



Smarter recovery

Integrated Operations – Enabling safe and profitable operation of remote and mature assets

KATRINE HILMEN AND ESPEN STORKAAS – As existing oil and gas fields mature they become more marginal and reservoir and fluid characteristics become more complex. In turn, newer fields are typically located in more remote and harsh environments. These challenges have triggered new approaches to oil and gas recovery both in subsea development and downhole technology as well as in new and leading concepts in remote monitoring, asset management and maintenance. Integrated Operations (IO) addresses these challenges and ABB offers a wide range of solutions in this area.

The upstream oil and gas business continues to face challenges that make safe operation with sensors, computing power, diagnostics and communication technologies and work processes less profitable. As fields mature they become marginal, resulting in increasing operational costs. Newer, remote fields in harsh environments, such as arctic or deep water, provide their own set of challenges. Drivers for change are, then:

- Economy (reduced operational expenses, increased reservoir recovery and production capacity increase).
- Geography (harsh environments, remote locations).

- Safety and environmental surveillance (exposure to hazards, integrity, emissions).

Technology advances are also changing the game by continually expanding the technical capability envelope.

The challenges, combined with the advances in the enabling technologies, have triggered new approaches to oil and gas reserve development. Examples are satellite fields and subsea tie-ins,

Title Picture

To get the maximum return from industrial plant, be it offshore assets or the complex processing plant shown here, it is essential to harness all available relevant data and make it work for you.

1 The various phases, roles and responsibilities related to the enhanced production target

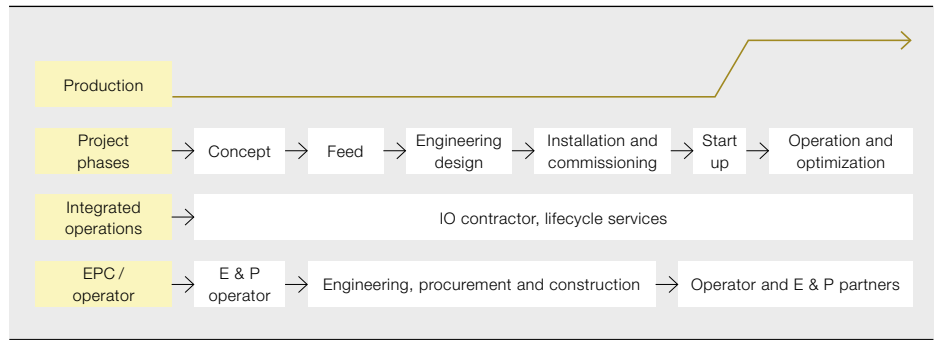


ABB offers a portfolio of technology and services to optimize production and facilities operation and maintenance from wellbore to export.

smart wells and light well interventions, as well as an increased interest in remote monitoring, organizational models with integrated asset management and adoption of world class maintenance principles.

Integrated operations (IO) is a collective term that addresses some of these challenges, and is embraced by the main players in the oil and gas sector under such names as “smart fields”, “digital oil-field”, “intelligent energy” and so on. IO concepts and solutions can be utilized from the earliest phases of field development right up to production tail-end.

ABB has developed a suite of IO solutions, methodologies and services targeted at safety, health and environment and increased production. → 1 illustrates the various phases, roles and responsibilities related to the enhanced production target. Faster startup, leaner manning, improved execution and readiness for operation can be provided by ABB as an IO contractor or engineering services provider, supplementing the more traditional project execution. Examples include life-extensions where ABB brings operational experience into early phase concept selection, design engineering, commissioning, startup and optimization. Process control strategies, alarm management, control room design, use of lifecycle simulation, system functional integrity, flow assurance and optimization are other examples where ABB can provide value.

The elements of Integrated Operations

ABB offers a portfolio of technology and services to optimize production and facilities operation and maintenance from wellbore to export. Key components are → 2:

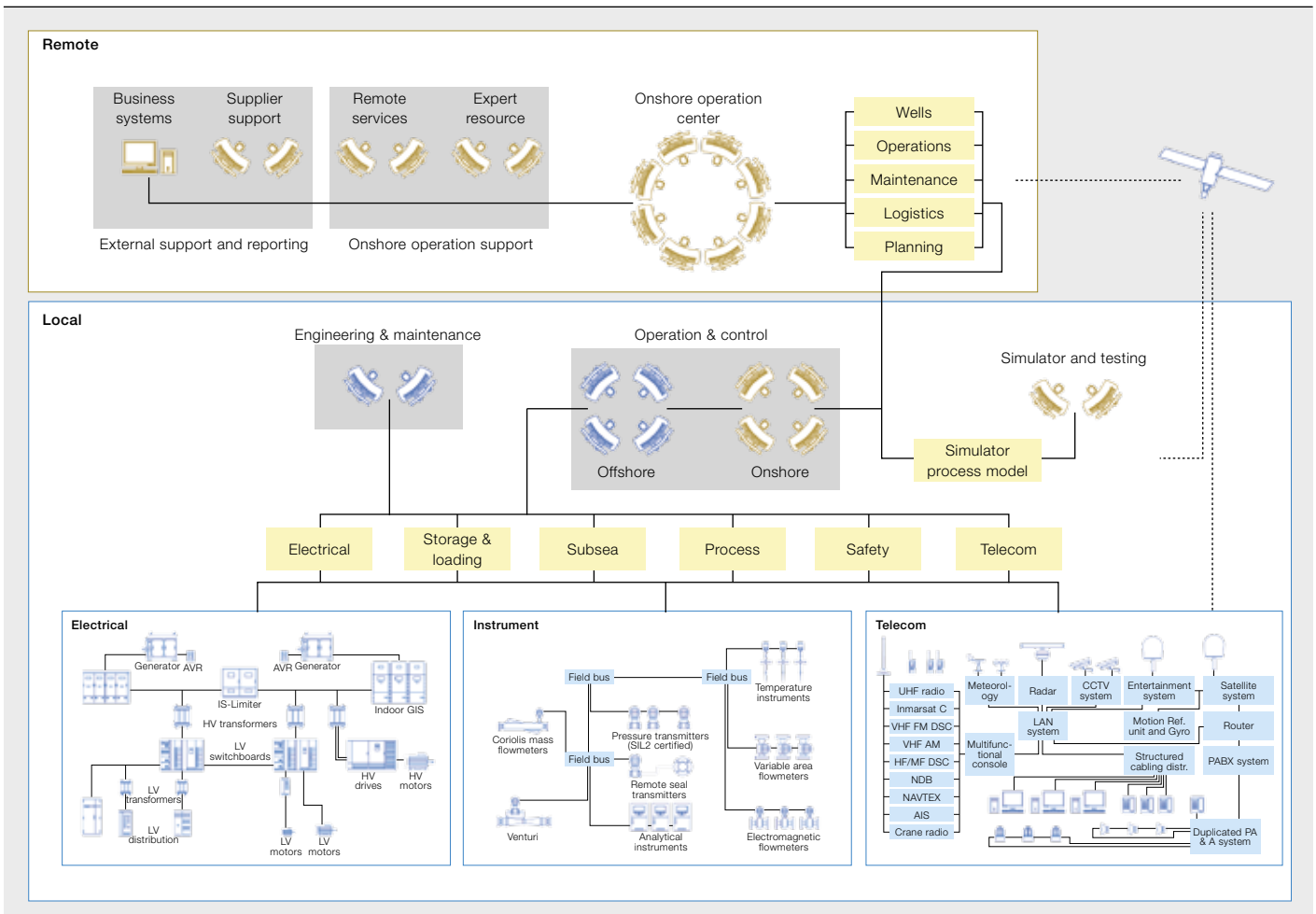
- ICT infrastructure and security
- Data capture and access, including software applications for remote support
- Production and operation intelligence and optimization
- Condition monitoring, diagnostics and reporting

ABB intends to be a lifecycle partner and integrated system vendor in this context. Integrated Operations Products and Solutions Center has developed solutions and support offerings that supplement both third-party and ABB technologies for upstream oil and gas use, in particular for offshore and subsea operated assets. To fully benefit from these offerings, multidisciplinary team thinking is required as well as knowledge and training in petroleum technology and operation.

The solutions specific to the oil, gas and petrochemicals industry cover areas such as:

- Production and process optimization and control
- Safety integrity and alarm management
- Integrated systems for remote control and operation
- IT security and communication network infrastructure
- Condition monitoring systems and services
- Emission monitoring and energy efficiency improvement
- Multiphase flow assurance and optimization
- Subsea intelligence
- Data capture and storage and collaborative work environments
- Process control performance lifecycle services
- Wireless sensor systems

2 Remote support and IO are enabled by proper asset infrastructure and facilities design. In particular, integration of the instrumentation, automation, information and communication technologies (ICT) with the operation and maintenance management systems is critical.



Integrated Operations: the benefits

Added infrastructure investment cost is generally paid back in the operational phase. The value potential of IO can be summarized as:

- Increased production (3–5 %).
- Reduced production losses, deferment or Increased Oil Recovery (20–40 %).
- Reduced operation and maintenance costs (15–30 %).
- Improved safety through risk reduction and improved work environments; logistics and transport benefits.
- Reduced emissions, better energy efficiency and improved environmental surveillance and marine operations monitoring.

ICT and system topology

The principal components in a system facilitating Integrated Operations for an offshore operated asset comply with the ISA 95 Level 5 hierarchy standard → 3:

- An efficient historian and data integration infrastructure with associated connectivity and interface

solutions to gather and distribute all relevant data.

- An efficient and secure IT and communication networks infrastructure that facilitates remote access, monitoring and collaborative support.
- A comprehensive asset management system giving both maintenance and performance measures of all key systems and processing units.
- Daily operations and optimization applications.
- A common user interface.
- Collaboration rooms and workstations.

In addition to these technical components, associated work processes, appropriate operational philosophies and an organization with a mindset and culture suited to Integrated Operations are all required to fully exploit the opportunities provided by Integrated Operations. Cross-disciplinary decision-making processes and collaboration between different parts of the organization, or even between the operating company and

suppliers and service providers, are all essential ingredients.

Some ABB highlights in the areas of production optimization, asset management

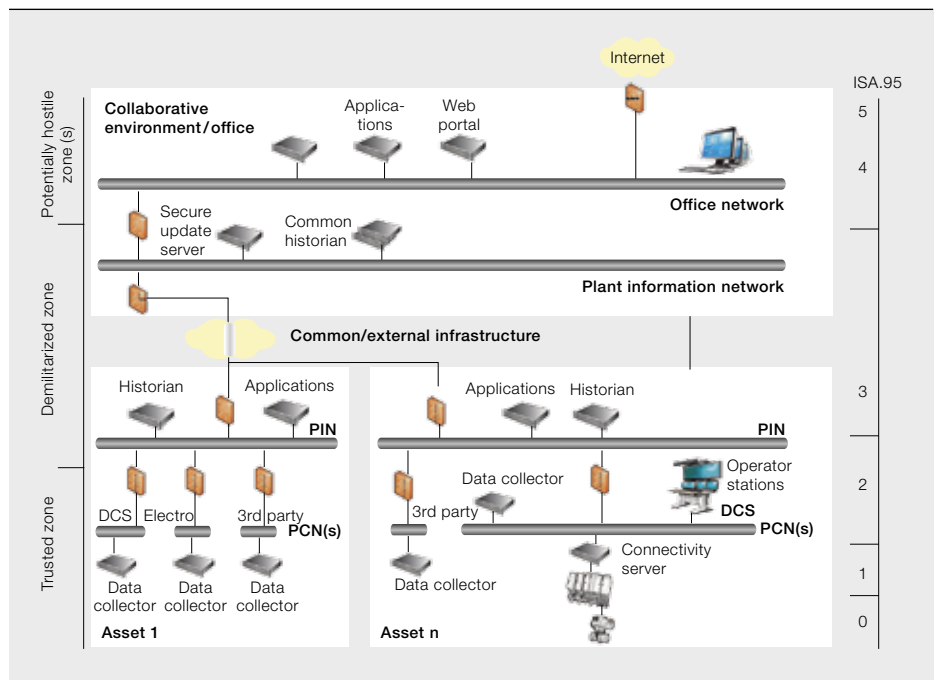
Integrated Operations is a subset of solutions, methodologies and services targeted at increasing oil & gas production.

and safety may now be described in more detail.

Production optimization

Subsea developments are becoming ever more important for the upstream oil and gas industry, both in deepwater

3 Principal IT topology showing layers of integration related to ISA.95.



and for tying-in smaller fields to existing infrastructure to make up for production decline. One of the main challenges to subsea field operation is production optimization; reservoir recovery for subsea developments are typically 10–15 % below that of platform wells, for example.

The Flow Assurance and Optimization System (FAOS) is an ABB control, monitoring and optimization and flow management product. The key components are:

- Control: ABB’s patented Active Flowline Control (AFC) controls and stabilizes wells and pipelines to ensure stable and uninterrupted production. AFC also very accurately controls wells and pipelines during well test, thus providing invaluable information for production optimization. AFC’s other control functions include protecting wells against rapid pressure changes during start-up and protecting downstream equipment against overload.
- Production monitoring: Well and pipeline monitoring is of vital importance, especially in preventing blockages due to hydrate formation. Apart from these frozen mixtures of hydrocarbons and water, there is also a wide range of other detrimental flow phenomena, such as wax formation, deposition of solids and slugging, that must be guarded against. Real-time

mathematical models can predict many of these problems as well as provide inputs to production optimization programs.

For simpler cases, ABB has its own model-based Well Monitoring System (WMS) for monitoring pipelines and wells. This is based on steady-state models and can be used to calculate production rates throughout the system as well as warn of potential flow problems. For more complex systems, where dynamic behavior can be of great importance, OLGAs Online, the leading multiphase flow simulator (delivered by ABB’s collaboration partner SPT Group) should be utilized.

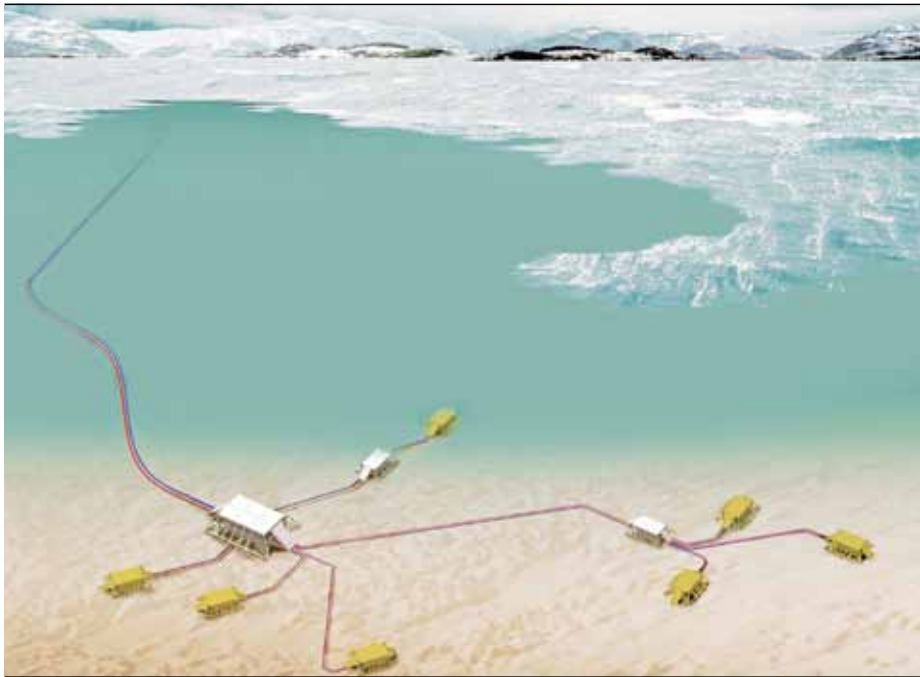
- Optimization: With control and monitoring functionality in place, optimization, utilizing both primary (physical) and secondary production measurements, can proceed. Optimization strategies range from targeted solutions, for example gas lift optimization, to generic model predictive control solutions, such as ABB’s “cpmPlus Predict & Control”. For optimization on longer timescales, production monitoring can give invaluable inputs to reservoir simulations (Eclipse) and optimization.
- Maintenance management: Due to the severe consequences of any equipment error and the expense of intervention with ROVs or workover

vessels, seabed equipment maintenance requires careful planning. Therefore, timely detection of emerging faults and maintenance requirements can be a critical success factor. FAOS provides extensive tools to ensure optimal maintenance management.

FAOS delivers all the above, and more, in an integrated system. This ensures that the synergies between the various elements are fully utilized. For example, virtual measurements from the monitoring system can be used as (secondary) control variables by AFC. Also, AFC can serve as the implementation platform for the set-points sent from the optimization module. Furthermore, such integration ensures a unified user interface, for both a quick overview of key data and for detailed analysis by expert users. FAOS resides within ABB’s integrated operation infrastructure and all information can be accessed through the client’s corporate network.

As regards client data security, ABB offers a comprehensive set of security consulting services that focus on protecting the confidentiality, availability and integrity of the local asset information and automation system network. Corporate, national and international standards are adhered to and good technical and procedural solutions are developed. Also

4 Predictive maintenance is increasingly seen as key to cost-efficient operation of complex assets, like these subsea production units.



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offered are standard pre-packaged security solutions to help establish baselines for addressing the risks associated with plant automation systems.

Asset management system and lifecycle services

Predictive maintenance is increasingly recognized as the key to cost-efficient maintenance → 4. The method implies that maintenance operations are managed according to reliable prognosis of the equipment wear and tear. Predictive maintenance also ensures the reliability and integrity of the equipment. This is particularly appreciated at offshore and remote installations where personnel and travel costs are considerable. The method also provides cost reduction by reducing unplanned downtime, allowing operation closer to the design limit and by facilitating more structured maintenance planning. A key to condition-based maintenance is real-time monitoring and reporting technology.

ABB's Integrated Asset Management system provides a common infrastructure to integrate maintenance data from individual systems. All major ABB electrical, instrument and control and telecoms systems components are available with intelligent monitoring and diagnostics functions suitable for inclusion in the Asset Management System. Long-term monitoring functions deliver important

information on equipment status, tasks due and possible performance improvements. Third-party systems can also be integrated.

The Asset Management System allows real-time access to these functions, supports monitoring and diagnostics and integrates planning and enterprise-wide ERP connectivity.

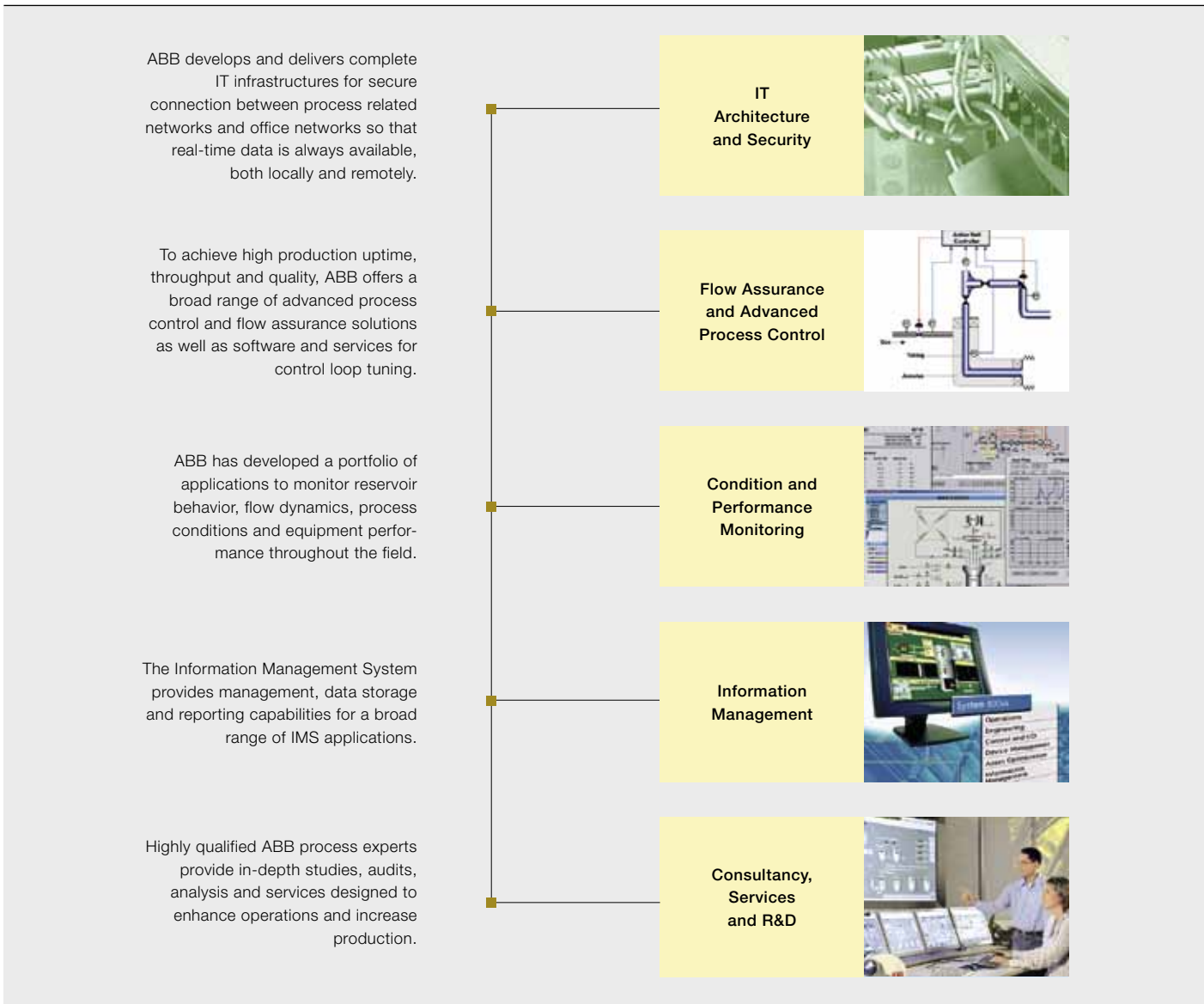
The main advantage lies in the ability to display all relevant maintenance data in a uniform user interface. This allows for more informed decision-making as overlapping monitoring functions can easily be compared.

Safety

ABB has a complete portfolio of lifecycle solutions and service offerings within the area of safety and alarm management, including awareness training and performance benchmarks, improvement projects and services, reporting applications and system maintenance as well as integrated safety and control system installations. These all follow industry standards and best practices.

Importance of the "soft factors"

Integrated Operations experience so far has indicated that organizational change and the mindset of individuals, especially as they strive towards acquiring new knowledge and skills, play a critical role



Predictive maintenance is increasingly recognized as the key to cost-efficient maintenance.

in the success of the enterprise. In fact, more than 80 % of the effort involved resides in this area.

Swallowing your own medicine

The drive towards Integrated Operations has changed ABB too. ABB Services itself is adapting to this shift in the industry via client partnering and the adoption of new service concepts, as well as improving IO-enabling products and services. New contract strategies such as performance contracts, with full-service at the extreme, are an emerging business area. Electrification and subsea intelligence solutions are other examples.

Delivering value

An early adopter of Integrated Operations saw the lifting cost of a small, tail-production North Sea field significantly re-

duced. The main contributor to reduced operational expenses and an extension in production forecast was the 'soft IO', ie organizational change, which was eagerly embraced by staff keen to see their facility have a longer life. ABB was a partner for the operator in the whole change program, conducting interviews and handling change management in addition to installing enabling remote operation support technology. Since then, this very significant customer has established standard work processes, roles and responsibilities and introduced a new off-shore organizational model based largely on this pioneering work.

More recently, work carried out by a team specializing in process and production optimization from ABB Integrated Operations has made a big impact at the Shell Ormen Lange facility in the areas of pro-

cess control performance services, simulation and tuning, commissioning and startup support. Benefits were delivered in terms of on-stream days, less fluctuations, energy efficiency and reduced emissions. Uptime was “increased by four to five days per year”. The magnitude of the financial savings here can be guessed at by taking into account that, at its plateau production, Ormen Lange will process some 20 billion standard m³ of gas per annum – equivalent to Norway’s entire energy consumption.

Statoil, too, has benefitted from ABB partnering and technology development targeting production optimization: following an Integrated Operations initiative to improve sand management at the Gullfaks field in 2003, \$300 million was added (15,000 barrels per day of the retention volume). In 2004, a further \$190 million was added (3.8 million barrels). A key factor was the establishment of an erosion management system based on process and production data combined with choke models allowing active

In the Ormen Lange facility uptime was “increased by four-to-five days per year”.

sand control. Statoil reported further, in SPE 94511 [1]: “During 2004 a total of \$95 million (1.9 mill. barrels) of additional revenue was achieved on the Statfjord field.” These immense sums are based on a \$60/ barrel oil price; more recent Integrated Operations successes are valued considerably higher. The safety gain of having more accurate sand monitoring and erosion estimates, and adapting the permitted sand to various well conditions, is invaluable in itself for such a mature field. This is an excellent example where the combination of enabling technology and actual operational change adapting to a new strategy have delivered value.

Integrated Operations for the future

ABB’s portfolio for enabling Integrated Operations → 5 is tailored to increase throughput, decrease energy consump-

tion and decrease the cost of operation by advanced use of available data, such as real time process data and asset condition monitoring. Integrated Operations provides an opportunity to significantly optimize reserve exploitation. Integrated Operations has already proven itself in financial terms and it will continue to grow in importance in the oil and gas sector as the industry moves forward.

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