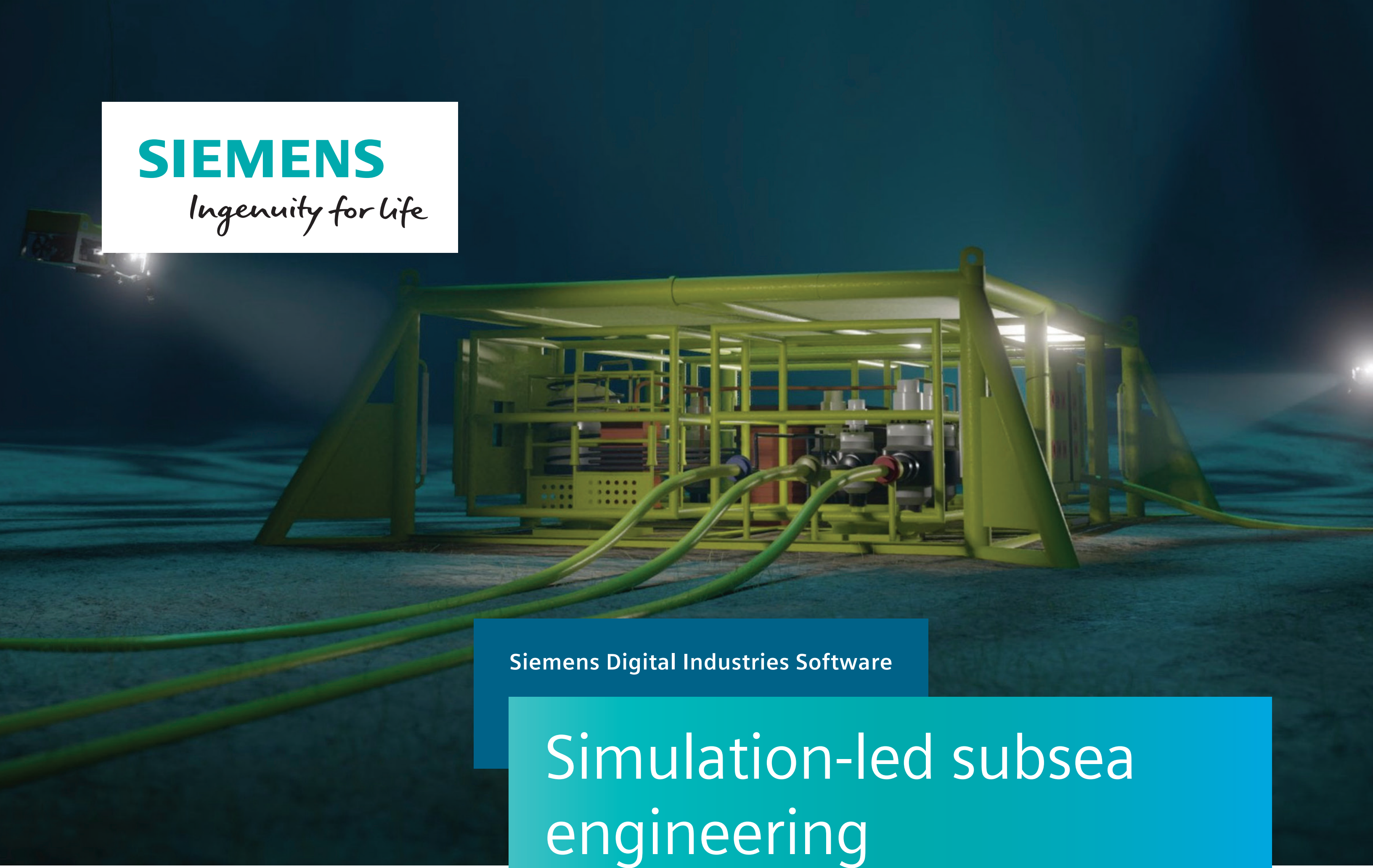

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Siemens Digital Industries Software

Simulation-led subsea engineering

Using a digital twin to enable safe, reliable and efficient design and operation

Executive summary

Subsea engineering and production present some of the most complex engineering challenges in the energy industry. Deepwater, harsh offshore environments and complex operating conditions make design, installation and reliable operation even more challenging than for onshore or platform-based systems.

In this white paper we look at the role of engineering simulation across a wide range of aspects related to the full lifecycle of subsea equipment and facilities throughout the operating life.

Having the ability to predict how a system will behave, function and operate enables engineers to make informed decisions, delivering improved designs and enabling safer, more reliable and cost-effective operations.

From system level to high-fidelity, physics-based predictive analytics, the importance and value of multiphysics simulation approaches must be embraced to maximize the value of the comprehensive digital twin.

Contents

Abstract

The design, installation and operation of subsea production systems present some of the most complex engineering challenges faced in the energy industry.

In this white paper we discuss challenges faced by subsea system, flow assurance and production engineers and show how simulation and predictive analytics are critical components in both design and operation of these complex engineered systems.

Subsea systems

Subsea developments typically refer to oil and gas production equipment (and sometimes processing equipment) that is physically located on the seabed, as shown in figure 1. Systems will typically comprise a subsea production and processing system connected to an offshore floating facility by pipelines and risers. Subsea production systems and offshore floating structures designed to act as production facilities are some of the largest engineered structures and once installed need to be able to operate safely and efficiently for many decades in harsh and hostile environments.

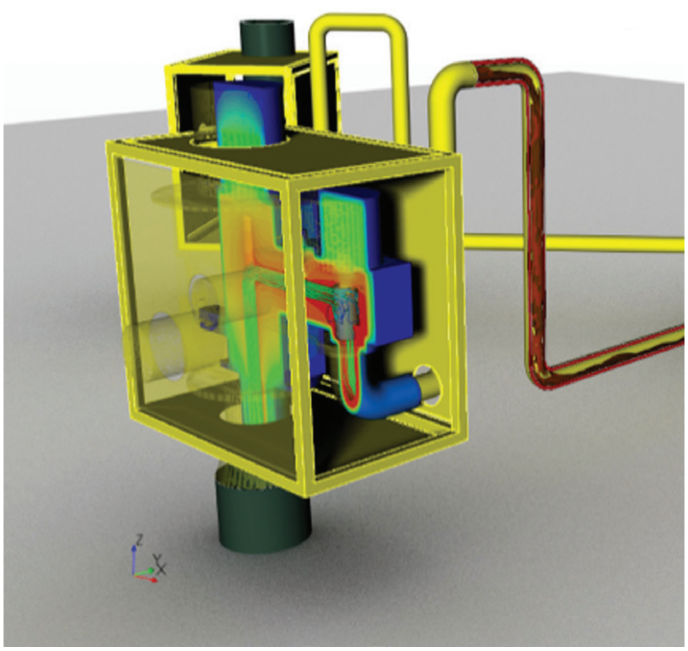


Figure 1. Simulation of subsea tree and jumper.

Advanced engineering simulation

Advanced engineering simulation is the application of mathematical models based on scientific first principles. These approaches offer engineers predictive tools that enable understanding and provide insight using a comprehensive digital twin of the system, product or component being designed or operated.

Based on the fundamental principles that govern the physical world around us, advanced engineering simulation enables us to predict real-world phenomena. Advanced engineering simulation can cover:

- Fluid and multiphase flow
- Heat transfer
- Structural behavior and response
- Acoustics and vibration
- Electrical and control systems
- Chemical reactions
- Material behavior and characteristics

There are a wide range of simulation approaches and levels of fidelity that can be applied, from system simulation to high-fidelity 3D simulation. The greatest value of advanced simulation is obtained when engineers have access to multi-fidelity and multiphysics tools covering the spectrum of their needs.

Multiphysics system simulation approaches need to enable engineers to rapidly build, assess and configure flow, hydraulic, piping and electrical or control systems. High-fidelity simulation approaches like computational fluid dynamics (CFD) and finite element analysis (FEA) are needed when greater detail is needed either to guide design decisions or to inform operations – situations where having the ability to capture complex multiphase flows, thermal phenomena and structural behaviors is critical.

From simulation-led design to operational excellence

In this white paper we will discuss many applications relevant to specialist subsea equipment designers, flow assurance specialists, systems engineers and operational teams.

Whether working in early concept, detailed design or operations, the value of advanced engineering simulation is clear.

Multiphase and multiphysics simulation

Complex flows require high-fidelity simulation

Multiphase flows are common in subsea production. They present many design and operational challenges, ranging from integrity issues presented by liquid slugs damaging pipework to ensuring efficient handling of multiphase flows in pumps, boosting and separation systems.

Throughout the life of a subsea well, the proportions of oil, gas, water and sand produced may vary signficantly. This means that design and operation of a subsea production and process system will need to account for many multiphase flow regimes and challenges. Simulation of such complex phenomena needs to be able to deal with this variation.

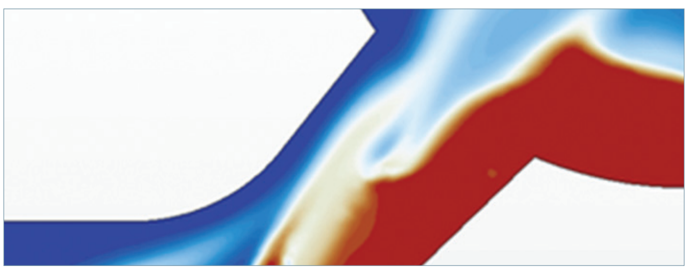


Figure 2. Stratified flow with liquid interface breakup and entrainment.

Simulating multiphase flow regimes

The value of multiphase flow simulation can only be realized if engineers have the tools available to simulate the full range of complex flows in complex operating environments and systems.

System simulation can be used in some cases, but for high-fidelity simulations of multiphase flows, CFD is needed as it is based on the governing equations of fluid flow.To date, there is no single multiphase model capable of predicting all flow regimes. Simcenter™ STAR-CCM+™ software, which is part of the Xcelerator™ portfolio, the comprehensive and integrated portfolio of software and services from Siemens Digital Industries Software, provides a comprehensive range of models that can be used together to simulate multiple flow regimes and, critically, the transitions between them. The breadth of models and ability to combine these transforms the value of a CFD-based approach. The volume-of-fluid (VOF) approach provides the ability to capture the behavior of immiscible fluids at any scale while Eulerian multiphase models enable simulating interpenetrating and reacting fluids and phases.

Lagrangian methods are most efficient in simulating discrete droplets or solid particles dispersed in a fluid while discrete element methods (DEM) enable non-spherical particles and particle-particle interactions to be captured. Other approaches like mixture multiphase, dispersed multiphase and cavitation models and liquid films offer computationally efficient approaches to capture complex flow phenomena. In Simcenter STAR-CCM+ many multiphase models have additional functionality to enable complex phenomena like boiling, freezing, reactions, breakup and coalescence to be captured.

One of the major developments that has transformed how CFD methods can be applied across a range of applications is the ability of multiphase models to interact. Multiphase flows rarely occur in isolation and traditionally, many CFD simulation solvers have had to focus on capturing a specific flow regime or phenomena in a simulation. Recent developments are transforming this by capturing the transition between different flow regimes.

Using Simcenter STAR-CCM+ enables the application of multiple multiphase models together in a single simulation to better capture real-world multiphase flows and transitions.

This technical capability and flexiblity enables the application of the highest fidelity simulations or combination of several models to cover all flow regimes. This has been shown to be critical in a number of real-world applications as discussed below.

Developments such as this are enabling engineers to apply simulation to a wider range of applications and deliver ever-greater value across design and operation of subsea production and process systems.

> *"From a modeling standpoint the largest technological leap has been the validation of a proven reliable model to predict multiphase flow behavior."*
>
> *Henrik Alfredsson*
> *Aker Solutions*

Multiphase with multiphysics

In subsea engineering, multiphase flows are commonly one part of a broader technical challenge, which may combine multiple physical or chemical phenomena. These multiphysics challenges often involve multiphase flows combined with other behavior such as structural interactions, adding greater complexity.

We discuss a number of applications in later sections for when multiphysics simulation is required to capture the full problem. The Simcenter suite provides a complete range of tools to enable multiphysics simulation. The use of Simcenter STAR-CCM+ is focused on offering solutions to multiphysics problems; for example, high-fidelity multiphase flow together with other physics such as fluid-structure interaction and thermal design challenges, which are highly relevant to many applications, including:

- Multiphase pumping
- Flow assurance
- Offshore floating structure design
- Flow-induced vibration assessment
- Subsea structure installation

Having the ability to simulate both the complex multiphase flow and structural response in the same simulation marks a step-change in the role of simulation for many applications from floater design to flow-induced vibration.

Multiphase simulation for real-world challenges

Simulation offers a digital means to test ideas, rapidly develop new designs and explore operational decisions in a virtual or digital world. In subsea, this is especially important since physical testing is complex, time-consuming and costly, not to mention often impractical due to working temperatures, pressures and fluids. However, to rely on simulation-based design or operating decisions, we need confidence in the data obtained.

Simcenter STAR-CCM+ is used by Aker Solutions due to its ability to accurately predict the complex multiphase flows. One example of this was in an operational challenge involving subsea production flows.

A simulation approach was needed to predict flow splits in a subsea compression manifold. Flow distribution was critical to understanding whether the system operated within its intended envelope as the field aged into late life.

Aker Solutions demonstrated that it was critical to accurately predict the changing droplet sizes through the system to correlate field data with simulations, a challenge met with the multiphase S gamma model in Simcenter STAR-CCM+.

The image below shows volume fraction of gas condensate within the manifold for one case simulated. Aker Solutions demonstrated the ability of the CFD approach to replicate current system operation using comparisons with flow meter data before demonstrating the value of a predictive approach by simulating late field life conditions and demonstrating the manifold would operate within the intended envelope in the future.

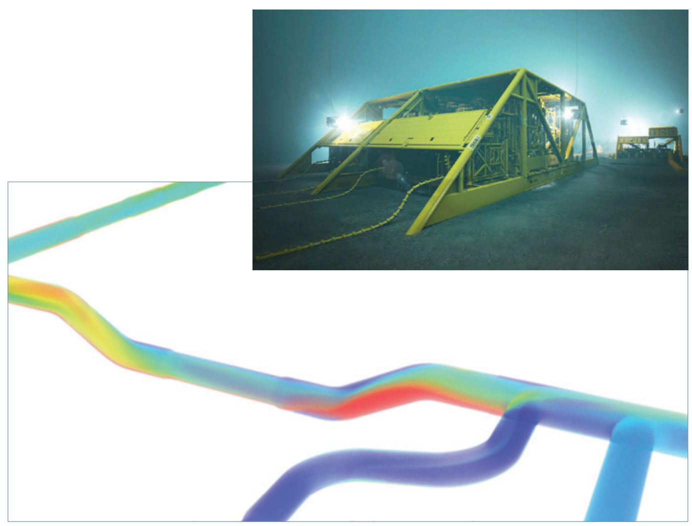


Figure 3. Aker Solutions' simulation of Åsgard subsea compression manifold.

Flow-induced vibration risk quantification

The challenge

Flow-induced vibration is driven by internal flow phenomena. It can result in lost production, unplanned shutdowns, reduced equipment life or even loss of containment. It is a complex challenge for subsea production. Having the ability to simulate both the flow-causing vibration and the resulting structural behavior is critical to minimizing risk.

Industry guidelines, such as those by the Energy Institute, assess likelihood of failure or risk from vibration using empirical approaches. They rarely enable quantitative assessments. Instead, they may refer to the need for further actions if unacceptable risks are identified, such as:

- Redesign of pipe sections at risk
- Vibration monitoring during operation
- Performing detailed analysis

Of these, detailed analysis is the only option that enables engineers to quantify whether vibration will occur, understand its extent and quantify its impact on component or system life. In addition, it is the only approach available to explore options for mitigation before design or operational changes are made.

Causes of vibration and risk identification

Flow-induced vibration of pipelines and piping can be caused by several mechanisms, including:

- Pumps and compressors
- Fluctuating flow-past objects
- Multiphase flow behavior
- Rapidly opening valves, cavitation or other large pressure variations

Advanced engineering simulations must have multiphysics capability to aid in the assessment and quantification of vibration. We need to predict the full range of complex flow phenomena along with the structural responses induced.

With predictive engineering analytics capabilities, it is now more practical than ever to simulate flow and structural responses of systems.

Fluid-structure interaction simulation

Siemens' Simcenter portfolio brings together industry-leading, fluid-flow CFD and structural FEA capabilities. Its multiphysics and multi-scale predictive capabilities enble engineers to simulate the full range of flow and structural behaviors both separately or together in a fully coupled manner.

Simcenter STAR-CCM+ integrated CFD and FEA simulation solvers are can be used to predict complex multiphase and high-speed flow phenomena as well as structural behavior and response. The multiphysics capability of Simcenter STAR-CCM+ has been applied to both subsea and topside challenges where it enables coupled fluid-structure interaction simulations to be performed in a single environment for both small deflections and large structural displacements driven by flow-induced phenomena.

If acoustic-driven vibrations are of prime concern or where flow-induced vibration (FIV) risks require complete durability assessments to be undertaken, it's important to have the flexibility to move between time and frequency domains to capture the relevant system responses. Simcenter 3D software offers industry-leading FEA capabilities from linear to nonlinear structural behaviors to complex contact. In addition, specific durability workflows have been integrated in Simcenter 3D and coupled with Simcenter STAR-CCM+, which enables time and frequency domain analysis of flow and acoustic-induced structural response and predicts durability and life of components and systems.

For larger systems, Simcenter Flomaster™ software enables system-wide flow and acoustic simulations to be performed across complete facilities and allows forces to be captured. These can easily be exported for subsequent structural analysis.

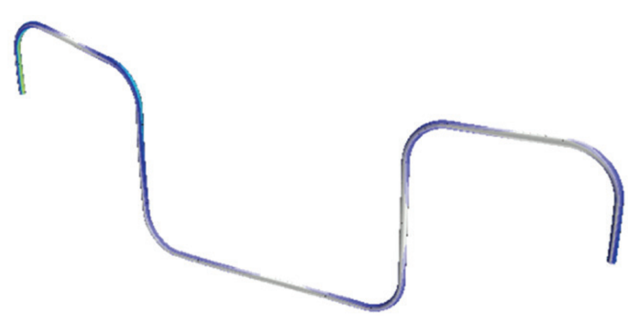


Figure 4. Multiphase flow through subsea jumper driving vibration.

Erosion prediction and management

The challenge

Erosion from sand poses significant design challenges as well as production and integrity risk to subsea systems. Using predictive engineering analytics in the form of CFD offers a high-fidelity, time- and cost-effective means of predicting the location and magnitude of erosion in a component or system.

A CFD-based approach provides unparalleled insight and data and has been used to save time and costs in equipment design and in avoiding lost production during operation. A simulation approach must cope with a range of fluid types, multiphase flow regimes and solid particle loadings. It must also have the ability to capture the range of erosion mechanisms that may be present. Simcenter STAR-CCM+ software has been developed to meet these challenges.

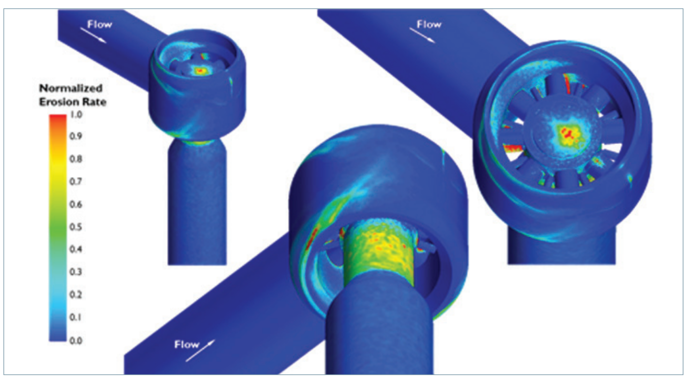


Figure 5. Predicted sand erosion rate on subsea component.

Erosion models

In a CFD erosion simulation, it is necessary to include a solid 'phase' (grains of sand, for example) in the simulation. In this way, the motion of particles moving under the influence of the transporting fluid can be predicted. Simcenter STAR-CCM+ contains a comprehensive suite of multiphase models to capture a large range of flow regimes efficiently and effectively.

Simcenter STAR-CCM+ has industry-recognized erosion models built into the code including those from DNV, Oka, Ahlert (Tulsa) and Nelson-Gilchrist. In addition, it is simple to specify user-defined erosion relationships. The Achard correlation is also implemented in Simcenter STAR-CCM+ to predict erosion from abrasive wear, where high solid loadings or low impact angles need to be taken into account.

> *"Predicting erosional wear needs simulations to be capable of capturing all of the relevant physics from multiphase flow and particle impacts to wall material loss."*
>
> *Alistair Gill*
> *Wild Well Control*

Wide-ranging operating conditions

The Lagrangian method allows an efficient calculation of impact erosion, depending on the number of particles modeled. DEM can predict impact and abrasive erosion, along with particle-to-particle collisions. For high sand and particle loadings, an Eulerian approach models the eroding particles as a continuum, so simulations can be carried out that approach maximum packing. All of these approaches are integrated within Simcenter STAR-CCM+.

Having the ability to model a full range of multiphase flows and sand loadings ensures simulations can capture the required mechanisms.

Predicting equipment life

A 'standard' erosion calculation using CFD will provide the erosion rate for a given as-built component. Is it then acceptable to assume the same erosion rate is maintained over the life of the asset or the impacted surfaces will not change form as eroded material is lost? Not always.

As a component suffers erosion, the eroded surfaces may change shape, altering the flow field to such an extent that it can impact the erosion occurring for better or worse. In Simcenter STAR-CCM+, the predicted erosion rate can be used to simulate the effect of wall material loss resulting from erosion.

This approach has been shown to be important for erosion rate in geometries with sharp corners and recirculation regions characteristic of subsea production systems. This capability enables Simcenter STAR-CCM+ to be applied to the largest number of applications.

Vortex-induced motion and vibration

The challenge

Vortex-induced motions (VIM) and vibrations (VIV) are motions induced on structures that interact with an external fluid flow, such as a current. These complex behaviors present design and integrity challenges to many fields of engineering design from bridges and chimneys to power lines and aircraft. It is a challenge in subsea engineering as well.

There are numerous areas in subsea engineering, drilling and production where VIM or VIV risks need to be addressed, including:

- Drilling risers
- Production risers and conductors
- Subsea jumpers and free-spanning pipelines
- Thermowells or other sensors in production flows
- Floating structures and platforms
- Mooring and tethering lines

The impacts of vortex-induced motions in general can be severe, presenting complex design challenges and limitations, reduced fatigue life of systems or other costly operating limitations.

The risks

VIM and VIV are driven by complex fluid-structure interaction. For a subsea riser, strong sea currents can induce the flow around them to separate and initiate vortex shedding. The resultant forces excite oscillations of the riser, known as VIV.

When the VIV frequency is close to one of the natural frequencies of the structure, a resonance phenomenon commonly referred to as “lock-in” may occur, resulting in exacerbation of the vibration amplitude of the structure – and thus its destructive potential.

Simulation of complex phenomena

Capturing this complex flow phenomena in physical testing is challenging due to reasons such as scaling of the fluids, structure and complexity of the flow conditions. Applied appropriately, CFD-based simulation is capable of predicting VIV onset; this is an area of active industry investigation regarding best-practice development and comprehensive validation with reliable physical data (in which Siemens is active).

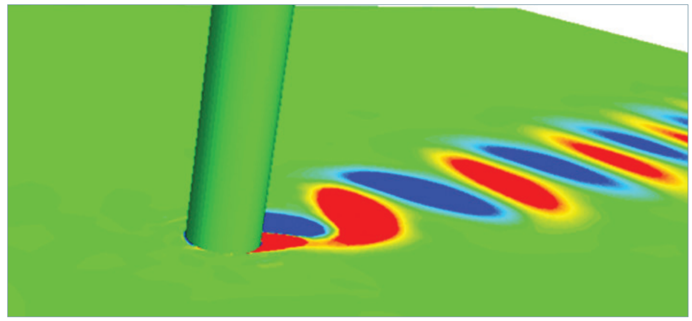


Figure 6. Simulation showing vortex shedding past a subsea riser.

It has been typical for flow simulations used to predict the likelihood of onset of vortex shedding to be performed separately from structural assessment. This approach can identify if vortex shedding and natural frequencies of the structure align, helping identify vibration risk. However, if assessing structures already installed or operating, identifying onset of VIV or VIM is only part of the solution. In such cases, we also need to predict the structural response that is induced to fully quantify the extent of the issue and the impact on the system’s life or integrity. For this we require fluid-structure interaction to be simulated.

Complex flows and complex motions

Simcenter STAR-CCM+ has the flow and structural simulation capability to capture the full fluid-structure interactions necessary to simulate both VIV and more general VIM phenomena with its integrated CFD and FE solvers. It is also possible to couple CFD from Simcenter STAR-CCM+ with external structural codes such as Simcenter 3D with data shared between the fluid and structural simulations.

For design and operation of major offshore structures such as spars or semisubmersibles, there is the added complexity of wave and wind loads to be simulated. In these cases it is possible to combine multiphase flows with structural responses and free-body motions, including the ability to add catenaries to represent moorings and other connected systems.

Managing pressure surges in hydraulic systems

The challenge

Subsea systems and their associated production facilities contain a range of liquid systems and hydraulic networks, such as for production liquid transport and offloading, controls systems and seawater systems used as working or cooling fluids.

Having the ability to predict system-wide behavior of large fluid and hydraulic systems can save time and cost in design and operations in different ways, including:

- Avoiding or managing pressure surge for sizing pipes, pumps and injection systems
- Sizing and configuring systems for flow rate delivery and pressure loss requirements
- Safety assessments
- Understanding unexpected system responses during operations

When to use system simulation

Across the subsea engineering and production industry there are many areas where having the capability to understand system responses can save design costs, manage technical risks and provide rapid operational assessments when issues arise.

System simulation enables rapid development of a model capable of predicting certain physical behaviors and phenomena such as a pressure surge. This system-level simulation approach is invaluable in:

- Early design stages to size and configure hydraulic systems
- Detailed design when ensuring system behavior
- Commissioning to virtually test if the system responds as designed
- Operations to help rapidly troubleshoot problems or understand unexpected system response

These hydraulic systems need to be designed for safe use over a wide range of operating conditions from steady operating conditions to transient events during startup and shutdown. In addition, unexpected scenarios or extreme events may need to be addressed to fully assess risks.

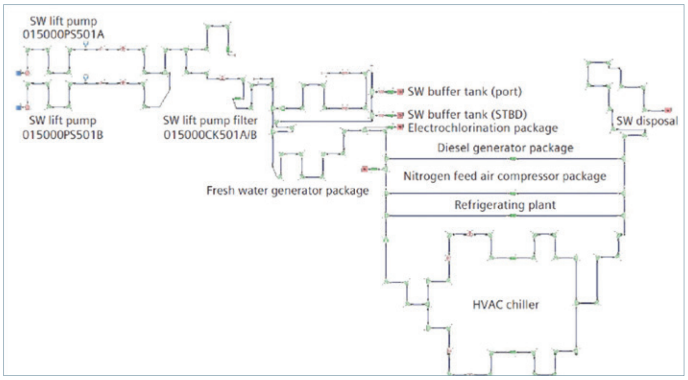


Figure 7. Seawater system simulation.

Determining maximum forces

Hyundai Heavy Industries uses system simulation to design seawater systems in its floating production units. A seawater system needs to be designed for safe use over a wide range of operating conditions. Although designing a system for expected pressures, temperatures and flow rates is generally a straightforward process with steady state analysis, often the most dangerous situations arise because of a change in the system that hasn't been accounted for. Hyundai Heavy Industries uses Simcenter Flomaster to determine the maximum force due to pressure surges the seawater system could experience under different operating conditions. The forces would then be compared against the maximum allowable forces for the pipes or fittings where the force occurred.

This approach rapidly enables many operating scenarios to be assessed and a range of design configurations to ensure safe and effective system design.

To analyze the potential effects on the system at either design or operational stages, system simulation can be used to predict a range of physical behaviors from fluid phenomena like those discussed here or other challenges relating to flow, heat transfer and electrical system responses.

Thermal design and performance

Thermal challenges

Thermal design challenges exist in many areas of subsea design and operations, including:

- Thermal insulation and hydrate avoidance
- Embrittlement risk from cold temperatures in production startups
- Seal and component selection for high-pressure/high-temperature fields
- Subsea heat exchanger design

System simulation or high-fidelity CFD?

Thermal and fluid simulations add value from initial concept through detailed design to production operations and troubleshooting. But do we need the same tools and approaches at every stage in the process or to solve every challenge?

Early in the design process, or indeed during operational phases, engineers may need to assess thermal performance quickly or explore many options or scenarios. System-level simulation can provide rapid turnaround of thermal assessments, enabling engineers to perform rapid design assessment and explore many options and design configurations quickly and efficiently.

When more detailed insight is needed, perhaps during detailed design or for complex components, thermal behaviors need to be resolved at a higher level of fidelity to ensure performance is fully understood. With these aims, using CFD-based methods for high-fidelity simulation is the only approach capable of capturing all fluid and thermal behaviors such as multiphase flows combined with natural and forced convection, conduction and radiation mechanisms of heat transfer.

Design exploration

TechnipFMC has harnessed the accurate flow and thermal capabilities of Simcenter STAR-CCM+ with the integrated optimization and design exploration tools in designing various subsea equipment. The image shown on this page is of a subsea heat exchanger, the design of which was optimized by TechnipFMC using this approach. By defining target performance criteria and design parameters within a simulation environment, an automated and intelligent search engine SHERPA was able to evaluate 150 designs and rapidly identify which design parameters were most important in finding the best performing designs. This process led to three major design groups each of which offered significant subsea heat exchanger performance improvements.

> *"Simcenter STAR-CCM+ helps us rethink, reinvent and reimagine the design process to reduce cost and improve operator returns."*
>
> *Dr William Thomas*
> *TechnipFMC*

Not only did the design exploration approach deliver a final design delivering a 20 percent performance improvement, the automated search and simulation processes also significantly reduced the engineering time required.

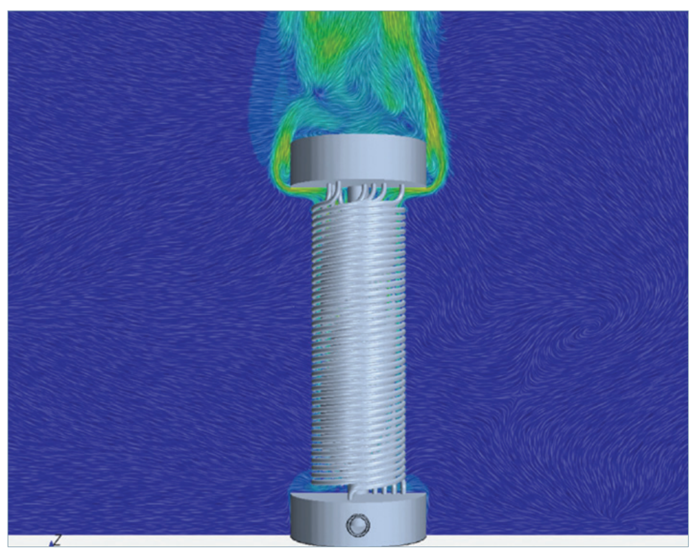


Figure 8. Design exploration of subsea heat exchanger.

Hydrate avoidance and thermal design

The challenge

Hydrate formation is a major flow assurance risk to subsea production. Hydrates are ice-like formations that can cause blockages that have significant repercussions in lost production costs and significant cost and technical challenges involved in remediation.

Insulation is commonly used for subsea production systems with hydrate risk, with technologies including pipe-in-pipe and direct electrical heating systems sometimes needed to maintain pipeline delivery temperatures.

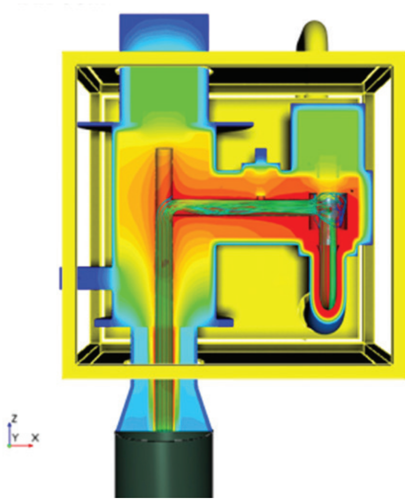


Figure 9. Simulation of thermal performance of the subsea tree.

Thermal design is not straightforward, especially for designing insulation systems for subsea trees, connectors and manifolds due to their complex designs and functional requirements. Simulation is critical to subsea designers needing systems that will perform reliably and effectively.

Cooldown simulation

Thermal simulation can come in different forms, from high-fidelity 3D CFD simulation to system simulation approaches.

High-fidelity CFD simulation has been proven to be the most accurate, cost-effective and expedient method to support thermal design and performance assessments, especially when compared to the major cost, time and technical implications associated with physical testing.

> *"Simulation-led design enabled us to save our client $4 million and two and one-half years of testing."*
>
> *Dr Matt Straw*
> *Norton Straw Consultants*

Complex subsea production equipment like trees and manifolds require high-fidelity CFD simulation to accurately capture thermal performance. During shut-in events, systems (and their contents) cool down and complex flow and thermal behaviors such as natural convection need to be captured for reliable and accurate thermal simulation data.

The ease-of-use and accuracy of Simcenter STAR-CCM+ has made it a leading simulation tool within the subsea engineering industry. The integrated environment of Simcenter STAR-CCM+ means that model preparation, meshing and thermal simulations are all undertaken in an integrated environment, saving flow assurance and subsea engineers significant time in finding optimal designs. Critically, engineers have demonstrated accuracy of simulations against full-scale test and operating data.

Operational performance

Thermal performance is not just a design requirement. Although performance needs can be demonstrated using simulation before production begins, during operations there is significant value in being able to understand how a system will perform thermally. At any given point in time based on real-world operating conditions, simulations can inform operators of the implications or shutdowns in production and help identify time available to make critical preservation, intervention and operational decisions. By combining high-fidelity CFD and system simulation capabilities it is possible to combine predictive techniques with real-time operating data to build a comprehensive digital twin to aid operational decisions.

Installation of subsea infrastructure

The challenge

Deployment and installation of subsea production equipment is a complex process. Consideration must be given to size and weight of structures both for design and the method of installation to be used.

Offshore construction and installation vessels are used to install subsea production equipment, structures and pipelines on the seabed in harsh offshore environments.

Both the design of the systems and the installation method need to account for the structure weight and geometric complexity as well as the offshore conditions and vessel installing the structure.

Engineering simulation techniques are the only practical means of assessing how a structure can be installed by understanding loads induced during the process and supporting development of safe, practical and achievable installation procedures.

Complex structures and environments

CFD analysis coupled with structural motions enable engineers to capture the complex behaviors involved in:

- Calculation of hydrodynamic coefficients
- Full fluid-structure interaction of the deployment process

Actual hydrodynamic behavior of subsea structures is related to drag and added mass and the offshore conditions that may be experienced. For complex structures, estimating the hydrodynamic drag and added mass based on industry-recommended practices can introduce excessive conservatism, which can limit installation operations in terms of the allowable sea state. Using CFD analysis it is possible to perform detailed analysis to accurately predict the hydrodynamic characteristics, in many cases enabling a wider operating weather window for offshore installations.

The forces induced on deployed structures through the splash zone need to be assessed as they can be significant; both on the structure and installation equipment. Having the capability to simulate the interaction of the deployed object with both the installation vessel and the sea can present many advantages for helping to identify maximum loads for design and safe offshore conditions for installation to take place.

High-fidelity simulations offer huge value to engineers such as:

- Informing subsea structure design to aid installation
- Enabling the development of safe and efficient installation procedures
- Widening the installation weather window
- Enabling installation of complex systems

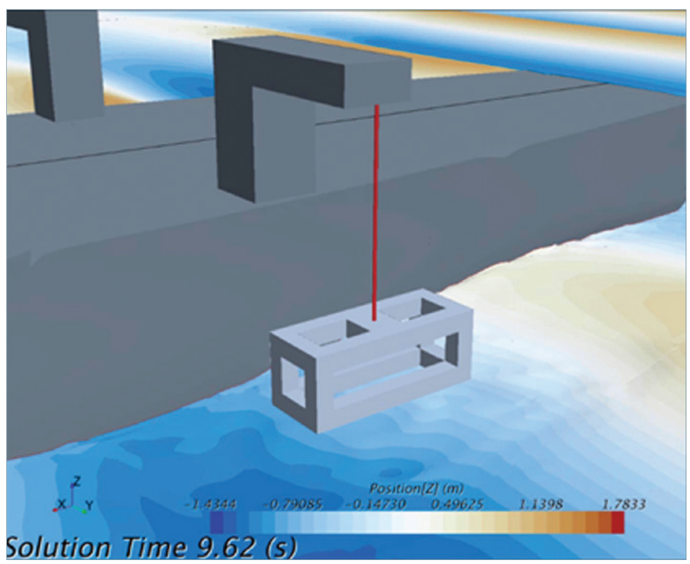


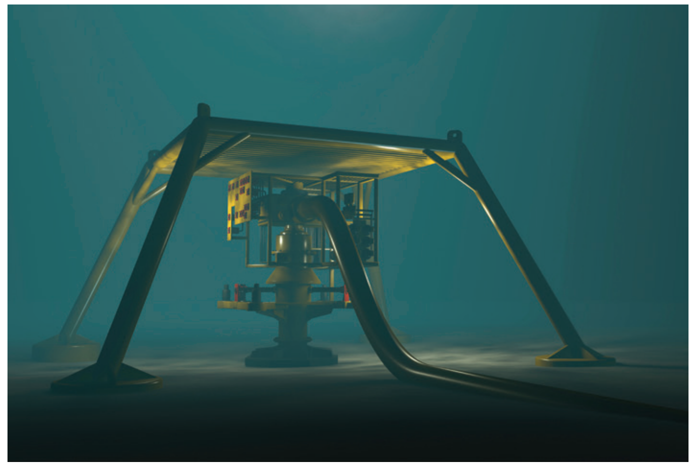
Figure 10. Simulating deployment of subsea structure.

Conclusion

This white paper presents the role of engineering simulation across a wide range of applications for the full lifecycle of subsea equipment and systems.

The predictive capability of simulation can be maximized when engineers and designers have the tools to predict the full range of physics and real-world behaviors whether at system level or when high-fidelity understanding is needed.

Having the ability to predict how a system will behave, function and operate enables engineers to make informed decisions, delivering improved designs and enabling safer, more reliable and cost-effective operations.



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Siemens Digital Industries Software is driving transformation to enable a digital enterprise where engineering, manufacturing and electronics design meet tomorrow. The Xcelerator™ portfolio, the comprehensive and integrated portfolio of software and services from Siemens Digital Industries Software, helps companies of all sizes create and leverage a comprehensive digital twin that provides organizations with new insights, opportunities and levels of automation to drive innovation. For more information on Siemens Digital Industries Software products and services, visit siemens.com/software or follow us on LinkedIn, Twitter, Facebook and Instagram. Siemens Digital Industries Software – Where today meets tomorrow.

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