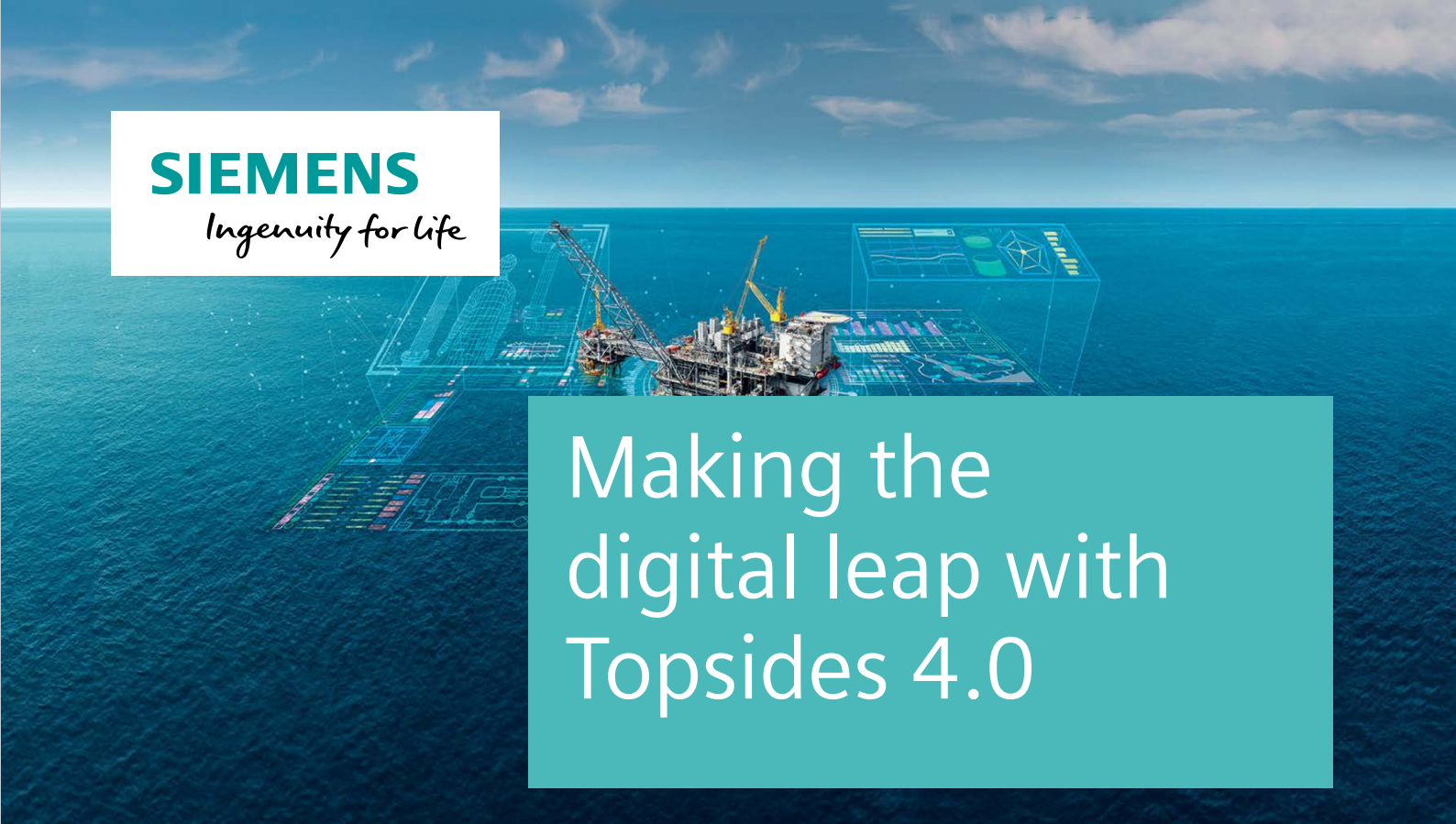




SIEMENS

Ingenuity for life



Making the digital leap with Topsides 4.0

After two and a half years of cutbacks, reduced capital spending, and project delays, a harsh reality is setting in for the oil and gas industry: “lower-for-longer” oil prices may be the new norm and companies are going to have to change the way that they do business in order to remain competitive.

This comes as the world sits on the cusp of the Fourth Industrial Revolution – a time when the proliferation of digital tools and technologies is enabling businesses across every industry to work smarter, make better decisions, and improve project outcomes. From improving patient diagnoses in healthcare, to guaranteeing on-time arrivals in rail networks, to increasing production in automotive factories, the capabilities offered by Industry 4.0 are real and they are fundamentally transforming the way businesses operate.

Despite this paradigm shift, the oil and gas industry has been slow to realize the full potential of digitalization. While an increasing number of oil and gas companies today are using digital tools to harness the power of Big Data, most are doing so as part of a bottom-up approach, where technologies are unsystematically implemented (often at the plant level) and have little if any impact on operating or business models.

While the current downturn in the oil and gas industry is certainly a partial contributor to the industry’s slow growth in adopting digitalization due to constrained capital budgets, the overall conservative nature of the industry and its risk-averse culture is also a contributing factor. The time for change, however, is now as the industry has reached a tipping point. The need to improve productivity and achieve further cost reductions in the sustained low-price environment is creating significant opportunities for companies who embrace digitalization.

It is no longer a question of *if* the industry will undergo full-scale digital transformation, it is a matter of *when* – and early adopters are those poised to benefit most.

A digital roadmap for offshore oil and gas

In the offshore oil and gas sector there has been much talk surrounding the opportunities presented by digitalization. However, the industry has largely failed to deliver a comprehensive solution that enables operators to address the challenges they face, such as high capital and operating costs, and long cycle times.

Recognizing this need and drawing off its extensive software suite and deep expertise in data analytics, Siemens developed Topsides 4.0 – the industry's first comprehensive digital solution for offshore oil and gas production.

Siemens has a long-standing track record of helping customers in oil and gas and other industries harness data to enhance efficiency and reduce costs. With Topsides 4.0, that experience is being applied in the offshore environment.

Topsides 4.0 is a digital lifecycle approach that begins during the conceptual and design phase of a project with the development of a comprehensive digital roadmap. It is during this time that Siemens evaluates how the operator is using data, where the gaps are, and how best to fill them. With that knowledge, Siemens then collaborates with the operator and tailors a solution to their specific needs.

Overall, Topsides 4.0 is designed to reduce capital and operating expenses, shorten project development cycles, minimize interfacing risk, and decrease offshore labor requirements. This is achieved by enabling advanced capabilities, such as enhanced design, testing, manufacturing, and lifecycle maintenance through advanced virtualization (i.e., creation of digital twins); remote monitoring and pre-emptive maintenance of mission-critical equipment; and cybersecurity.

The digital twin is a software model that not only mirrors the status and working condition of the offshore asset in

near real-time, but also behaves like its real-world counterpart. In doing so, it gives operators the ability to perform design and testing in a risk-free environment and serves as an invaluable tool for lifecycle decision-making support and asset optimization.

With Topsides 4.0, an intelligent digital twin is constructed in parallel to the physical topsides during the design and build phases of the project. It consists of two main components: a process twin and a plant twin.

The process twin is a digital replica of the process and automation system that enables testing of the process and control infrastructure, safety logic, and operating procedures before start-up. The plant twin is a smart 3D viewer for the entire topsides that provides access to equipment, maintenance, and real-time operations data for construction, commissioning, and maintenance planning.

These tools provide operators with the capability to run virtual what-if scenarios on the asset and better understand the impact of different operating conditions on the process, equipment, and maintenance.

The digital twin's intelligence derives from the capability to interpret raw data through a variety of analytics, some of which are automated and others that are offered as an OEM service. The automated analytics are independent of equipment vendor and based on statistical analysis of real-time data from the instrumentation and automation system. For critical equipment like compressors and turbines, Siemens supplements this layer of monitoring with OEM-connected services for predictive diagnostics, spare parts management, and outage planning.

The harnessing the power of the digital twin

The digital twin is more than a design tool; it's more than a punch list of parts to fabricate, and it's more than the 3D model. It's the joining of the physical and digital worlds as



The new age of oil and gas requires smart technologies and sustainable solutions.

the asset moves through the three phases of a project: design and configure, build, and operate.

Phase 1: Design and Configure – The entire project lifecycle benefits from the digital twin, beginning with the client's planning process and then moving into design and configuration.

Core to the digital twin is a central data hub of all project knowledge. The more data that is ingested by the model, the more accurate it becomes. The configured compressor, gas turbine, E-house, or module can be seen on-screen. This ability to configure and interact with the asset provides significant advantages, such as the ability to change configuration or arrangement as well as visualize equipment maintainability, footprint, and overall dimensions. It also creates value by allowing operators to change operating conditions and see the resulting performance in a matter of minutes. It also drives cost optimization before the project moves into the build phase, and long before the operate phase, where the majority of optimization takes place.

Additionally, the digital twin eliminates design, engineering, and manufacturing silos, bringing the project workflow together. It allows clients to design and configure their solutions concurrently, which reduces cycle time from six to nine months, or even up to a year – down to weeks.

The savings clients achieve in this first phase are measurable in terms of reduced engineering costs and lower CAPEX because they can quickly and accurately change configurations and optimize the solution to minimize total installed costs.

Phase 2: Build – The digitalization of the first phase of the project also minimizes the risk of hand-off mistakes and expensive changes as the project moves into the build phase. It is in this phase when the facility enters production and manufacturing and where the digital world joins the physical world.

Because the digital twin represents the engineered solution, production cycle times can be greatly reduced. Project schedule risks decline as well, and perhaps most importantly, commercial operation can begin sooner, thus allowing clients to generate return on their investments faster.

During the build phase, Siemens interacts with clients on a digital platform via progress reports, virtual inspections, and document / drawing reviews and approvals. Virtual test witnessing is also available. More important, however, is the ability to start up the plant on the digital twin and fully train field and control room operators in their tasks before setting a foot on the actual topsides facility.

Phase 3: Operate – By the time the project is ready to move into its operational phase, the digital twin is already integrated with configuration, design, manufacturing, and other project data, including the baselines from factory testing, bills of material, spare parts, and O&M documentation. Moreover, it continues to receive data as the asset is operating and maintained.

During this phase, design and build engineering data residing in the digital twin is leveraged and used to apply in-depth analytics to the actual operational data. This gives clients the capability to monitor changing site conditions, predict equipment failures before they occur, plan outages, manage inventories, and optimize equipment performance. They can also model how the equipment will perform if site conditions change (i.e., flows, pressure, temperatures, gas composition).

Real-world benefits

The foundation of Topsides 4.0 is the workflow and data integration of solutions that Siemens has successfully delivered to the oil and gas industry over many years. Although the integrated approach is new, the digital solutions that comprise it have a strong track record of success.

Some of the real-world benefits that mid-size FPSOs (100k barrels per day) can see from embracing the Topsides 4.0 approach include the following.

Shorter Project Development Cycles – Using configurators and engineering templates, Topsides 4.0 allows operators to develop an industry-compliant solution from user requirements, without the need for a full functional specification.

Additionally, through digital engineering and fabrication of equipment, the delivery time of long lead items such as rotating machinery is significantly reduced. Developing a digital twin of the topsides facility also enables clients to virtually test and commission their topsides before construction of the actual facility is complete. All of this results in a faster time to first oil and a three-to-nine-month reduction in project cycle time.

Reduced CAPEX – Topsides 4.0 helps reduce CAPEX by enabling operators to evaluate more design scenarios during the conceptual phase and identify a configuration that maximizes return on investment throughout the life of the field. Furthermore, automation designs that support remote control and monitoring means smaller offshore living quarters, while virtual commissioning reduces yard and offshore commissioning costs. This can generate CAPEX savings to the order of \$10 - \$15 million.

Reduced OPEX – With Topsides 4.0, Siemens maintains the facility's digital twin by continuously monitoring engineering and maintenance data, providing clients with visibility of their equipment and asset performance in near real-time. Engineers always have access to as-is asset data and can plan maintenance campaigns based on condition monitoring analytics.

Additionally, the integrated control and safety system solution is designed for remote control and monitoring so that clients can improve safety and reduce costs by shifting labor resources from offshore to onshore. All of these benefits combined can reduce OPEX by more than \$100 million over a 10-year period.

Improved Safety and Performance – Topsides 4.0 enables companies to train operations and maintenance (O&M) personnel well before the asset is on location. This is made possible through a virtual “walk inside” of the topsides facility. Clients can locate valves, panels, and process equipment like coolers, separators, and filters in the digital twin and familiarize themselves with the switchgear and other electrical equipment. The opportunity to run various simulations and conduct “what if” scenarios ensures that O&M personnel will react in the safest and most productive way when they are working onsite.

Minimized Interfacing Risk – Siemens takes responsibility for the integrated control and safety system (ICSS) of the entire asset and natively integrates third party package controls into its ICSS system. This minimizes interfacing risk, shortens testing and commissioning time, and reduces spares holding and maintenance cost. Integration also provides the capability to operate and maintain the ICSS for the entire topsides, which is a key enabler of remote operations.

Safe and secure remote operations

The digital revolution has led to significant performance improvements for producers who are harnessing data-driven solutions; however, despite the largely positive developments, connecting critical equipment to cloud-based platforms does mean that the oil and gas industry must be prepared to respond to an evolving security landscape in which cyber threats are the norm. This is particularly critical when extending the operation of the platform to an onshore location, as is the case with Topsides 4.0.

A key differentiator of Topsides 4.0 is that all electrical, instrumentation, control, and telecommunications (EICT) systems and equipment are integrated into one solution. The EICT design establishes a secure, reliable, and scalable system backbone and architecture to enable safe operation of the topsides facility from an onshore control center.

This enables companies to adopt low offshore manning strategies, thereby reducing the CAPEX associated with the provision of larger living quarters, as well as the OPEX of offshore allowances and transportation. It also reduces the number of offshore resources for performing important functions, from daily production and maintenance, to reporting, procurement, logistics, services, and more.

Changing the culture

Although Industry 4.0 has the potential to produce unparalleled value for the oil and gas industry, organizations will first have to change the way they go about adopting digital initiatives.

The piecemeal approach of deploying standalone digital tools that is prevalent throughout the industry today will have to be replaced by more holistic strategies that originate from the top of the organizational hierarchy with C-suite executives. Companies will have to fundamentally change the way they view “business as usual” and strive to

create a corporate culture that puts innovation and technology adoption at the forefront.

Commitment and willingness from decision-makers to collaborate with vendors across the entire supply chain will also be required to deliver on the promise of digitalization. It will also require a combination of clients’ domain expertise, along with partners’ knowledge of products, automation, software, and data analytics. Getting to the point where oil and gas companies feel comfortable sharing data in a secure but open ecosystem will be critical as the industry forges ahead with Industry 4.0.

At the same time, it is critical that whatever digital, cloud, or big data infrastructure that operators choose to deploy is open and scalable so that many different stakeholders can contribute and the digital framework can grow and improve as new technological opportunities arise.

Only the beginning

“Lower for longer” oil prices are forcing the oil and gas industry to step back and re-evaluate the way that they do business. In the midst of this, one thing is becoming clear: digitalization is not a passing trend. It will forever change how companies work internally and how they engage with suppliers and customers.

It is also fundamentally transforming contracting and business models, bringing clients and service providers closer together through strategic partnerships.

Oil and gas companies today should not view digitalization as an IT initiative, but rather a business transformation initiative enabled by IT. Because of this, digital solutions need to be customized to strategically align with the operator’s business drivers, level of in-house expertise and how far along they are in the digital transformation process. As the oil and gas industry is only at the very start of the digitalization S-curve and no one can fully foresee how it will shape the industrial world in the future, these will change over time and the operator’s digital solutions should evolve accordingly.

Adopting digitalization, therefore, is not about purchasing a one-off solution – it is about clients embarking on a journey with strategic partners to make their businesses more competitive in the real world, by continuing to take advantage of advances in the digital world.

With Topsides 4.0, Siemens aims to help the oil and gas industry achieve that by responding to the challenges of the Fourth Industrial Revolution.

Case Study

Topsides 4.0 – the solution is virtual, the benefits are real

While the integrated Topsides 4.0 approach is new to the offshore sector, the components that comprise it have a strong track record of delivering real-world benefits in a wide range of industries, including oil and gas. One of these components is COMOS – Siemens integrated plant information software – which serves as the central engineering data hub for the topsides facility.

In 2010, Siemens implemented COMOS software on a semi-submersible floating production system in the North Sea. The initial scope of work involved the migration of roughly 120,000 documents from the operator's project information management (PIM) system into the COMOS platform. It also included the conversion of more than 600 piping and instrumentation diagrams and 5,000 instrumentation loop diagrams from PDF format into intelligent data files. This allowed for piping and instrumentation diagrams (P&ID) to be generated whenever they were required -- similar to the way electronic map software can create a map from a live database.

Today, the COMOS software is still used to plan, organize, and track maintenance work on the platform. The system manages all work orders, including inspections and modifications to work orders. The software generates roughly 70,000 maintenance work orders annually. It also generates reports and calculates key performance indicators (KPIs), which can be used for intelligent decision-making. In addition, the COMOS platform stores information about maintenance events. From 2010 to 2015, the system stored 18,000 events on the platform, including malfunctions, temporary repairs, program changes, and modification proposals.

COMOS Walkinside

The COMOS system contains 130,000 tags (i.e., lists of information about pieces of equipment). The operator's modification contractor and instrumentation contractor can directly update the master database, allowing them to use the data in numerous ways – for example, to generate 3D virtual reality models of the platform using COMOS Walkinside.

COMOS Walkinside allows operators to create a series of real-life scenarios in which employees can literally see and experience the tasks they will be required to perform. They can virtually look around, listen, practice, and learn operational procedures at zero financial or physical risk to themselves or the operator.

For example, maintenance personnel can view in a 3D digital space where equipment is located, if it is accessible from the floor, or if scaffolding or a crane is necessary. Using the link with the COMOS platform, they can directly access equipment characteristics, maintenance history, and documentation by clicking through on the equipment in the 3D view. Similarly, if an engineer is working with the engineering and maintenance database, he/she can click through to the 3D view of the equipment and see the spatial context of locations where work permits are issued and risk factors like hot surfaces.

Getting tangible results

As one of many components that make up Topsides 4.0, the COMOS software system provides critical support to engineering, operations, and maintenance throughout the entire lifecycle of the platform. In doing so, it enables operators to make intelligent decisions based on up-to-date plant information. It also allows operators to ensure that regulatory obligations are fulfilled at all times and minimizes exposure to health, safety, and environmental risk.

"From the very outset of the development of Topsides 4.0, the emphasis was on bottom-line gains that could be measured and quantified in concrete ways," said Elgonda La Grange, Director of Digital Solutions at Siemens. "The COMOS software helps us achieve that by serving as the central engineering data hub for the asset, which is a key enabler of digitalization. Overall, the benefits companies are seeing from adopting Topsides 4.0 have been significant. It really is proving to be a game-changer for offshore oil and gas production."

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