ARC VIEW

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Automated Digitalization of Engineering Documentation at an Oil & Gas Major

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Keywords

Digitalization, Digital Twin, P&ID, TCS

Summary

Is your plant a new greenfield with design drawings and data readily available electronically? Yeah, right! The vast majority of plants were designed and built decades ago with hardcopy or .pdf documentation. If you aspire to modern digitalization with a shared current version of piping and instrumentation drawings (P&ID) and other engineering information, then you will want to learn more about automated digitalization. When everyone uses the same consistent information, projects become easier to manage and complete on-time, in-budget and within specifications.

Old format documentation has become a clear barrier to digital transformation. Modernization starts with digitalization for a shared current version of piping and instrumentation drawings (P&ID) and other engineering information. TCS's DeepReader service automates this digitalization.

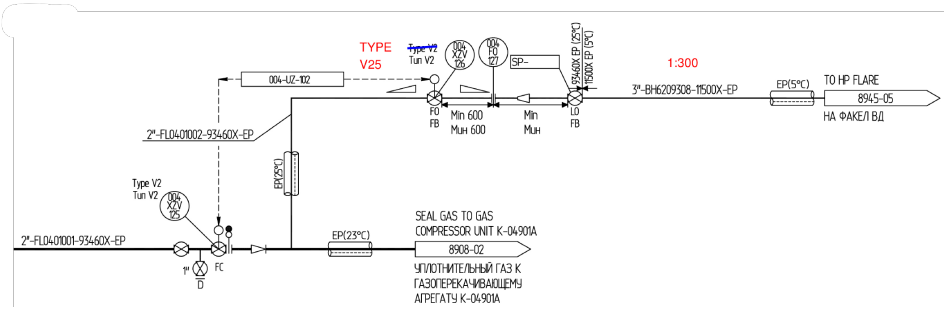
Introduction

A global energy and petrochemical company with over 80,000 employees in 70 countries uses advanced technologies with an innovative approach to help build a more sustainable energy future. It has interests in upstream, downstream, and petrochemical plants including over a dozen refineries. Though many of these plants were built decades ago, upgrades have kept them productive and financially viable. ARC recently had a briefing with TCS to learn how the company used its DeepReader service for digitalization of engineering documentation.

Barrier to Improving Project Execution

The pace of change has quickened for improved plant performance with a new generation of technologies including the internet of things (IoT), predictive analytics, digital twins, and more. Also, new goals for environmental,

social, and governance (ESG) have become a mandatory requirement. Unfortunately, having the key engineering documentation – like P&IDs – in Adobe Acrobat format (.pdf) or paper is a painful impediment to progress. Searching for current documents typically consumes 30 percent or more of engineering time. In addition, copies in various siloed departments have markups that needed verification and rationalization. To overcome these barriers, the company formed a digitalization team.



Portion of a P&ID Sheet with Mark-ups

Digital Transformation in Engineering

Digital transformation affects people and processes and requires electronic data for automated business processes. In engineering, this digital transformation takes the form of a 3D digital twin. A digital twin is a dynamic virtual representation of a physical device, system, or plant that exists or will exist. The twin has a level of completeness, accuracy, documentation, and data for users to improve performance and/or project execution in the physical (real world) environment.

Digital Twin Applies to the Plant's Entire Lifecycle

The digital twin has a 3D model with links to up-to-date information for cross-disciplinary and cross-ecosystem (internal and external) collaboration. Usually, the twin is created during the engineering and construction phase of a project. This project digital twin can become the primary vehicle for handover of engineering information to operations and maintenance. Using the 3D model, users navigate to the asset, double click on the software object, and immediately gain access to current information. A digital twin can include engineering data (P&ID sheets, point clouds, etc.), operational data (historian), and maintenance data (EAM). This is a straightforward approach to new construction. But older infrastructure built with paper drawings needs these documents to be converted to digital form.

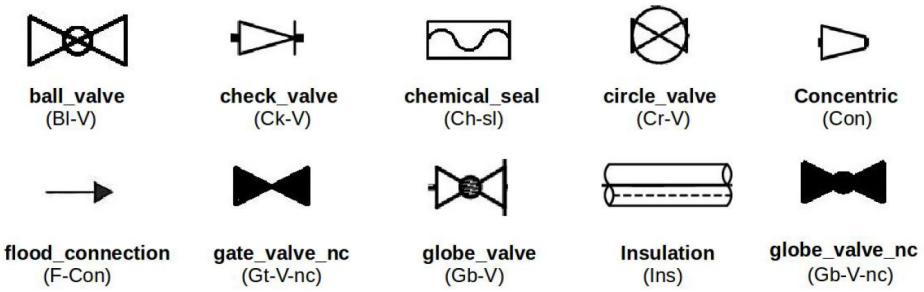
Digitalization of P&IDs

A typical plant has 5,000 P&IDs with circuits crossing multiple sheets. The digitalization process involves interpreting P&IDs and converting the variety of engineering data into electronic formats. In plants, P&IDs represent a schematic process flow of materials through various components like pipelines, valves, actuators, meters, instruments, and other devices. Digitalization involves identifying pipeline codes, pipelines, inlets, outlets, and symbols. Then, mapping the relative positioning of the individual components on the pipeline circuits.

Digitalization Automation

Converting the documents manually is a labor intensive, daunting process requiring specific engineering skills – a valuable and limited resource. By training a deep-learning artificial intelligence algorithm, Tata Consultancy Services (TCS) developed a means to scan the documents and extract the data. This DeepReader service uses vision techniques for extracting different components like pipeline-codes, symbols, pipelines, inlets, and outlets present in P&IDs. These components can be divided into two-types:

- Text containing pipeline codes and information
- Graphic objects like pipelines and symbols



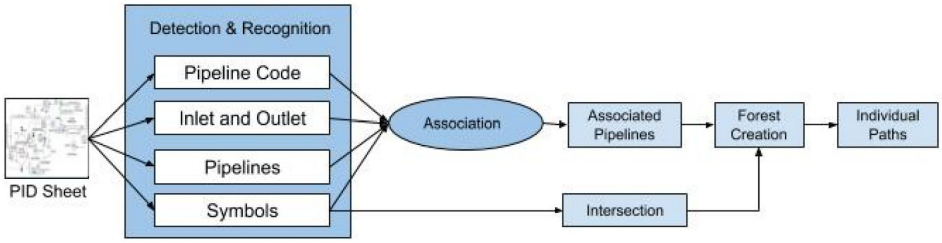
Examples of Symbols in P&ID Sheets

DeepReader Process

The DeepReader extraction of engineering data from P&IDs uses deep learning models for text and symbol identification and image processing for the extraction of components like inlets, outlets and pipelines present in the sheets. This digitalization process weaves together:

- Heuristic rule-based methods for pipeline and flow identification.
- Deep learning-based models for identification of text and symbols.

- Rule-based association of detected objects and a tree-based representation of process flow to determine the inlet to outlet path.



Flowchart for the DeepReader Automated Digitalization Process

The DeepReader service has two major steps. The first step detects and recognizes individual components like pipeline-codes, symbols, pipelines, inlets, and outlets. The second step involves association of detected components with the appropriate pipelines followed by formulation of tree-like data structure for the process flow of pipeline schematics. These two steps currently employ a combination of automated processes, model training, and manual association of components with pipelines.

DeepReader Business Benefits

The DeepReader service supports digitalization for modernization and digital transformation. The benefits here focus on using DeepReader compared to manual processes. Additional drawings continuously improve the AI learning and these benefits.

Engineering Benefits

- **High data quality**: Improved accuracy comes with automation. Also, mitigation of inconsistent symbology due to multiple EPCs having been involved in upgrades during the life of an asset.

- **Lower cost with faster time-to-benefit**: Compared to manual methods, automation reduces cost and improves the speed of digitalization. Initially, projects required 35 percent less labor – which continues to improve with additional training. Also, fewer seats are needed for the plant design software used during the digitalization process. With lower costs, more projects become financially viable.

- **Lower project risk**: Projects become more likely to be delivered on-time, in-budget, and within specifications with high quality digitalization.

C-Suite Benefits

- **Higher revenues**: Improved speed of project execution provides earlier return to production.

- **Higher asset value**: Digitalization allows an asset sale to be evaluated by the buyer more quickly and with lower risk, which will likely command a higher price.

TCS Domain Knowledge in Engineering Services

As a well-known global service provider, TCS delivers technology services, consulting, and business solutions. The company is part of the Tata Group, one of India's largest industrial conglomerates. TCS was established in 1968 as a division and became incorporated as a separate entity in 1995.

TCS offers a consulting-led portfolio of business, technology and engineering services and solutions. Among these services, TCS offers a broad portfolio of solutions, services, and domain expertise in plant design, operations, and Industry 4.0. This includes a practice area dedicated to DeepReader for digitalization and the associated business processes.

Conclusion

The benefits of digitalization of plant engineering documentation start with reduced out-of-date information, search time by engineering, design errors, construction mistakes, and associated rework. When everyone has access to the same information, a project become easier to manage.

Digitalization is required for modernization and sustainability of plants.

- Digitalization of old hardcopy and .pdf P&ID sheets is a precursor to meaningful digital transformation.
- Plant data need to be structured and organized to be useful. Data lakes have been problematic.
- High data quality enables a high pace of digital transformation.

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