

# ARC WHITE PAPER

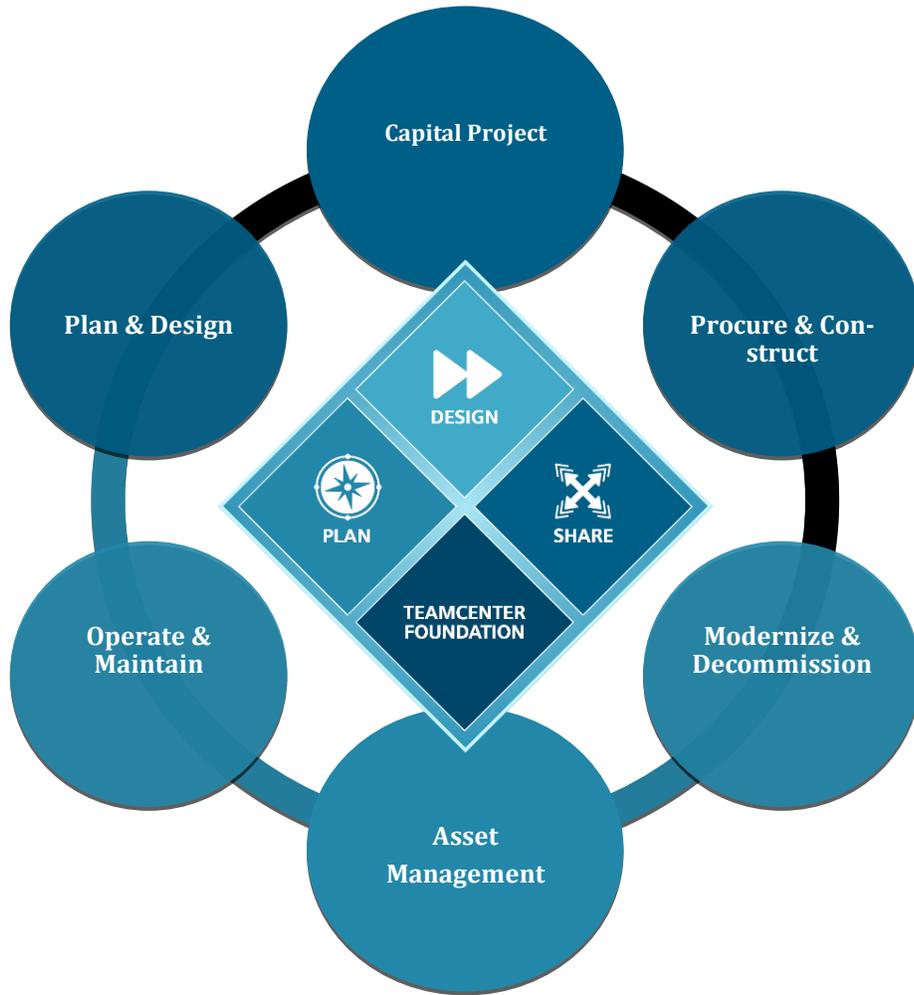
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## Siemens and Bentley Systems Partner to Digitalize and Optimize Capital Assets

Executive Overview .....	3
Teamcenter: Enterprise Data Management for Capital Assets.....	4
Bentley’s iModel Supports Data Exchange for Capital Projects .....	5
Siemens-Bentley Partnership Offers a Unique Value Proposition .....	7
Conclusions .....	10





## Siemens/Bentley Capital Assets Project Management

## Executive Overview

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The partnership between Siemens and Bentley Systems does more than just combine two proven areas of expertise and industry solutions to solve and improve collaboration and data management across the design/build/operate/maintain lifecycle. It brings together the two separate

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and distinct worlds of product lifecycle management (PLM) data management and process plant design. The goal is to address the persistent issues of project inefficiencies and poor access to engineering data that begin within the capital project and continue with ongoing operational complexities after project delivery.

This partnership brings together Siemens' Teamcenter portfolio of enterprise data management solutions and Bentley Systems' iModelHub service for an integrated solution set to digitalize and optimize the lifecycle of a capital asset such as a plant, factory, or other industrial facility. Teamcenter is the market leader for product data management (PDM) within the overall PLM market, while Bentley's customers make wide use of that company's iModel containers.

The Teamcenter enterprise data management platform includes a master repository for asset data with configured visualization for 1D/2D/3D, project planning and coordination capabilities, enterprise-level change management, plant breakdown, and functions as the digital thread for the entire design/procure/construct/maintain lifecycle. Bentley Systems' iModelHub, in turn, functions as the hub for engineering data, harmonizing proprietary data formats and bringing them into Teamcenter.

The clear value add for combining Siemens Teamcenter enterprise data management capabilities with Bentley's iModelHub is the digitalization of the entire capex/opex lifecycle. This establishes a continuous and consistent digital thread from the capital project to the plant operations, enabling a digital twin of the asset that aligns the virtual engineering models with the physical assets of the plant under construction. Once operational, the Siemens enterprise digital twin aligns the operational data with the physical as-operated assets. By connecting a digital twin with a digital thread across the capex/opex lifecycle, companies can reduce capital project delivery costs and improve operational margins significantly while reducing operational overhead.

## Teamcenter: Enterprise Data Management for Capital Assets

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Designing and building process plants is different than designing and making products. However, these different domains have many similarities and share many common processes. While designing and constructing a power generation facility, refinery, or chemical processing plant requires specialized design tools that differ from those used to design automobiles, airplanes, and medical devices; the process for managing engineering data across the design/build/maintain lifecycle is surprisingly similar.

Discrete manufacturers must maintain a common repository of design and manufacturing data, often referred to as a “single source of the truth.” Product data management is a critical component of the design/build lifecycle. This is a repository for all engineering design, version control and

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*Siemens Teamcenter meets all the requirements and provides the features needed in a central repository that must handle all enterprise data management.*

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change management, engineering and manufacturing BOMs, production processes, materials and tooling, and all things needed to drive this lifecycle. Siemens’ Teamcenter PDM solutions meet all the requirements and provide the features needed in an enterprise repository that must handle all enterprise data management and business processes. By using Teamcenter’s web-

based client platform, Active Workspace, stakeholders across the design/build/maintain lifecycle can collaborate on asset data stored in the enterprise repository while utilizing a simple, role-based user interface on a desktop, tablet, or smartphone browser.

### Teamcenter Manages Data at the Enterprise Level

In a capital project for a plant, Teamcenter would function as the single point of access for federated data, including all data related to plant engineering design, procurement and materials management information, equipment and assets, construction processes, and project management. It would represent the enterprise repository for all plant breakdown data, provide visualization for 2D and 3D models across the project, and enable lifecycle digitalization of the plant. Overall, Teamcenter significantly improves the coordination of design, procurement, and construction for a capital project and provides the ability to view the plant as a “work in progress” with a coordinated workflow process.

Teamcenter would provide planning and coordination of design and engineering activities in the context of the overall capital project plan, including coordinating with industry-standard project management tools (such as Primavera) and other procurement, material management, and construction planning solutions. Additionally, Teamcenter would provide an enterprise-level change management version control process, which is often critical for delivering projects on budget and within schedule.

Another important function of Teamcenter is the breakdown of major equipment components, including interoperable access to engineering models of these components. Teamcenter also provides plant and process designers with the often-needed access to engineering models of equipment and components that are integral to the overall plant design.

## Bentley's iModel Supports Data Exchange for Capital Projects

Capital projects are often very complex, with many unique characteristics. They typically involve many collaborating disciplines where the work is interconnected, with thousands of asynchronous decisions and changes for engineering design, material choices, structural integrity, safety, regulatory issues, and more.

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*Bentley Systems has addressed the complexity and variability of infrastructure projects with an EPC-tested portfolio of solutions across the design/construct/maintain lifecycle.*

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Bentley Systems, drawing on decades of experience and expertise with capital projects, has addressed the complexity and variability of capital project design data with the iModel.

### iModel Enables the Digital Thread for Capital Projects

Capital projects typically pose multiple challenges related to data management. Typically, a project will involve a variety of disparate teams. These range from engineering design, to multiple sub-contractors, procurement and materials suppliers, and construction companies involved at various stages of the construction schedule. To manage all these components successfully in terms of schedule and budget, a mechanism is needed to process **the high volume and frequency of data** and, moreover, to provide project data access to all stakeholders across the project. This is where the iModel comes into play.

Bentley's iModels have been very popular with users since their introduction. iModels are used to exchange information for projects associated with the lifecycle of capital assets. iModels help ensure that information flows easily, completely, and accurately between and within design, construction, and operations environments. Users can share all component information, including business properties, geometry, graphics, and relationships. The open format provides standard interfaces for business, engineering, construction, and operations applications from multiple vendors.

One of the reasons iModels are so readily accessible, open, and reliable is that they work within a Base Infrastructure set of Schemas (BIS) that is, in

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*iModels help ensure that information flows easily, completely, and accurately between and within design, construction, and operations environments.*

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turn, based upon an embedded, open-source SQLite relational database. iModels have evolved from the SQLite iModel format to cross-platform C++ libraries for Windows, iOS, and Android iModel release 2.0 in 2018. The iModel 2.0 BIS includes all disciplines and lifecycle phases for all BIM, infrastructure, plant (power and process), facilities, cities, rail and transportation,

utilities, mining, and alternative energy and nuclear power across the complete Bentley portfolio for design, construct, and operations.

### **iModelHub: the Heart of the iModel**

As a core component of Bentley's iTwin Services, the company has architected iModelHub from the ground up to process a high volume and frequency of data. It maintains a "timeline of changes," an accountable record of who did what and when. Any version of the iModel can be accessed, and significant versions named. Visual and textual reports can show the difference between any two points on the timeline.

The iModelHub brings a high level of interoperability to project delivery. It bridges existing and third-party plant design and engineering authoring tools through the iModel Bridge Service. Users and project participants can send existing digital engineering models from other design applications without making any changes or format conversions. This enables participating organizations to contribute to the project with minimal disruption to the existing workflows.

## Siemens-Bentley Partnership Offers a Unique Value Proposition

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Siemens and Bentley Systems have been partnering with their respective technology solutions for many years. Siemens' COMOS for front-end engineering, electrical, instrumentation, and process design is teamed up with Bentley's OpenPlant 3D plant design to offer engineers the object database capabilities of COMOS with the 3D capabilities of OpenPlant. Siemens PLM's Tecnomatix factory simulation and NX line Designer solution are combined with Bentley's laser point cloud modeling solution to enable users to model and simulate production systems, and with facility modeling

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*This latest partnering of Siemens and Bentley for project delivery represents yet another milestone in a history of partnerships that bring significant value to the plant design and infrastructure user communities.*

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to help ensure factory design compatibility. And, in 2018, the two companies jointly announced PlantSight, a cloud services solution that benefits customers through more efficient plant operations. PlantSight enables as-operated and up-to-date digital twins that synchronize with both physical reality and engineering data to create a holistic digital context for any operating plant. This latest partnering of Siemens and Bentley for capital project and plant lifecycle digitalization represents yet another milestone in

a history of partnerships that bring significant value to the plant design and infrastructure user communities.

### **Dynamically Manage Capital Projects at the Enterprise Level**

Capital projects are often subject to inefficiencies and lack of access to engineering and construction information over the design/construct/maintain lifecycle. These often lead to project cost overruns and schedule delays. Moreover, the sheer scale and inherent complexity of a large capital project demands that it be managed at an enterprise level. This helps ensure that all the various organizations, subcontractors, and stakeholders are provided with access to all necessary engineering and construction information in a timely and efficient manner. Change management becomes a primary challenge. One of the clear values of combining Siemens Teamcenter with Bentley's iModelHub is that this total environment enables users to dynamically manage a complex capital project at an enterprise level.

### **Remove Boundaries Between Plant and Enterprise Data**

Teamcenter's strength has always been its enterprise-level data and business process capabilities. The strength of Bentley's iModelHub has been the continuous coordination and exchange of project data. To succeed, capital projects need to connect plant data with an enterprise data management system. This provides users with access to the plant data to support concurrent engineering and visualization of 2D/3D data across the project and the enterprise. By establishing this connection, continuous digital handover of the project data becomes possible, providing operations with the asset information needed to help optimize performance over the asset lifecycle.

By combining their respective domain knowledge, these two market leaders can help optimize coordination and collaboration across internal project teams, suppliers, and all project stakeholders; with complete traceability of requirements, design decisions, and expected and realized project outcomes. This helps lower project delivery costs, meet schedule delivery, lower maintenance costs, and increase operational efficiencies. Taken together, these represent a strong value proposition.

### **Teamcenter and iModelHub Combine to Optimize the Performance of Capital Assets in Project Delivery and Operations**

With Siemens' Teamcenter functioning as the collaboration platform for enterprise data management and Bentley's iModelHub providing data acquisition and exchange services for plant data, even the most complex capital project will have all stages of the lifecycle connected and accessible.

At the *plant data management level*, interoperability is supported with the plant engineering design models that may be used by other project participants. These include OpenPlant, COMOS, AVEVA, Hexagon PPM, Revit, and others. At the *program level*, Teamcenter integrates engineering and construction with program planning and execution to manage the program plan, plant and work breakdown, and work-in-progress. At the *operational level*, a closed-loop digital twin is used to visualize and simulate performance, which can be reported back to plant operations for production planning and design for further optimizations. Together, the Teamcenter platform combined with the Bentley solution set offers an end-to-end digitalization solution that can be used to optimize the performance of a capital asset in project delivery and operations.

## The Digital Twin for the Connected Intelligent Plant

Today, the digital transformation is taking place across many industries. Companies clearly understand that to remain competitive, grow business, and embrace emerging technologies, they will need to understand, develop a strategy, and implement some form of a digital transformation. For many industries, including process plants, this is manifested by the digital twin.

The basic premise of the digital twin is a merging or connection between virtual engineering (digital models) and the physical plant equipment and other assets. This connection is typically made through intelligent sensors

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*Combining the enterprise data management capabilities of Siemens' Teamcenter with the data acquisition capabilities of the iModelHub creates an ideal environment for implementing the digital twin.*

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that can monitor, collect, aggregate, and (in some cases) perform analytics. This is now commonly referred to as the intelligent edge, or edge computing. For industrial plants, the fundamental requirement for a digital twin is that the asset must be both connected and intelligent. When the physical and virtual worlds of the plant (including its engineering design and operational functions) are connected and intelligent, a range of possibilities are enabled. These range from design improvements, operational optimization, continuous process improvements, conditional states of the equipment, and both predictive and prescriptive analytics.

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Combining the enterprise data management capabilities of Siemens' Teamcenter with the data acquisition and exchange capabilities of the iModelHub creates an ideal environment for implementing the closed-loop digital twin and using it to create new efficiencies across the design/construct/operate/maintain lifecycle.

The closed-loop digital twin exemplifies a lifecycle approach. It is part of what Siemens calls the Digital Enterprise, which is used to improve all the processes along the entire value chain. As the enterprise repository and collaboration platform for the design/construct/operate/maintain lifecycle, Teamcenter is the gateway into the Siemens Digital Enterprise portfolio of integrated technology. This includes an open IoT platform, design and simulation software, a rapid app development, robotics, automation and control systems, as well as additive manufacturing.

## Siemens and Bentley Bring Thought Leadership to Capital Assets

Both companies bring decades of experience and expertise to not only capital project delivery, but also to areas of engineering design, digital

modeling, program planning and project management, data management, requirements engineering, change management, and enterprise-wide 2D/3D visualization. Moreover, both Siemens and Bentley can draw upon an expansive solution set of technologies. These include virtual simulation tools, virtual modeling tools based on laser point cloud and photometry, virtual and augmented reality, geospatial information systems, and a range of complementary technologies for the plant design and infrastructure space.

Going forward, each company exhibits a vision for the future of AEC/BIM, process plants, smart cities, and infrastructure. Both understand the need for their customers to succeed in digital transformation and provide technologies, solutions, and strategies to help those customers realize the full breadth and scope of digitalization.

## Conclusions

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Several key themes drive both Siemens and Bentley in bringing a robust and comprehensive capital asset digitalization solution to market. The overarching theme here is the management of data across the design/construct/operate/maintain lifecycle, including change management for data that is both evolving and dynamic. This partnership of systems, platforms, engineering design, and construction methods is predicated on a democratization and accessibility of data across the asset lifecycle that involves all players, organizations, and stakeholders.

The success of any project of scale and complexity depends largely on the ability of the tools, solutions, and platforms to manage change and the perishability of data. By combining their respective domain expertise and quality of solutions, Siemens and Bentley are enhancing and progressing the current state of the capital project, while simultaneously extending this value into plant operations.

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**Acronym Reference:** For a complete list of industry acronyms, please refer to [www.arcweb.com/research/pages/industry-terms-and-abbreviations.aspx](http://www.arcweb.com/research/pages/industry-terms-and-abbreviations.aspx)

<b>AEC</b>	Architecture, Engineering & Construction	<b>HMI</b>	Human Machine Interface
<b>API</b>	Application Program Interface	<b>IOP</b>	Interoperability
<b>BIM</b>	Building Information Management	<b>IT</b>	Information Technology
<b>BOM</b>	Bill of Materials	<b>MIS</b>	Management Information System
<b>BPM</b>	Business Process Management	<b>OpX</b>	Operational Excellence
<b>CPG</b>	Consumer Packaged Goods	<b>PAS</b>	Process Automation System
<b>CPM</b>	Collaborative Production Management	<b>PDM</b>	Product Data Management
<b>CRM</b>	Customer Relationship Management	<b>PLM</b>	Product Lifecycle Management
<b>EAM</b>	Enterprise Asset Management	<b>RFID</b>	Radio Frequency Identification
<b>ERP</b>	Enterprise Resource Planning	<b>ROA</b>	Return on Assets
		<b>RPM</b>	Real-time Performance Management
		<b>SCM</b>	Supply Chain Management
		<b>WMS</b>	Warehouse Management System

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