Cost Optimization for Subsea Utilities

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Subsea Controls Systems
Offshore & Subsea...

Long term subsea production from oil & gas reserves remains out of sight
What are Utility Services?

- Electrical Power
- Command & Control Communications
- Fluids Services
The condition of the supplies to the utility services received subsea is a function of a number of variables.

Validated Interfaces
Complex design and optimisation required to deliver matched interfaces for power and comms

SOURCE
Electrical supply, Comms modems, Hydraulic & chemical power units

Seabed Umbilical & Distribution Network

O = f(x_1, x_2, x_3, x_4) x Inputs

END USER
Actuators, Control Modules, Instrumentation, Injection Valves
The condition of the supplies to the utility services received subsea is a function of a number of variables.

Validated Interfaces
Complex design and optimisation required to deliver matched interfaces for power and comms

Opportunity for system optimisation

System Performance Envelope

Seabed Umbilical & Distribution Network

SOURCE

Bi-directional

END USER

Bi-directional

Electrical supply, Comms modems, Hydraulic & chemical power units

Actuators, Control Modules, Instrumentation, Injection Valves

$O = f(x_1, x_2, x_3, x_4) \times \text{Inputs}$
Impact of Layout on Characteristics

Basic cable for electric power & comms – twisted shielded quad

Composite umbilical with stainless steel lines and external armour
Case Study: Lessons from STFLs

The signal, as transmitted

The signal at the far end of the GE default cable

The signal at the end of the vendor’s cable

Lesson learnt, new ‘worst case’, but early umbilical definition gives;

- Opportunity for umbilical optimisation
- Reduction in cross section

Opportunity for umbilical optimisation
Connectors as a potential source of unreliability
Distribution hardware in an ‘integration & test’ environment
Industry Observations

Vulnerability to functional failure throughout the field life;

- Probe / bayonet failure or deformation
- Screw thread damage or seizure
- Unplanned shear pin failure
- Marine growth and calcification
### Design Criteria

<table>
<thead>
<tr>
<th><strong>FACTOR</strong></th>
<th><strong>NEED</strong></th>
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<tbody>
<tr>
<td>Number of Ways</td>
<td>- Quantity of hydraulic connections</td>
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<tr>
<td></td>
<td>- MQCs per field installation</td>
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<tr>
<td></td>
<td>- Cost and handling time</td>
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<tr>
<td>Make-up time</td>
<td>- Make-up time</td>
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<td></td>
<td>- Installation costs and diver/ROV time</td>
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<td></td>
<td>- Risk in difficult conditions (such as high water current or deep fields)</td>
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<tr>
<td>Offsets and Misalignments</td>
<td>- Misalignment offset range</td>
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<tr>
<td></td>
<td>- Diver/ROV installation time</td>
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<td>- Risk of an incorrect mating</td>
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Innovation

Remove screw threads
- Metal-to-metal, high torque risk
- Avoided in other parts of subsea

Improve reliability
- Leave as few components subsea as possible
Verified Reliability

Extended qualification tests verified reliability of concept

- Full FMECA
- Underwater ROV tests by experienced operator
- Deliberate misalignment
- Carrier Frame shock & vibration tests

Concept verified under all conditions identified during design

Removed the need for secondary release mechanism

Single moving part

Verified Reliability
Integrate all moving parts into topside-recoverable tool

This serviceable tool removes the complexity from subsea

Performs all required actions with two levers

Can exercise plates without the need to disconnect
Connectors and Reliability

Where marine growth and calcification are prevalent;

... how do we support through life reliability?
Injects slow stream of weak acid to reach hydraulic couplers through dedicated channels.
Product Structuring as a contributor to Cost Optimization
Manifolds

Objectives

Reduced Engineering

Reduced Cycle Time

Reduced Execution Risk
<table>
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<tr>
<th>Depth Range</th>
<th>Cluster Manifold – Vertical Connections</th>
<th>Cluster Manifold – Horizontal Connections</th>
<th>Template Manifold</th>
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<tbody>
<tr>
<td>0 – 100m Diver Assist</td>
<td>N/A</td>
<td>N/A</td>
<td>DVCM</td>
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<tr>
<td>100 – 750m Guideline</td>
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<tr>
<td>750 – 3000m Guidelineless</td>
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A pre-engineered, Structured Manifold Portfolio delivers...
One Structure

Standard structure and design

... with 5 Manifold options
The Indonesia Deepwater Development Subsea Umbilical Termination Assembly

- Terminates the umbilical
- Distributes hydraulics, chemicals, power and communications
- Modular design expandable, re-useable, simplified and optimised
Product Structuring for Topside Control Stations
One System

Modular Design

- Power Control
- KVM
- 3rd Party Servers (SIIS 3)
- Gateway
- PLC
- PLC Configurator
- RSLogix5000 Project Code
  - Program UDT
  - Program Add-On
  - Program Tags
  - Program Routines
- Excel Database Containing General Data to Generate the Code
- VBA Code Templates (XML Format)
- UDT XML Export
- Add-On XML Export
- Tags CSV Export
- Routines XML Export
- RSLogix5000 Code Template
- Program UDT
- Program Add-On
- Program Tags
- Program Routines
One System

Modular Design

Modular Hardware and Software

Reduced Engineering with off the shelf code

Reduced Cycle Time using lower hours in configuration

Reduced Execution Risk from repeatability and constant review
Subsea Electric Actuation for manifold cost reduction
All Electric Optimisation

Electric cables replacing hydraulic lines for manifolds
Summary

- The importance of Integration of the **Subsea Utilities** distribution with the key **Controls components**; to deliver an ‘end-to-end’ performance envelope

- We have stressed **component reliability** as key contributor to reducing the **cost-of-ownership**

- Illustrated capital **cost reduction** through a process of **Product Structuring** – standard designs, custom solutions

We conclude that optimisation – in terms of Cost, Installability, and guaranteed performance envelope – are more easily achieved if the Distribution scope is integral with the whole Control System scope.