Cost overruns and schedule delays are common in capital projects in the oil and gas industry. For example, Bain & Co. estimates that 84% of projects end behind schedule and 34% exceed budget. Among the many different issues that can negatively impact outcomes, one that is especially prevalent is the mismanagement of information flow as the project progresses from design through to construction, commissioning and operation. On downstream capital projects, massive volumes of critical information need to be available as the right data at the right time and in the right place. The traditional approach to addressing this challenge has been to enhance the project’s document and transmittal management systems. However, doing so can contribute to increased overhead costs and does not effectively solve the problem.

For nearly two decades, organisations such as POSC Caesar, EPISTLE and USPI have been exploring standards for the exchange of data and the move from document-centric to data-centric projects within the oil and gas industry. In 2012, USPI began developing the Capital Facilities Information Handover Specification (CFIHOS) from the Shell Engineering Information Standard (EIS). In January 2020, governance of the CFIHOS/JIP36 project was transferred to the International Association of Oil & Gas Producers (IOGP).

Bruce Bailie and Arja Talakar, Siemens Energy, USA, discuss the process behind ensuring that oil and gas professionals have access to the right data at the right time and in the right place.
While CFIHOS and other initiatives are helping to enable dynamic data exchange, Industry 4.0 is now reaching an inflection point, even in the traditionally conservative oil and gas industry. Data-centric projects will soon become the norm and organisations will have to fundamentally change the way that they work in order to reap the benefits.

**Document-centric project approach**

Presently, the formal means of information flow on most capital projects is via documents. In recent years, several digital tools have been developed that have improved document management and translational tracking. However, the process remains cumbersome and a significant cause of errors and inefficiency.

Apart from pure communication challenges, inefficiency often stems from the lack of standards applied to project specifications. Vendors are typically asked to deliver against a different set of requirements for each project, and in many cases, for the same commodity components.

The vendor response is usually in the form of non-standard and company-specific documents, which means that EPCs must spend many hours manually verifying requirements in relation to design specifications. Additional time is then spent entering data into separate information systems. As a result, it is estimated that oil and gas engineering departments devote nearly half of their time to locating and validating information available in disparate systems.²

The reliance on manual data extraction from project documents reduces productivity and constrains extraction to the perceived ‘critical attributes’. In addition, a great deal of important information remains in the documentation and is not readily accessible to those who need it, when they need it. This increases the likelihood of errors during handover and can result in late-stage design changes, cost increases, schedule delays and even safety issues.

Another problem with the document-centric approach is that asset data quality tends to degrade quickly after installation and commissioning, when the as-built documentation is turned over to the operations team. The as-maintained data is often siloed and managed independently of the as-built documentation. Studies have shown that maintenance crews spend approximately one-third of their time rectifying data that has not been correctly reconciled with the as-built documentation.³

These challenges are magnified by the fact that design, engineering and operational systems are also siloed. More broadly, there is a lack of integration between different EPC design tools and information technology (IT) solutions used by multiple stakeholders. This inhibits information transfer and sharing and can be particularly problematic as the project moves into the operational phase.

**The importance of standardisation**

Standardisation is the first step to making data-centric projects a reality. This starts by defining the ‘common language’ that will describe all of the plant’s functions, equipment and components, as well as the relationship between objects. At a high level, the JIP36/CFIHOS initiatives define the language to support a more data-centric approach to handover, by identifying what data is required and how it should be structured, described, transferred and implemented.⁴

In addition to the common language, standardising specifications used by operators and EPCs for the project is also important. This can reduce the engineering and procurement effort to review, issue and validate the specification. Significant progress has already been made on this front through JIP33, which was established in 2017. To date, more than 40 standard specifications have been published, with more planned for the coming years.²

Establishing a common digital language and framework streamlines information flow between disciplines and work processes. Additionally, it becomes possible to reduce human intervention and to use artificial intelligence (AI) to automate certain tasks, such as verification of the project against defined requirements. This is the primary goal of the Requirement Asset Digital Lifecycle Information (READI) JIP, which establishes a platform for automated digital verification of requirements and design, including governance and validation.⁵

More broadly, standardisation facilitates the integration of traditionally disparate engineering and information systems, which is a prerequisite for the creation of a unified data model that accurately reflects the virtual representation of the asset as it moves through the different phases of the asset lifecycle (commonly referred to as the digital twin). By maintaining the asset knowledge base in an ‘as-maintained’ digital twin and integrating it with operations and maintenance data, productivity across the entire asset lifecycle is enhanced.

**Challenges**

A data-centric project approach can provide tremendous value for stakeholders, in terms of reducing schedule and capital costs. However, as it requires organisations to fundamentally change the way that they have traditionally done business (i.e. embrace the vision of a ‘born digital’ project), it does not come without challenges.

The first potential hurdle is the existing IT landscape, which is highly disparate. With continuous mergers and acquisitions, most companies have a collection of engineering tools and do not have a ‘common language’ – even internally – to holistically define an entire project. The cost of IT application harmonisation or building integration platforms is significant.

Furthermore, the digital twin represents multiple levels of suppliers. The requirement to move away from document-centric to data-centric, and to support a common language such as CFIHOS, must flow down through all levels in the supply chain. Without total alignment, organisations will likely incur a substantial cost to digitise sub-contractor documented data.

Complications can also arise when stakeholders use different industry standards or do not adhere to a specific standard such as CFIHOS. However, this is less of a challenge, as it is relatively straightforward – though inefficient – to map the desired structure once data is available digitally.
Perhaps the most difficult challenge is the change in management in order to fundamentally alter the way in which organisations have traditionally worked. Not only do job functions have to change on data-centric projects, but there is also a much higher ‘digital’ requirement in the modified roles. The oil and gas engineering community is an ageing demographic and there is resistance to adopting new technology such as AI. To this end, any introduction of new digital technologies will require reskilling and training to gain acceptance and ensure competency.

Finally, a shift needs to occur in the way in which data handover is viewed. Currently, many stakeholders treat the handover process as a one-off event. However this is not ideal, particularly in the case of downstream facilities such as refineries or petrochemical plants, which often undergo numerous modifications and upgrades over their lifespan in order to increase productivity and comply with evolving environmental regulations.

**Conclusion**

Oil and gas may have lagged behind other industrial verticals on the digital maturity curve. However, the industry is now at an inflection point where the pace of digital adoption is rapidly accelerating. Unfortunately, for many organisations, the speed of digital technology development and associated industry standards is occurring faster than they can adapt. The key for these companies moving forward will be recognising that digital transformation is a journey rather than an event. Reaping the full range of benefits will require careful planning and a willingness to embrace new ways of working.

In the context of capital project development, the benefits of transitioning from a document-centric to data-centric approach can be challenging to quantify. The value added is primarily a result of a reduction in rework caused by data errors and increased productivity as a result. While this is certainly visible early on during the design and engineering phases, there is also a substantial hidden benefit.

To be contractually compliant, the minimum set of data required is defined for every handover gate in the project lifecycle. Data that is not deemed necessary for contractual compliance typically does not flow to the next phase. However, secondary data often has relevance for future project phases and particularly for the plant operator. When it is lost, there is a corresponding loss in the body of knowledge for the operational asset.

By avoiding this problem, stakeholders can achieve the goal of any project or facility: to ensure that people have access to the right data at the right time and in the right place.

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