How we think UIDs will be used by Statoil in the future

IOGP Geomatics Industry Day, Stavanger, 26th April 2017
INTRODUCTION

What is this presentation about?

Basically, it is Statoil’s vision for use of ROVs, AUVs, etc, in the future.

• I will explain what we mean by «UID»
• Give some definitions; for example, ‘autonomous’ and ‘remotely-operated’
• Say a little bit about the evolution of Statoil’s Technology Strategy in the context of UIDs
• => minimise use of surface vessels => replace, where practicable, with ‘resident systems’
• Application types
• Potential benefits
• Development Schedule
• Navigational Challenges
• Finally, I will try to bring this in to the context of the work being done by IOGP
DEFINITIONS: UID

Underwater Intervention Drone
DEFINITIONS: UID

Underwater:
Self-explanatory

Intervention:
Statoil fagråd: Subsea intervrensjon og dykking:
• IMR
• Diving
• ROV
• ROT
• Survey

Not just “well intervention”; aim is to encompass a wide variety of disciplines

Drone:
???
DEFINITIONS: UID

Consumer level: Blueye Ocean Drone....

DOUBLE YOUR OCEAN EXPERIENCE

Blueye is the maker of premium ocean drones with superb stability and user interface. The underwater eyes you need, the serene experience you want. Our Pioneer drone allow you to explore the world under water while staying safe and dry on top.

Whether in your boat or on shore, the Blueye Pioneer can be a family activity for exploring and learning about the oceans.


**DEFINITIONS (cont.): AUTONOMY**

**Manual**
The system is fully controlled or manipulated by a human operator, in real-time

**Automatic**
The system does not make choices— it follows a program (or a “mission”)

**Autonomous**
The system does make choices - it attempts to accomplish its objectives without human intervention, even when encountering unanticipated events

**Intelligent**
Artificial intelligence: the system is able to act appropriately in an uncertain environment and is capable of modifying the way in which it achieves its objectives

*In the context of using ROV/AUV:*

**Manual:** conventional use of ROV

**Automatic:** Supervised AUV (or, more correctly, UUV)

**Autonomous:** Unsupervised AUV
DEFINITIONS (cont.): REMOTE CONTROL

Traditional ROV (vessel-deployed)

“Remotely Operated Vehicle”
but operated by on-site (ie, on vessel or rig) personnel

Traditional AUV (vessel-deployed)

“Autonomous Underwater Vehicle”
but operated in non-autonomous (ie, supervised) mode

Remotely-controlled ROV

“Remotely Operated Vehicle”
operated by personnel at a remote location (eg, this office)
DEFINITIONS (cont.): RESIDENT SYSTEMS

Resident UID in docking station

**Function**
- Power
- Comms
- Protection

**Installation**
- Permanent
- Mobile

**Power / Comms**
- Connector
- Inductive

**Docking**
- Fully autonomous
- Manual control

**Configuration**
- Single vehicle
- Multi vehicle

**Interface with vehicle(s)**
- Universal (“USB”)
- Proprietary

*Image: Saab*
Humble beginnings......

«I utgangspunktet er dette et forbedringsprosjekt som drives som en dugnad.»

Google translate: “Basically, this is an improvement project that is run as voluntary work.”

Extract from 2015 email on an ROV/AUV Technology Development issue......
Early 2016: Various uncoordinated efforts on promoting use of resident systems, including this one
Memo

To: [Redacted]

Copy

From: [Redacted] (on behalf of AUV strategy task force)

Subject: Recommendations from the AUV strategy team

1 Purpose

The purpose of this memo is to recommend a strategy and a roadmap including actions for effective implementation of Autonomous Underwater Vehicles (AUVs) into Statoil’s subsea operations.
"AUV Strategy" evolved into "UID Strategy" and is fully incorporated into the 2017 STS with specific action points and schedule.
UID: CONVERGING PATHS

Application
- Survey
- IMR, etc
- "AUV"
- "ROV"
  - tethered
  - untethered
  - Autonomous
  - Human-operated

Platform
- both

Configuration
- both

Mode of Operation
- both

UID
- Resident

Classification: Open
2017.04.26
WHY RESIDENT?

The **support vessel** is the main *cost-driver* in the performance of many offshore operations performed with the aid of an ROV/AUV, for example seabed mapping, inspection, etc.

Remove the need for the vessel and a significant percentage of the cost of the operations is removed.
Pipeline Surveys
- Seabed Mapping
- Environmental Surveys

IMR – eg, intervention operations (could influence/simplify the design of subsea structures)

BUT to make this more attractive (or feasible) we could look beyond traditional O&G applications done for a single operator:

- JV with, or lease to, other operators?
- Civilian mapping applications?
- Surveillance / Security applications?
- Military mapping applications?
UID: TYPICAL APPLICATIONS

UID Applications can be divided into 2 groups

i. Existing assets / Developed areas

Point
- Centred on installations (or localised subsea structures)
- Can have tether, can be operator-controlled, must be hover-capable
- Typically, IMR tasks

Line
- Along linear subsea features (such as pipelines, cables, etc)
- Must be untethered, must be (semi-) autonomous, must have capable nav systems
- Typically, pipeline inspection tasks

Area
- For example, Carbon Capture and Storage (CCS) monitoring, Permanent Reservoir Monitoring (PRM), etc
- Must be untethered, must be (semi-) autonomous, must have capable nav systems
- Environment tasks, Survey tasks if within range

ii. Undeveloped areas

- Not immediately suited to “resident” systems (no power / comms)
- Mobile docking stations or vessel-based solution (eg, AUV c/w improved LARS, etc)
- Typically, Survey tasks
POTENTIAL FINANCIAL BENEFITS

Operational time
Reduced WOW, UID hosted below sea line

Response Time
Improved response time → Increased Production Efficiency (PE), the UID is hosted near the subsea installations; 24/7

Effectiveness
More cost-effective acquisition of seabed mapping, pipeline survey and environmental data

OPEX
Reduce OPEX for challenging prospects; in harsh conditions, long distance from shore, remote areas and deep water.

CAPEX
Reduced CAPEX for new fields → possibility for simplified and less complex Subsea Production Systems (SPS)
OTHER POTENTIAL BENEFITS: HSSEQ

Health & Safety (HSSEQ):
remove the site-based people

Security (HSSEQ):
surveillance role?

Environment (HSSEQ):
«Zero emissions»; No more WOW; Oil spill monitoring & response?

Quality (HSSEQ):
More data; more information; better decision making
UID TECHNOLOGY DEVELOPMENT SCHEDULE

All schedule items subject to final approval

Short perspective (1-3 years) 2017-2019

- Statoil to commit XX MNOK in UID-related R&D funding each year for this period

- Statoil to commit XX IMR vessel days per year for testing and piloting new UID technology

- Statoil eROV concept to be piloted

- Piloting of «USB» docking station for UIDs

- Eelume piloted and tested
UID TECHNOLOGY DEVELOPMENT SCHEDULE (cont.)

Medium perspective (4-7 years) 2020-2023

- Install first field-proven “USB” docking station on an SPS

- Install pilot for UID on a dedicated field that can swim autonomous between “USB” docking stations and performing survey, inspection and light IMR tasks

- UID solutions considered to be an integrated part of a future subsea field development
Long perspective (7 -10 years + ) 2024-2027 and beyond

Difficult to predict in longer term
Some thoughts:

• Unmanned Surface Vessels (USV) to assist in subsea operations (IMR, etc)

• Large unmanned UIDs to assist in IMR operations with $X$ tonne payload. There is a project in EU looking into this solution. Statoil is following that project.

• The agriculture / sea farm industry is moving offshore with very big units and high levels of autonomous operations. There could be possibilities to collaborate between O&G and sea farm industry regarding use of UIDs.
EXAMPLE 1: AMOS

Norges Teknisk-Naturvitenskapelige Universitet (NTNU)
Norwegian University of Science and Technology

Centre for Autonomous Marine Operations and Systems (AMOS)

National Partners:
• Norwegian Research Council
• NTNU
• SINTEF Fishery and Aquaculture
• MARINTEK
• SINTEF ICT
• Statoil
• DNV

knowledge transfer to industry through research and direct collaboration
EXAMPLE 2: EELUME

Kongsberg Maritime and Statoil collaboration with Eelume (an NTNU spin-off company)

Utilising snake robotics

The intention is that the flexible body of the Eelume robot shall provide access to confined areas that are difficult to access with existing technology

Typical applications include: visual inspection, cleaning, and adjusting valves and chokes, etc
EXAMPLE 3: NETWORK OF STATIONS FOR SURVEY / INSPECTION

50 NM radius (24hrs @ 4 knots)  100 NM radius (48hrs @ 4 knots)
Navigational challenges with fully autonomous operations of long duration: Could this be a showstopper?

**Independent (only onboard sensors):**
- INS, DVL, pressure depth sensor, etc
- As above, plus: GNSS

**Real-time:**
For seabed mapping – need to ensure that we survey the correct area – requires higher accuracy in real-time

**Dependent (external augmentation):**
- GNSS/USBL (supervised mode)
- Array / sparse array
- Terrain navigation / pipeline tracking
- (requires input of DTM or linefile)
- Homing devices (on docking station)

**Post-processed:**
For other applications (eg pipeline survey) we can accept poorer quality in real-time navigation providing that improvements can be made in pp
CONCLUSIONS

Can IOGP help promote collaboration between operators on this theme?

Is there scope for collaboration between IOGP & IMCA on this?
There’s never been a better time for good ideas