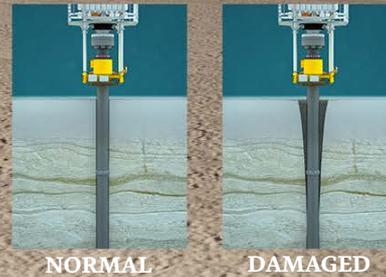


SWIM™ showing conductor instability before repair, confirming safe drilling conditions after repair.



*The use of 4Subsea's SWIM has enabled us to avoid escalating conductor instability and continue the drilling operation on one of our exploration wells.*

Randi Næss,  
Lead Drilling Engineer  
Lundin Norway  
April 2018

## How Lundin Norway avoided escalated conductor instability by utilising a well specific digital twin

In the spring of 2018 Lundin Norway experienced escalating conductor instability while drilling on one of their exploration wells. The instability was caused by wash-out, resulting from vessel and wave induced motions on the BOP and by challenging soil conditions. Lundin Norway used an ROV to visually observe the movements of the BOP.

By using the well specific digital twin to update conditions, evaluate the consequence and verify wellhead integrity throughout the remains of the operation after soil stability issues, the operation did not have to be aborted. The drilling campaign continued, with the benefit of significant cost savings.

## THE QUICK OVERVIEW

# Lundin

Norway



**WHO:** Lundin Norway and 4Subsea

**WHAT:** Using SWIM™ to identify and avoid conductor instability during a drilling operation on 100 m water depth in the North Sea.

**WHERE:** Luno II

**HOW:** Establish a digital representation of the wellhead system, instrument the BOP and LMRP with autonomous sensors, and transfer data to the cloud solution DataReservoir.io™.

Process and analyse data and present mitigating actions.

**WHY:** Empower engineers to make operational decisions based on data analysis, enabling Lundin Norway to avoid aborting the drilling campaign.

## Background

In 4Subsea we believe new insights arise when engineers are empowered with the right data at the right time, and in the right manner. This case is an example of how digital technology and advanced data analysis empowered engineers in Lundin Norway and 4Subsea to collaboratively take operational decisions and avoid abortion of an ongoing drilling operation.

## Objectives

**Technical:** Use state-of-the-art sensor technology in combination with Microsoft Azure and engineering competence to identify and mitigate well instability during a drilling operation.

**Operational:** Empower engineers to collaborate and utilise data to avoid abortion of an ongoing drilling operation.

**Commercial:** Reduce cost and risk by ensuring safe utilisation of the mobile drilling unit.

## Technical Solution

A digital twin is in this context a model representation of the well system, riser system, and boundary conditions, using data from autonomous sensors. Historical data from related applications is also used to strengthen the model.\* A machine learning based alarm, trained on historical data, was used to detect a change in soil support based on sensor data. The digital twin was used to evaluate the consequence of change in well support with respect to structural wellhead utilisation and soil utilisation. Well specific operating envelopes and wellhead fatigue development were adjusted according to the change in well support stiffness.

Autonomous sensors and a wireless modem enabled Lundin Norway to read data from the sensor system and transmit that data to the cloud solution DataReservoir.io™. Creating insight from big data is enabled by DataReservoir.io™, which is implemented in Microsoft Azure (PaaS) to handle large amounts of time-series data and distribute them in a secure and efficient manner. Data and insight can be distributed through REST API, advanced Python API, or through dashboards in the web solution WellTrack.io™. The advanced Python API is typically used by the engineers to run specialised analyses.

## Result

Successful identification of an escalating conductor instability situation, resulting in targeted mitigating action; filling the washed out well slot. The drilling operation could continue.

\* The basis for the methodology was presented in 2017: "OMAE2017-62066: Observation of subsea BOP response from field measurements and reflections on conductor design challenges" by Harald Holden and Heidi Gryteland Holm, 4Subsea; Youhu Zhang and Victor Smith, NGI; Randi Næss, Lundin Norway.



4Subsea is a leading provider of technology and services that help operators maintain production from subsea oil and gas fields and offshore wind farms. By combining expert engineering competence, practical experience and a digital service, we ensure the integrity of assets all the way from reservoir to deck.

We deliver solutions on a unique digital platform, aiming to be in the forefront of digitising oil, gas and offshore wind operations worldwide. The company was established in 2007, and clients include all the major oil and gas operators as well as the large suppliers of subsea equipment.

Click [here](#) to view a short video of our solutions and offerings.

**4Subsea - Share ideas, move forward**

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