

INTEGRATING DISPARATE INFORMATION IN THE DIGITAL TWIN WITH CADMATIC eSHARE

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Digital twins used in plant design, construction and operation promise enormous benefits and cost savings, but they can be difficult to implement if users employ multiple software tools to manage design and information. One solution is to deploy eShare, an information management solution that works “on top” to integrate asset information from a wide variety of disparate sources.

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Executive Overview

Digital twins are widely used as representations of products or processes. In the world of process plant design and operation, digital twins are used to improve access and visibility to design, engineering, or operational information of plants and processing equipment during all phases of the asset lifecycle. A digital twin built on top of information from different sources can provide enormous added value to the management and execution of complex projects.

In the design-and-build phases of the asset lifecycle, an accurate, up-to-date, and accessible digital twin reduces time to operational readiness and can

influence time-to-market. The ease with which the twin can be updated during operation or modified during projects, supports the need for increased flexibility and adaptability. The steadily progressing integration of process engineering, maintenance, 3D representation and operational performance information, speeds up and supports continuous improvement and thereby efficiency, sustainability and return on assets.

Owner-operators can build asset management best practices around a digital twin to improve useful life and asset value. The twin makes it easier to engineer for safety and compliance and to verify compliance of the as-built and as-maintained facility.

Asset Management Challenges in the Process Industries

- *Unused and inconsistent data in drawings, PDFs and legacy tools*
 - *Information accessed by several stakeholders in multiple tools*
 - *Requirement for long term asset and operational efficiency*
 - *Regular modernization and/or adaptation of plants*
 - *Regulatory pressures, sustainability, security, and safety*
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eShare is an information management solution from Cadmatic that takes use of design, construction and operational plant information to the next level and transforms EPC, owner-operator, and engineering company perceptions of the process. eShare's powerful information visualization contributes to faster and more accurate decision-making. The independent web-based portal can integrate, visualize and share any facility-related information via the 3D model. The result is seamless navigation through 3D, 2D and 1D information in a single environment, federating virtually any asset information source.

Challenges in Capital Project Information Management in the Process Industries

The double punch of the COVID-19 pandemic coupled with geopolitical turmoil in Europe and Asia has resulted in abnormally high fluctuations in demand and asset utilization in process plants. This exposed the drawbacks that large-scale and single-purpose assets have when markets are highly volatile. The resulting pressure to increase efficiency and return on assets requires shorter times to operational readiness and greater flexibility in operating and modifying assets to meet changing market demand.

The key to meeting these challenges today is to establish good asset information practices, accompanied by the judicious use of digital twins. During the design phase, EPCs use digital twins to simulate plant design and validate production processes before they are built and implemented (sometimes referred to as the project twin). During construction, digital twins help ensure that engineering changes are validated and implemented more quickly and effectively. Finally, in the operate and maintain phase, owner-operators can use digital twins to manage extensions and upgrades.

Disparate Data and the Single Version of the Truth

Modern plant design software does a good job of managing asset information, but owner-operators often have dozens of various tools, and EPCs may have hundreds, most of which don't necessarily integrate well. The result is asset information locked in a variety of current and legacy

Many independent contractors are involved in the building or upgrade of plants. Poor access to project information and engineering documentation from multiple sources remains a chronic problem – especially for EPCs. Siloed groups lead to poor business processes, missing or outdated engineering information, and inefficiencies.

software tools. For existing assets, the documentation of updates may have been inconsistent over the years, which implies the presence of incorrect information and information gaps, which may result in “different versions of the truth.” Today's challenge is for owner-operators to strike the right balance between the effort of reviewing, completing and correcting asset information in building the

digital twin and managing the wealth of information from multiple sources once the digital twin is built, and considerable real value from using digital twins, by having consistent up-to-date and accurate asset information in a single unified view.

The need to control a variety of risks is a significant element of project planning. Often, the execution of massive projects requires the forming of partnerships of engineering, construction, and owner organizations. Bringing together disparate stakeholders means that a solution is needed to navigate the jungle of disparate engineering software solutions to create an open, collaborative environment.

Technologies like laser scanning, LiDAR systems, photogrammetry, and point clouds provide the means to measure as-is conditions for an upgrade project or new infrastructure. These technologies reduce design errors, interferences, rework, schedule delays, budget overruns, and risk. Using measurements of current conditions rather than old CAD documents helps get it right the first time with reduced rework, associated schedule delays, and added costs.

Challenges for Asset Information Management

Many independent contractors are involved in the building or upgrade of plants. Poor access to project information and engineering documentation from multiple sources remains a chronic problem, especially for EPCs. Siloed groups lead to poor business process performance due to missing or outdated engineering information. Today's tools are often specialized for a certain type of task, but lack the connectivity that would enable the easy comparison and cross-referencing of asset information. If they do, connectivity can be a resource-intensive task.

Engineering tools are well-suited for design and build phases, but may be less-suited for use in operations and maintenance. In most instances, functional information is disconnected from 3D designs, even though the designs could provide excellent context for operations training, maintenance task planning, troubleshooting, and decisionmaking under abnormal conditions. In turn, 3D designs for project planning often lack access to engineering design or information, and/or maintenance records, thus narrowing the user's view. In fact, 3D models are rarely updated after plant changes, and are typically not reused for operator training.

One of the reasons for the disconnect between simulations and asset information is the lack of support for keeping them in synch. The tools used are often demanding of skills, license costs, computing and network resources, and demand may fluctuate wildly. When a project is executed, the bottlenecks appear.

Tighten collaboration in capital projects	For plants under construction by EPC firms, owner-operators require tighter collaboration.
Prevent information loss during handover	The asset information built up during engineering and construction is often incomplete or outdated at the moment of transfer. NIST estimates the cost of information losses during handover to be 1.8% of capital expenditures.
Improve change management	There is a huge opportunity to enhance the process by improving change management to ensure the data are accurate and information is reused.
Integrate functional, operational and 3D spatial information	When engineering or maintenance teams often lose precious time trying to determine the current status and performance of the asset before starting work because the asset information is often missing or inaccurate. Functional, operational and 3D spatial information – for the plant, building, or both - are often not available side-by-side and may be inconsistent. Complete, accessible, and accurate asset information can shorten project duration and mean time to repair, and lower operational and capital expenditures.
Increase reliability with seamless access to asset information	High reliability is required for the best return on assets and process safety. Reliability-centered maintenance methodologies are well advanced and remote equipment monitoring is available. To be efficient, reliability engineers need seamless access to all asset information.
Improve efficiency of compliance processes	As regulatory requirements tighten, compliance costs increase. In some cases, compliance becomes impossible as accurate information cannot be produced at any point in time. The efficiency of compliance processes must be improved using electronic design and requirement documentation, with electronic sign-offs.
Support flexibility and efficiency for fast-track engineering with digital twins	Modular production plants that are easier to modify and use process technologies that are more energy and material efficient are on the horizon. Initial use in pilot installations will gradually be extended to mainstream production. This will further increase the pressure on flexibility and efficiency for fast-track engineering as well as on operation and requirements for a digital twin.

How to Improve Asset Information Management

Most plants in advanced economies are brownfields that were built decades ago, so asset documentation is a real challenge. While there is a business case for up-to-date asset information, ARC estimates that the average percentage of assets with current asset information is below 50 percent and, in best cases, rarely exceeds 70 percent. It is troublesome that most owner-operators are not able to identify their out-of-date information, let alone show a progression of improvement over time. When users notice that data are incomplete, inaccurate, or outdated, they begin to question the validity of all accessible data.

The Dynamics of EDS and BIM Solutions

Today's engineering design software (EDS) and building information modeling (BIM) solutions address the information management issues resulting from siloed business processes and related inefficiencies, spanning the spectrum of stakeholders, from designers (frontend engineering design and detailed design), to construction contractors, and owner-operators (operations and maintenance). These solutions provide owner-operators with access to engineering models, operations and maintenance documents, and information that supports their asset management solutions. Adoption rates are high as owner-operators realize the benefits of having organized and comprehensive operations, maintenance, and asset information available to them on single-source platforms.

For greenfield projects, plant owner-operators are increasingly using EDS and BIM together with digital twins at earlier stages in the project to allow continuous handover. The goal is to provide faster time to production, allowing improved revenue and high operational performance for better margins and profitability. After handover, owner-operators continue to use these solutions together with their asset reliability and asset performance applications to optimize operations, improve uptime, and prevent unplanned downtime. For large plants, the challenge is to create digital twins that access information from multiple sources, including from legacy systems, without moving information around or converting formats.

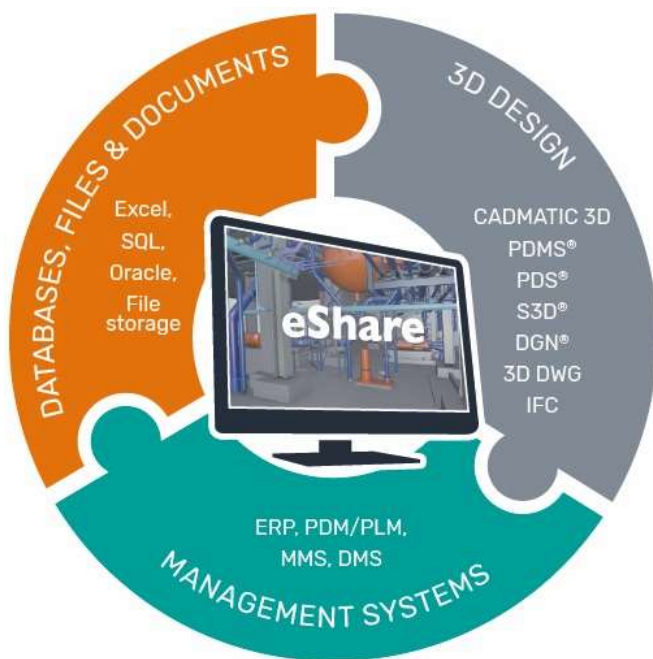
Digital Twins as Support for EPC Projects

Digital twins are used widely in all areas of industry and infrastructure. In product and process design, digital twins are used to simulate and validate ideas early in the game, and for new processes, to reduce the need to build many pilot plants. In process plant design and operation, digital twins provide a visual layer on top of asset information that makes it easier and faster for stakeholders at all levels to click through to the information they need. Digital twins in eShare can also be configured for individual users to tailor the view to specific needs. When used correctly, they help users at all levels to make better and more frequent project decisions, ultimately improving overall project or asset efficiency.

eShare: A Comprehensive Information Management Tool for EPCs and OOs

While EDS and BIM solutions address data management needs, they tend to be monolithic and difficult to integrate with other similar solutions, and it may be difficult to access information in legacy systems. One answer to this challenge is eShare, a comprehensive solution for information management from Cadmatic. eShare is designed to address these issues by drawing

together information from multiple sources via a federating layer added on top rather than by duplicating existing functionality. eShare is essentially a platform that provides a window into all asset information. The solution accomplishes this by interfacing to existing sources and providing integrated visualization. In other words, the data stay where they are, but are viewed together in eShare's integrated digital twin.



eShare Draws Together Information from Multiple Sources Rather than Duplicating Existing Functionality

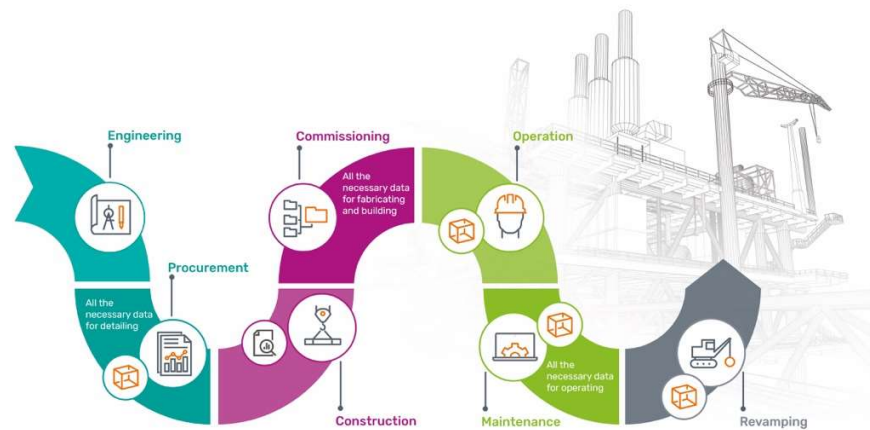
eShare for EPCs

As an “on top” solution, eShare helps EPCs manage project information from design, engineering, procurement, construction analysis and tracking, and ERP. By visualizing federated information, users can follow engineering processes, monitor constructability, material

availability and construction processes, optimize change management and support decisionmaking. eShare provides instant understanding by finding and visualizing information in different ways.

The benefits of such a solution are many, beginning with the reduction of costly errors by improving communication between project stakeholders, including the owner-operator who will eventually inherit the project. By improving or enabling access to critical project information, users can make better decisions about daily project activities. Overruns can be avoided in timelines and budgets by visualizing work packages in critical paths. Finally, the creation of a single platform enables people to collaborate continuously

throughout the course of a project, instead of the traditional one-time handoff after commissioning.



Asset Information Management Accompanies Assets Throughout their Lifecycle, from Design to Operate/Maintain, Providing a Digital Thread

eShare for Owner-Operators

For owner-operators, the eShare platform creates a digital twin of industrial facilities, providing a single window to all facility-related data. Users can integrate their 3D model, engineering data, 3D captured data from laser scans, together with the plant's operational and maintenance data from within an easily accessible web portal. According to Cadmatic, 3D models in eShare are at least 10 times smaller and easier to handle than native formats, and they can be enriched with data from 3D point clouds and various reports and linked documentation. Inspection data can be linked from the maintenance system and visualized without additional integration. The central storage of comments allows eShare to be used as a discussion board and for change management tracking.

Owner-operators can benefit from the fact that a digital twin reduces operational costs and streamlines maintenance and operations processes. Users can access up-to-date and correct information for effective decision making to ensure safety, and optimize production and quality. Regarding the source of the asset information, eShare helps the user to visualize an asset, check its status, perform analysis and generate insights to predict and optimize asset performance. With real-time trending, users can observe process behavior as is done traditionally, but can now also virtually inspect

the plant in 3D, and get real-time process data directly from critical locations or equipment.

Looking to the Future: AIM Along the Asset Lifecycle

Asset information management is often subject to breaks – for example, after handover from the EPC, and during upgrades and retrofits. eShare addresses this issue by helping owner-operators to manage the digital twin of assets throughout their lifecycle in an easy-to-use platform. Even if the underlying design and information management solutions change, eShare allows the user to monitor project progress and minimize the impact of changes during re-engineering and revamping. As assets evolve and change, users can collect and combine 3D models, and add laser-scanned data to update information.

<p>Make better everyday project decisions, on time</p>	<ul style="list-style-type: none"> • Use 3D model as discussion board to compare, comment on and review design changes. • Combine 3D models from various formats (PDS, PDMS, S3D, CADMATIC, DWG, IFC) and laser scans of the facility. • Flow check in processes is 5 times faster with automatic color-based links between P&IDs and the 3D model. • Project review and access to engineering information on site with eGo on mobile table. Use it to add pictures and comments from the construction site visit.
<p>Better quality by combining and visualizing data from different sources</p>	<ul style="list-style-type: none"> • Complete control of engineering data and standardized way of accessing data from different systems. • Categorization based on e.g., the stress calculation of pipelines. • Access information directly and automatically in 3D interface without need to use other systems or check documents.
<p>Make construction a success</p>	<ul style="list-style-type: none"> • Integrate with feasibility data and constructability analysis combines data for: <ul style="list-style-type: none"> ○ Prefabrication analysis ○ Site warehouse management ○ Progress monitoring of construction and prefabrication process and stages ○ Aligning 3D digital data with existing environment in AR/VR/ MR HoloLens

Project Benefits of eShare as a 3D Visualization Layer

Case Study: Bonatti Boosts Efficiency in Oil & Gas Projects

Bonatti is a general contractor for the construction of plants and pipelines in the energy industry. Based in Italy, a country with many well-known energy-focused EPCs, the company employs over 10,000 people worldwide in the realization of large energy projects. Bonatti manages the entire project lifecycle in all phases, from engineering, procurement and logistics, to civil

construction, mechanic and piping erection and E&I installations, up to commissioning and start-up. The company has been using eShare to boost the efficiency of its constructability and construction project phases since 2018.

Bonatti's chose eShare to optimize construction sequences and practices and visualize the current status of the construction phase in the 3D model. eShare is implemented on projects once they are sufficiently detailed, usually when the model is about 30 percent defined. At this stage, the first conversion from the native 3D model to eShare is executed. As more detail is added to the model from engineering disciplines, the link to

engineering data from different corporate systems is established. This allows the site to take advantage of the system according to the discipline under construction at the time.

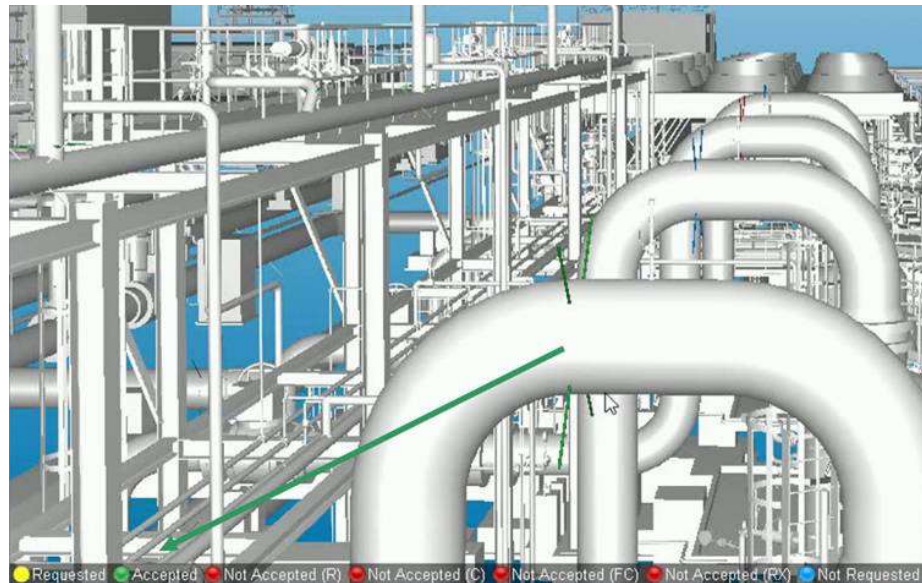
Another goal is to provide support to the construction site in managing and tracking specific activities, including workforce planning, a process that improves the productivity of the construction workforce by removing execution constraints. This ensures that required installation inputs such as drawings, materials, procedures, permits, equipment, etc. have been previously monitored and are promptly available to the crew assigned to the work package. In addition, the company uses eShare to highlight construction priorities associated with the relevant material availability (feasibility), to track electrical and instrumentation installations, and to display welding joint data in real time. A key reason for selecting eShare was the ability to view the progress of installations and visualize quality control activities with color coding.

eShare Key Concepts

Integrate: Access all project data in one place. All project data is accessible in one place via the 3D model hosted in the eShare web portal. No data relocation nor cloud storage is required.

Visualize: Speed up and enhance understanding. Users visualize any data available in the 3D model, external databases, or information added by users.

Share: Bridge the information flow between engineering information produced in design applications and information produced during the construction, operation and maintenance.



Bonatti Uses eShare to Visualize Weld Examination Status.

Another key feature is how eShare helps Bonatti to ensure constructability, a core element in the successful implementation of the company's projects. Bonatti analyzes all project processes with the aim of optimizing construction sequences and practices. Interferences and possible schedule impacts are identified before starting construction, thereby preventing errors, delays or cost overruns. Project processes can be reviewed from the pre-construction phase. According to Bonatti, using eShare to effectively integrate construction knowledge with planning activities, design and field operations has allowed the company to achieve its overall project objectives in compliance with time, accuracy and HS&E requirements.

Conclusion and Recommendations

Digital twins used in plant design, construction and operation promise enormous benefits and cost savings, but they can be difficult to implement if users employ multiple software tools to manage design and information. One solution is to deploy an information management solution that works "on top" to integrate asset information from a wide variety of disparate sources to achieve seamless navigation through 3D, 2D and 1D information in a single environment, federating virtually any asset information source.

Based on ARC research and analysis, we recommend the following actions for EPCs and owner-operators:

- Review your design, construction, operations, and maintenance processes for performance and challenges to identify areas where information management can be improved.
- Consider solutions such as eShare that integrates asset information from a wide variety of disparate sources. Customer testimonials report that its powerful information visualization supports faster and more accurate decisionmaking, and its web-based portal can help integrate, visualize and share facility-related information via the 3D model.
- Talk with your peers about their strategies and experiences. Join the end user-focused ARC Digital Transformation Council to benefit from peer-to-peer discussions and networking opportunities.

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Acronym Reference:

ALM	Asset Lifecycle Management	HMI	Human Machine Interface
APM	Asset Performance Management	IIoT	Industrial Internet of Things
CMM	Collaborative Management Model	IoT	Internet of Things
CPM	Collaborative Production Management	IT	Information Technology
CRM	Customer Relationship Management	MES	Manufacturing Execution System
DT	Digital Twin	OO	Owner-Operator
EAM	Enterprise Asset Management	PAM	Plant Asset Management
ECP	Engineering, Procurement and Construction	PLM	Product Lifecycle Management
		ROA	Return on Assets
		SCM	Supply Chain Management
		WMS	Warehouse Management System

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