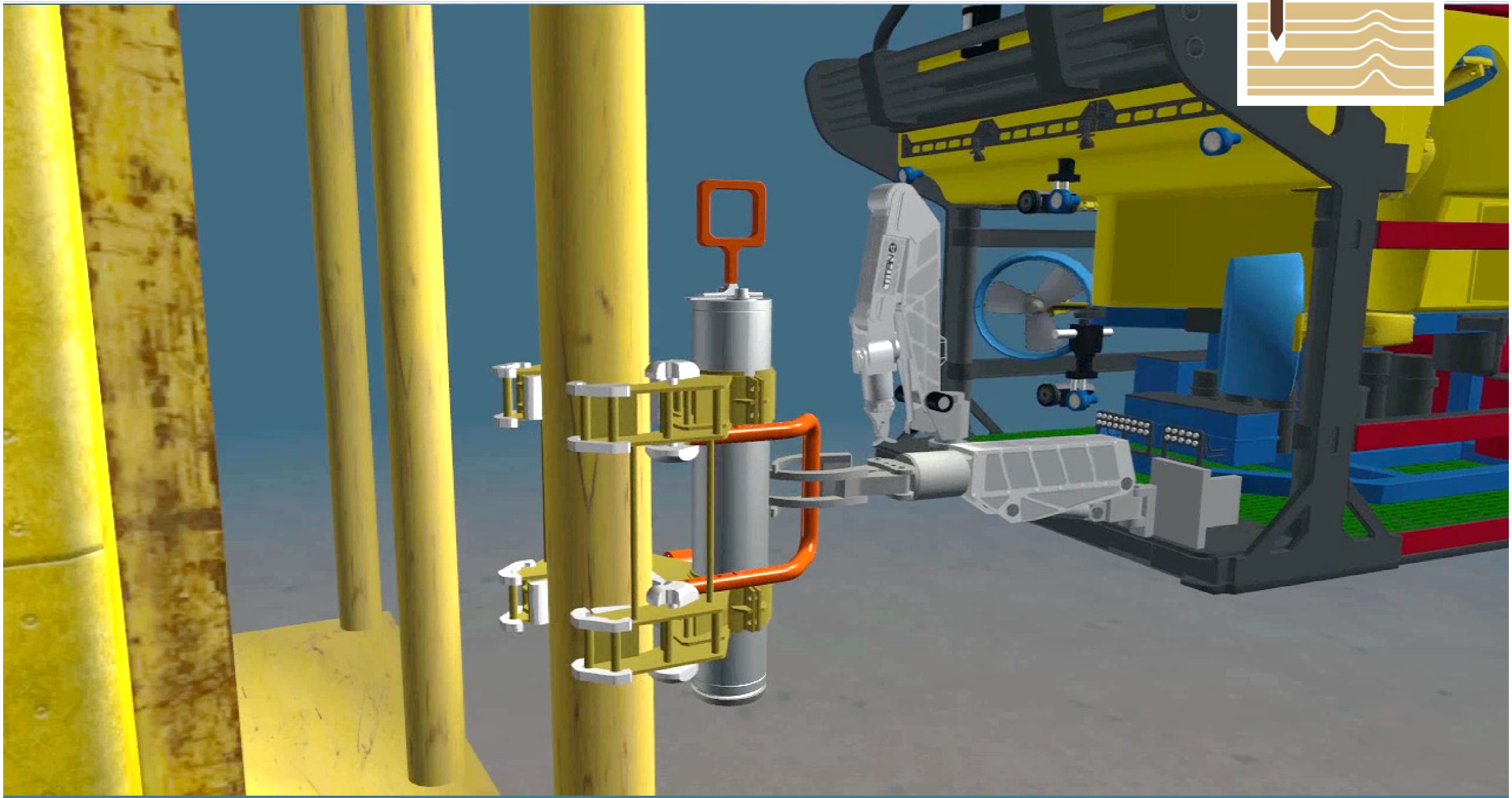


ROV Intervention Technology

Andy Stewart – Fugro

18th May 2016

Topics to be covered

- What is an ROV / AUV?
- ROV key features
- ROV capabilities
- ROV to world interface
- ROV intervention tooling
- Installing an ROV at worksite
- Simulation of intervention activities
- Summary

What is an ROV? / history

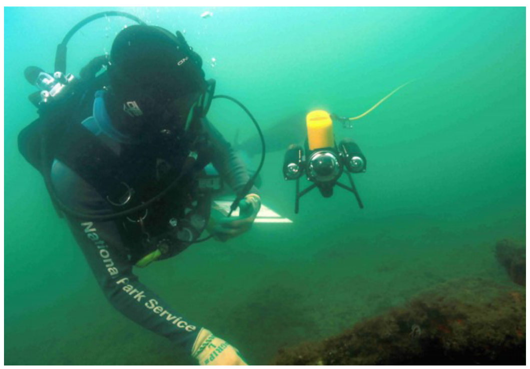
- First used in the 1950's – Navy developed – CURV / Cutlet
- Used for torpedo recovery / diver observation / assistance

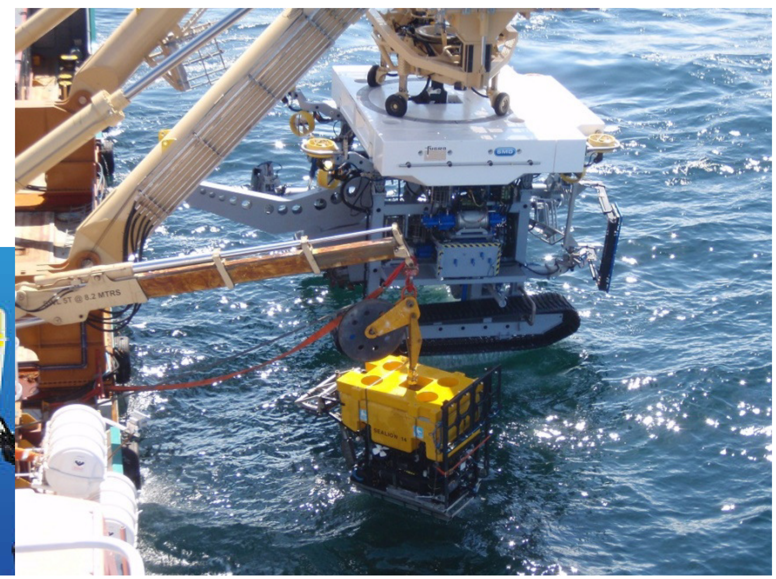
- Entered O&G in the 1960s – RCV225
    - ➢ Mainly diver observation / inspection
    - ➢ No manipulators
    - ➢ Shallow water

- Un-manned / control & power via cables
- Electrical or electro-hydraulic
- Today – multiple applications: security/leisure/renewables
- Exclusively used in deepwater survey/research and exploration up to 10,000mtrs, commercially ~3400mtrs max drilling.

ROVs - classes

- Micro ROVs (Videoray)
- Observation ROVs
- Light work ROVs
- Heavy / Work class ROVs
- Trenchers / bottom contact ROVs





ROV key features

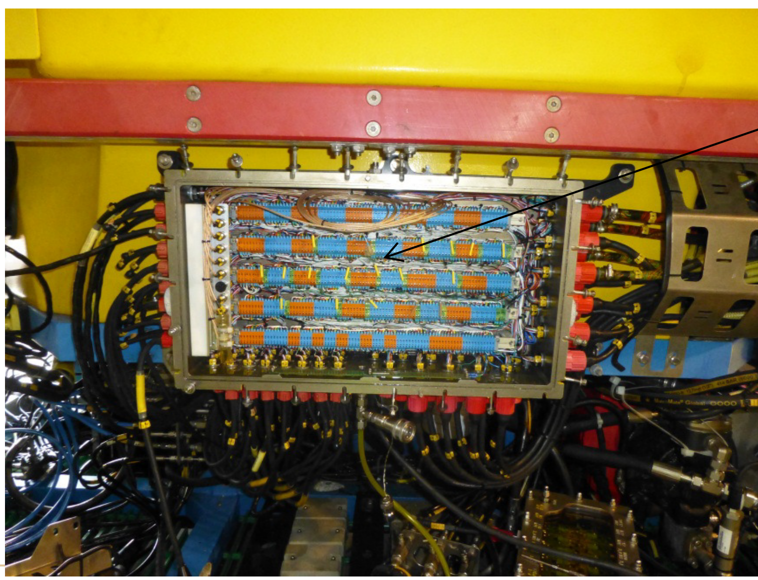
Bumper/sensor bar

Buoyancy

Manipulators

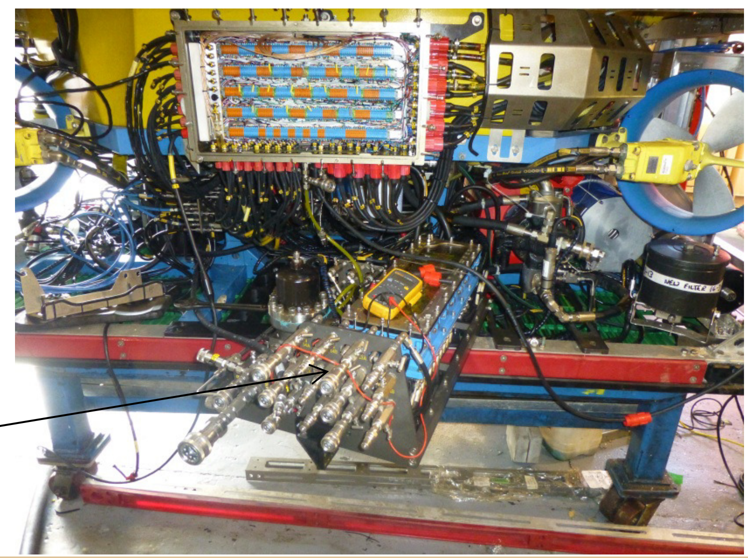
Thrusters

- Use of Titanium pods/frame
- Node / Ethernet based comms
- Fibre optics
- Environmentally friendly oils



Electrical junction box

Hydraulic Tooling manifold



ROV Capabilities – a tractor?

- Depth rated, generally 100mtrs to 4000mtrs
- Deployment – crane / A-frame / HWDS / Moonpool launch
- Task related – observation; inspection; intervention; construction; dredging/trenching/jetting; survey; rescue;
- Manipulator or ROV mounted tooling/sensors (front/rear/underslung)
- Electrically or hydraulically powered tools/sensors
- Weight/buoyancy/size capabilities
- Excursion capability(100 - 1400mtr) tethers
- On O&G installations – zoning requirement (zone 1 or 2)
- Personnel training / availability / skill sets

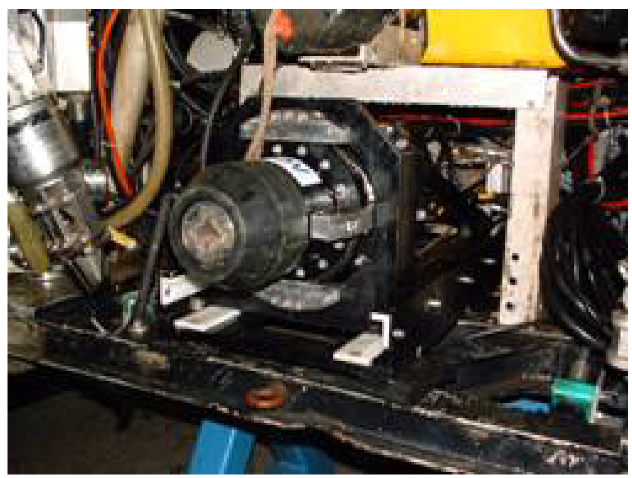
ROV to real world interfaces

- Manipulators are not arms/hands!
- Don’t replicate diver interfaces

Subsea Engineering

- Remote interfaces must be ROV designed

Thought must be given to:
ROV operable – torque/hot stab
ROV ‘proof’ – API 17D – torque settings
ROV access – physical limitations
Contingencies/damage
Trawl protection
time submerged/corrosion
ROV company universal



Typical ROV worksites

often little or no deck space/project
After-thought?

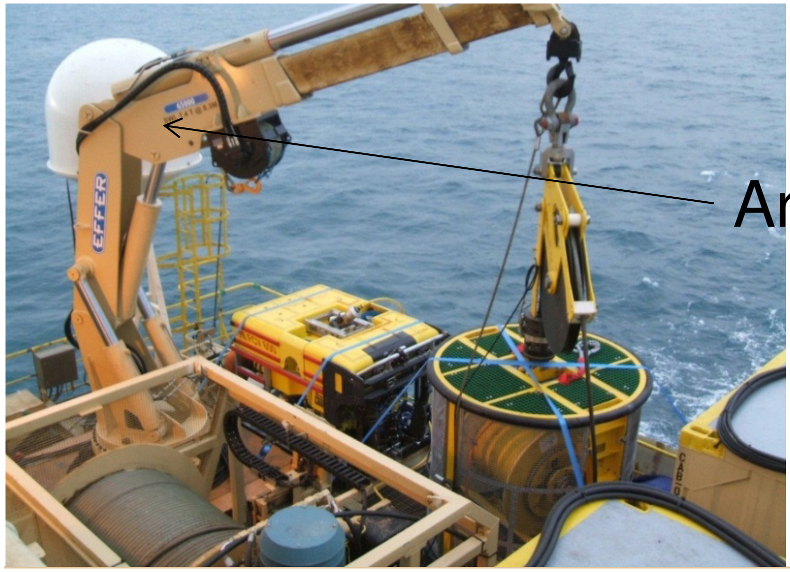
- Requirements:

Work class spread = 100Te
Deck strength min = 5t /m^2
Safe deployment = thrusters/props?
Enough power = 500KVA typ.
Access to worksite = enough tether?
Dive planning = what ifs?!

ROV Deployment Solutions.

Moonpool

A frame



Articulated crane

Content

With the advent of increased computing power, simulators are used in many applicable training / re-certification of competence. The space / aircraft industry is at the forefront of simulation for training / mission rehearsal and personnel re-classification.
Now many industries use simulators including, Marine; Drilling; Driving; ROV and many others.

- Application of simulation on engineering projects
- Overview of Fugro DeepWorks subsea simulator
- Graphical workflow to create simulation models
- Case Study 1: Guidepost relocation and buoyancy transfer
- Case Study 2: ROV data monitoring clamp deployment
- Case Study 3: Virtual SIT
- Case Study 4: Alternative uses of simulation
- Summary

Project lifecycle

Requirements capture

↓

Initial specification

↓

Front End Engineering Design (FEED)

↓

Detailed design

↓

Build and delivery

↓

Installation and commissioning

↓

Support and maintenance

↓

Decommissioning

Could the project benefit from the use of simulation?

Simulation being used to optimise design for efficient use offshore

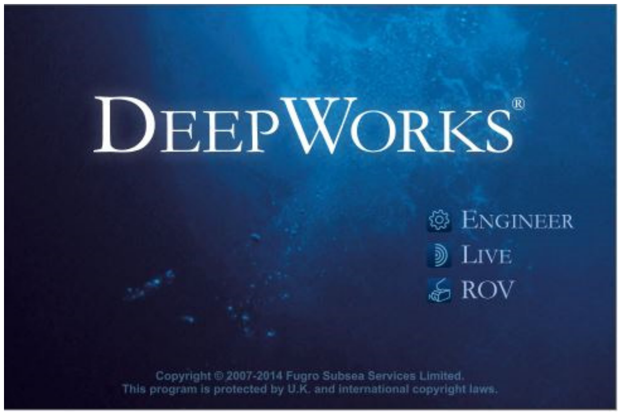
Simulation can provide a virtual Site Integration Test (SIT)

The creation of videos to outline each step of a repair or inspection procedure

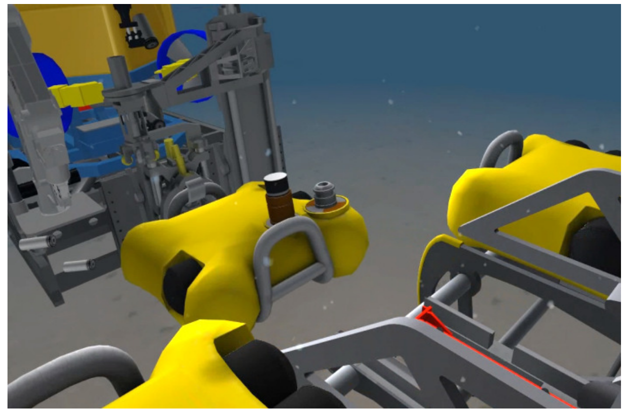
A complex working environment can be visualised using simulation

Simulation overview

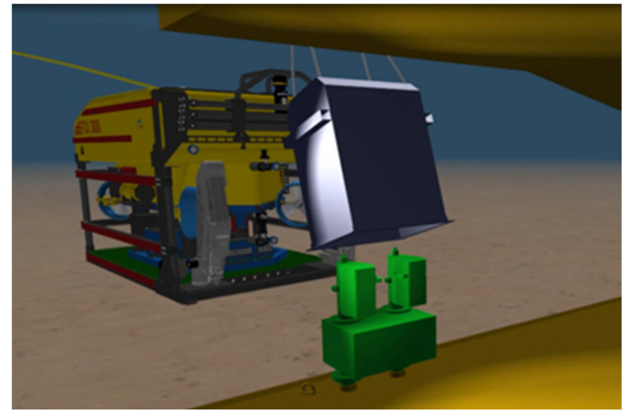
Dynamic real-time simulation



Fugro DeepWorks subsea simulator

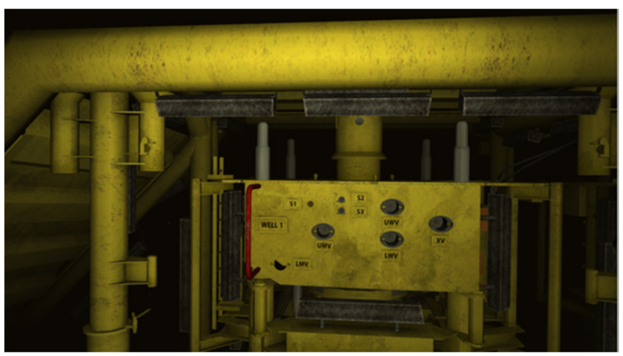


Simulation of mechanisms

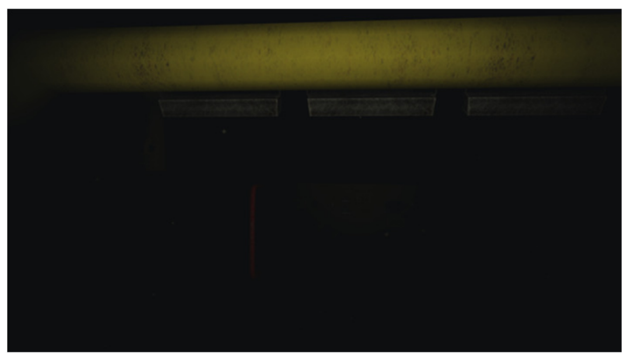


Reaction forces between objects

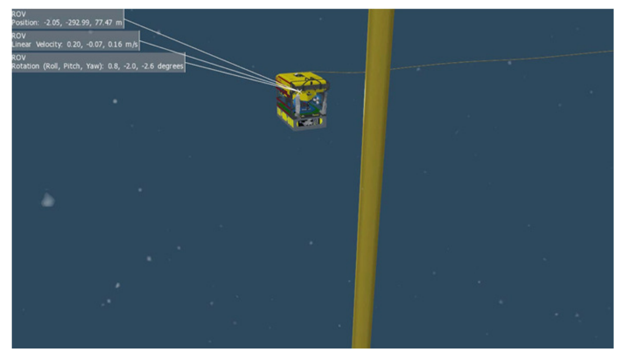
Realistic environmental conditions



Front Camera View. Visibility 10m



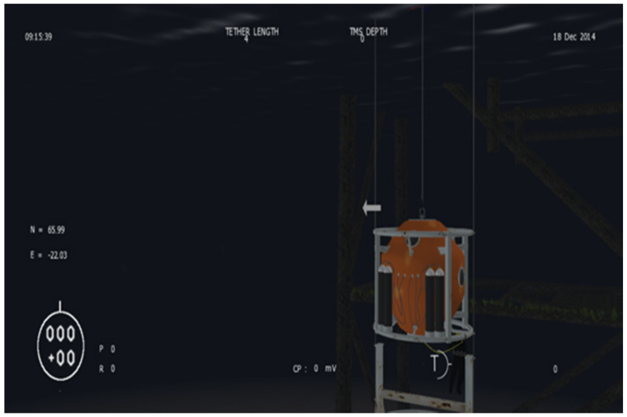
Front Camera View. Visibility 5m



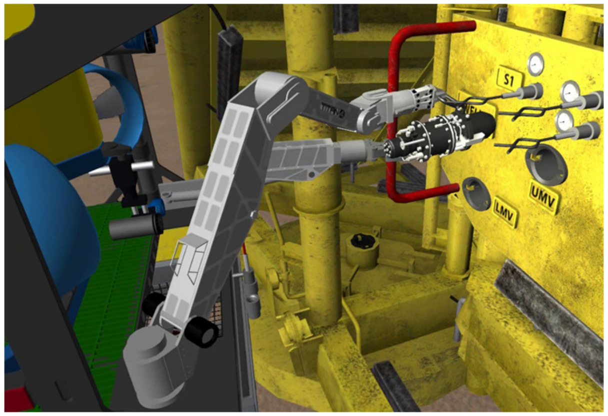
Current profile simulation

Simulation overview

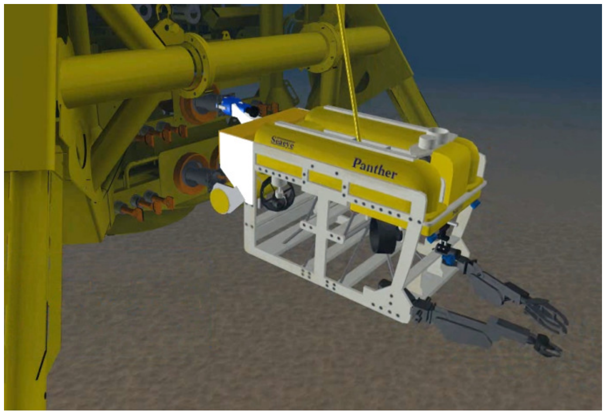
Modelling of hydraulic and electrical ROV components



Camera positions and overlays

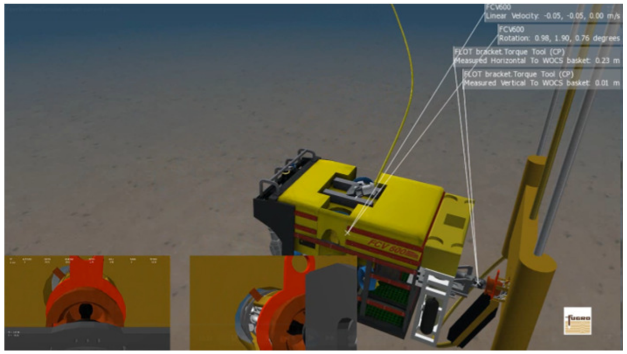


Control manipulator arms real-time

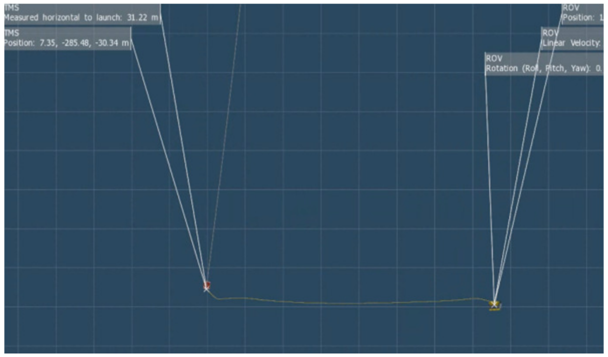


Range of ROV vehicles

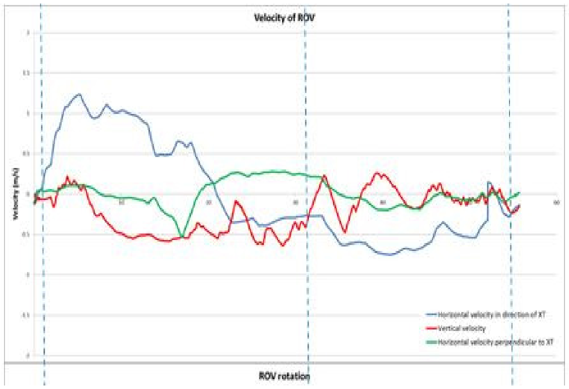
Simulation metric data.



ROV and tooling

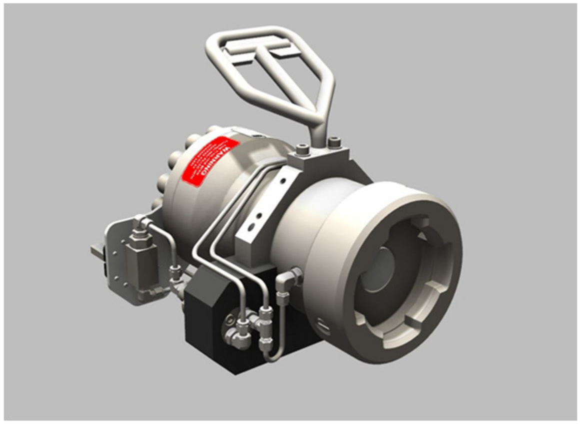


ROV and TMS

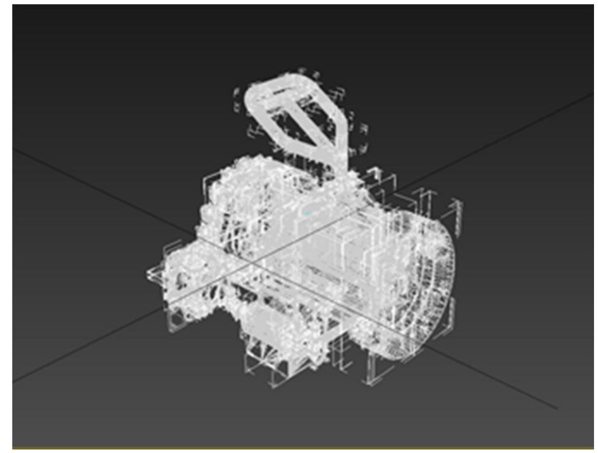


Time history

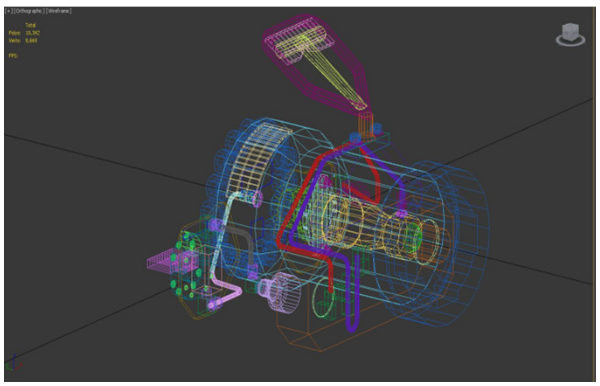
Model generation process



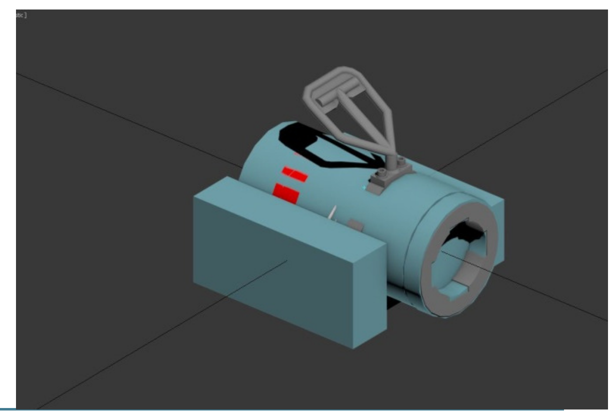
STEP 1
Receive 3D model



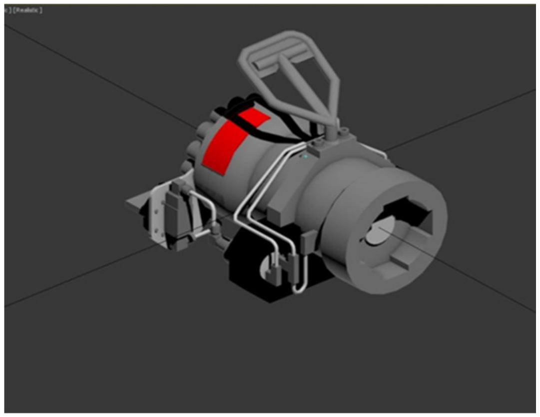
STEP 2
Review scope for optimisation

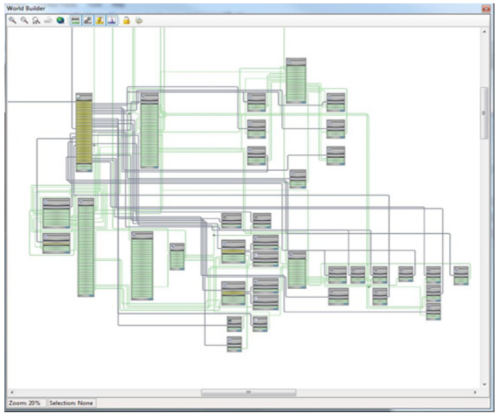


STEP 3
Optimise model

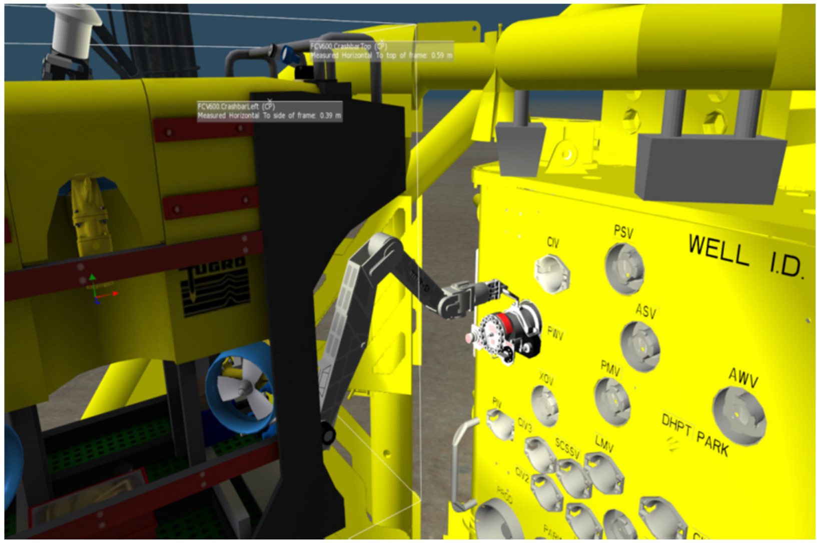


STEP 4
Link graphical model to a collision object





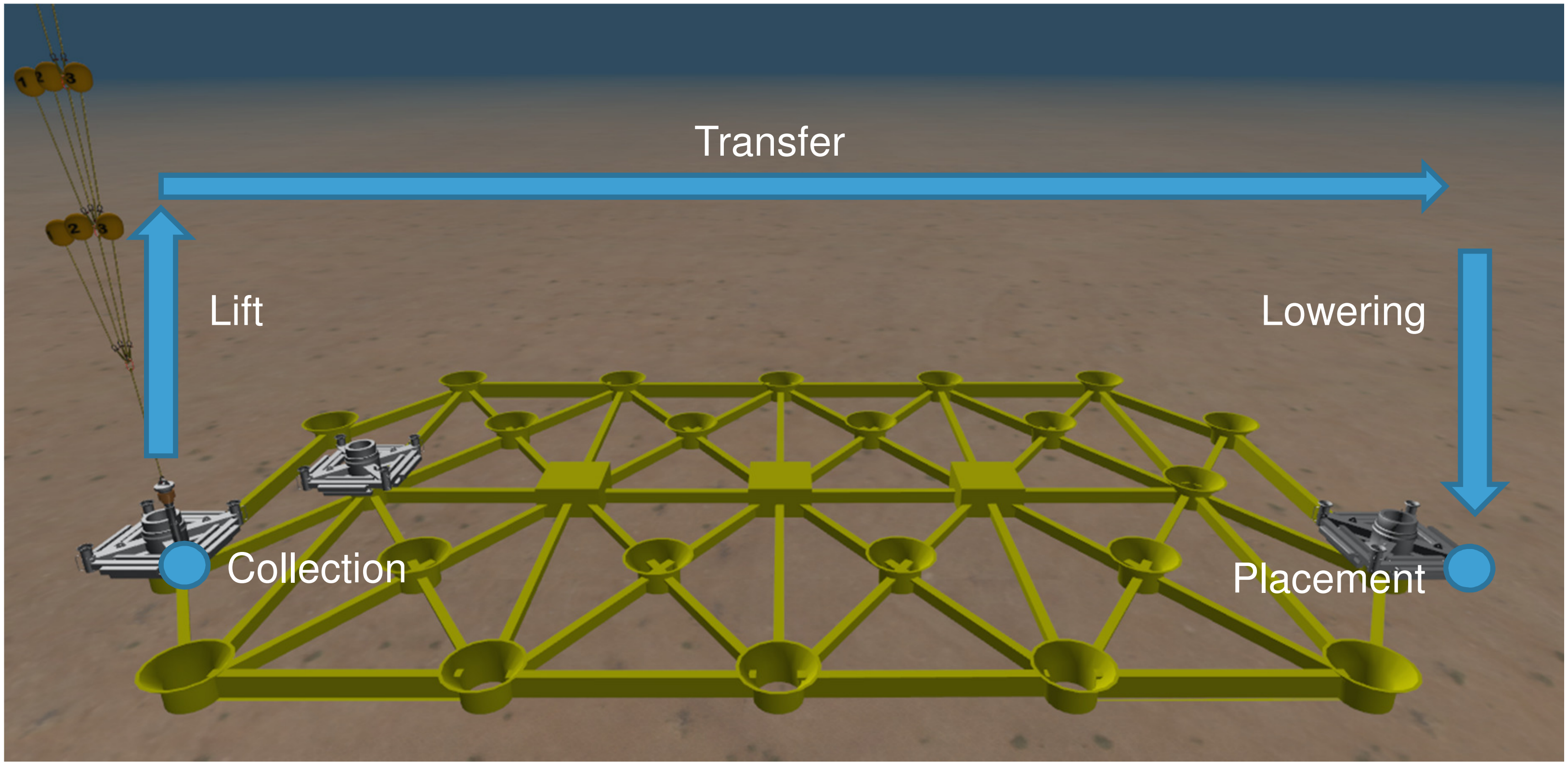
STEP 5
Create simulation configuration



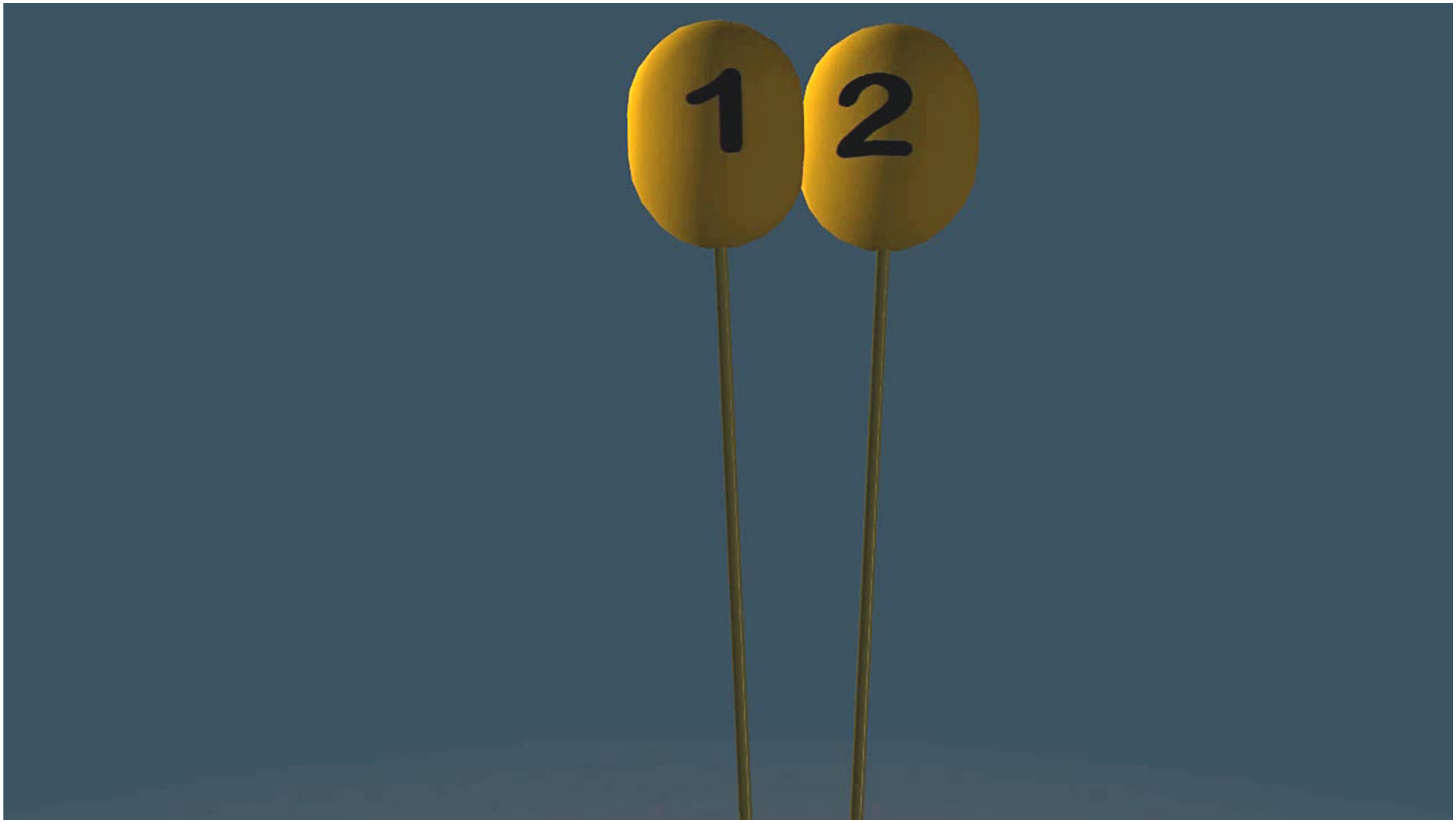
Tool being used for **mission rehearsal**

Case Study 1: Guidepost relocation and buoyancy transfer

- Feasibility study of relocating guidepost between guidebases using ROV.
- Buoyancy design review and identify potential snag points between ROV tether and guidepost rigging to **identify and reduce operational risk**.
- Simulation video created for **task familiarisation** and mission rehearsal.
- Validation that attached buoyancy allows movement of guidepost using ROV.

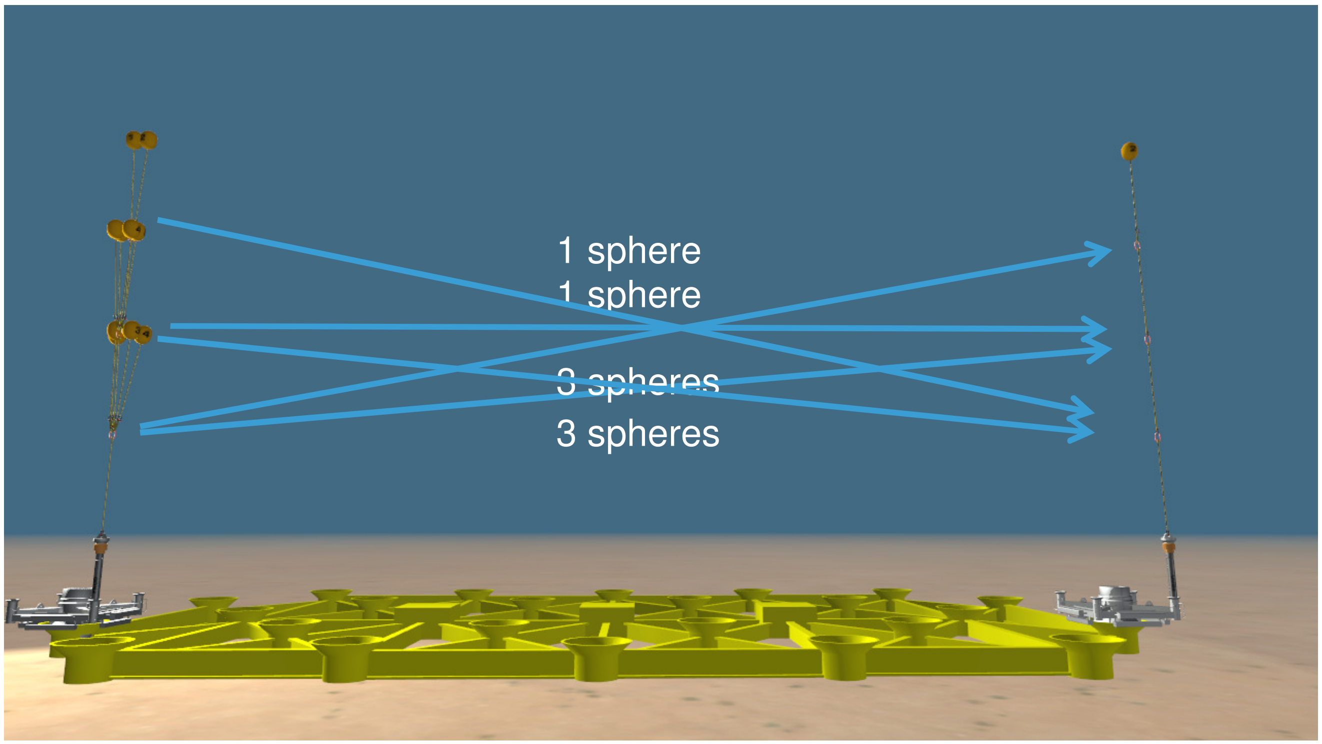


Case Study 1: Guidepost relocation and buoyancy transfer



Case Study 1: Guidepost relocation and buoyancy transfer

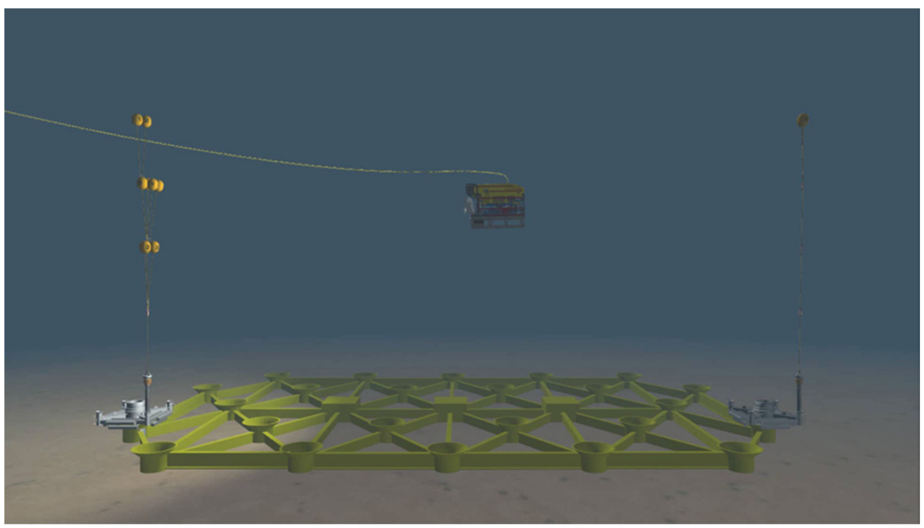
- Check stability of ROV when moving the buoyancy spheres.
- Calculate time to complete the full transfer to **improve efficiency.**
- **Verify suitability** of ROV hook arrangement on rigging.
- Ability to **replicate the process** using the onshore simulator within the engineering department.



STEP 2

Case Study 1: Guidepost relocation and buoyancy transfer

Process to transfer individual sphere.

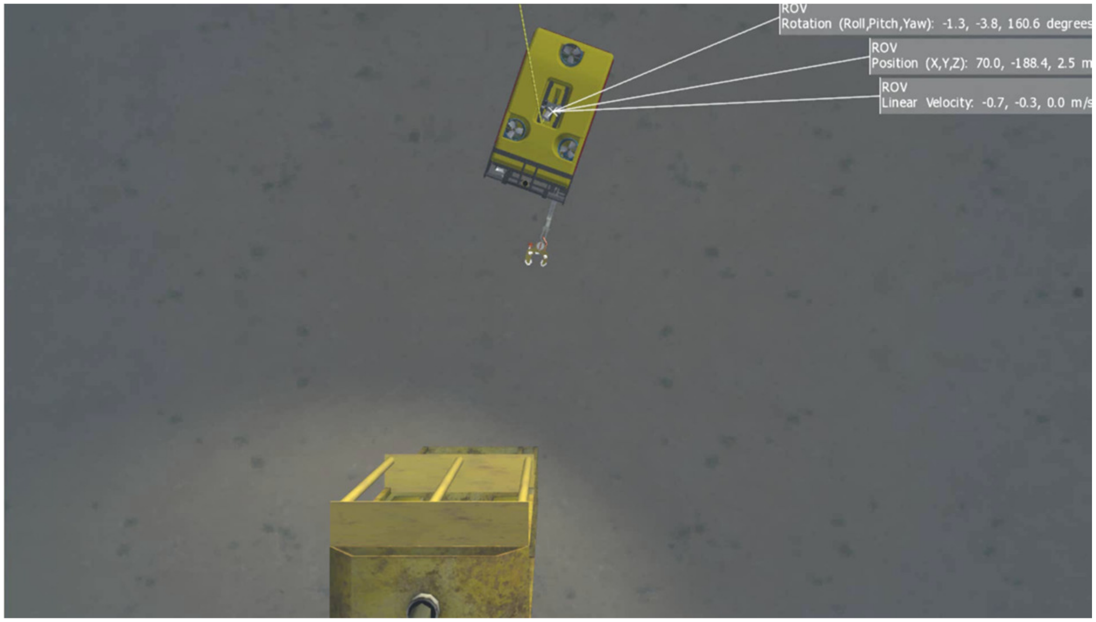


Full operation piloted in simulation.
Recording of the simulation replayed with x100 real-time speed.

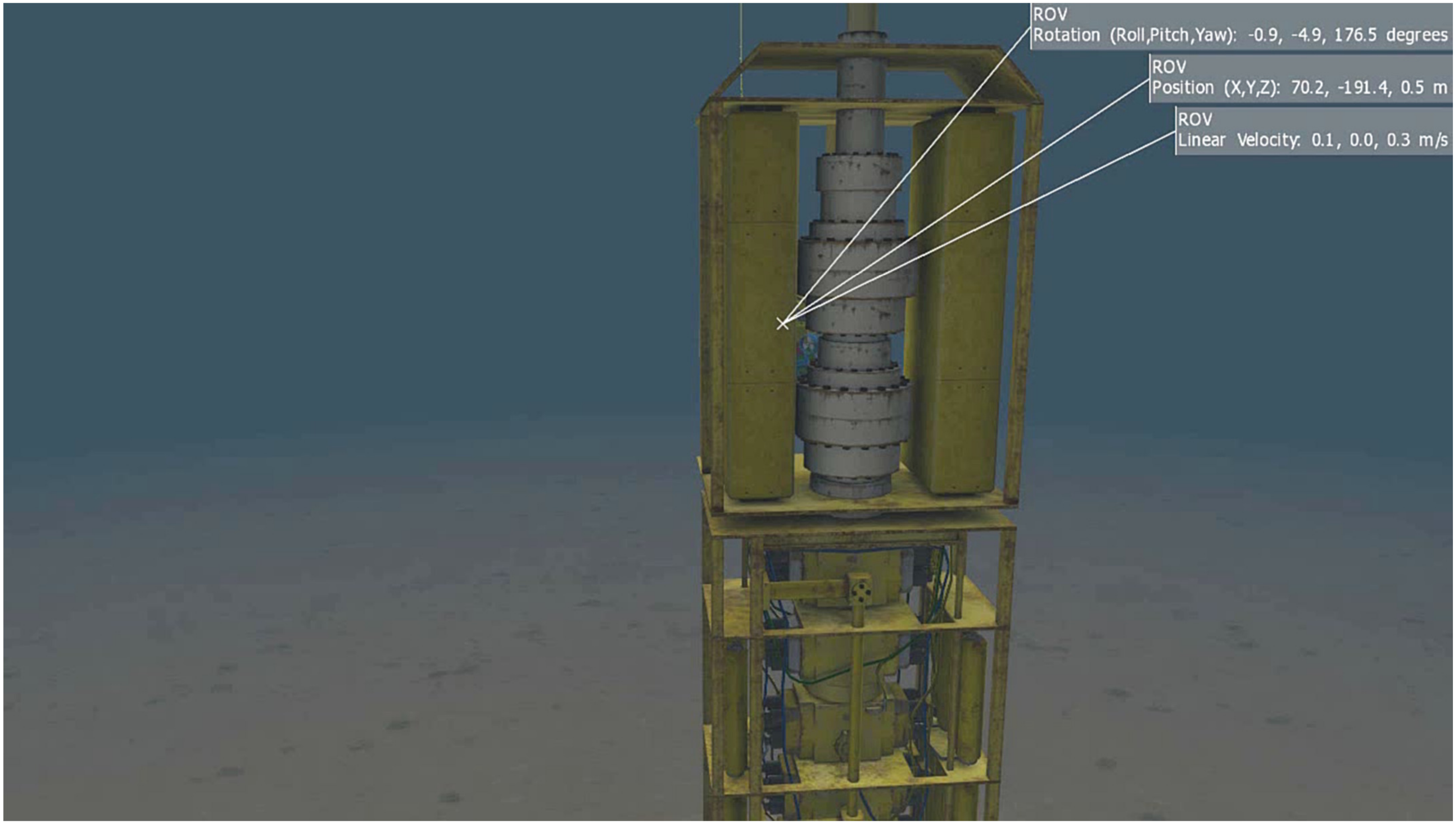
Case Study 2: DeepData ROV clamp deployment

- ROV deployment verification of a 170kg motion sensor pod and clamp assembly.
- Clamp design review.
- Access check of clamp locking mechanism.
- **Controllability of the vehicle** when a current profile is added to the simulation.
- Consider the change in ROV pitch attitude if additional buoyancy is added to the clamp.

https://www.youtube.com/watch?v=U19O_-pfB6w



Case Study 2: DeepData ROV clamp deployment

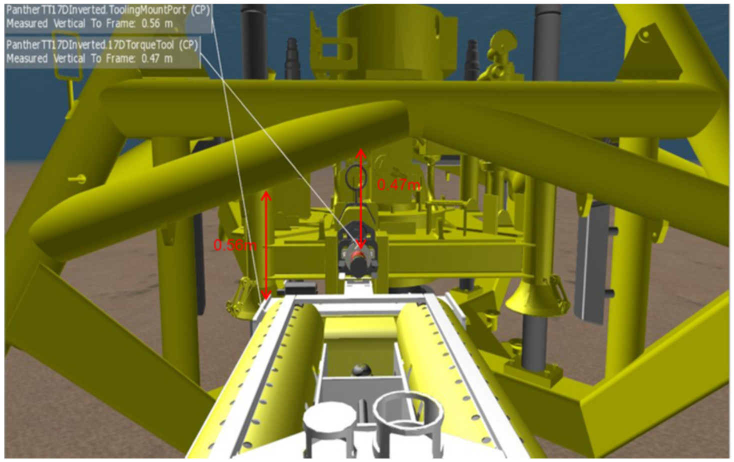


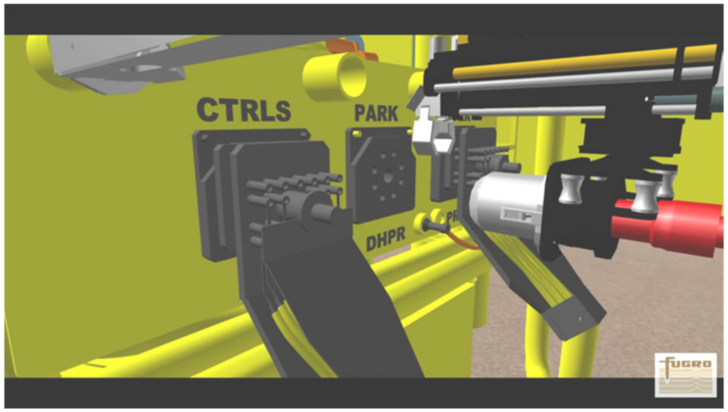
Case Study 3: Virtual SIT

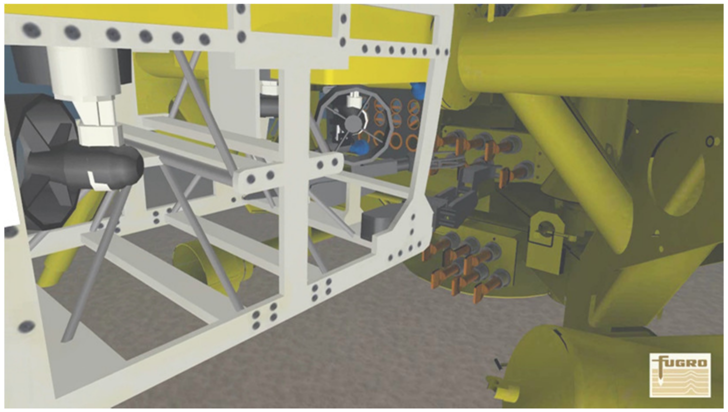
Virtual SITs provide a service for external clients to **raise awareness** of any issues to addressed before the SIT is performed and **optimising the design** of the tooling interface.

Requirements for equipment design:

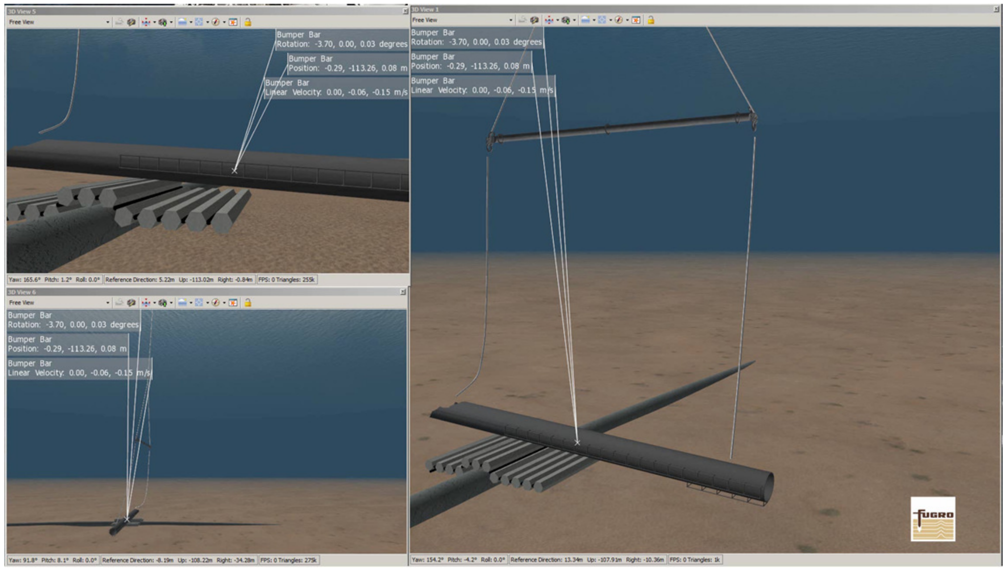
- Access
- Stabilisation
- Manipulation
- Tooling interface
- Tooling visibility
- Marking and monitoring visibility
- Tether snag points



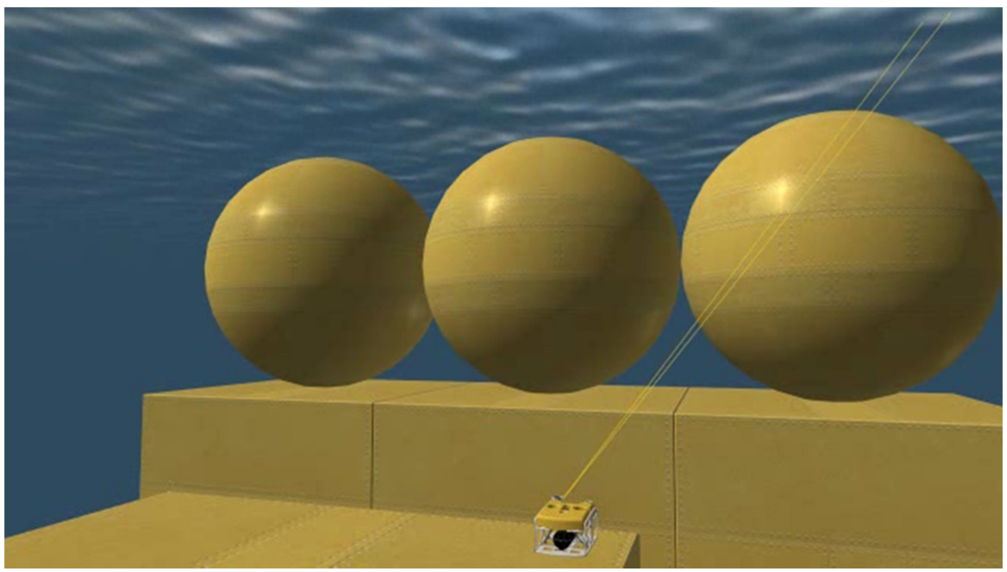




Case Study 4: Alternative uses for simulation

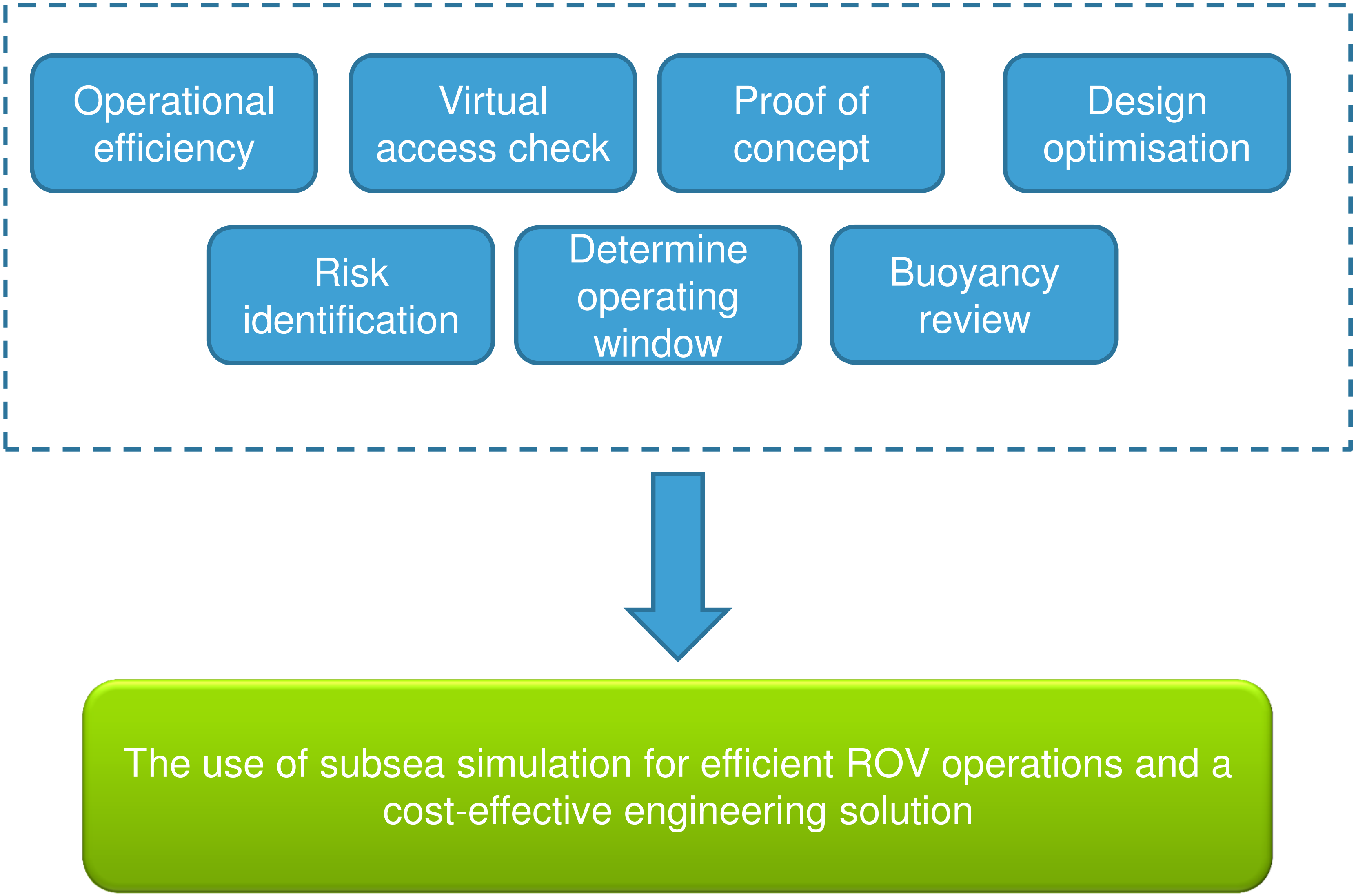


Simulation raising a failed bumper bar from the seabed to **mitigate risk** of a potentially hazardous situation.



Simulation to review the blind spots on the sonar display as a result of the introduction of a protective frame on the ROV.

Summary



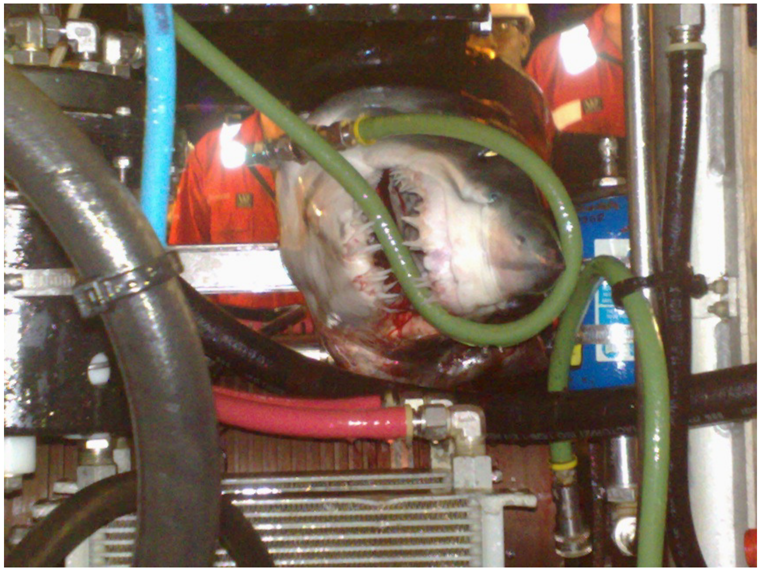
Operational efficiency
Virtual access check
Proof of concept
Design optimisation
Risk identification
Determine operating window
Buoyancy review
The use of subsea simulation for efficient ROV operations and a cost-effective engineering solution

ROV engineering solutions - Deepwater manifold pipework repair by ROV at 414mtrs

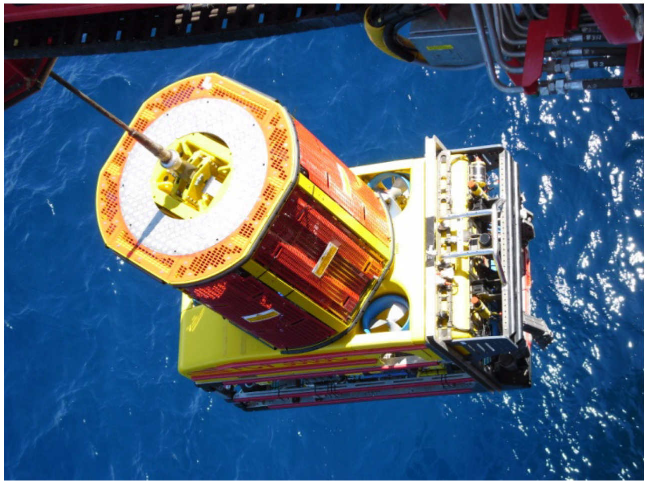
Summary – Project success factors / recommendations

- Define - Clear scope of work
- Environmental conditions?
- Define/agree equipment / subsea interfaces
- Early involvement of ROV/engineering contractors
- Consider simulation engineering? Design modification cycle
- Correct work site? – space/environment
- Train / rehearse (worksite simulation?)

Just another day at the office?!



Any questions please?



Thank You !