Collaborative Working - Harvesting Value and Evolving with New Technologies
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Abstract
Collaborative Work Environments (CWEs) were implemented in the majority of Shell’s assets, now covering over 55% of the production. Collaborative working has evolved beyond production and surveillance processes, includes new mobility and visualization technologies and supports the cost reduction drive.

The paper provides:
• Business Value and Lessons Learnt from global CWE deployment;
• Examples from three assets in different countries and environments;
• Evolution of the collaboration model;
• Use of new technologies in mobility, visualisation and exception based surveillance.

Collaborative Work Environments
Under the heading of Smart Fields, Shell has pursued intelligent energy in its oil and gas fields for the last ten years (Van den Berg 2010, De Best 2012). The value of collaborative working was understood early on, both in Shell (Knoppe 2008) and in industry (e.g. Gilman 2012).

By 2015, Shell had CWEs operational in more than 40 of its largest assets (Van den Berg 2014, 2015), as shown in Figure 1. More than 55% of Shell’s production is now managed through CWEs. These CWEs target a single asset and provide effective collaboration between the office asset teams and the field operations staff. The key processes in these CWEs are production surveillance and management and maintenance processes including equipment and reliability monitoring.

The asset team in the office and the operations teams in the field have high quality video connections and visually share data and information in real time for analysis and fast decision making. The CWEs enable the field and office staff to connect to experts, service companies, suppliers and other key stakeholders without the need for the experts to travel to the field or into the country. A structured work week guides the asset team and the operational staff with standard processes and regular meetings, for example daily production meetings.
Building on the success of the production and maintenance focused CWEs, assets have embarked on wider application of the concept of collaborative working. In some cases, collaborative working has been expanded to include elements of logistics, well services, logistics, supply chain management and field development planning. An example will be provided in this paper in Case Study 1.

**Value Achieved Through CWE**

CWEs have been shown to contribute to production and availability gains of 1 to 5%, creating annual value in the region of $5 to 10 million per asset (Van den Berg 2014). This gain pays back every year the CWE investment.

Many examples of the benefits from Shell’s CWEs have been cited in previous SPE papers (Van den Berg 2014), including:

- Improved management of the wells, reservoirs and facilities, contributing to a field-wide arrest of the production decline achieved over several years;
- Reduced average re-start time from six days to less than three, for wells that had quit production;
- Enhanced surveillance capabilities, resulting in a 0.2% reduction in deferment from trips and failures of sea water injection pumps;
- Improved cooperation between the asset teams, instilling a high level of trust, contributing to reliability of over 97%, overall availability of 93% and near zero maintenance backlog.

The following sections provide case studies from assets in three different countries.
Case Study 1 – Gulf of Mexico Integrated Operations

The Integrated Operations (IO) approach to exploration and production in Shell’s Deepwater Gulf of Mexico assets was a natural evolution of the Remote Assisted Operations (RAO) program (Chevis and Weiss 2010). The operations manager for the new Olympus green field project stated as a basic requirement: We need to have the surveillance and engineering teams and the remote control room co-located in the Shell offices in New Orleans. This requirement and the introduction of a fiber optic link to offshore caused Shell to rethink how to support the deepwater offshore activity from its broad network of teams in the region. This resulted in the creation of multiple Integrated Operations Centers (IOCs), a new design for work environments for technical workers and elimination of numerous silos. The progressing capability is shown in Figure 2.

Deepwater IO Timeline

<table>
<thead>
<tr>
<th>Pre-RAO/CWE</th>
<th>RAO/CWE</th>
<th>IOC – Olympus &amp; Mars</th>
<th>IO – GoM Operations, Maintenance, Development &amp; Wells</th>
<th>Extension of Deepwater GoM IO (Present)</th>
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</thead>
<tbody>
<tr>
<td>• Facilities in GoM are operating in manner necessitated by communications and technology limitations: Silo approach to facility operations, with 'impaired' collaboration between shore and offshore.</td>
<td>• RAO creates 12/7 staffed Remote Control Room providing the shore a real-time window into facility conditions and operations.</td>
<td>• Co-location of 24/7 Remote Control Room with VAT.</td>
<td>• IOC practices are replicated and applied to brownfield and greenfield facilities.</td>
<td>• Incorporation of a broader spectrum of work processes into the IO Model: Logistics, broader Wells integration, P&amp;T, etc...</td>
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<tr>
<td>• CWE centers virtually linking VAT ↔ Extended VAT ↔ offshore teams.</td>
<td>• Broader window into facility operations via extended virtual connections.</td>
<td>• Surveillance &amp; Operations working on the same page at all times.</td>
<td>• Refinement of IO Collaboration Model.</td>
<td></td>
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<td></td>
<td>• Establishing the new baseline for future facilities.</td>
<td></td>
<td>• Provides structure for limited resources to work as effectively and efficiently as possible.</td>
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Figure 2: Integrated Operations (IO) capability development

The First Integrated Operations Center

Starting in 2012, the idea that core surveillance disciplines needed to have a direct line of sight into the Remote Control Room (RCR) drove the initial design of an open-floor CWE. As the design gained broader exposure, additional teams were identified as needing to be incorporated into the space. Ultimately, an entire floor was needed to host the full scope of teams in the Mars Area IOC.

To move from the concept to the final IOC design required the use of a structured methodology that looked at work processes, business objectives, activity timelines and teams involved. Analyzing the key points of interaction, a “collaboration heat map” was created. This map led to logical groupings of co-located staff and where the groups were located relative to each other.

This led to the design of one of the IOC’s main features, a “Work Zone”. A Work Zone is an interactive, semi-open CWE that allows staff to work on individual tasks and also quickly engage with others without having to leave their workstation. The Work Zone, along with open collaboration rooms, remote control rooms and other open areas and meeting rooms, provides a physical space optimized for the
team interaction. In addition, it can easily accommodate changing processes and staffing needs.

In addition to the floor design, a CWE audio visual (AV) infrastructure was created. Like the space itself, it also tied directly to work processes and business objectives, and was developed in parallel with the architectural floor design. The resulting IT infrastructure had three main goals:

1. **Local Data Share**: Staff can easily share the information from their local workstations onto the Work Zone screen, for easy discussion, supporting ad-hoc needs and structured work.

2. **Internal Situational Awareness**: Provides common data visualization to ensure process health, with always up asset CCTV, control system views, engineering surveillance views, drilling data, third party reporting tools, etc.

3. **Remote Connectivity**: Allows staff to quickly link to their offshore facility and other Shell locations.

![Figure 3: The Integrated Operations Center (IOC) for the Olympus and Mars platforms in the Mars Area of the Gulf of Mexico](image)

The operational asset teams of the two sister assets Olympus and Mars moved into the IOC floor in 2013, shortly followed by their field development colleagues. This brought together the operational surveillance and support, plus the field development activity supporting both assets in the Mars area of the Gulf of Mexico (Fig. 3).

Fig. 4 shows examples of the type of work environment created.
To assess the effectiveness of the new environment and staff placement, a formalized set of Key Performance Indicators (KPIs) were tracked for the first several months of operation. The results were better than expected:

- **Avoided Deferment**: >10 kboe production saved through avoided platform trips;
- **Production Increases**: >40 kboe through accelerated production and reservoir processes;
- **People on Board**: Approximately 2200 beds, 280 flight seats and 760 travel hours freed up;
- **Staff Efficiency**: Approximately 3500 engineer hours saved.

These results validated the concepts that drove the design. Having the RCR and CWE infrastructure offshore, work could be executed in the IOC onshore that previously required traveling offshore. Additionally, staff roles that were previously located offshore were brought onshore, to do their work from the IOC. These two factors freed offshore bed space, allowing drilling, construction and maintenance teams to have bigger crews and complete their projects faster, thus reducing the overall project timelines.

A side effect was that technical workers were now able to effectively use the time previously slated for travel to and from offshore. In addition, engineers and other technical workers saw their day-to-day efficiencies increase and had work hours saved through easy access to the personnel and the always-on data they needed to work with. This eliminated many formal meetings, repeated email exchanges and instant messaging to gain consensus or work an issue.

**Field Development and Well Engineering**

Building on the success of the IOC in New Orleans, CWE Work Zones were incorporated into the design of Shell’s new Woodcreek buildings in Houston in 2015. The analysis of the required co-location and adjacencies resulted in Well Engineering team members sitting next to their Development counterparts. With this new office environment, collaboration successes have begun to take shape in the
development and wells activities, similar to those in the operational IOCs. Co-location of staff and easy visualization in the work zones has had a direct impact, accelerating teams’ ability to monitor, discuss and respond to active drilling and completions as well as to engage directly with each other for future well planning. Teams also interact easily with their remote Wells and Production counterparts in the New Orleans IOCs.

**IOC Expansion to more Assets**

Once the Mars Area IOC KPIs were finalized, the advantage of the Integrated Operations way of working over previous approaches to supporting offshore facilities was clear. Looking to the future, the leadership identified additional deepwater assets that would benefit from an IOC configuration (Fig. 5). The resulting IOCs covered several more floors in the New Orleans office. Two of these facilities, the Auger and Ursa platforms, had fiber-based communication in place, so it only required some IO improvements offshore to increase the collaborative links when their IOCs onshore were completed and came into operation. The deepwater organisation aims to establish more IOCs for new green fields when they are developed.

In the newer IOCs, learning from the earlier ones, some changes were made. A ten-person Work Zone was introduced for the Maintenance and Integrity team, the number of smaller conference rooms was increased, and the CWE Audio Visual infrastructure took advantage of newer technology to support greater flexibility at a reduced cost.

During construction, the low oil price resulted in a reorganisation. The flexibility of the IOC design proved its worth by easily accommodating a changed staffing footprint and associated process needs. Indications from these new IOCs are that the IOC model will continue to be successful.

![Figure 5: Integrated Operations and Remote Capability growth](image-url)
Case Study 2 – Using Mobile Devices in the Field in Oman – the Smart Mobile Worker

Industrial Mobility in PDO
Oil and gas producers face severe challenges as major hydrocarbon resources become depleted and oil prices are under pressure. Petroleum Development Oman (PDO) is continuously expanding its footprint in terms of wells and facilities and its staff count has been growing yearly. In order to stay competitive, PDO needs to manage this growth by doing more with the same people. To maintain the highest possible production in the harsh operating environment of the desert, the company has turned to new technologies to improve the effectiveness and safety of staff and contractors working in remote sites.

Smart Mobile Worker
The Smart Mobile Worker (SMW) capability combines industrial mobile devices and new work processes to help staff operate more safely, efficiently and effectively. Industrial oil and gas explosion proof certified (EX) tablets and smart phones can access real-time data from deep inside the desert, right at the heart of PDO’s operation.

Since 2013 PDO has embraced the live field collaboration aspect of Smart Mobile Worker and deployed specifically designed cameras at several sites (Fig. 6). This technology is used to collaborate between remote locations and centralized expertise via a real-time audio and video link to the Collaborative Work Environments (CWEs) in the field office and in PDO’s main headquarters. With the technology PDO is saving significant travel cost and reducing deferment by faster response to issues.

Mobile Nibras
To improve efficiency and productivity PDO has recently merged its real-time production data portal Nibras with the SMW mobile capabilities using the EX tablets, resulting in an application called Mobile Nibras for use in the field.

The Nibras platform is used daily by many parts of the business. It delivers real-time data and analytics about production with intelligence about production improvements and alarms. These improvements and alarms are handled by field staff that in many cases needs to travel to the well site and make a visual
inspection or adjustment. These field visits usually take up significant time and effort of the staff. In order to truly fix an alarm or realize an improvement, the Nibras portal is consulted to assure the issue is dealt with and the loop is closed.

In the past Nibras was not available to staff when they were in the field, it was necessary to call an office-located team member by phone to verify. In such phone calls, mistakes easily happen while transferring the information verbally. In some cases the team member could not even be reached or contacted due to a lack of cell phone coverage or unavailability of the person. This could result in an extra trip later or significant inefficiency of the field staff that were delayed in their work.
With Mobile Nibras, field staff can now use the SMW platform, allowing them to directly confirm and validate any data required to attend to the issue themselves (see Figs. 7 and 8). The application also allows offline data to be stored inside the device to review specific occurrences. Besides delivering real-time feedback to the field staff for planned activities, the application can also be used to connect back to the field office or to the PDO head office to address unplanned field activities. This reduces the number of trips to the well site and increases flexibility of the operational staff whilst in the field.

The core value for PDO using Mobile Nibras lies in time efficiency improvement of staff. Based on field deployments it has been measured that the same job can now be done in half the original time. With the improvements, more work can be done resulting in a better performing asset. Other benefits are: reducing down time, reducing staff HSE exposure and minimizing extra field visits.

Enhanced Video Collaboration
As a follow-up to the video collaboration, PDO has recently increased the capability by enabling the Smart Mobile Worker tablets to become collaboration tools as well. Now, these EX certified devices are able to chat, share files, establish video calls and receive desktop sharing media links within the PDO IT network and with external parties (Fig. 9).

Figure 9: Collaboration by Smart Mobile Worker tablet: Ecom Tab-EX Zone 2 with Cisco Jabber

Recently PDO has used this technology to give high government officials the opportunity to have a live video discussion with PDO field staff at the wellhead to understand the day-to-day challenges they face in the field. This helped PDO to show its innovation maturity and gave the officials a rare opportunity to view a wellhead up close.
The technology is also used for emergency response situations making use of BGAN Portable Satellite links. This gives PDO the flexibility to connect the field staff live to its Emergency Control Centers even when conventional communication links are down. This in turn helps Emergency Coordinators to make more informed decisions.

**Smart Mobile Worker and Integrated Assurance**
PDO is also focusing on Operational Excellence with SMW. A pilot Integrated Assurance project is using the same mobile devices whilst running a software solution called Intelatrac. This allows PDO to digitalize data entry forms used for operator rounds in the field and to manage the entered data more sustainably. Data is entered in a standardized fashion, which improves the data quality and minimises rework in the office. The mobile forms have been set up to allow extra photo attachments. Because all data is stored digitally, anomaly reports can be generated immediately and non-compliance is visible instantly.

PDO envisions that the solution can significantly change the way it manages compliance with its Operational Excellence standards. This ultimately results in better performance and improved safety.

**Smart Mobile Worker Infrastructure**
Today the SMW devices connect wirelessly to the PDO IT network via pre-installed PDO Wi-Fi networks in production stations, buildings and wellheads or via a uniquely designed battery powered plug and play portable Wi-Fi access point (Fig. 10). The portable solution gives PDO the flexibility to connect the mobile devices from any wellhead in PDO. The PDO IT department is also working to support mobile phone technology such as LTE and 3G as connection mediums in the near future.

**Way Forward**
In view of implementing this technology across the company, PDO is addressing aspects that will make the solution more scalable. All business process workflows are being mapped that are affected by SMW. The corresponding standard operating procedures will be updated to include the use of industrial mobile devices. The tablets used for SMW are managed in PDO IT centrally via the Mobile Device Management (MDM) portal. This allows the company to guarantee IT security compliance and to support end users when required. Full-scale deployment in PDO also requires definition of clear roles and responsibilities to manage the support and provisioning.

In conclusion, PDO has embraced Industrial Mobility. Many new mobility opportunities are being discovered and piloted continuously to improve the company’s competitiveness.
Case Study 3 – Managing Wells in Remote Locations Operated by Shell

A remote field operated by Shell has been using CWE technology for two years to support field production operations activities from UAE. CWE facilities were installed in Shell UAE office (see Fig. 11). In the field location, CWE rooms were housed in two Porta cabins (Fig. 12).

A team of sub-surface and production support engineers based in UAE uses the CWE to connect with field based staff to review integrated production system performance daily, address any production shortfall issues and agree mitigation measures for identified production threats and actions to be taken to optimize production.

In this way, the CWE facilities are used by this asset for various meetings such as:

- Daily Production Review meetings
- Daily Operations Support meeting
- Well Reviews and Facilities Reviews
- Annual Field Performance Review
- Management of Change meetings

Benefits of the CWE
Since the CWE facilities have been in use, the asset has recorded increased field support efficiency with hundreds of man-hours saved from the ability to quickly gain consensus on key issues without the need for follow-up meetings and repeated email exchanges.

Key benefits of the CWE in the Shell operated asset are:
- More efficient Well Reservoir and Facilities Management
- Efficient daily production meetings and well review meetings
- Faster and wider decision making, prioritization of activities
- Good continuous communication between field and office, enabling critical production related actions to be closed out quickly
- Reduced HSE exposure through less frequent travel between the field and UAE office
- Staff efficiency – reduced time waste

**Well Reviews using the CWE**

A specific example of the new ways of working that the CWE has enabled is the way the Well Review meetings are conducted. The CWE capability has enabled the team to hold well reviews at a lower cost, but maintain the required quality. Previously, due to limitation of large conventional video conference rooms, three-day long well reviews were held face-to-face at a location in UAE, usually in a hotel or conference room due to the number of participants. This involved large time and travel investment and HSSE exposure. In addition, it posed challenges such as the high cost of hotel conference rooms, the ability to share only one screen (video or data) and the limited access to the company’s network, data sharing and video conferencing which was needed to link in experts from other locations.

The CWE has largely addressed these limitations, enabling connection between multiple locations (UAE, field location, Netherlands and India) during the well reviews (Fig. 13). The technology brings together Shell experts virtually, enabling sharing of high resolution well and reservoir data in real time among the review participants. In this way, the distributed review team has instant access and shares data repositories such as well data, production data, activity data, reservoir flow data, PI Historian etc. on the screens, often multiple datasets simultaneously.

![Fig. 13 – A Well Review, held between four locations in four countries](image)

The use of CWE for well reviews has resulted in lower cost (especially travel cost) and efficient meetings with active contributions from all parties involved in the reviews. In addition, several hours of preparation time have been saved e.g. printing documents and booking conference facilities.
Conclusions

Collaborative working in Shell upstream has matured and provides large benefits in production, cost, HSE exposure and time efficiency.

Collaborative working can be applied to a wider set of business processes such as field development and well engineering, building on the experience in operations, maintenance and surveillance.

New technology for example mobile devices in the field will further enhance the use and value of collaborative working in upstream oil and gas and potentially in downstream.

References


