The engineering and technology complexities found in contemporary process plants demand that owner/operators continually reassess and apply new approaches and business practices to manage the effective handover of assets, both physical and digital, following the engineering, procurement and construction (EPC) phase of the asset lifecycle. The delivery of high-quality, validated project data and associated project documentation during handover can have a significant impact on the operational efficiency of the asset once in production. In the long term, this can also affect the overall profitability of the facility. Poor project handovers can have a substantial cost impact and expose underlying business and engineering challenges. To combat this, there are a number of new and effective strategies that support high-performance handover.

Project handover is not a new activity in plant engineering. The business processes and underlying workflows associated with the handover phase have evolved over the last three decades, alongside advances in engineering and data management software systems. Today, due to the scale and complexity of industrial plants, project stakeholders face increasing demands to provide high-quality, high-integrity, consistent technical data to agreed formats. The volume and scope of data and associated documents created during detailed design can demand a rethink of the way in which relevant data is delivered and managed as part of an integrated handover/data management strategy.

Handover challenges

Various studies undertaken over the last two decades have reviewed key industry and lifecycle challenges facing stakeholders involved in all aspects of major capital projects. A report by the National Institute of Standards and Technology (NIST) identified and estimated annual losses of US$ 15.8 billion. These losses were incurred as a direct result of inadequate interoperability between project data and the information systems used during the asset lifecycle, especially between design, construction, and handover, and the systems used to support asset operators.
Business process improvement

The handover process

In the overall asset lifecycle, the handover represents a major project milestone. It signifies the completion of construction, commissioning and testing. In practical terms, this involves the transfer of control of the physical asset from contractors and suppliers to the operations team. It also involves the issue and physical transfer of important project documentation describing all aspects of the asset and its systems, much of which is still provided as paper documents.

The information generated during detailed design, construction, precommissioning, commissioning and mechanical completions leading up to handover is highly important. Understanding and managing the interrelationships of the data has a significant impact on the overall handover process, which must be taken into account during initial handover planning.

One of the main findings from the NIST study was the importance of real time data sharing and exchange. These conclusions form the basis of today’s continuous data management handover process, which combines status based data being delivered on a regular basis into information systems used by operations.

Figure 2 outlines key components of an integrated data management environment supporting continuous data handover. This environment is built on agreed data formats coupled to a digital definition of all asset object classes and underlying data (the class library). All project documents and associated data is validated against the class library to ensure data has been provided in a consistent, agreed format within parameters and boundaries set for each asset class. Data that does not meet the specified format or parameters is rejected and returned for further rework. Data that meets the defined conditions is transferred directly into an asset lifecycle information management (ALIM) system, which is linked to operations systems such as maintenance management and asset integrity systems. Project documents are validated in a similar manner before being transferred into a document management system.

Technology improvement

ALIM systems

As part of an overall asset information system and data strategy, the introduction of project information management (PIM) systems over the last 10 years has improved the overall quality and availability of project data and documents. These systems provide the means for coordinating all aspects of data as it matures through the design phase, with capabilities to manage changes and revisions as part of a ‘work in progress’ workflow.

The PIM system acts as an important bridge to downstream operations systems but does not directly address the lifecycle requirements of data during the operational life of the asset. As a result, PIM systems are now complemented by ALIM systems. These address not only project-related data management but also the lifecycle aspects of data as it undergoes change and modification as part of an operation led ‘management of change’ workflow. The resulting environment supports the transition of data through handover, integrated into mainstream enterprise systems used to support all operations, maintenance and revamp activities.

Four key aspects of data management provide a foundation for the introduction of ALIM systems to drive and support the continuous handover process as part of an integrated information management strategy. These include an agreed scope of data, agreed data formats, implementation of industry standards and an agreed data status/maturity model, which is milestone based.

Historically, one of the main issues inherent in a paper based handover process is the type, scope and nature of information
The inability of application software to read and manipulate associated data (the inability of application software to read and manipulate associated all project stakeholders. They also forced fixed ways of working due to the 1980s and 1990s constrained the federation of information across formats inherent in software application systems implemented during the early definition and capture of key information supporting the operational availability in operations. Today, an important aspect of ALIM, especially during handover, is the early definition and capture of key information supporting the operational and business aspects of the asset. This can be established through the definition of structured data and document templates describing the nature, type, formats, scope and retention levels for all data in a consistent, extendible framework. When combined with the process of data delivery captured as part of a handover plan, the overall environment establishes a clear baseline of data with associated responsibilities to create, deliver, review, transmit, validate and store key data and corresponding documents.

While a concise data and document handover template establishes clear boundaries for the supply of project data, establishing structured data formats accessible by application software used throughout the asset lifecycle is of equal importance. Proprietary data formats inherent in software application systems implemented during the 1980s and 1990s constrained the federation of information across all project stakeholders. They also forced fixed ways of working due to the inability of application software to read and manipulate associated data (Figure 3). To overcome these limitations and provide a truly federated information framework, structured standard data formats such as ISO 15926 (integration of lifecycle data for process plants) and building SMART International® industry foundation classes (IFCs) now offer a more open information framework, which addresses the lifecycle demands throughout the entire operational life of the plant. In future, data handover based on an ISO 15926 information model is seen as a practical exchange mechanism from the engineering contractor into the owner/operator’s enterprise systems used to support operations.

To tie together the generation and production of agreed data and documentation as part of a continuous handover process, clear rules and triggers for the release of data must be defined at the start of the project. Traditional project milestones such as ‘approved for process’, ‘approved for design’ and ‘approved for construction’ establish a clear timeline and framework for release of information. Yet they often constrained the issue until all associated data had reached the appropriate milestone status. By managing the asset as unique items or objects, individual status tracking and maturity of asset objects can be more effectively tracked and managed to correspond to a project baseline or asset configuration during each phase of the lifecycle. By reviewing the evolving project data during each lifecycle phase based on an agreed data status/maturity model, workflows can now be defined within both PIM and ALIM systems to trigger the issue of approved data with greater levels of assurance and integrity.

Figure 4 shows the relationship between data flows at key project milestones during the design and construction phases, transitioning into specific project baselines (or configurations). It is this baseline data that is transferred into the operations information repositories following data validation.

**Organisational and commercial improvements**

The formation of operational readiness teams over the last decade represents a major shift in the level of engagement, communication and collaboration between the operations team and the contractors involved in capital projects. Increasingly, operational readiness teams are formed and deployed early in the detailed design phase of a project, working with and alongside the engineering contractor.

The benefits and advantages to this approach are clear. The operational readiness team brings valuable insight and practical first hand knowledge of how to safely operate and maintain the plant. The team also acts as the ‘conscience’ for plant operations, validating all aspects of constructability, operability and maintainability from past project experience to ensure considerations are built into the initial plant design.

While established project contracting and contractual models continue to be used on all capital projects today, the continued industry practice of contractually breaking up key aspects of the asset lifecycle into discrete contracts or work packages (such as front end engineering, detailed design, commissioning and testing, and construction) perpetuates the compartmentalisation of data. The NIST study identifies that dividing projects in this manner ultimately limits collaborative working and data exchange. Clearly this represents a substantial opportunity for the process plant community to restructure in the future.

**Future trends and directions**

Looking to the future, easy access to current asset information at the point of use represents the next evolution in providing an open framework in which to undertake asset handover, and ultimately, to manage the entire asset lifecycle. Project portals combined with project dashboards offer the opportunity for a broader community of end users to access relevant information without the need for major information systems infrastructure. The use of handheld mobile devices linked via cloud computing, in which project data is easily accessible, offers further information and technology integration benefits. Overall, greater interoperability at both data and software application levels will contribute to reducing lost revenues and increase operational efficiencies across the entire asset lifecycle.

**References**