AADE-07-NTCE-44

ConocoPhillips Onshore Drilling Centre in Norway - A Virtual Tour of the Centre Including a Link Up with Offshore

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Abstract

"*e*Field or Integrated Operations include the use of information technology to change work processes to achieve better decisions, to remotely control equipment and related processes, and to move functions and operations personnel onshore" as stated in the Norwegian White Paper, number 38, 2002.

Integrated Operations are often characterized by operational concepts where new information and communication technologies are used in real time to optimize offshore oil and gas exploration and production resources. This enables large volumes of data to be measured, sent to users via high bandwidth computer links that are shared amongst a broader user audience, and data that can be used to form better decisions.

Integrated Operations cover all aspects of business activities from Exploration to Drilling to Production though this discussion will focus on the Drilling aspects. For ConocoPhillips Norway (COPNo.) to employ this technology there has been a need to re-organize operations, to investigate new work processes and a need to establish a willingness to share information.

According to a study by the Cambridge Energy Research Associates in 2003, the increased use of new and emerging digital technologies could potentially boost world oil reserves by 125 billion barrels over the next 5 years. Petoro A.S. of Norway has estimated the added value of applying *e*Field and Integrated Operations (IO) on the Norwegian Continental Shelf to be USD 25 billion. A more recent report by the OLF (Norwegian Oil Industry Association) report indicates that the value of IO to Norway could be 250 billion Norwegian kroner (USD 35 billion)[1]. In summary, industry studies indicate that the potential benefits for IO are significant.

Five key digital technologies will substantially improve the oil industry's ability to see reserves more clearly, plan optimal drilling and production strategies and manage operations more efficiently. They are:

a. Remote sensing
b. Visualization
c. Intelligent drilling and completions
d. Automation, and
e. Data integration.

This paper outlines the industry-leading experiences of the COPNo. drilling group over the last 3 years within Integrated Operations and real-time operations.

Integrated Work Process Developments

The integration processes are best expressed in the chart shown in Fig. 1. The industry sees the following development scenario for IO[2] where the Generation 2 processes develop as a result of more integration not only internally, but externally with the Operator's service providers.

The Onshore Drilling Centre and Offshore Integrated Systems

The Onshore Drilling Centre (ODC) at the COPNo. offices in Stavanger, Norway, consists of a group of inter-related operations rooms.

The centre was initially established with a large operations room as can be seen to the lower right in the picture in Fig. 2. Large wall screens display drilling parameters such as depth, bit weight, string torque, gas levels, mud weight and volume information. Geological formation information can also be displayed, including real-time visualisation and the recent addition of a high-resolution digital microscope offshore, to help in the decision-making process. Closed-circuit TV (CCTV) is also available from the offshore operations. The operation room supports all COPNo. drilling facilities in Norway, and also provides services for UK-based drilling operations. Operational geologists, Measurement Whilst Drilling (MWD), data or logging engineers, directional drillers, plus others, work remotely from the operations room.

The large central room is primarily for collaboration and video-conference meetings with offshore operations and external parties. The communications systems have been set up to enable a single morning video-conference meeting with all six offshore operations, the drilling contractor and other service providers, which ensures that all onshore and offshore operations are up-dated within a 30 minute meeting period.

There is a large 3-dimensional visualization room to the left of the picture in Fig. 2. The visualization facility enables a 3-D view of the field area and reservoirs, with any number of

[1] http://www.olf.no/io/aktuelt/?32691

[2] http://www.olf.no/io/arbprosesser/?30333

selected wells showing. This room is used for well planning and reservoir evaluation purposes. It is also used in a real-time mode particularly whilst geosteering in the reservoir. Two smaller operations rooms are shown in the upper central picture in Fig. 2 together with three offices to the upper right.

The ODC and related offshore systems that enable the COPNo. *e*field operations originally cost USD 4 million to set up. This includes refurbishing of office space.

Documented savings from using the ODC initially compared to operating conventionally has shown that the ODC was benefiting positively by over USD 1 million per month. This has steadily increased to USD 1.5 million per month. These savings do not include the benefits of increased oil production volumes gained from the use of the visualization room while drilling.

In addition, over 600 helicopter seats have been saved within the 3-year period and the number of offshore days reduced by 4,672 through the use of the remote working practices, video-conferencing, and the use of real-time data and information. There has also been a positive impact on HSE as a result of utilizing remote working practices.

More recently, COPNo. has moved two drilling teams into a semi-open plan office arrangement where operations screens and monitors have been placed in and around the teams displaying their respective operations information (Fig. 3). This change in work methodology has taken the ODC facilities to the drilling teams and engineers instead of requiring them to visit the ODC rooms. It also allows improved collaboration and knowledge sharing within the teams for each of the Operator's assets, and also cross asset collaboration.

Offshore, each of the drilling facilities has video-conferencing facilities including portable and wireless Visiwear camera/sound systems. This allows flexible communications from most parts of the offshore drilling areas.

Technology and Equipment Enabling Operations

In 1998/1999, a 714-mile long fibre optics cable with 24 fibre strands was run from Kaarstoe on the west coast of Norway, via the North Sea oil platforms Draupner, Ula, Ekofisk, Valhall and Murdoch, to Lowestoft in the UK. COPNo. utilises part of the capacity of one pair of strands in this cable for a 2 x 155 Mbits/sec data connection between the Ekofisk field and the offices onshore. The Ekofisk area, which consists of many platforms, is interlinked with fibre optics connections or high-speed radio links, in turn meaning that the lowest bandwidth available to shore from any COPNo. platform on the Norwegian Continental Shelf is 155 Mbits/sec. This huge increase in available bandwidth, compared with traditional offshore installations, has revolutionized the communication between onshore and offshore.

Key types of services delivered through the cable include:

- Telephony
- Video conferencing
- Closed Circuit Television (CCTV)
- Direct communication between handheld UHF radios offshore and phones onshore
- Wireless video and audio communication between VisiWear units offshore and PCs onshore
- Wide variety of real-time data transfers
- Remote support / remote control

Video conferencing, once regarded as too unreliable or cumbersome to use - or simply not feasible in an offshore environment - is now a business-critical service within ConocoPhillips in Norway. About 2,200 video conference meetings are held each month, the majority of these between onshore and offshore. Moreover, the demand for point-to-point and multi-party conferencing continues to increase.

The Learning Curve

The ODC is differentiated from other IO centres in that it combines operations rooms, collaboration rooms and the visualization room as an information unit. It also includes both Operator and Service providers in the collaborative environment, enables cross discipline and cross company integration. This ensures improved work processes and support throughout the whole process from planning to execution, and including the post-well feedback. It is also intimately linked to the other IO processes of COPNo., such as Production, Logistics, and Planning and Scheduling.

The experiences of working in this environment have shown that individuals react to the information facilities and information availability in differing ways. The change in management processes and work processes are seen as key areas needing more focus. Changes have also been realized affecting the offshore positions of COPNo. and service providers. For example, the drilling supervisors perceive that their decision-making responsibilities can be taken from them. It has been made clear that this will not be the case and that the staff in the ODC is there to support the operations only.

Onshore, in conjunction with the drilling team overviews, there have been up-grade changes for the COPNo. engineers. To facilitate the availability and broader use of the real- time information onshore, all persons in the drilling group have been given dual PC screens improving operations monitoring opportunities. They have access to most data and information that is transferred in real time from offshore.

With the economic benefits of the ODC obvious to COPNo., the drilling group has recently opened up a new office area. This area has a semi-open office plan, each work station has two PC screens and there are information screens placed strategically through the work area. The area has been set up for wireless operations and each team member is equipped with a Personal Digital Assistant device. These facilities have in effect taken the ODC to the drilling teams.

ODC Operations – Today and in the Future

Initially some disciplines that were referred to as data functioning positions were transferred to the ODC. They include data logging, measurement-whilst-drilling (MWD), operation geology, and various other data intensive services. Re-locating these functions was a significant step-change to the conventional work processes. Directional drilling services

are also performed from the ODC, notably when drilling operations are in the geo-steering phase of the reservoir sections. The operational geologists, the MWD engineer and the directional drillers collaborate most tightly throughout this operation.

COPNo. currently monitors and, to some degree, advises the 4 – 6 drilling operations simultaneously from the ODC. Support is also provided to all operations in the UK sector.

The rig contractor also uses the ODC as a central base for overseeing rig operations including maintenance activities. As maintenance services are primarily preventive and are generally of a scheduled nature, the procedures can just as easily be administered from the ODC as from an offshore office.

However, the rig contractors also have their own operations centre. This is linked to the ODC, so they can view CCTV screens, real-time data, have access to the video-conferencing and portable Visiwear systems directly in their office.

The geologists are able to use recently introduced offshore digital microscopes to assist with critical casing picks. This function is performed by having formation samples cleaned for digital photographing and the resultant photos sent onshore for analysis and comment by a team of geologists. In fact, the microscope can be remotely controlled from onshore when required. This practice strengthens the earlier position of one geologist in the field performing the same function. The photo shown in Fig. 3 indicates the quality and detail possible.

COPNo. has a number of new projects under development for application to operations in the ODC. A research and development agreement with an institute in Norway has been established for the following:

1. Virtual reality and augmented reality drilling optimisation application: The *e*-Drilling project is focusing on providing virtual reality displays to improve the manner in which information is displayed, particularly for drilling and drilling optimisation disciplines.
2. Intelligent applications which warn and advise of potential hazards.
3. Real-time visualisation of formation types, drilling properties, and the well trajectory: These new visualisation functions use real-time data and information as seen for communication and collaboration between disciplines that are involved in not only drilling, but all aspects of IO.
4. Data-quality models that analyse the real-time data feed streams: Owing to the large volume of real-time data incoming, new applications that intelligently analyse and screen the data quality will advise the user regarding optimal future decisions. This facility is recognised as very important for helping determine operational procedural or management practices.

Hydraulics services are also provided remotely and real time at request for critical wells such as exploration wells or the recent casing drilling operation. The COPNo. drilling fluids service provider is currently attending to two fluids related projects:

1. Real-time mud properties: A number of key mud properties have been identified that will enable adequate control of the mud characteristics. They are fluid density, temperature, funnel viscosity, varying rheological and shear measurements, electrical stability, and oil/water content. Presently, attention is being given to developing testing equipment units that can function automatically, transmit electronic signals, and self-operate and clean.
2. Real-time hydraulics: The fluids service provider has implemented a real-time hydraulics program that is coupled to an interactive 3-D visualization system. The simulated wellbore graphically shows the well, well path, virtual drill string, string contact zones and coloured displays showing flow patterns during drilling, tripping, and running casing. The system is designed such that the virtual wellbore can be independently navigated on different PCs connected to the ODC network. Also, one of the navigation screens can be simultaneously displayed on any of the large screens in the operations room (Fig. 5). Drilling parameters are being coupled to this virtual well using a heads-up display.

Summary

1. Establishing and operating the Onshore Drilling Centre has required dedicated management leadership and support.
2. The ODC is realising significant economic and HSE benefits.
3. The Onshore Drilling Centre (ODC) at the COPNo. offices in Stavanger, Norway, consists of a group of inter-related operations rooms.
4. The ODC is differentiated from other IO centres in that it combines operations rooms, collaboration rooms and the visualization room as an information unit.
5. Use of the ODC has improved decision making processes and results.
6. Operational Geologists, Measurement-Whilst-Drilling (MWD), Data and Logging Engineers, Directional Drillers, plus others, work remotely from the operation room.
7. Changes in the way persons integrate must generally be encouraged.
8. Automatically operating data gathering technologies are being developed specifically for the purpose.
9. While pre-planning for operations from the ODC are important, actual ODC operations often identify new and unrealised task challenges.
10. Moving the drilling teams into the ODC environment has removed many cultural barriers and stimulated a new operations approach.

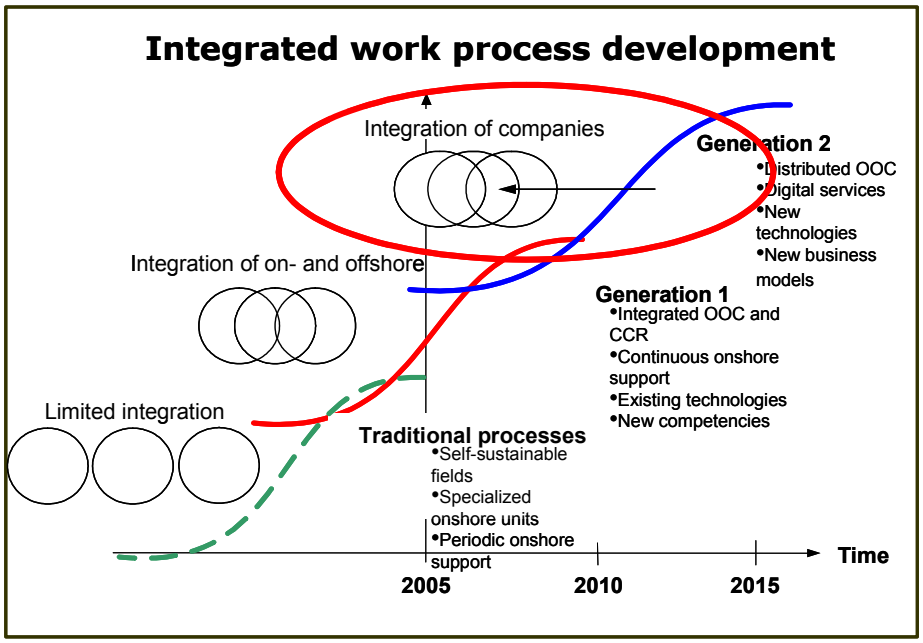

Fig. 1: Evolution of integrated work processes from Traditional to Generation 2.

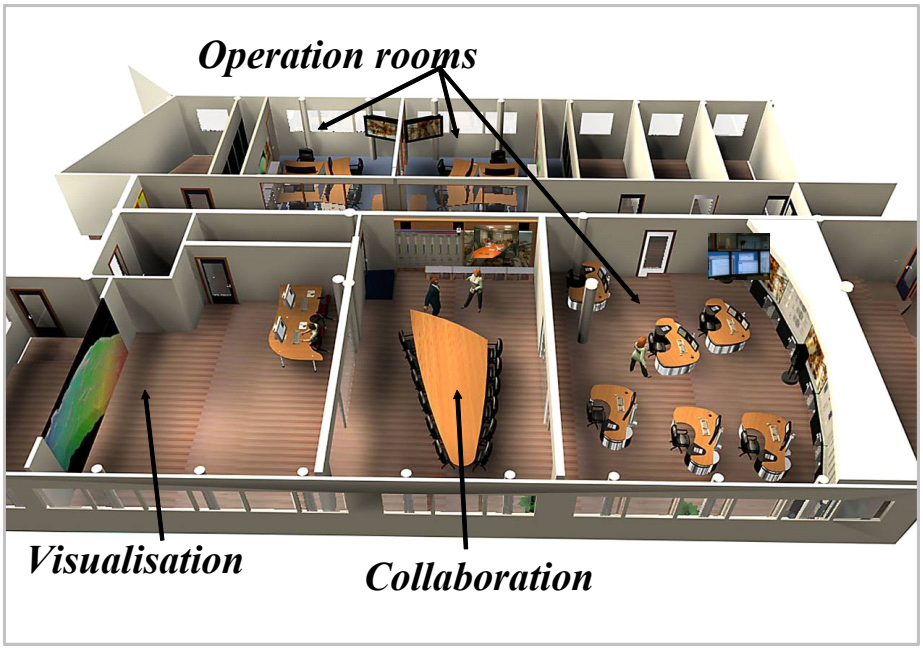

Fig. 2: Inter-related operations rooms in the COPNo. Onshore Drilling Centre in Stavanger, Norway.

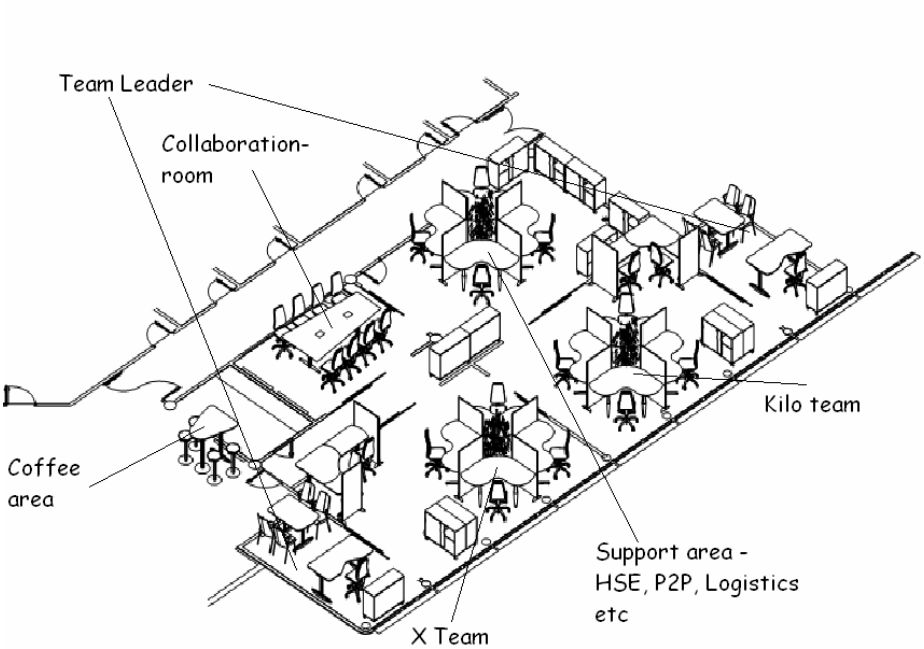

Fig. 3: Semi-open plan office arrangement where operations screens and monitors placed in and around the teams display respective operations information.

Fig. 4: Photographic example from offshore digital microscope: Mixed claystone assemblage; Brick red, fg, claystone, mod Hd, v. slightly calcaereous, (caving?); Olive-green black, fg, claystone, soft, non-calc; Rare micas, graphite, lmst (LCM material); Rarely pyrtic.

Fig. 5: Real-time hydraulics and ECD-management system coupled with interactive 3-D visualization of the wellbore displayed on the screen on the right side of the picture.