Block: Exploration and Production of Oil and Natural Gas
Forum: Exploration and Production in the Arctic

How digital oilfield solutions improve operational safety and profitability: Balancing evolution with revolution

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Havard Devold, Market & Technology, ABB, Global

Abstract

[…]
If you want to perform a lean operation in remote areas, such as the high north, away from populations, whilst maintaining a good understanding of the nature of the well and production facilities with active monitoring and good contingency planning, integrated operations are the way forward. In the Arctic, you cannot go into the ice to replace a failing turbine or any other piece of heavy machinery. Smaller elements can be flown in with helicopter, but heavy equipment cannot be delivered in the winter. If there is a failure and resultant spill in this environment there is no known technology for recovering oil under the ice. The only way that safe operation of wells in the Arctic will be made possible is through digital oilfield solutions.

Operations in the high north

Ensuring safe, efficient and sustainable operations

Challenges

- Cold climate, harsh environment
- Lack of infrastructure
- Long distance, remoteness
- Attract workforce
- Autonomy of operations

Issues

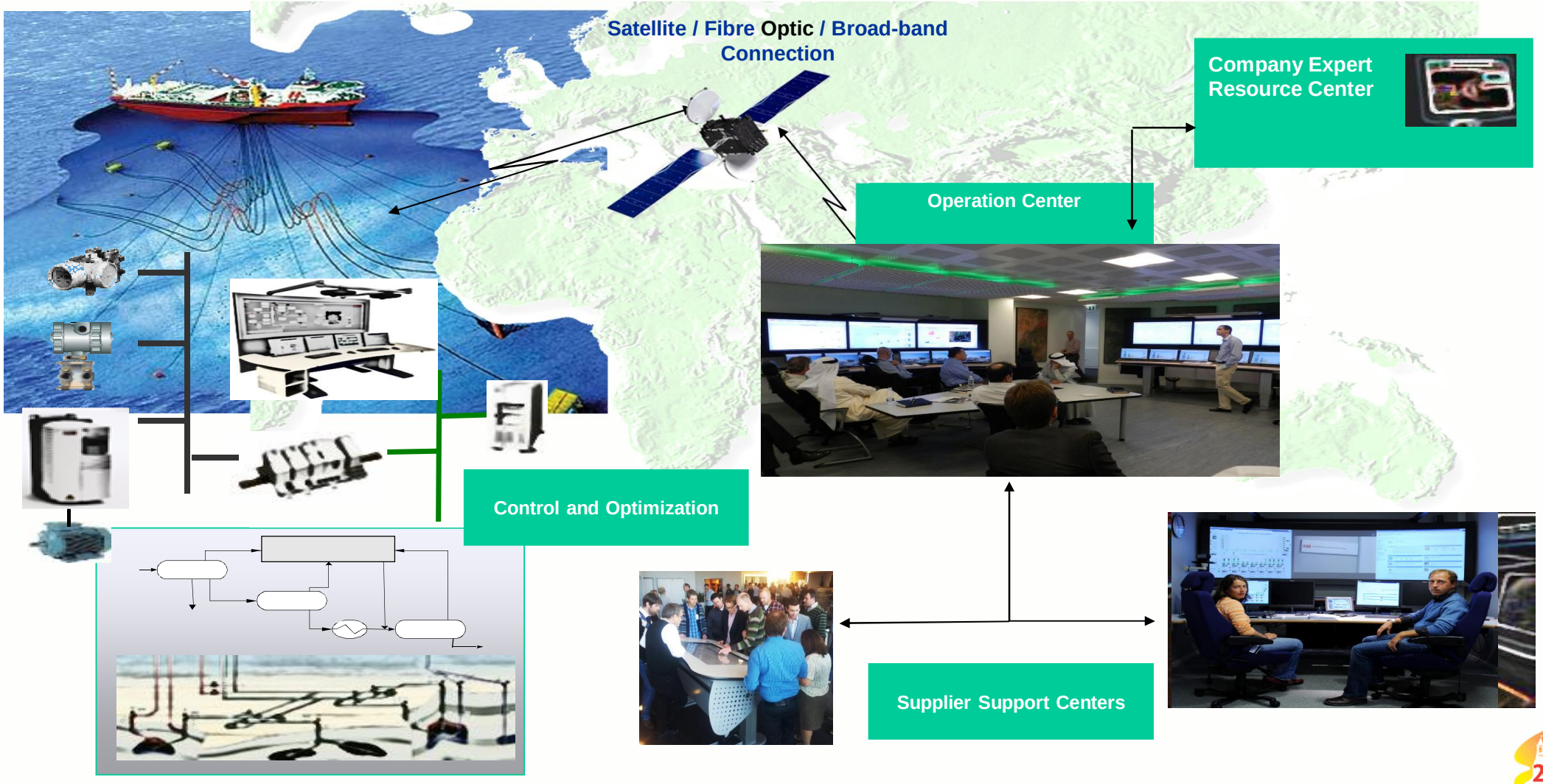
- License to operate
- Risk
- Environment
- Safety
- Latent developing faults
- Preparedness

Constraints and opportunities

Exploration
OPEX
Investments

Reservoir
IOR
Lifting cost

Digital infrastructure enabling remote and integrated operations



Integrated operations

Definition

Remote support

Onshore organization mainly acts as a support organization for the offshore operations; some of the routine tasks which can be conducted during normal office hours can be handled by onshore staff

Remote monitoring

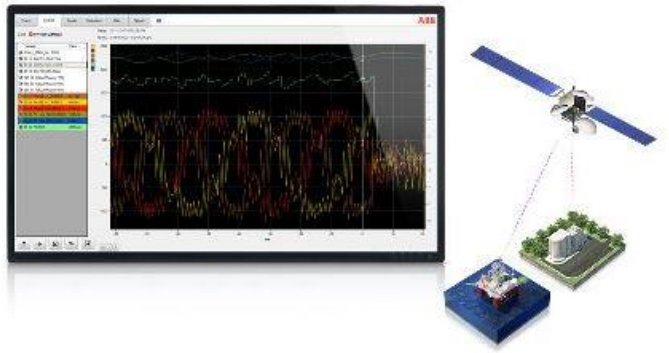
A continuous process to invoke condition, status and performance of inventory and transfer data and information to Onshore Maintenance Center (OMC). Operational liability will be allocated locally at the offshore facility

Remote control

Remote control is defined as partly or fully remotely supported from an Onshore Control Center (OCC) in a pre-defined pattern, where roles, tasks and responsibilities is clearly defined between the two control room facilities.

Remote operations

Remote Operation is defined by that the entire offshore facility is controlled and operated from an Onshore Control Center (OCC). The operational responsibility is entirely transferred to the OCC



How operational flexibility assure safe and reliable operations

Most safety incidents

- are caused by human error
- occur when the plant is in an ”unusual” operational mode
- occur when several unusual operations are executed in parallel

Safety incidents are unlikely to occur when

- the plant ”operates itself” – robust control
- the alarm frequency is low – robust operation
- the operator can have sufficient focus on unusual operational modes
- an active safety and alarm management program is in place

How operational flexibility assure reliable operations

Situation

- Plant operating at reduced production due to maintenance on one of the compressor trains, resulting in an unstable operation
- Pigging of inter-field pipeline in progress
- Line testing of gas detectors in progress
- Maintenance of pressure sensors in progress

Result

- Operators overloaded with tasks, and due to a miscommunication, a pressure sensor on the firewater ring is not inhibited when it is disconnected
- Disconnected sensor results in an indication of insufficient firewater pressure to the safety system
- Full process shutdown

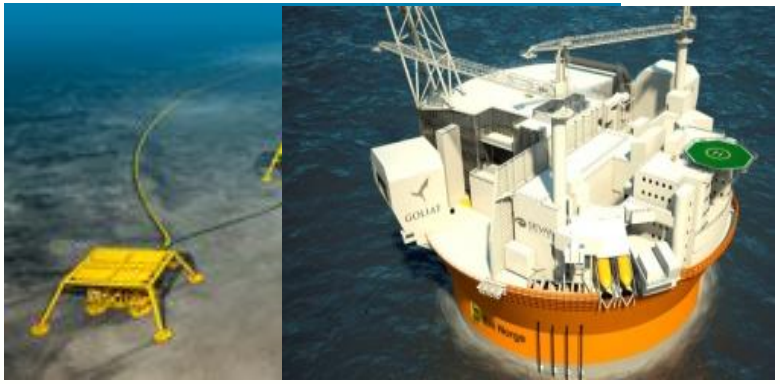
How operational flexibility assure reliable operations

Alternative outcome

- Plant is stable even during reduced production because control system is regularly tuned using a remote service
- Condition monitoring of gas detectors reduces requirements for testing. In this case, the testing is scheduled for a time with less operator load
- During a safety analysis of the planned activities, a ”high operator load” situation is identified. In such cases, control of parts of the process is being handed over to the onshore control room
- The result: The operators in the control room can give sufficient attention to their remaining tasks, and no incidents occur
- Savings per avoided shutdown 1-10 MUSD

Early adaptation, experiences from the North Sea

ENI Goliat



Shell

Ormen Lange

GDF Suez

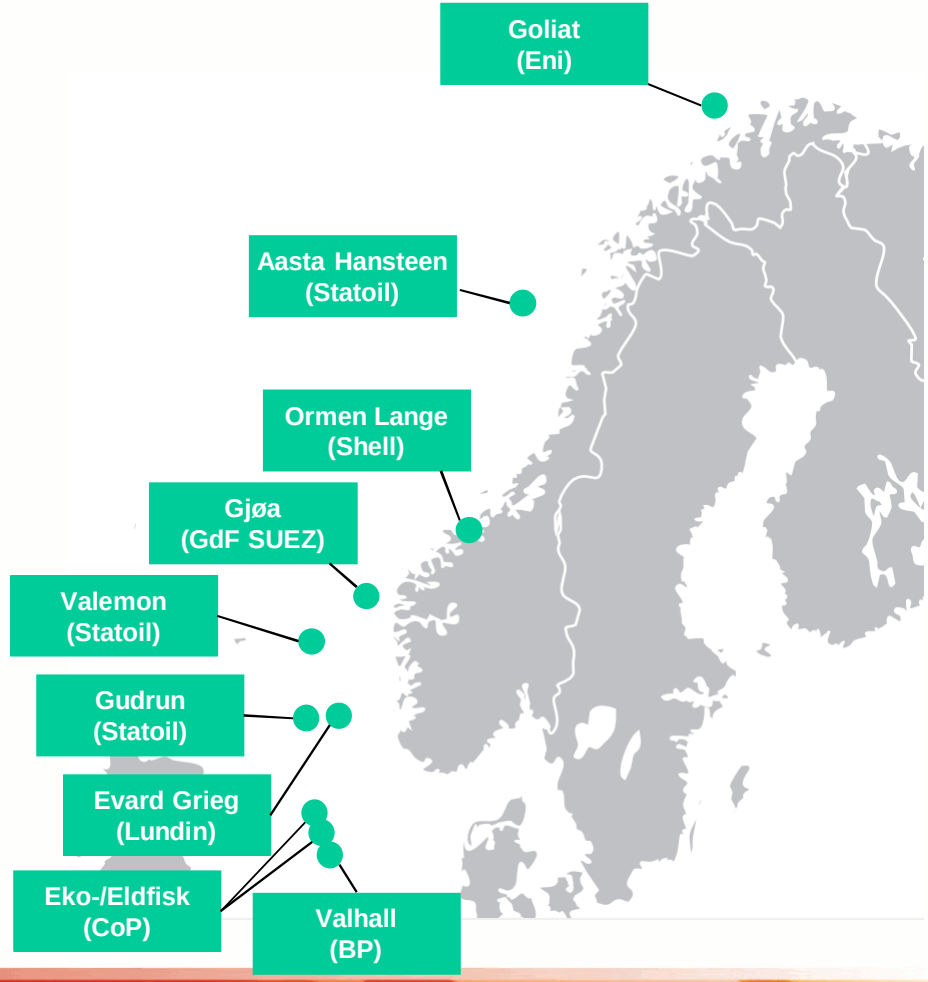
Gjoa

BP Valhall

Example from the North Sea
Remote centers and integrated operations

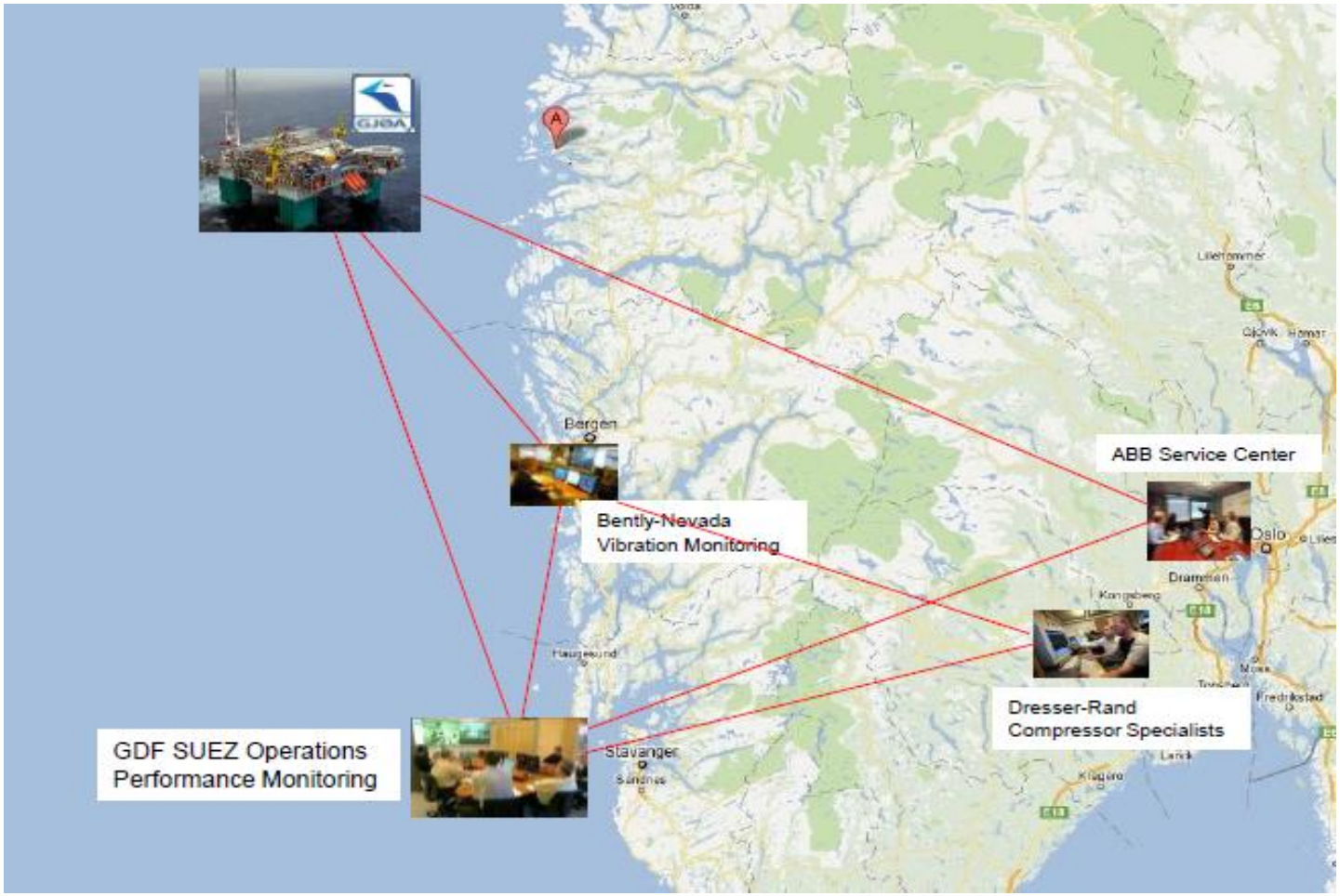
Gjøa

http://www.statoil.com/no/NewsAndMedia/News/2010/PublishingImages/Gjoa-strom-468.jpg



How remote condition monitoring improve availability

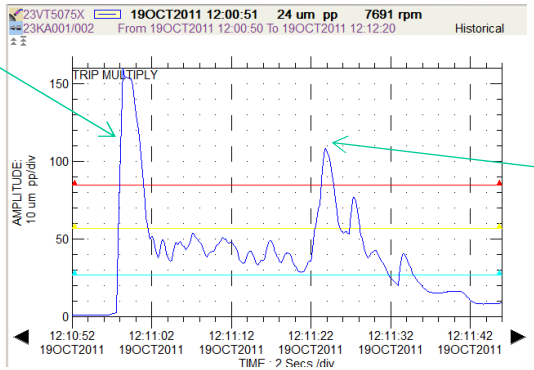
Gjøa



Compressor tripping on high vibration

Case

High vibration suppressed due to startup conditions



Compressor trips due to high vibration in gearbox-compressor connection

Sequence of analysis

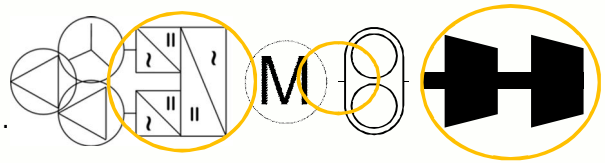
- GDF SUEZ — Mechanical Equipment Engineers
  - Performance Monitoring (Turbowatch) excludes surge as an issue
- DRESSER-RAND — Compressor Specialists
  - Resonance frequencies for the compressor train provided
- GE Bently Nevada — Vibration Monitoring
  - Indications of excitations on resonance frequency 14-15 Hz, however this mismatches with compressor RPM (3900)
- ABB Service Environment — Drive / Electrical Monitoring
  - VSD monitoring reveals torque fluctuations of 14-15 Hz in motor when motor RPM is 800-900, Drive excluded as possible cause

Compressor tripping on high vibration

Root cause and solution

Trip caused by vibrations in 14-15 Hz regime
Resonance frequency of the compressor train in 14-15 Hz domain
Resonance frequency excited when motor RPM is 800-900
Detection of critical rotation speed via the VSD monitoring analyzing torque fluctuations

Solution: Fast acceleration through the critical rotation speed interval
Trip-multiply implemented from onshore location
Result Minor changes in the protection system eliminated the problem.
The platform can continue operating with minimal downtime



Enablers

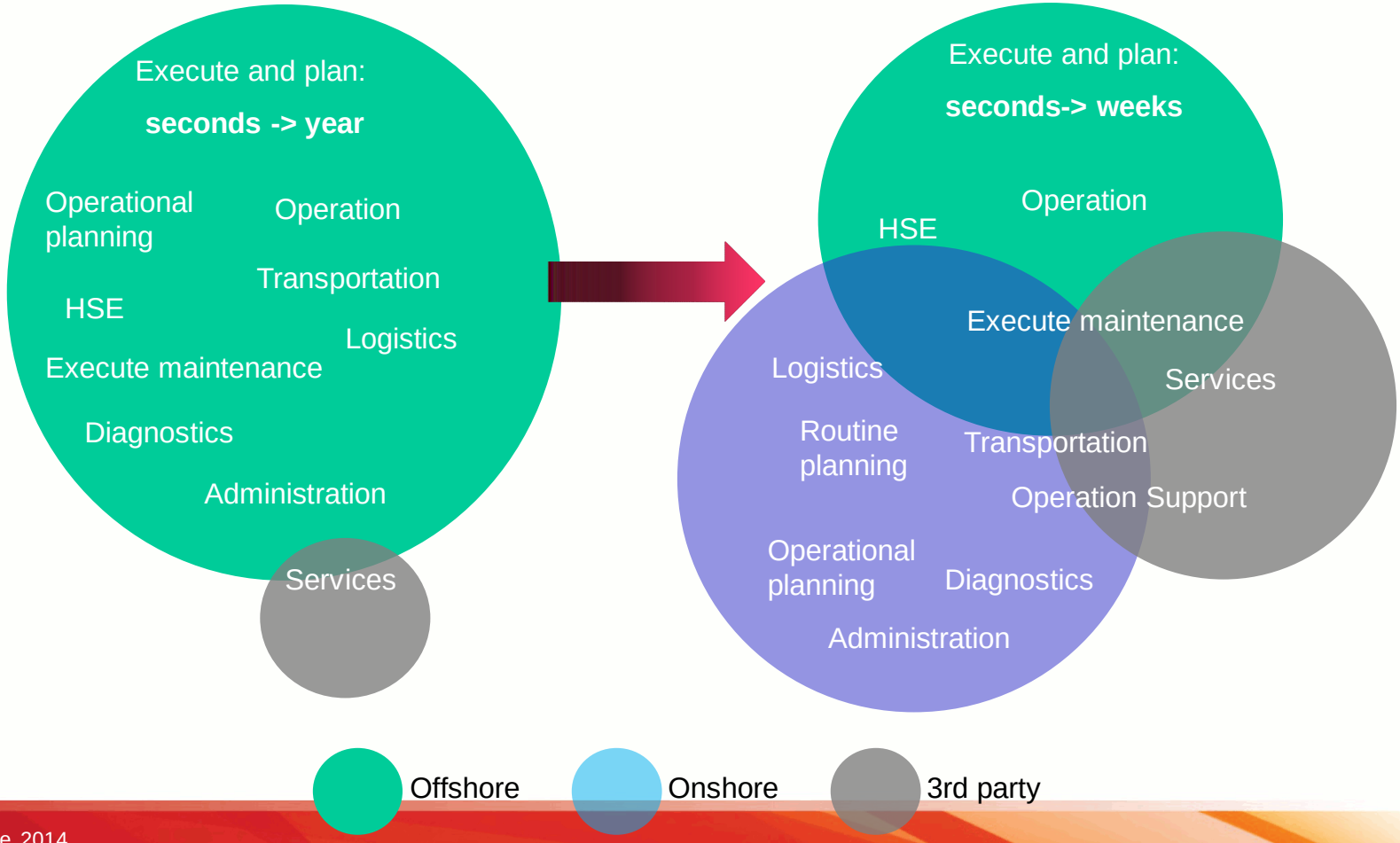
GDF SUEZ strategy for Integrated Operations, Integrated Operation Strategy
”Based on criticality classification, all equipment and systems shall be designed for real time condition monitoring.”
”The data shall be made available both onshore and offshore using high quality data/information transfer ….”
GDF SUEZ Operational Philosophy

Access to information for internal and external users and extensive use of service partners
Instrumentation to cater for condition based maintenance as a part of the project delivery
All relevant parameters for the compressor were monitored
The process conditions and performance
Vibration analyzes
The electrical parts of the system monitored as a part of the compressor train

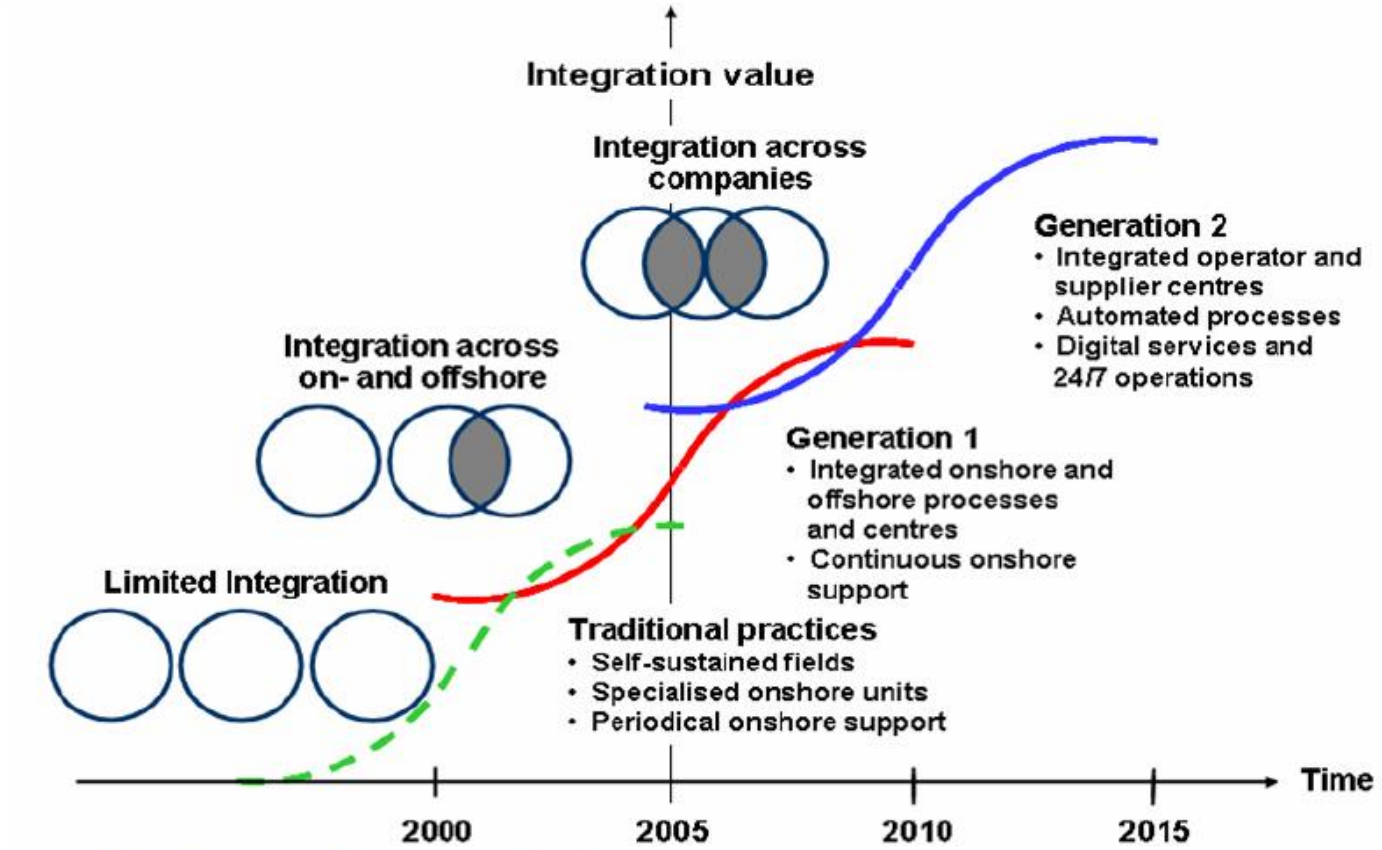
ABB Service Environment provided easy access to experts for discussions, analysis, data collection and problem solving.


Right Information
Situation Awarness
Analysis
Options Evaluation
Decisions
Trade-offs ranking
Planning
Implementation
Outcome review
Right Data

Operations versus integrated operations



The North Sea experience



Source: NOROG (OLF) – Integrated Work Processes, 10.2005

Example from the high north
Remote area integrated operations

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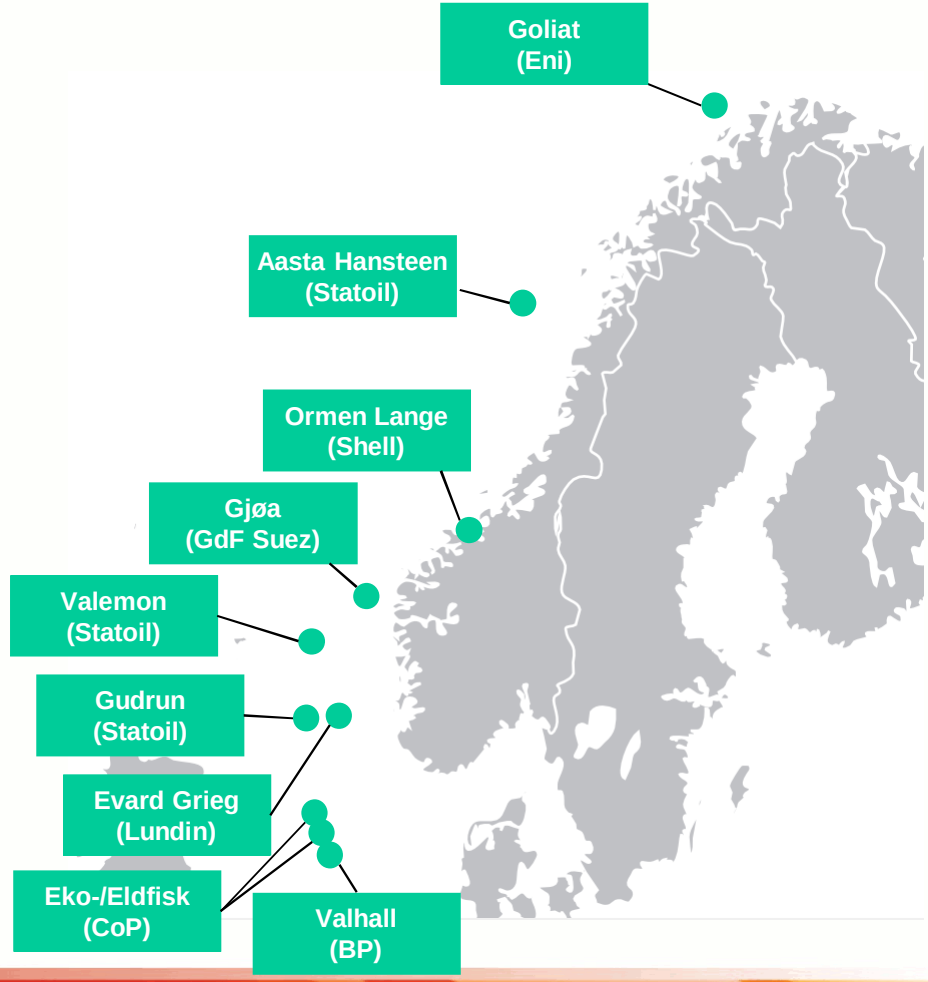
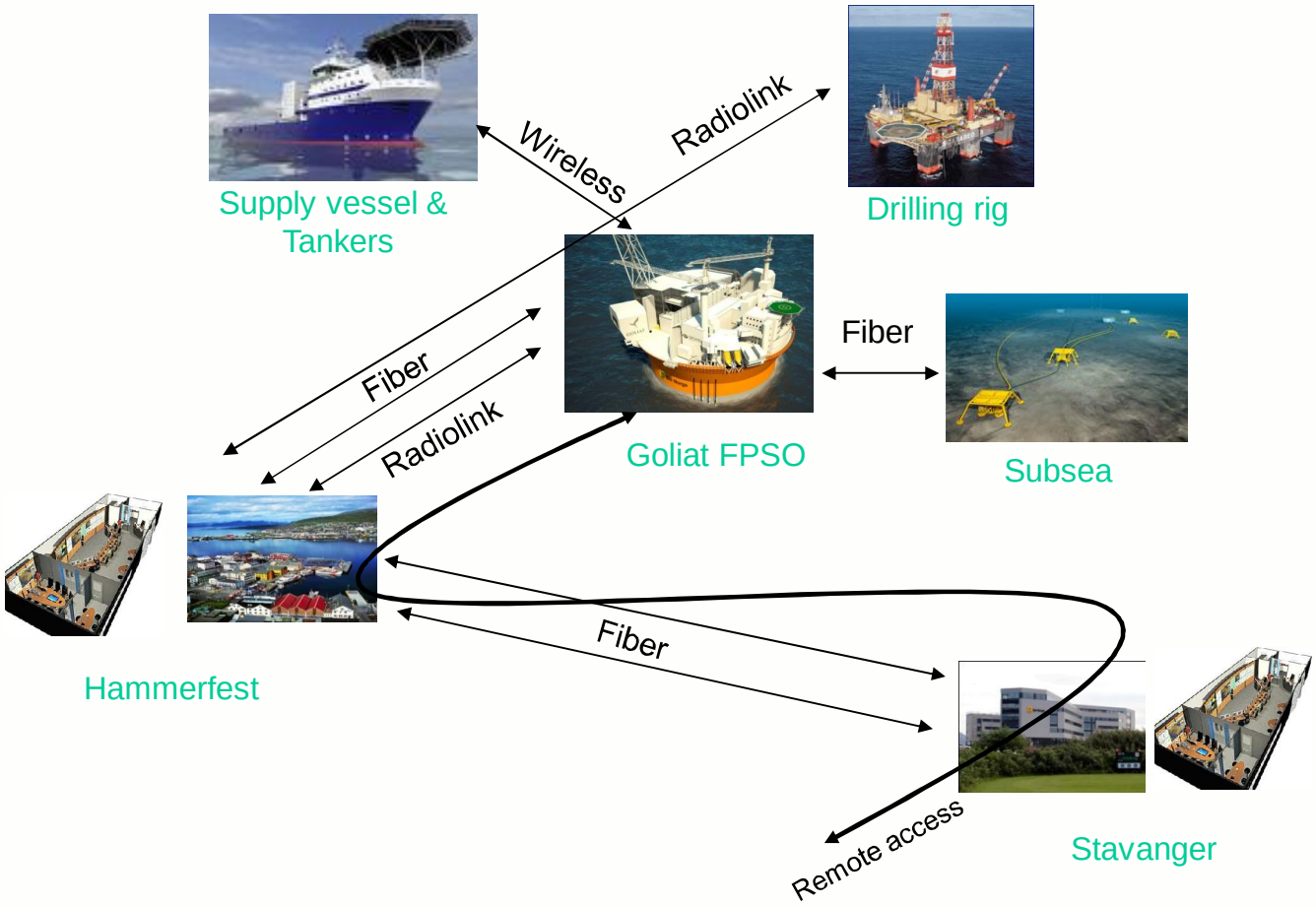
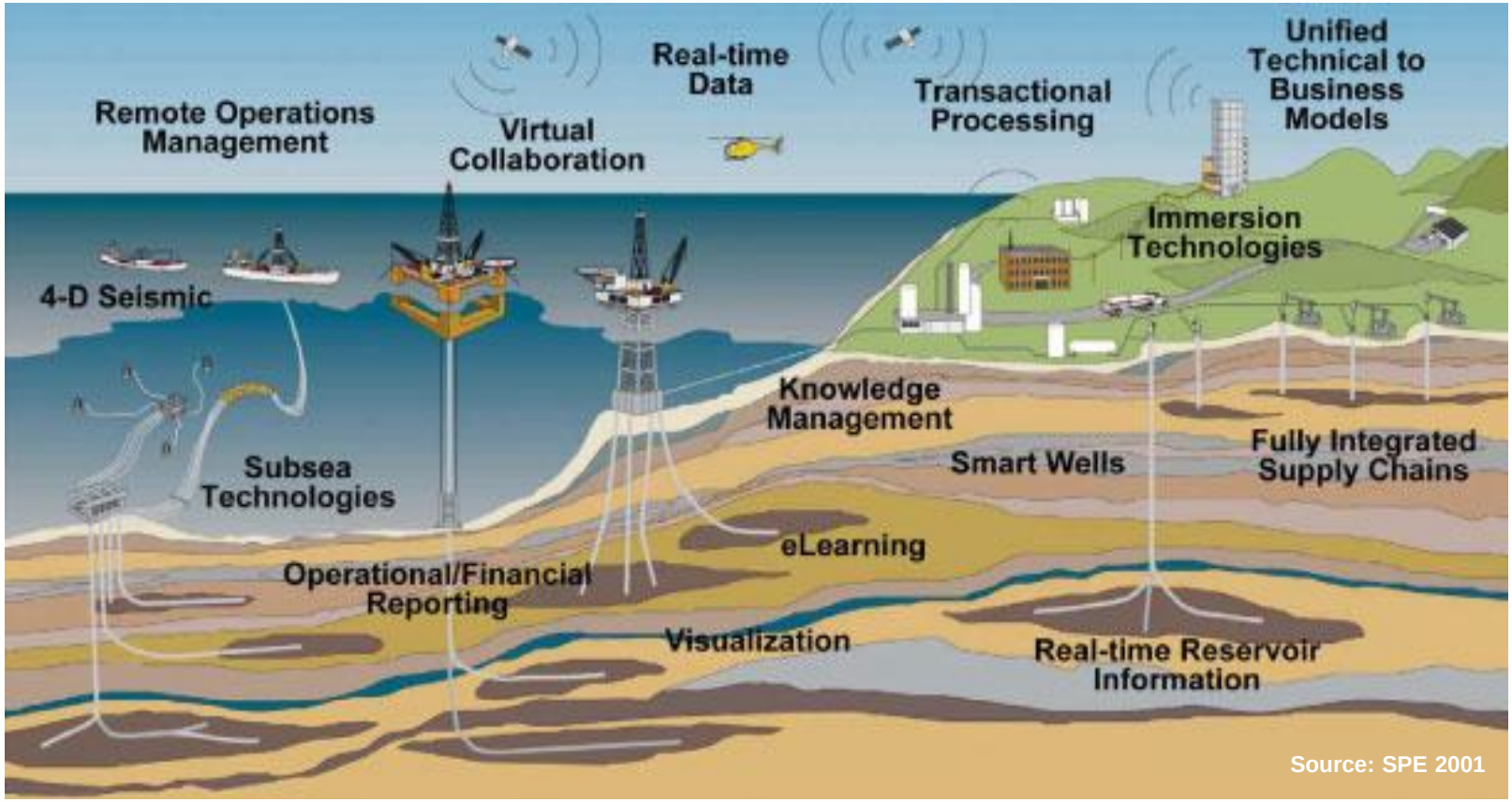



Supply vessel &
Tankers
Wireless
Radiolink
Drilling rig
Fiber
Radiolink
Goliat FPSO
Fiber
Subsea
Hammerfest
Fiber
Remote access
Stavanger

The digital oilfield: A journey from vision to realization

Pull for digitalization and automation



Mature field redevelopment versus new fields developments

Conclusions
Personal reflections

People trump technology
- Technology will help you **enable** better maintenance
- People will **execute** better maintenance

There is no silver bullet
- Vendors will be good at different things
- Choose solutions that you know you will be able to utilize
- System integration that fit your people and way of working

Think condtion monitoring when ordering long lead items
- Equipment must often be «maintenance enabled» out of the factories

Know what you want and challenge your vendors
- Include vendors in performance thinking
- Trust and ownership

Every asset is unique
- But they are also quite similar
- Learn from others and adapt

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Author Biography

Educated NTNU (M.Sc., Ph.D.) in chemical engineering, modeling dynamics, advanced process control and systems engineering. In ABB since 2001, working with flow control and enhanced oil production, industrial IT and integrated operations services. Taken a central part in the pioneering age of digital oilfield in the North Sea and its adaptation to real practice. In 2005, Hilmen was awarded the prestigious TR35 top young innovators by MIT's Technology Review for having developed online monitoring and management tools for offshore oil production platforms. Hilmen heads the integrated operations portfolio globalization and studies at ABB's Industry Solutions Center in Oslo, Norway. SPE, AIChE member.