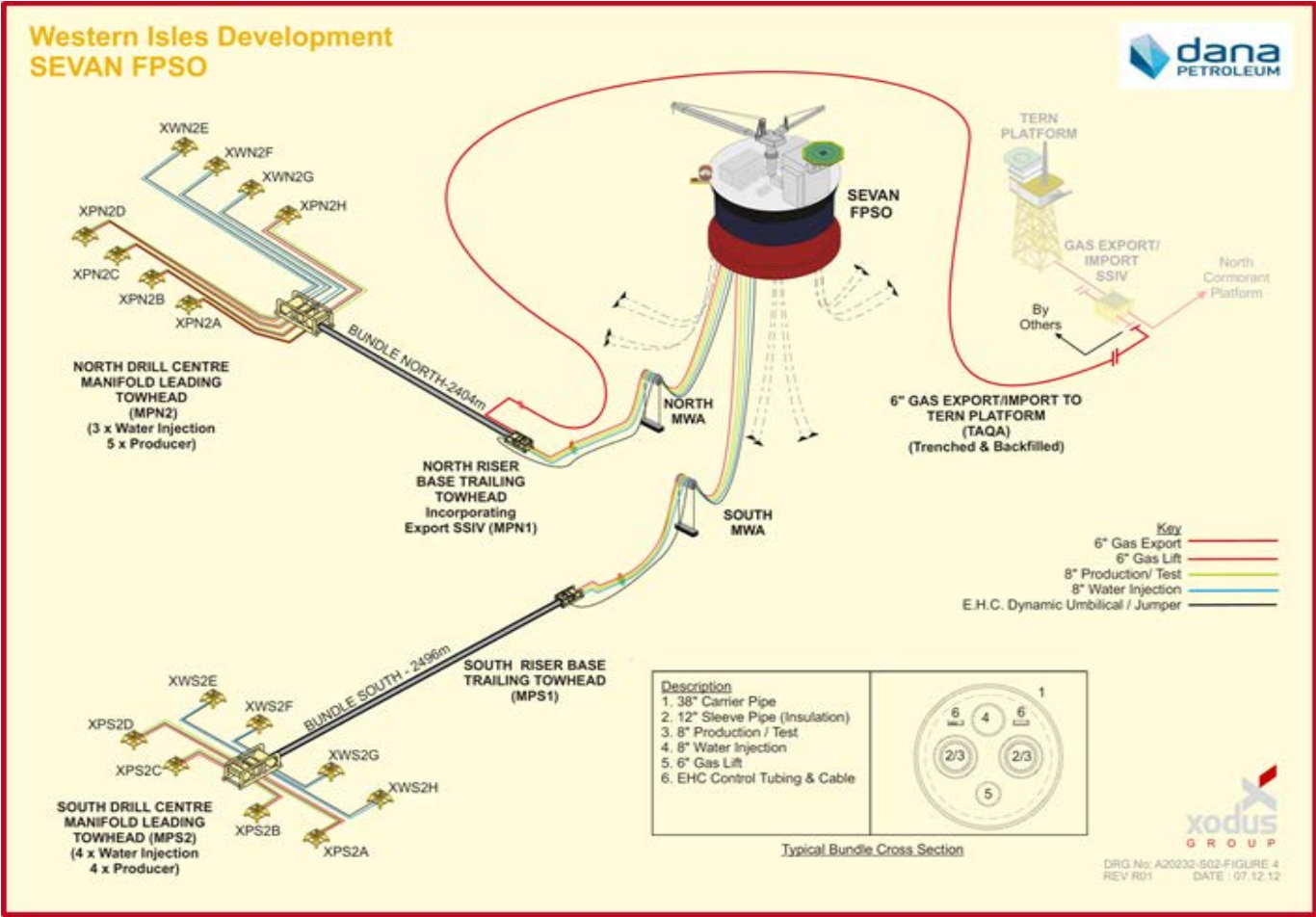


# Pipeline Bundles and Towed Production Systems

Towed to site by Controlled Depth Tow Method (CDTM) – upwards of 10,000 tonnes of pipeline system

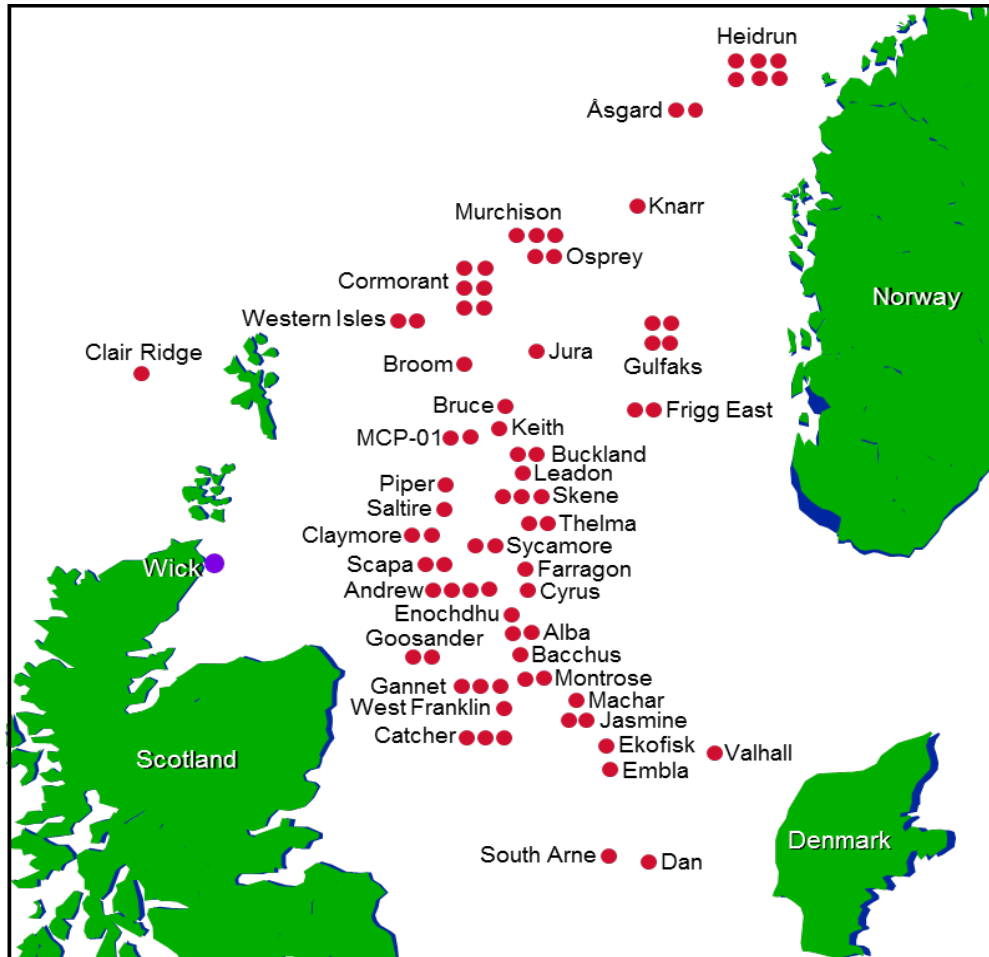


# Pipeline Bundles and Towed Production Systems



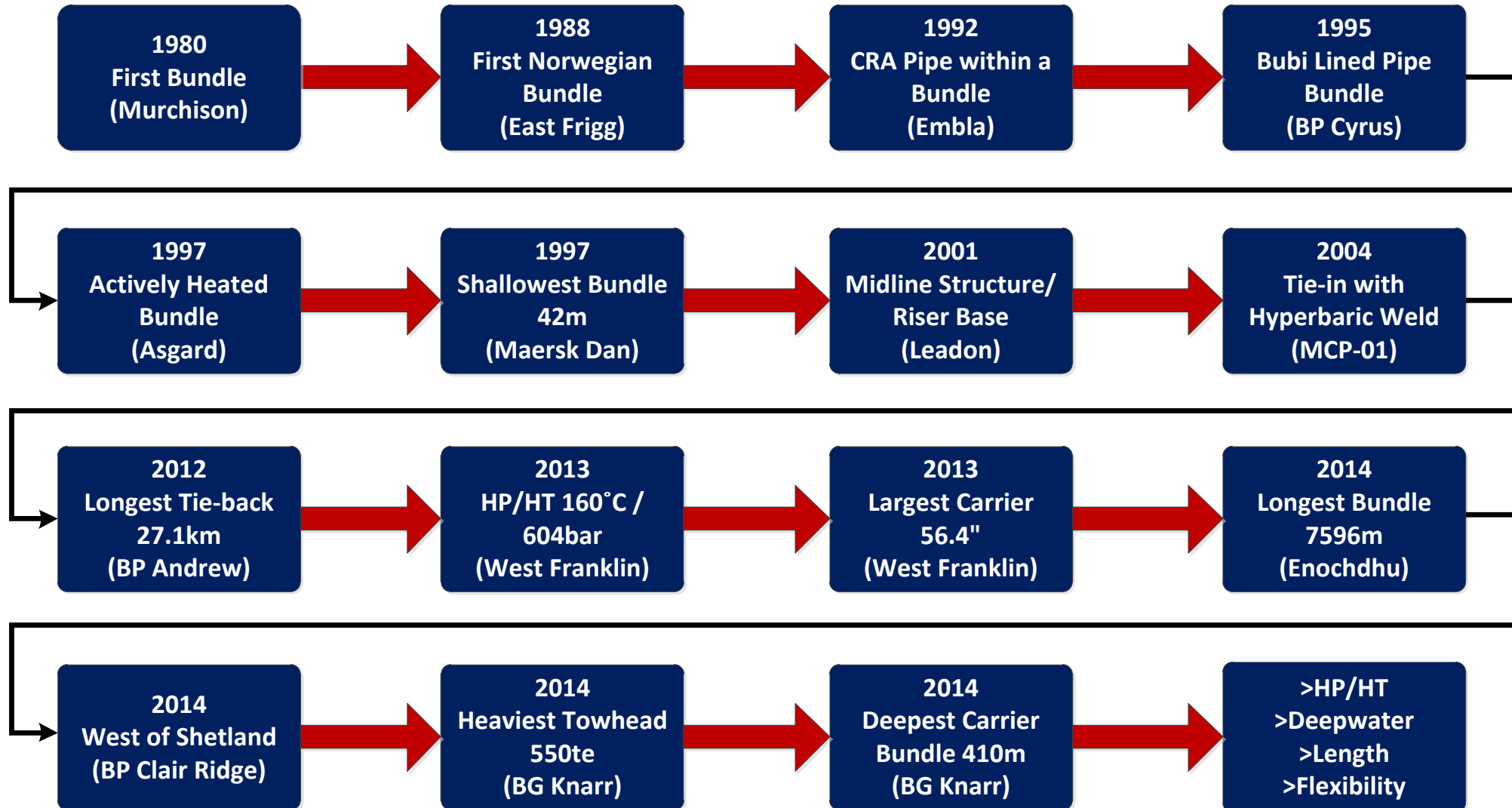


# Pipeline Bundles and Towed Production Systems



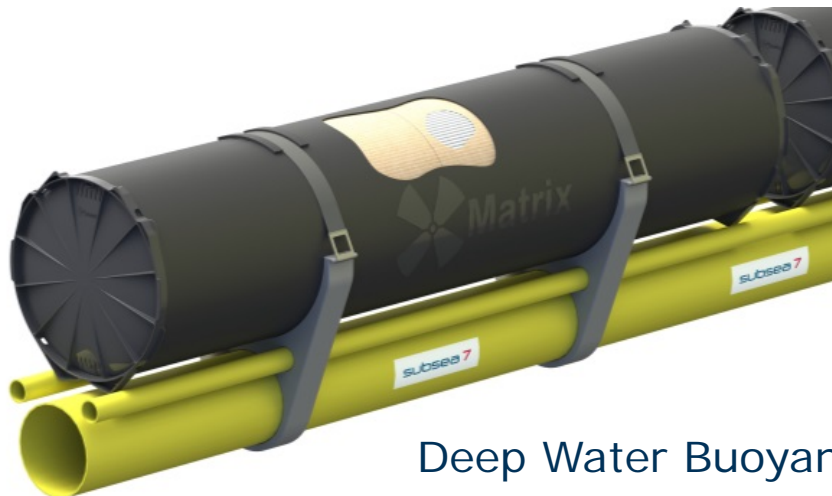
- Bundles completed: **81**
- Longest single Bundle length: **7681 metres**
- Longest tie back length: **28 kilometres**
- Heaviest single Bundle constructed: **9154 te**
- Heaviest Integrated Structure: **547 te Leading and 451 te Trailing**
- North Sea installation: **42 metres to 410 metres**
- Longest tow from Wick: **1000 km**

# Bundle Development Timeline



## Pipeline Bundles and Towed Production Systems

- Bundle Migration Plan
- HP/HT advancement ( $>220^{\circ}\text{C}$ )
- Deepwater Applications (500m  $>$  3000m)
- Condition monitoring – Fibre Optics
- Electrical Trace Heating
- Extended Length tows
- Subsea Processing within Towheads
- Temperature Control Systems
- Underwater Intervention Drones hosted in towheads
- Integrated towhead boost pumps



Deep Water Buoyancy



EHTF suitable for bundle solutions

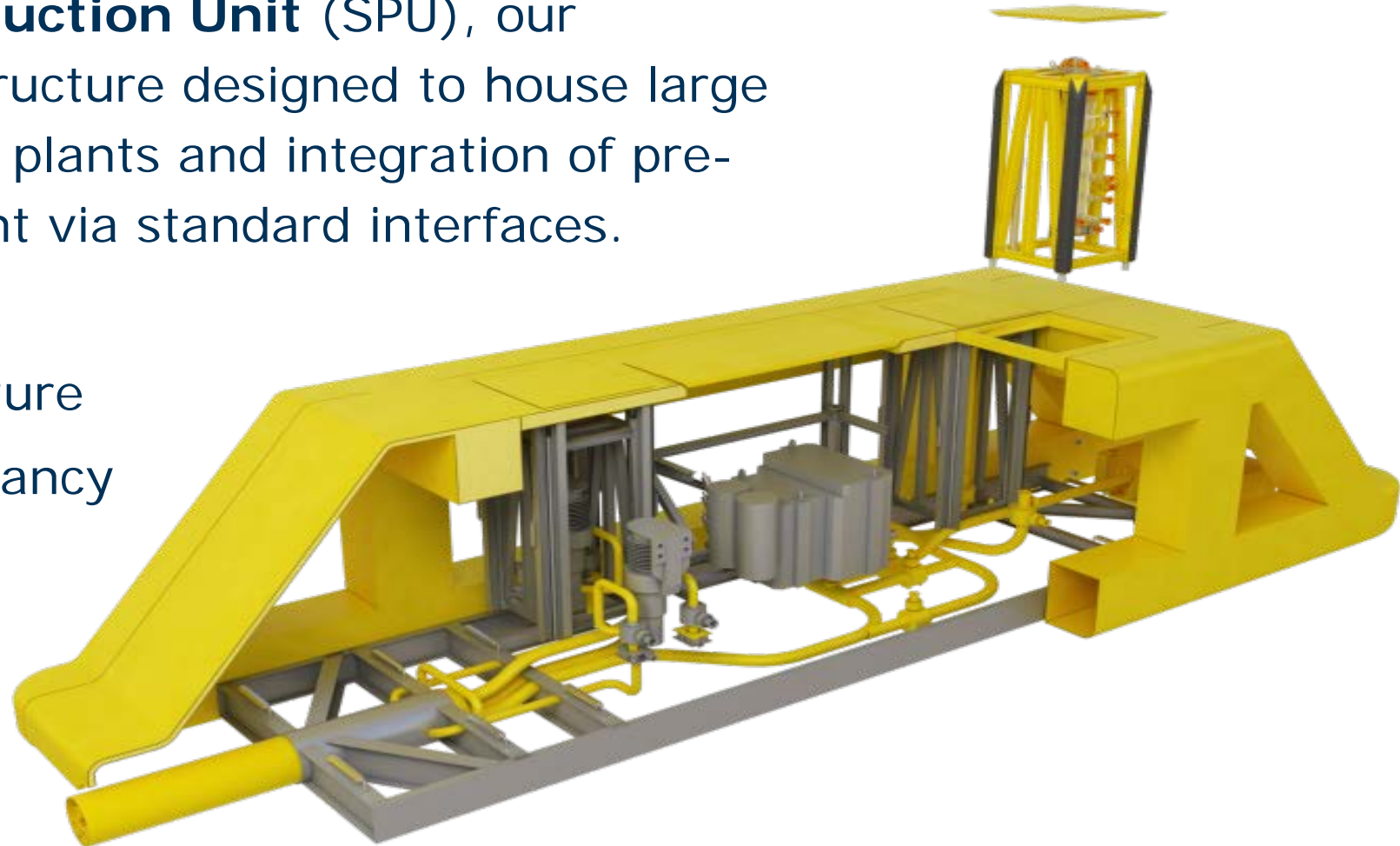


## Pipeline Bundles and Towed Production Systems

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**Submerged Production Unit (SPU)**, our versatile hybrid structure designed to house large subsea processing plants and integration of pre-qualified equipment via standard interfaces.

- Steel sub- frame
- GRP super structure
- Re-useable buoyancy



## Pipeline Bundles and Towed Production Systems

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**Transport and Installation Frame (TIF)** - allowing individual modules to be installed and changed out to suit field requirements



# Pipeline Bundles and Towed Production Systems

**Subsea Toolbox**  
Standardised  
Scalable  
Re-useable

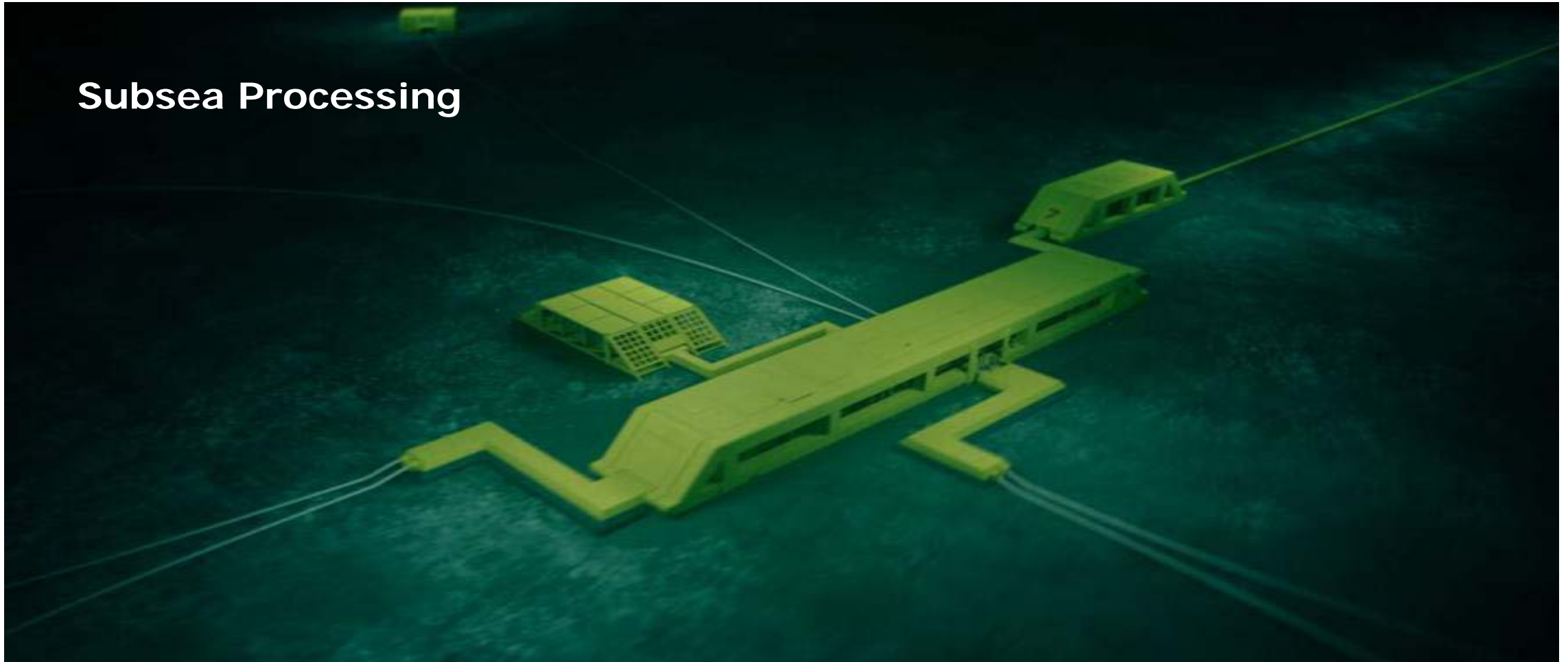




# Pipeline Bundles and Towed Production Systems

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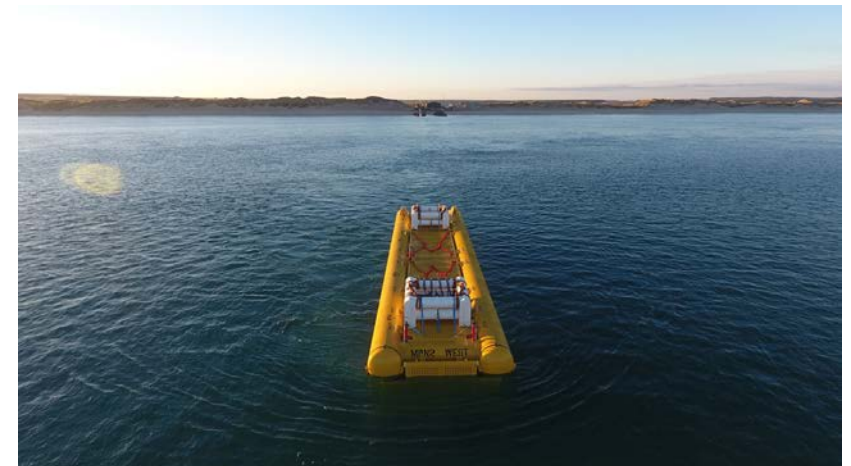
## Subsea Processing



## Pipeline bundles and towed production systems

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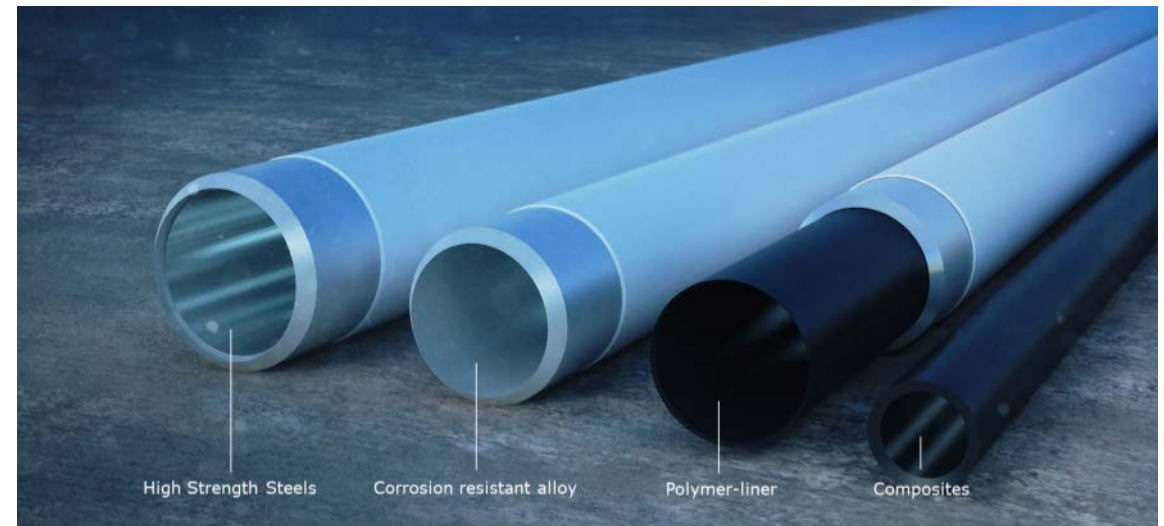
- Recent projects with Pipeline Bundles:
  - BP **Andrew** Development – 28 km tie-back
  - BG **KNARR** – deep water, large towheads
  - Premier **Catcher** - FPSO with 3 bundles
  - Apache **Callater** – new field with a repeat bundle design
  - Total **Jura** – large towhead with retrievable modules
  
- Tenders and prospects with Pipeline Bundles:
  - Statoil Snorre Expansion project
  - Shell Penguins project
  - Nexen Buzzard phase 2
  - Australian Bundle projects



## Cost-efficient pipeline materials

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- Conventional pipeline material solutions are reaching cost-efficiency limits for:
  - deeper water production,
  - higher pressure and temperature wells and
  - more aggressive service environments
- Subsea 7 continues to extend the boundaries of materials development
- Key enablers include:
  - polymer-liner,
  - high strength steels,
  - corrosion resistant alloy and
  - composites





# Cost-efficient pipeline materials

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## Higher strength steel

- Decreased pipe wall thickness lowers procurement and fabrication costs
- Reduced pipeline weight decreases the installation top-tension requirement
- Development collaboration with Vallourec
- Reelable X80 pipe and welding solution now qualified for flowlines and risers including sour service



Pulsed Gas Metal Arc  
Welding

## Cost-efficient pipeline materials

### Corrosion Resistant Alloy (CRA)

- CRA mechanically lined pipe is a cost-effective anti-corrosion solution
- Subsea 7 has pioneered the installation of Bubi® CRA lined pipe, in collaboration with Butting
- CRA pipe can be applied to both flowlines and risers
- Next evolution is adhesively bonded Glubi® lined pipe
- Subsea 7's **Girth welding technology** enables CRA to be combined with high strength steel pipe

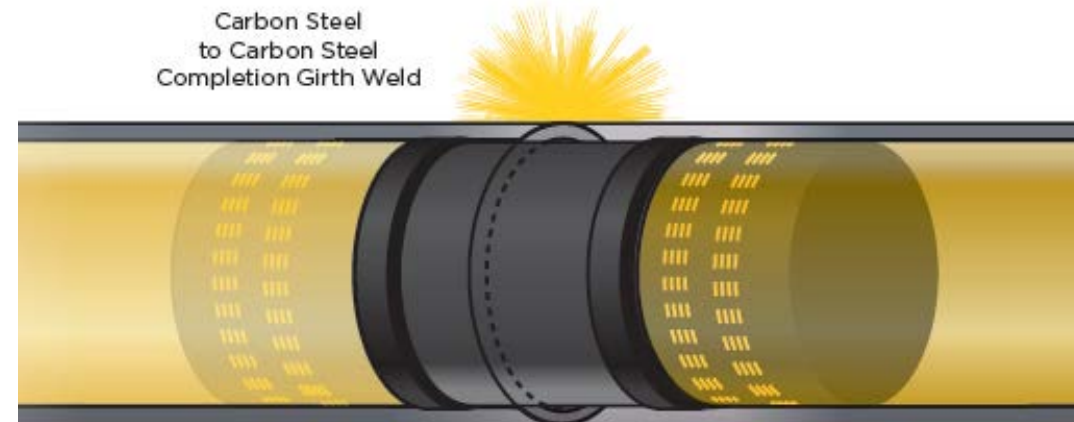


Seven Oceans installing mechanically lined Bubi® pipeline

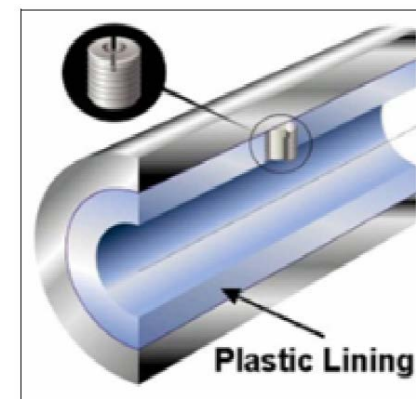
## Cost-efficient pipeline materials

### Polymer lined pipe

- Polymer lined pipe is approximately **35% cheaper** than CRA for water injection pipes and is suitable for all installation methods
- **Swagelining**, owned by Subsea 7, has developed a polymer connector, **Linerbridge®** as an alternative CRA connector
- The next step is to extend polymer linings to use in hydrocarbon pipelines



Swagelining LinerBridge® connection



**Linervent®** to avoid liner collapse for hydrocarbon service

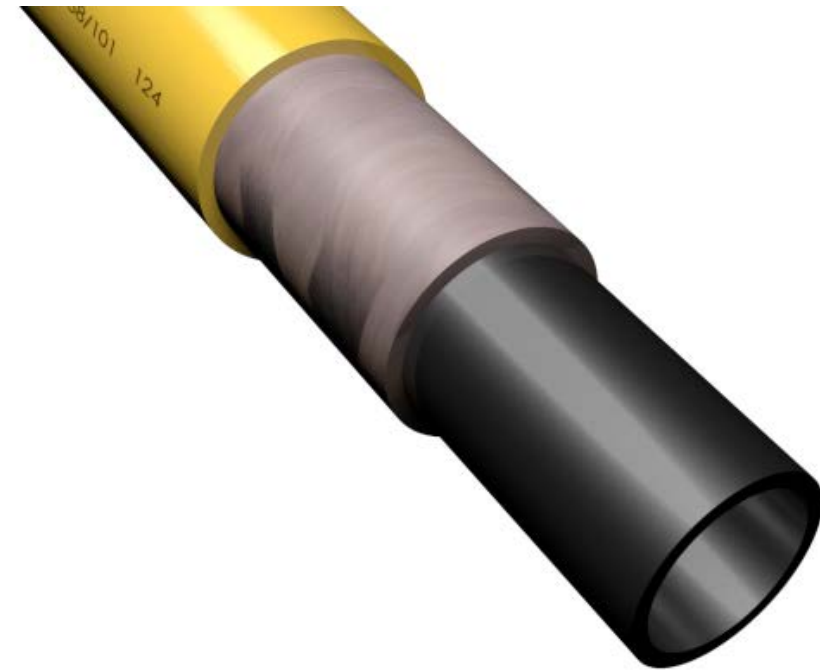


## Cost-efficient pipeline materials

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### Composite materials

- Alternative materials have already been used in subsea structures
- Alternative pipeline materials are being evaluated to overcome weight and expense limitations on ultra-deep and HP/HT developments
- Subsea 7 is working with vendors on developing Thermoplastic Composite Pipelines (TCP)



Thermoplastic Composite Pipe

## Cost-efficient pipeline materials

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Recent Subsea 7 projects with cost-effective pipeline materials:

- The **Mad Dog 2** project for BP is the first project outside the North Sea to use Swagelining technology
- The **Maria** project for Wintershall used LinerBridge® connectors on its reeled water injection pipelines

Tenders and prospects with cost-effective pipeline materials:

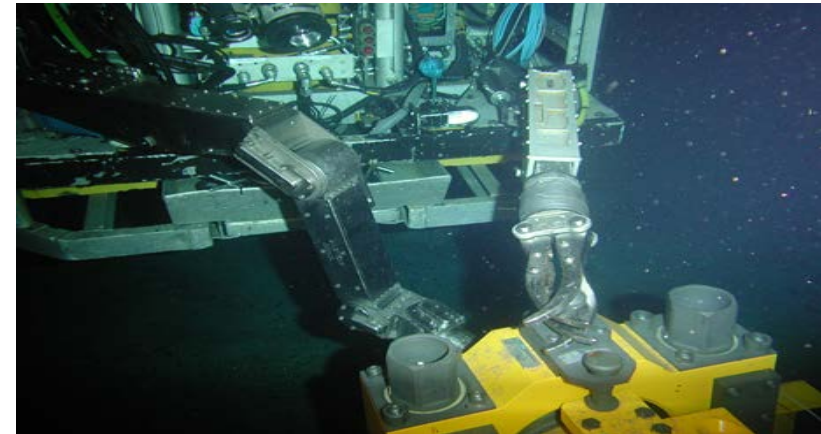
- Petrobras' ultra-deep Libra project could benefit from composite risers in the future for the later phases
- Swagelining is currently working with The Welding Institute (TWI) and Saudi Aramco to assess hydrocarbon pipeline applications

# IRM and i-Tech Services

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## i-Tech Services

- Inspection, Repair and Maintenance (IRM) of existing offshore infrastructure
- Drawing on cutting-edge data management and geographical information systems to increase maintenance efficiency
- Bespoke ROV tooling solutions
- Over 175 ROVs
- Over 35 year's experience.



# IRM and i-Tech Services



**INTEGRATED  
DATA &  
SURVEILLANCE**



**SENSORS  
&  
REPAIR SYSTEMS**



**AUTONOMOUS  
&  
HOSTED SYSTEMS**

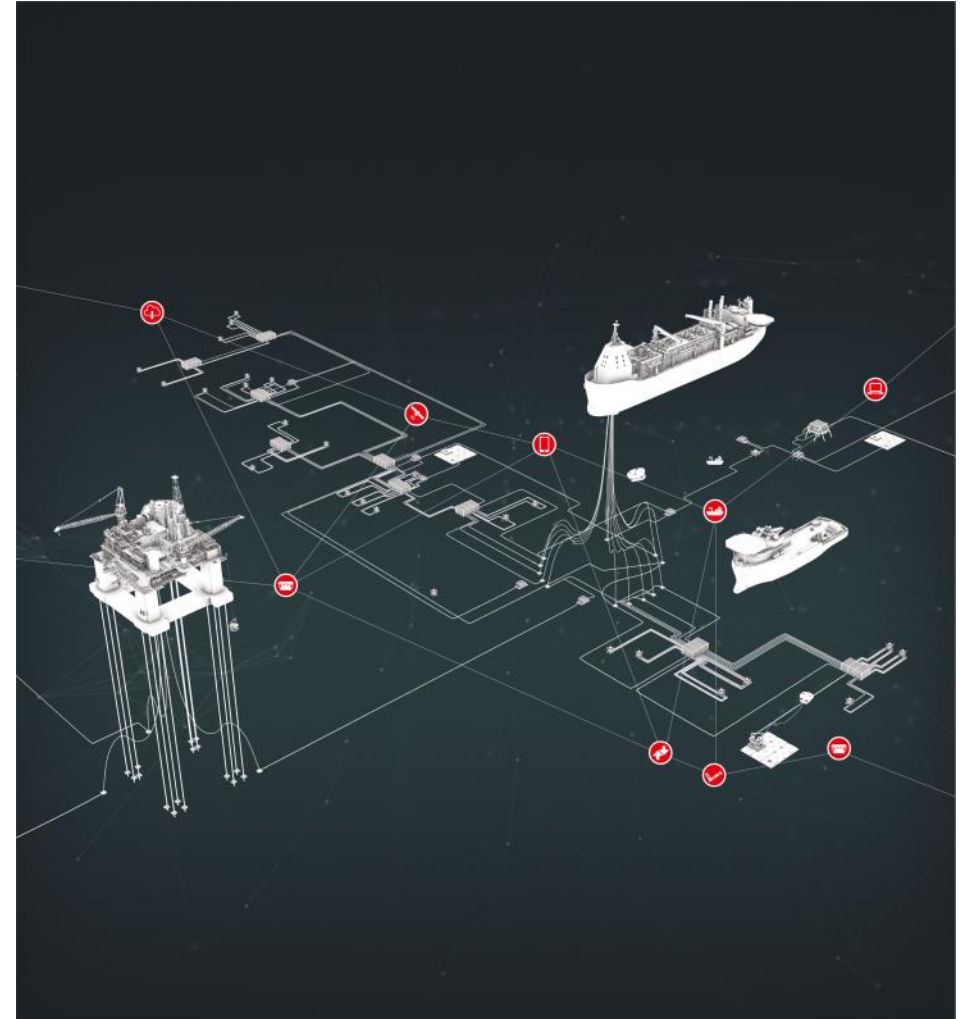


# IRM and i-Tech Services

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## Integrated Data & Surveillance

- Enabler to improved decision making and focus on critical datasets
- Increased responsiveness through Standardising and Automating data processing systems
- Visual recognition systems and AI predicting events, failures and trending data.



## IRM and i-Tech Services

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### Sensors, Monitoring & Repair Systems

- Enabling sensors for real time condition monitoring and life extension
- Fast response repair solutions to maintain availability and lower MTTR
- Development of low cost repair and tie-in solutions using epoxy
- Suite of tooling enabling rapid deployment.



Emergency Pipeline Repair System

## IRM and i-Tech Services

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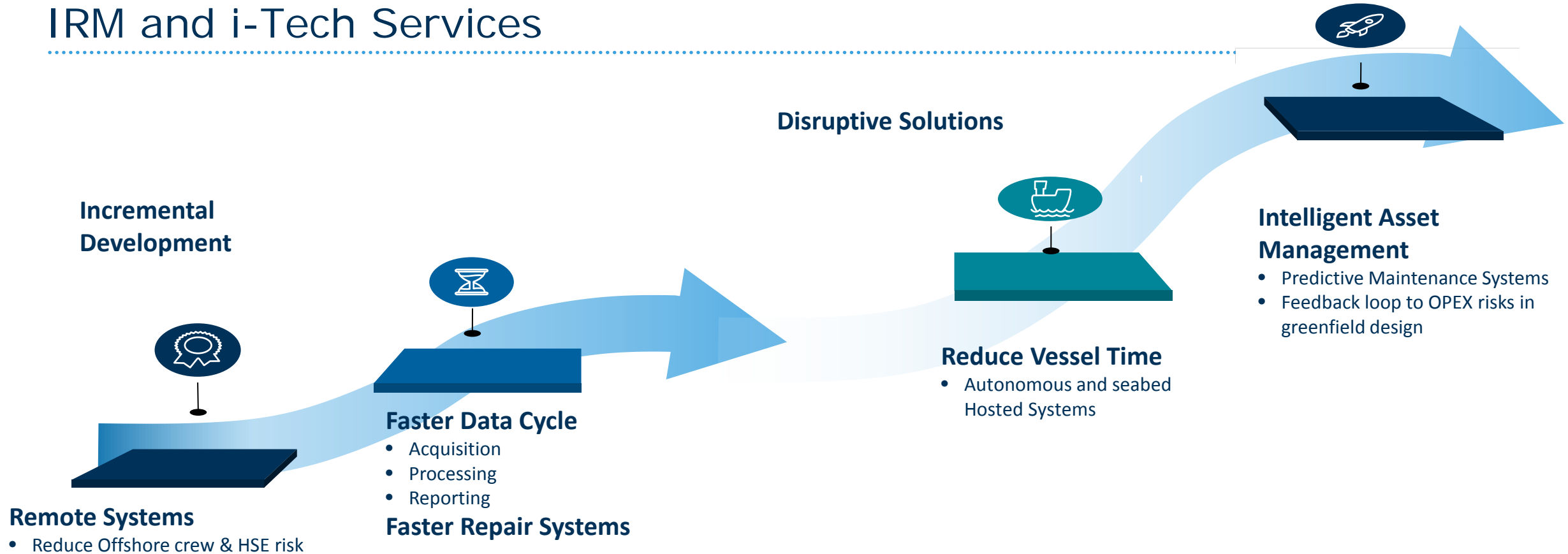
### Autonomous & Hosted Systems

- Enable harsh environment, remote and environmentally sensitive area operations and reduce dependency on ROV support vessel
- Electric based systems for reliability, power efficiency and environmentally sensitive
- Bring end user closer to operations through Autonomous and semi autonomous systems
- Machine/visual recognition systems enabled.



Electric ROV

# IRM and i-Tech Services



- Enhancing total cost of ownership of new and existing fields through technologies



## IRM and i-Tech Services

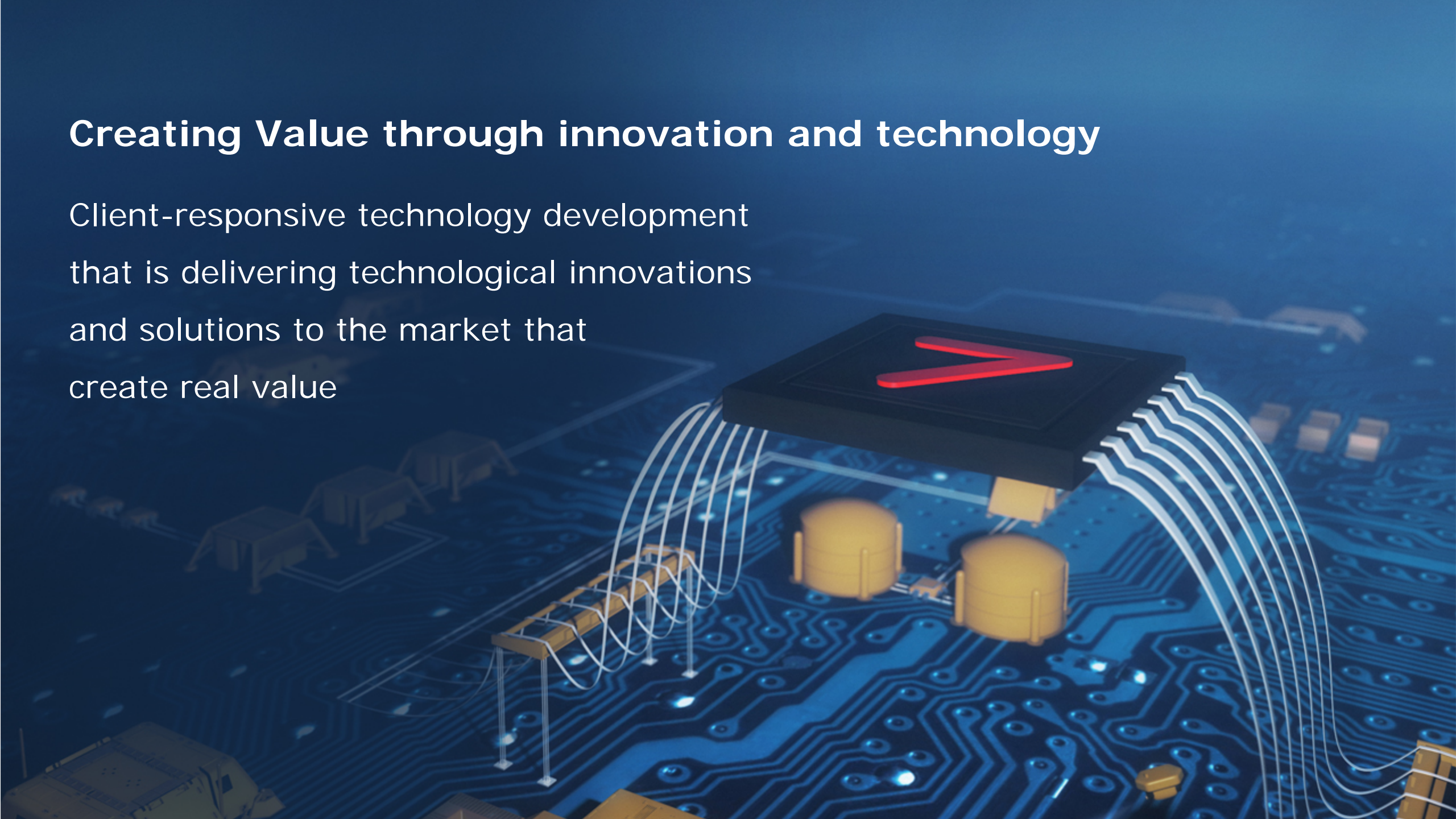
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Recent i-Tech Services technology activity includes

- The design, development and delivery of the EPRS for Chevron & INPEX
- Use of autonomous surface vessels in the metrology and survey of fields in Gulf of Mexico and Egypt
- Design, testing and verification by DNV-GL of an emergency closure BOP Intervention Skid
- Ongoing developments for Statoil on development of an underwater intervention drone concept.

# Creating Value through innovation and technology

Client-responsive technology development that is delivering technological innovations and solutions to the market that create real value



**THANK YOU**



**subsea 7**