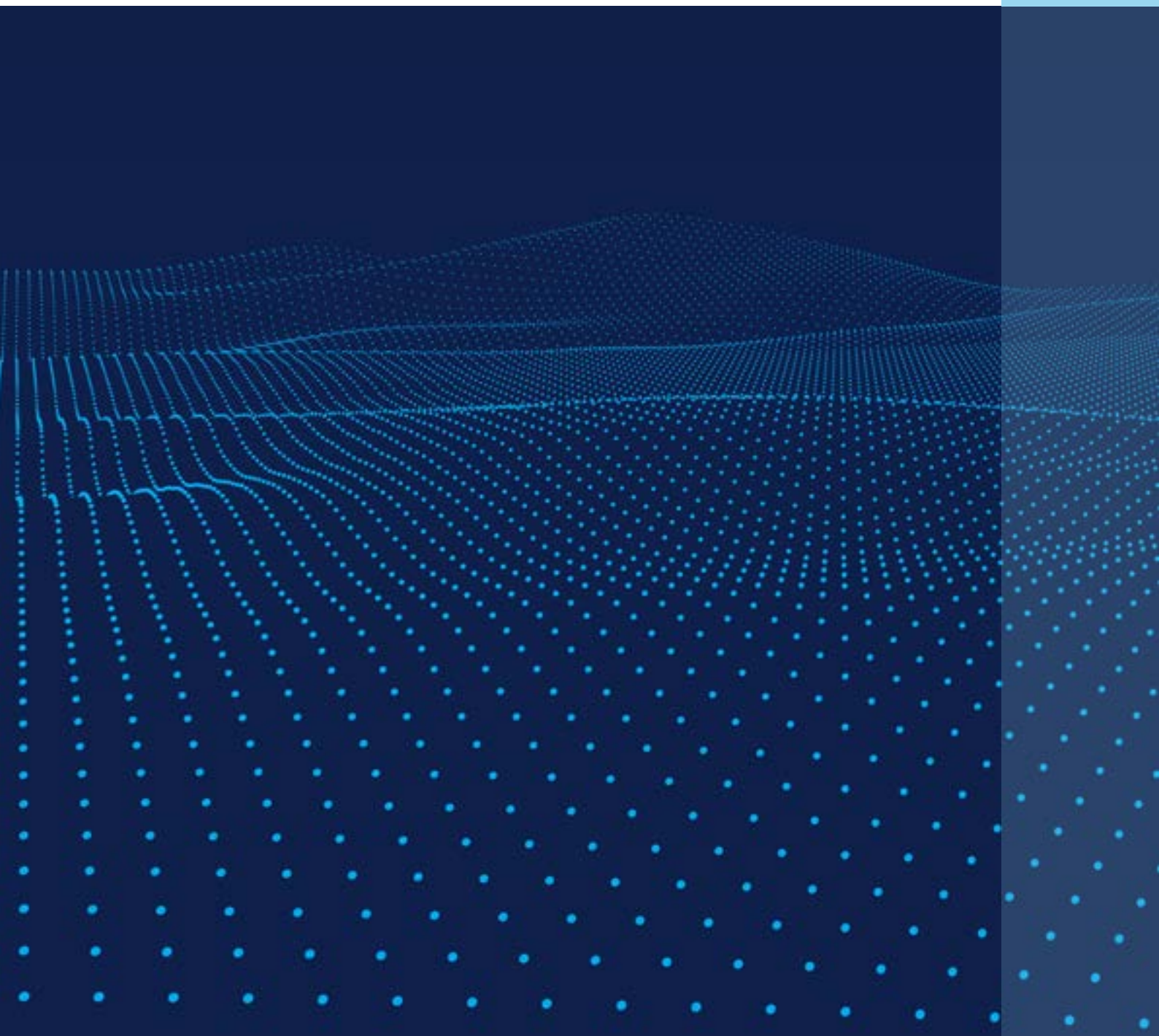
DNV

WHEN TRUST MATTERS

THE DIGITAL TWIN BUYER'S GUIDE

Four essential questions to ask when starting out



Huge potential – hard to get it right

Of all the ways that oil and gas companies can find further cost efficiencies in a period of lower oil prices and depressed demand, digitalization has the most remaining potential. More than two thirds (68%) of the one thousand senior industry professionals surveyed for DNV's study on the outlook for the sector in 2021 expect their organizations to increase investment in digitalization this year, the highest level ever in our research[1]. A further 25% expected to maintain current spending levels on digital transformation.

The big driver of this investment is the need to increase profitability, according to three quarters (73%) of the industry leaders we surveyed. Advanced data analytics and machine learning can potentially reduce up to 70% in engineering hours during field development, according to consultants BCG.[2]

However, achieving tangible results is not straightforward. According to a recent survey DNV conducted on behalf of the Norwegian Research Council on the potential of artificial intelligence, less than 10% of the initiatives had resulted in operational solutions; the rest were either pilots or ideas/concepts.[3]

Status of artificial intelligence projects in the Norwegian oil and gas sector

Source: OG21 – Study on Machine Learning in the Norwegian petroleum industry.

For 2021, digital twins appear among the oil and gas industry's top 10 digital spending priorities.

Implemented correctly, a digital twin could potentially become a platform combining real-time simulations, advanced artificial intelligence and machine learning to analyse and generate data to support decision-making.

There is a risk that digital technology such as digital twins, may not in itself guarantee higher returns, however. In a study of 46 oil and gas upstream operators, BCG highlighted how 'digital maturity', a measure of the ability to create value through digital means, is a key predictor of success for companies launching a digital transformation.[4]

Moreover, the track record of digital twin projects in the oil and gas industry indicates significant risk that they may not deliver what buyers expect, and could leave operators wondering if they can trust information from a twin. Hence, you need to know the risk of potential failure, how it could happen, and how to specify and implement digital twin projects, to mitigate against the finished product underdelivering against inflated expectations.

A physical oil and gas asset is designed and built to perform to the highest standards. It must go through rigorous assurance processes to meet regulatory requirements, company and industry standards. In stark contrast, there is no requirement for an asset's digital twin to obtain the same seal of approval, despite potential problems in implementing and using this technology.

This Buyer's Guide aims to explain how a robust quality assurance process can meet these needs so that you can trust that correctly specified twins will generate a return.

[1] Turmoil and Transformation, DNV 's outlook for the oil and gas industry in 2021, download at https://www.dnv.com/industryoutlook2021 [2] Creating value with digital twins in oil and gas', by H Holmås et al., BCG, October 2019, viewed at https://www.bcg.com/publications/2019/creating-value-digital-twins-oil-gas [3] OG21 - Study on machine learning in the Norwegian Petroleom industry', DNV GL - OG21-study, 2020 [4] Digital powers value creation in oil and gas', by H Holmås et al., BCG, 28 October 2020, viewed at https://www.bcg.com/publications/2020/creating-value-through-digital-in-oil-and-gas

FOUR KEY QUESTIONS YOU NEED TO ASK

MAKING DIGITAL TWINS A

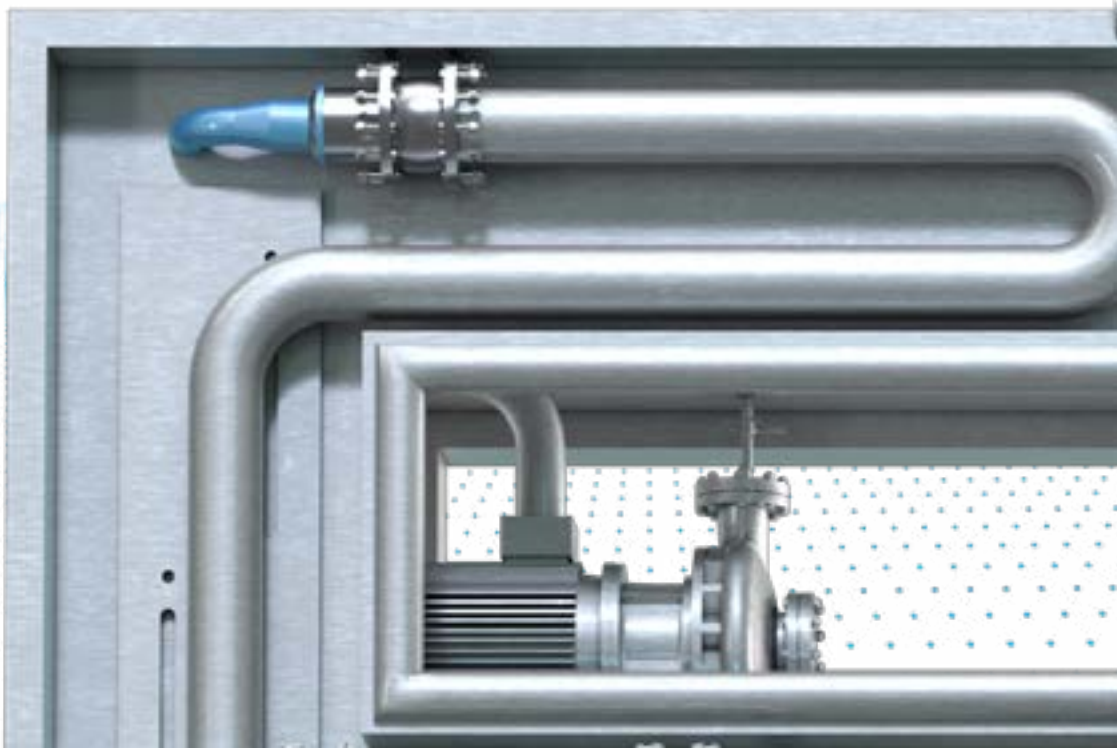
We see that companies hesitate to trust digital twins for several reasons. Finding the answers to key questions will support you in building confidence in the technology.

A digital twin may be incorrectly specified if the purchase is driven by technology rather than business needs. Problems may also emerge if a digital twin is inadequately maintained and updated as its real-world sibling evolves.

In addition, there are technical challenges relating to infrastructure environments for digital twins and data quality. Some companies will also struggle with digital transformations if they do not first tackle the change management challenges involved.

While there are potential problems, our sector's need for transformation means it is time to prove that digital twins can be trusted, and that investing in them can generate the right return. Answers to four key questions will help you to ensure the benefits of digital twins throughout their procurement, implementation and operation:

1. Am I confident in specifying the scope of the digital twin's functionality?
2. Will my digital twin work correctly and evolve alongside my physical asset over time?
3. Is my digital infrastructure right and safe for digital twin planning and operation?
4. Is my organization ready for digital twins and able to evolve alongside it?



1 AM I CONFIDENT IN SPECIFYING THE SCOPE OF THE DIGITAL TWIN'S FUNCTIONALITY?

There is a high risk that an inadequately or incorrectly specified digital twin may not live up to a buyer's expectations.

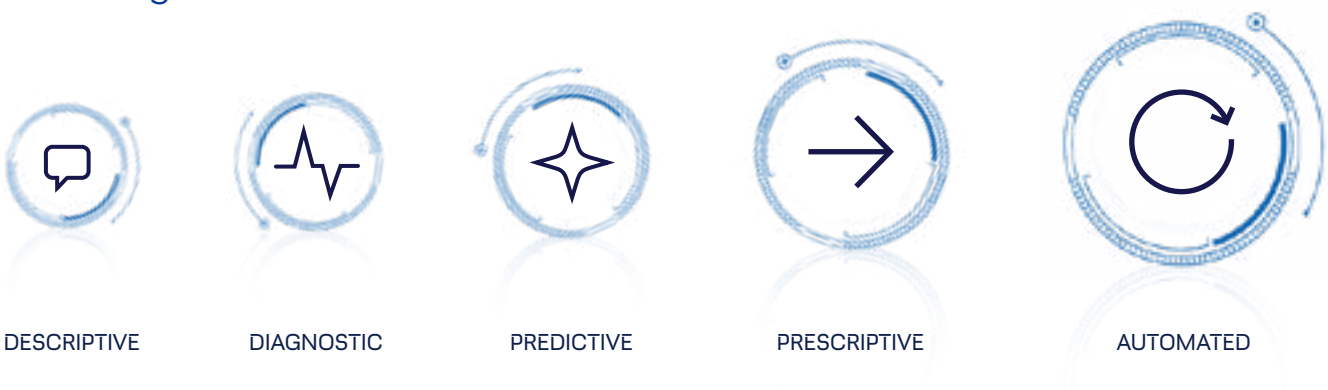
There is no need for buyers to fall into this trap, however. Industry-recognized, standardized processes exist for the qualification and assurance of each proposed 'functional element' of a digital twin (see illustration and details on page 9).

These processes can provide confidence that the digital twin will meet well-defined business needs. Once this has led to formal approval of a functional element, it can be deployed on the digital twin platform to enter active service and support decision-making.

A digital twin can be simple, perhaps covering a single component, such as a valve, or a complex one spanning entire facilities.

There are proven frameworks to define the use of the digital twin. These range from simply describing the asset to using fully automated solutions (see graphic below) to assess the quality of a digital twin's specifications and to stress-test its behaviour on a range of data quality issues.

Use of digital twins



In summary, applying proven technology qualification and assurance processes can verify and validate that a digital twin will perform to specification based on the business needs that you define.

2 WILL MY DIGITAL TWIN WORK CORRECTLY AND EVOLVE ALONGSIDE MY PHYSICAL ASSET OVER TIME?

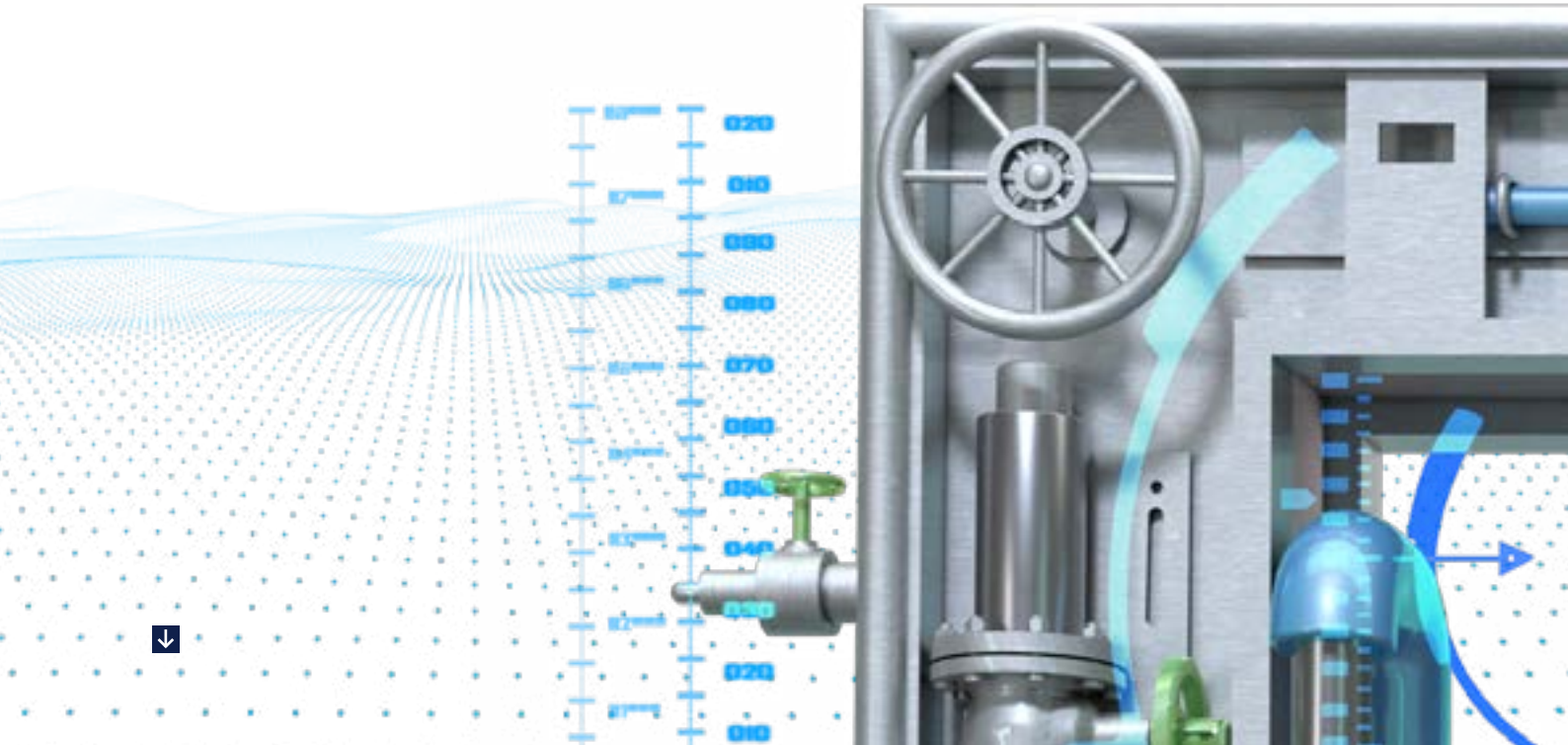
Even with correctly-specified digital twins, problems can arise in operation, as physical assets undergo many changes during their lifecycles.

This means companies must also be able to trust that a digital twin will remain fit-for-purpose long after being approved and deployed.

Change can come to an asset through degradation and aging, maintenance activities, larger modifications, and from other sources. Operators therefore need to be confident that a digital twin is accurately and reliably monitoring any changes, including those made by supply chain partners. They also need accurate up-to-date data for use in emergencies, and for compliance purposes. Hence, the digital twin must remain qualified over time.

The solution to these and other issues relating to the use of digital twins during oil and gas operations is to apply structured processes that ensure all changes are communicated either automatically or manually to the digital twin management team. Operators can then evaluate whether the changes will impact on functional elements of the digital twin. Verification and validation will be required again after updating functional elements, which will also need periodic evaluation to see if they still meet specifications.

In summary, you can apply structured processes to ensure that digital twins are updated to accurately reflect change during operations and will continue to perform to specification.



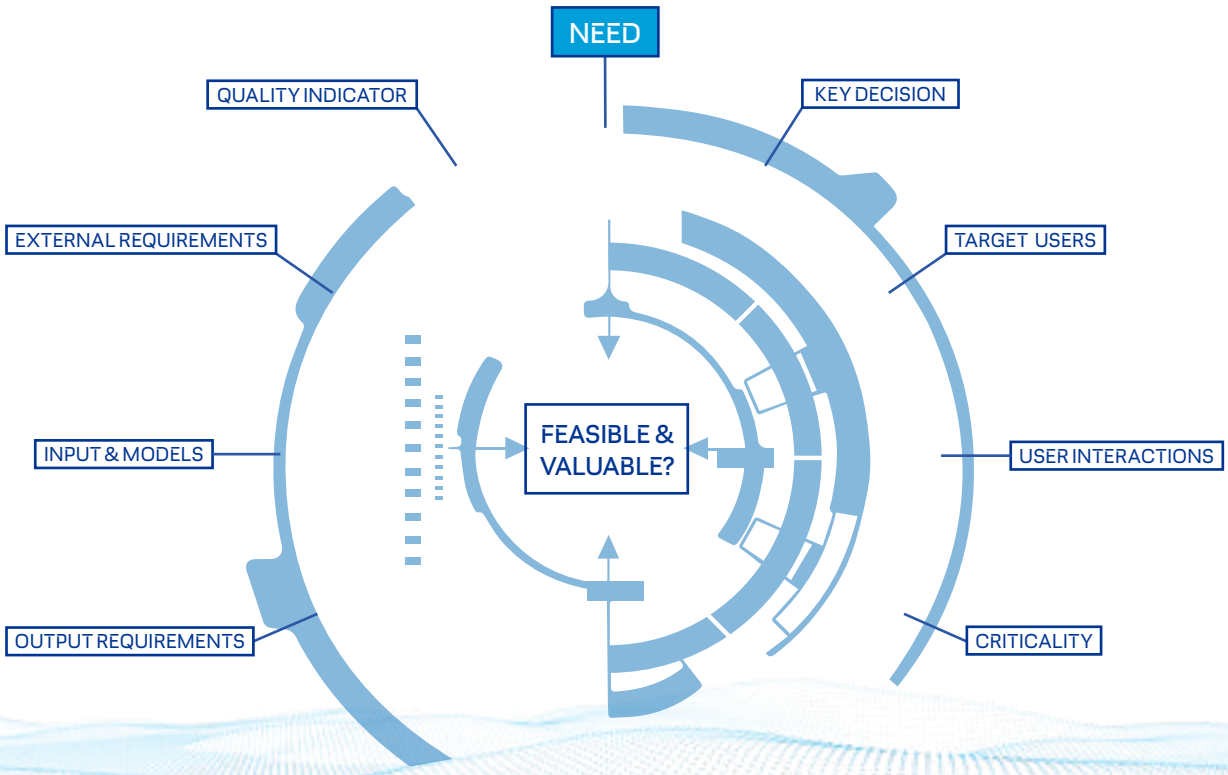
Splitting the digital twin and assurance process into manageable parts

Qualification and assurance programmes based on standards and recommended practices are familiar ways to build to trust in technologies used in industries, including oil and gas.

However, these approaches can be hard to manage for digital twins that are complex and impact on several areas of an organization. The solution is to break down the digital twin into manageable parts. We call them functional elements, but they are essentially software programs that analyse data from sources including sensors to provide information that can support operators in decision making.

Creating software to meet business aims means defining the need for each program, the key decision it will support, the data required, and other technical aspects. Getting it right can allow a digital twin, and the digital technologies with which it may interact and/or enable through data exchange, to deliver benefits across upstream midstream and downstream oil and gas activities from exploration through to decommissioning. In DNV's digital twin quality assurance process, the trustworthiness of the information is displayed by a self-diagnostic 'quality indicator'. This indicator may, for example, visualize the level of trust by using a colour scheme based on traffic lights.

Establishing requirements for functional elements depends on a well-defined process



Source: Process illustration DNV

3 IS MY DIGITAL INFRASTRUCTURE RIGHT AND SAFE FOR DIGITAL TWIN PLANNING AND OPERATION?

Digital twins interact with and have an impact on other information and operational technology systems.

This challenges operators to ensure that digital infrastructure is secure, robust, and suitable for all purposes to which it is put for as long as it is needed. They also want to be sure that the neither the data that drives a digital twin, nor the data it produces, are 'garbage' that could lead to incidents or and/or poor decisions.

Formal threat assessment can identify potential cybersecurity weaknesses. Information technology architecture specifications can include infrastructure components needed to install, operate, access, and protect digital twins. Best practices and monitoring for data quality are available.

For example, it is possible to monitor data flowing in and out of a twin and to display these against pre-defined metrics through a real-time dashboard allowing an alert to be sent when there is a deviation from what you expect.

In summary, applying assurance activities can ensure that digital infrastructure and digital twin platforms connected to it are secure, robust and fit-for-purpose throughout their lifecycles.

4 IS MY ORGANIZATION READY FOR A DIGITAL TWIN AND ABLE TO EVOLVE ALONGSIDE IT?

Organizational maturity is the key to digital twin adaptation.

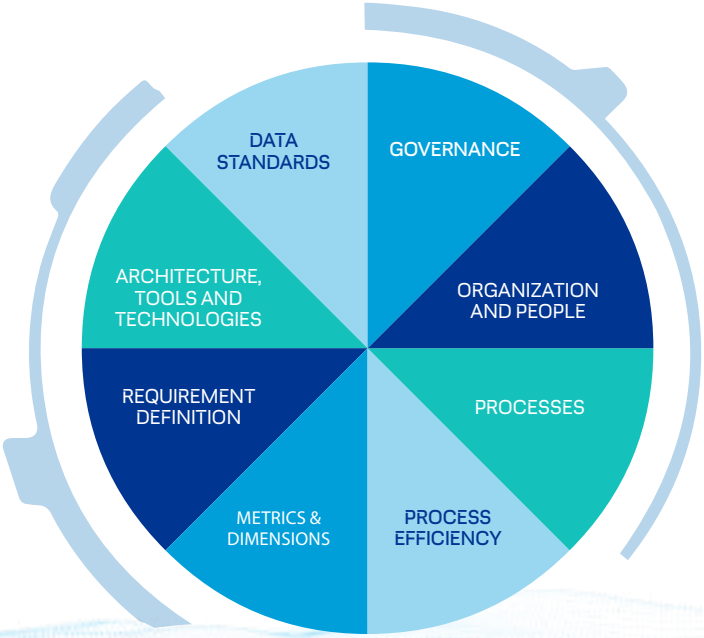
Despite potential problems, digital twins have already proved their huge potential for simplifying, organizing, and improving management processes. However, it has become clear that success depends on the organizational maturity and the capabilities of the workforce to change the way they work and develop alongside implementation of digital twins.

Effective change management also depends on the organization being able to develop and maintain a digital twin over its lifetime. Achieving this can help reduce the risk of systematic failures, which are difficult to control through testing alone.

Frameworks exist to assess organizations' tools, processes, competences, and capabilities to ensure that people are not a barrier to a digital twin delivering value.

In summary, applying a proven framework to assess organizational maturity over relevant areas can show whether an organization is ready for a digital twin, and able to evolve alongside it. Examples of relevant areas to assess include, among others, governance, management of digital infrastructures and architectures, and defined standards and metrics for measuring and recording digital twin performance.

The "engine" in successful execution is a mature organization



A RECOMMENDED PRACTICE FOR QUALIFICATION AND ASSURANCE OF DIGITAL TWINS

MAKING DIGITAL TWINS A

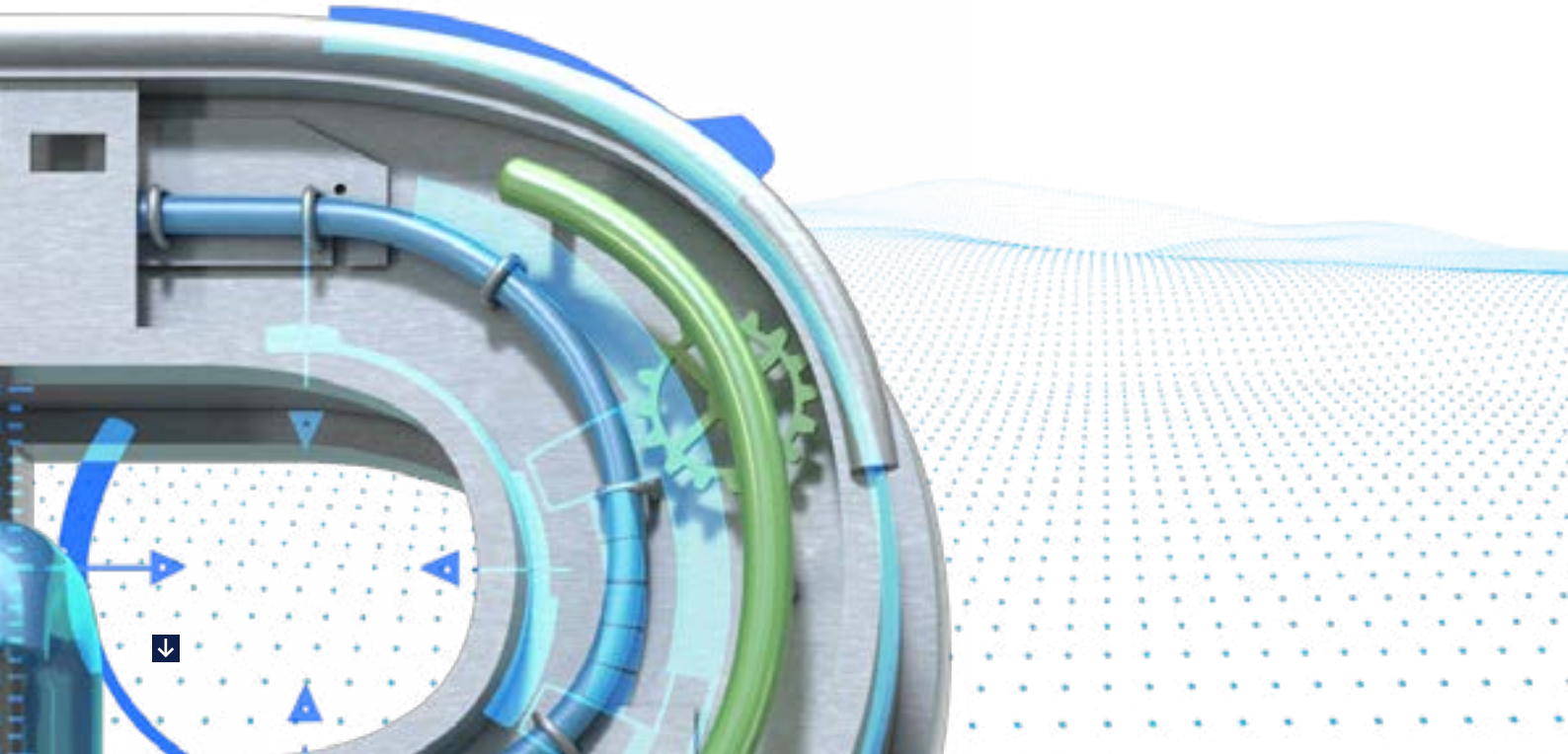
Asking the four questions posed in this Buyer's Guide will help to secure return on investment and support the industry on its journey towards implementing digital twins.

The answers describe proven ways to ensure that digital twins:

1. Are specified to achieve your defined business needs
2. Are updated to accurately reflect operations and keep performing to specification
3. Remain secure, robust, and fit-for-purpose along with associated digital infrastructure
4. Will be used in an organization that is prepared for and can evolve with it

Drawing on these insights, DNV has researched and published Recommended Practice DNVGL-RP-A204: *Qualification and assurance of digital twins* in collaboration with TechnipFMC, basing it on real oil and gas industry experience. The oil and gas industry's first Recommended Practice on how to build and quality assure digital twins sets a benchmark for approaches to building and operating the technology and turning potential into a real return on investment.

Our digital twin qualification service guides companies through specification, development, procurement and operation of digital twins. Supported by our industry-endorsed Standards and Recommended Practices, including DNVGL-RP-A204, our data scientists and oil and gas domain experts tailor the level of assurance to the scale, complexity and maturity of a digital twin.



CONTACT US AND DISCOVER HOW WE CAN CAN SUPPORT YOUR DIGITAL TWIN JOURNEY

www.dnv.com/digitaltwinassurance