Interactive Simulation Solutions

CETO®

Centrales Energies, Mars 2018
L. Gross ; A. Hardy
TechnipFMC in figures

- **126 Nationalities**
- **$15B Total company Revenue\(^{(1)}\)**
- **20 Vessels\(^{(2)}\)**
- **48 Countries in which we operate**
- **$13B Total company Backlog\(^{(1)}\)**
- **37,000 Employees**

Footnotes:
\(^{(1)}\) Source: TechnipFMC Q4 2017 results.
\(^{(2)}\) With two vessels under construction.
Broadest portfolio of solutions for the production and transformation of oil and gas
Business Needs

- Project Review tool
- Communication tool between engineering and operation
- Mission rehearsal and operator training
- Operations optimization
- Available at any location, even on vessels

Field proven (used on more than 20 projects)

- Kaombo spool installation (simulation is on the right)
- Moho Flet 11 deployment
- LIZA manifold interface check

In house

- Developed by TechnipFMC Interactive Simulations Solutions (ITC) since 2014
- Uses world class physics engine developed by CEA since 2003, with Marine add-on module (exploitation exclusive to TechnipFMC in oil-and-gas domain)
- Strong differentiator with competition

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CETO® Interactive simulation Framework

2014
- Project kick off
- 4 scenarios
  - Tested by offshore personnel
  - 1st Scenario in 3 months

2015
- Core modules
  - Hydro upgrade
  - FEA models
  - XDE Native integration

2017
- CETO
  - CETO® Stand alone release
  - Subsea behaviours
  - Edition Capabilities

2018
- GEMINI
  - Advanced ROV model
  - Full Size integration
  - Editor release
Kaombo
Large spool installation
Kaombo
Large spool installation

- Edition capabilities for deck layout (tagging towers, winches & bumpers)
- Multiple vessels with independent movement
- Rigid spool with flexibility
- Fast deployment of alternative scenario (less than a week)

- Scenario built early in design phase
- Multiple changes implemented after simulation session with Installation/Structural Design teams
- Sessions organized with vessel crew (OCM, Crane Operator)
- Partners (HMC) discussions eased from simulation
- Vessel & Client satisfied and confident
MOHO NORD
Flett11 Deployment

- Scenario built in late operation design phase
- Uncertainties wrt crane capacities (lead angles concerns)
- Video export of the simulation and sent to the vessel for feasibility feedback
- Conclusion: Removed the two deck winches
- Operational Weather window reduced to lower uncertainties

- 800m, >100t catenary.
- High density contacts (Forged piece in hang off module)
- Hydro-dynamics on subsea part of the pipe.
Appomattox & Lyza
ROV Interface Checks
Appomattox & Lyza
ROV Interface Checks

- Based on existing experience in the group
- Focus on lean process (reduce non productive time).
- Confirm similitude with actual processes
- Initiate tolling catalogue
- Target: Issue a report in less than a week (Lyza)

- Simplified ROV for ease of manipulation
- Client driven task definition
- Auto-report
- Graphics & Physical models convergence
IRIS
IRIS Deployment with ROV
IRIS Deployment with ROV

- Identify risks linked with IRIS AHC requirement
- Proposition for camera management.
- Assess ROV manoeuvrability impact linked with added mass of IRIS impact (shift of centre of rotation)

- Accurate Umbilical management (Real Time FEA).
- Accurate treatment of contacts (funnels, probes)
- Vessel motion impact on subsea loads
- Advanced Subsea Hydro behaviour (added mass & inertia)
### CETO®
Interactive simulation Framework

<table>
<thead>
<tr>
<th>Anticipate</th>
<th>Operate</th>
<th>Detect &amp; Monitor</th>
<th>Collaborate</th>
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</table>
| - Simulate subsea operations with accurate dynamics  
- Optimize designs/operations  
- Simulate incidents  
- Improve safety  | - Build virtual equipment models & scenario  
- Train operators  
- Improve operational efficiency  |
| Application:  
- Lifting simulation  
- ROV simulation  | Application:  
- Real time physical model to support decision making on site:  
  - Cranes  
  - Pipelay  
  - Vessels (LNG)  |
| Application:  
- Pipelay Monitoring  
- Tandem Offloading  | Application:  
- Use simulation rooms and VR for interactive design reviews between TechnipFMC centres  
- Use simulation to explain past incidents  |

**TechnipFMC**

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CETO®
Interactive simulation Framework

Improve safety of operations

Huge facilitator for team collaboration

Optimize engineering and operation

Reduce time & costs!

Be the reference for O&G interactive simulation