

Modernization of PLM—Accelerating Innovation

Teamcenter X: Simplified, proven, future-ready cloud SaaS PLM

Takeaways

What you need to know

Takeaway #1

Discontinuous innovation can lead to breakthrough products and huge success for a business, but it is high risk and can be disruptive, time consuming, and expensive for the manufacturers and especially customers.

Takeaway #2

Accelerating innovation and making it sustainable requires a modern, flexible, and robust PLM solution built for evolution, not revolution. An approach that enables companies to deploy best of breed solutions and applications with deep capabilities in a flexible and adaptable manner that supports and manages change.

Takeaway #3

Siemens Digital Industries Software is committed to helping companies drive digital transformation by delivering innovative technology and solutions spanning the extended enterprise and the end-to-end product lifecycle.

Takeaway #4

Teamcenter X is the latest evolution of the Teamcenter product suite. Teamcenter X *is* Teamcenter—delivering all the capabilities of on-premise Teamcenter via the cloud.



Image courtesy of Siemens

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Accelerating innovation

Manufacturing enterprises in every industry are working in complex, fast changing times. They are being challenged to develop more personalized, complex, smarter, and eco-friendly products. They need to undergo a digital transformation of their business and evolve their current product, production, and service lifecycles to enable true end-to-end lifecycle innovation and optimization. They need to dissolve the boundaries between their Product Innovation Platform and other critical innovation platforms. Success requires continuous and, more and more often, rapid innovation—innovation of their products and their processes.

Innovation has two primary modes, continuous and discontinuous. With discontinuous innovation, the new product obsoletes the previous product via a significant breakthrough. While exciting, and potentially having a huge impact on product benefits, discontinuous innovation is higher risk for both the product producer and the consumer or user. The marketplace is littered with hugely innovative products that bankrupted producers whether due to bugs, late delivery, or lack of adoption. But, when the producer gets it right, whole industries can be created or destroyed.

Continuous innovation occurs when regular

improvements are added to a product over time. Customers don't have to change their processes or behavior significantly to take advantage of the improvements. Over time, the incremental improvements add up to significant changes without customers experiencing a large productivity hit and manufacturers taking on too much risk.

Innovation of processes is driven by the adoption of evolving, enhanced, and/or new technologies applied in new ways. With IT solutions, including PLM solutions, innovation is often discontinuous. Rip and replace deployments have often been required to take advantage of discontinuous innovation. At times it has been worthwhile, the shift from explicit CAD to parametric solid modeling in the 1980s and early 1990s was such a shift. Unfortunately, IT solutions can become obsolete if not well managed forcing discontinuous innovation on a company.

To accelerate the opportunity for innovation, modern solutions, and their supporting infrastructure need to be architected to evolve as business, IT, and technology strategies evolve. This enables customers to focus on how to best innovate and leverage that evolution to enhance their business (products and processes) at their pace. Modern solutions will provide investment

protection (or future proofing) as they are architected to evolve and grow as needed.



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What is a Modern PLM Environment?

One that enables comprehensive Digital Thread and Digital Twin

A modern PLM environment must be built on a flexible, adaptable, scalable architecture that enables an enterprise to more easily adapt their technology, information, and supporting applications and environments to meet changing business needs. It must enable creation of an open ecosystem of connectivity with other business systems, applications, partners, and connected devices, whether run on-premise, in the cloud, or at the edge. Such open ecosystem capability is required to enable implementation of a true lifecycle digital thread and a comprehensive, actionable digital twin as described here:

- A *digital thread* is a communication framework that connects data flows, which can be used to produce an integrated, holistic view of an asset's data from physical and virtual systems (i.e., its digital twin) throughout its lifecycle across traditionally siloed functional perspectives.
- A *digital twin* is a virtual representation (i.e., digital surrogate) of a physical asset or collection of physical assets (i.e., physical twin) that exploits data flow to/from the associated physical assets continually evolving as it accompanies its real-world physical companion throughout its lifecycle.

A comprehensive, actionable digital twin possesses the required accuracy and fidelity to predict physical behavior and even optimize the actual performance of the physical asset (i.e., the product or process) it represents. Implemented fully, the digital twin thus represents both the entire history and the current state of all enterprise assets and can be used to accurately simulate past and future operational scenarios.

Modern environments are deliverable on multiple IT infrastructures from on-premise to the cloud so that companies can implement and scale (in capability, locations, and user count) as demand dictates. For example, today's cloud-delivered solutions address these issues by providing the ability to scale globally on demand while maintaining high availability and ensuring maximum IP protection. Other important characteristics of modern PLM environments are that they provide for fast startup and ease of onboarding so that customers (and their users) can get into productive use quickly. Since business needs will be continually evolving, a modern environment must provide the ability to easily, and rapidly scale at the customer's pace.

Additionally, an effective, modern PLM environment must provide easy-to-use applications and solutions that solve complex

problems and address various business needs. Importantly, it must be able to be "personalized" or tailored to corporate, business unit, functional domains, and individuals to deliver consistent, contextually relevant, user experiences all while enforcing appropriate standards across the extended enterprise value chain.

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The Manufacturing Enterprise Innovation Platform

Spanning the enterprise to deliver innovation

In CIMdata's view, to fully support digital transformation, manufacturers need to enable a holistic Manufacturing Enterprise Innovation Platform (MEIP).^{*} A MEIP is a specific configuration of domain-specific innovation platforms that enables and optimizes a complete, end-to-end digital thread and a comprehensive set of digital twins across all lifecycle phases. It needs to be built on a modern PLM-enabling Product Innovation Platform foundation, such as Teamcenter X, that has tightly integrated multi-domain applications that create and maintain a comprehensive and appropriate set of actionable digital twins.

A MEIP builds on the Product Innovation Platform as a foundation to deliver a suite of integrated

business solutions and applications that support product development, sales and marketing, manufacturing operations, and product service and support in close concert. It makes technical knowledge available to the business domains of the enterprise and creates an actionable environment based on clear, concise, valid data. It requires deep integration and understanding of business, industry, and domain-specific processes to eliminate the boundaries between technical and administrative functions. It helps individuals, organizations, and enterprises harness and leverage the power of data across multiple innovation platforms.

Important capabilities of a MEIP above and beyond those native to the Product Innovation Platform include:

- Ability to create and validate digital product and process models across all relevant functional domains and disciplines.
- Ability to provide fully-managed information access across all relevant functional domains and disciplines—well beyond product development.
- Develop technology-based tactics to improve business operations (e.g., virtual commissioning).
- Ability to manage and collaborate with suppliers and perform strategic sourcing activities.
- Ability to forecast, plan, schedule, execute, track, and measure the resources, components, and equipment required to manufacture and/or service a part, component, or full product.
- Support for comprehensive portfolio and end-to-end lifecycle profitability management.
- Support for customer management and interaction.



^{*} See:
<https://www.cimdata.com/en/news/item/13796-cimdata-publishes-an-enterprise-innovation-platform-for-manufacturers>

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Getting to Value Quickly

A modern PLM solution speeds implementation and adoption

Every company wants to get the maximum benefits from their PLM investment as quickly as possible. While purchasing PLM technologies and solutions can be done relatively quickly, benefits only come with successful, productive implementations. Or as we all know, “the devil is in the details.” The more rapidly an enterprise can deploy their new environment and users can adopt and use it, the quicker the company can achieve the value they expect and need from their PLM investment. The good news is that a modern PLM solution is designed and architected to help companies achieve rapid deployment and adoption of new solutions and create flexible, scalable environments. So, what are the factors that can drive quick value?

One of the major ways to achieve fast value is the use of cloud delivered SaaS solutions. SaaS via the cloud enables very fast startup and use of the desired solutions. With a SaaS implementation, companies can focus on using a PLM solution rather than going through a long implementation process before they get to productive work. Since the provider manages the solution including operational activities and upgrades, the customer can focus on their product, not the underlying technology or administrative tasks.

However, not every company wants to, or can, run its business exclusively in the cloud. Some companies, for security or other reasons, will need to maintain an on-premise capability. For

those businesses, solutions that can run either on-premise or on-cloud, or in some hybrid combination, offer the best options to implement a PLM environment most appropriate to their business needs.

Cloud technology such as multitenancy, containerization, microservices, and elasticity can significantly shorten time to value and provide the software running on a highly scalable infrastructure. Companies only need to add data and users to get started. Users can be added (or deleted) instantly regardless of where in the world they are located as business needs and projects dictate. Containerization enables solution portability. The container houses all the software and configurations in a format that simplifies cloud infrastructure changes. Service oriented architectures, especially microservices, are what make the cloud scale both performance-wise and cost-wise. All of these technology features simplify PLM implementations, reduce capital investment, and help achieve rapid return on investment.

A major benefit to cloud SaaS delivery is that a company can grow its PLM environment, solutions, and user base at their own pace—driven by their business needs, not by artificial release dates and lengthy roll-outs. Expanded or new functional capabilities and modules can be turned on immediately and put to productive use. Capabilities that are required for a short term can

be turned on and used while needed and then turned off to eliminate unnecessary expense.

Fast time to value is also driven by the rate of user acceptance and adoption. There are two key factors here. The first is the user interface (UI). A modern UI should be easy-to-use, easy-to-adapt, configurable by the individual user while consistent across the environment as defined by the organization, and provide context-driven built-in assistance and guidance. A UI with these characteristics will enable a user to become productive within the new environment quickly, bringing value to the whole organization. The second key factor is having industry best practices built into the solution with best practice solution deployments driven by experts. Although SaaS technology is inherently designed for quick-deployment, successful PLM deployments must include a thoughtful approach to deployment leveraging best-in-class industry expertise and guidance.

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Siemens-Driving Digital Transformation

A long history of innovation

Founded more than 170 years ago, Siemens AG is a global enterprise comprised of five operating companies focusing on the areas of electrification, automation, and digitalization. Siemens is a leading supplier of systems for power generation and transmission, as well as medical diagnosis and has been a pioneer in the development of infrastructure and industry solutions. Siemens AG's vision is to enable, participate in, and in some cases orchestrate value chain ecosystems and enable their customers to successfully undergo the digital transformation critical to future success. They want to do so via industry specific approaches that are often based on core technologies that enable open, interactive ecosystems with partners in the outside world delivering better integration of the industrial value chain.

Driving these digital transformation solutions is the Siemens Digital Industries Software business unit of the Siemens Digital Industries operating company. Initially built on Siemens AG's acquisition of UGS PLM Software in 2007, Siemens Digital Industries Software has grown significantly, augmented by external acquisitions and internal R&D (from multiple Siemens AG operating companies), as well as corporate alignment of other Siemens AG business units, to

be a leading player in the global PLM market. Siemens Digital Industries Software has been a leader in developing multi-domain solutions for many years with a commitment to both research and development tools, such as CAD, Simulation and Analysis, and manufacturing, including process planning, MOM and digital manufacturing.

Complementing these solutions, Siemens AG has also developed MindSphere, an open ecosystem IIoT platform, and acquired Mendix, a cloud-native, low code application development platform. They have invested in, and integrated with, solutions that span the mechanical, electrical/electronic, and software domains of products, as well as technologies and solutions for creating and connecting smarter products and systems. The use of Siemens Digital Industries Software solutions within the various Siemens AG business units is extensive—a major in-house customer, if you will. These operating units are often beta users of Siemens solutions and provide excellent examples of how that software delivers value and results to a complex commercial business.

Siemens AG is committed to helping companies drive their digital transformation by delivering innovative technologies and solutions spanning

the extended enterprise and end-to-end product lifecycle. As CIMdata discussed in a commentary,* the Xcelerator portfolio is an excellent example of the technologies and solutions required support digital transformation. Within that portfolio, the Teamcenter suite is their underlying core Product Information Platform that can support an extended enterprise.



Image courtesy of Siemens

* See: <https://www.cimdata.com/en/resources/complimentary-reports-research/commentaries/item/13915-siemens-2020-media-analyst-conference-commentary>

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Introducing Teamcenter X (1 of 2)

The next evolution of Teamcenter

Teamcenter X is the latest release of Teamcenter. It is a fully functional, future-ready, SaaS solution for companies of all sizes, across industries. Teamcenter X shares technology and a common code base with Teamcenter but extends it using multitenant services. Teamcenter X supports instant-on PLM, grows on demand, provides very strong security, and is maintained and updated by Siemens. Teamcenter X has the same proven capabilities provided by the on-premise version of Teamcenter including document management, workflow, requirements management, and many others. Siemens states that on-premise customers can work with Siemens to move to Teamcenter X, while applying their customer-specific configurations and customizations, protecting a company's PLM investment.

Modern Cloud Platform

Teamcenter X is built using industrial components from the Siemens Mendix low-code application development platform, such as authentication and file storage microservices. As new industrial components are added to the platform, they will be available for Teamcenter X to leverage them.

Historically, Teamcenter has supported some of the largest, most complex PLM implementations in the world. This means Siemens understands scalability. Cloud services used by Teamcenter X

are built to scale as needed and are used for critical PLM components. For example, Teamcenter X uses the AWS RDS cloud database service. This cloud architecture enables Teamcenter X to scale from startups to multinationals while delivering the performance demanded by today's users. Since Siemens maintains Teamcenter X, one of its major benefits is that it is always up to date with new capabilities continually being incorporated.

Instant-On and Grows as Needed

Teamcenter X's SaaS approach provides instant-on PLM using packaged solutions and industry expertise built into every deployment. This eases the onboarding of users and helps ensure adoption and success of PLM. Siemens drives the deployment of Teamcenter X, taking care of all software and hardware requirements, operations, maintenance, and upgrades. Customers have access to training and Siemens' consultation to ensure users have everything they need to get up and running quickly and successfully.

Siemens offers functional and domain-specific packaged solutions for Teamcenter X that incorporate best practices based on years of industry experience. These solutions contain preconfigured capabilities, such as workflows,

pre-defined user groups and roles, and CAD integrations that are intended to simplify PLM, without taking away the ability to address complex issues. Teamcenter X is positioned for growth. At any time, customers can opt to add-in more Teamcenter business and engineering solutions (e.g., Product Configurator, Program Planning, Schedule Manager, and Requirements Management) to fit new or evolving functional needs.

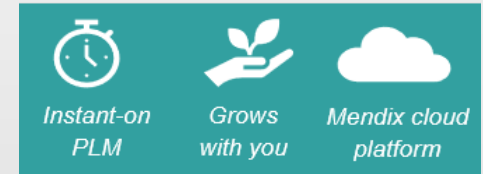


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Connecting the extended enterprise

Comprehensive Digital Thread and Digital Twin

Teamcenter X is a modern PLM solution that enables a company to create and manage a digital thread (i.e., communication framework) that connects data flows, which can be used to produce an integrated and holistic view of an asset's data from physical and virtual systems (i.e., its digital twin) throughout its lifecycle across traditionally siloed functional perspectives.

Teamcenter X supports a comprehensive set of digital twins by managing electrical, mechanical, and software components in a single, multi-domain Bill of Materials across all the functional modules that are part of the Teamcenter suite. Teamcenter X is designed to enable companies to create and maintain a complete digital representation (digital twin) of its product, production, and operations using Siemens tools or other best of breed applications via its open ecosystem and integration capabilities. The product can be fully represented via digital twin views of the technical domain (e.g., mechanical, electrical, hydraulic, etc.), and the lifecycle state (e.g., as-designed, as-planned, as-built, and as-maintained, etc.).

Evolve at Customer's Pace

It is important to note that Teamcenter X is Teamcenter—all the modern advancements Siemens is making in Teamcenter, are available for both Teamcenter and Teamcenter X customers. Also, on-premise/cloud hybrid environments can be supported so customers can migrate to the cloud at their own pace. A key point often overlooked is that an on-premise option is critical for certain industries, especially those involved with defense and intelligence or with extreme environment configuration traceability requirements. Teamcenter X compatibility with Teamcenter provides customers with this option.

The figure provides a high-level comparison between Teamcenter and Teamcenter X.

An important driver for Siemens is the concept of “no customer left behind.” Continuous innovation reduces risk both for Siemens and its customers. Teamcenter X can give Siemens' customers confidence that they won't be left behind regardless of their chosen implementation path, while maximizing return on their PLM investment.

	Teamcenter	Teamcenter X
Full Teamcenter	Yes	Yes
Operations	Customer	Siemens
Upgrades	Customer	Siemens
Purchase Options	Perpetual, Subscription	SaaS
Microservices	Yes	Yes
Containerized Deployments	Coming	Yes
Cloud Services	Not Applicable	Yes

Comparison of Teamcenter X and Traditional Teamcenter

Image courtesy of Siemens

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Maximize productivity

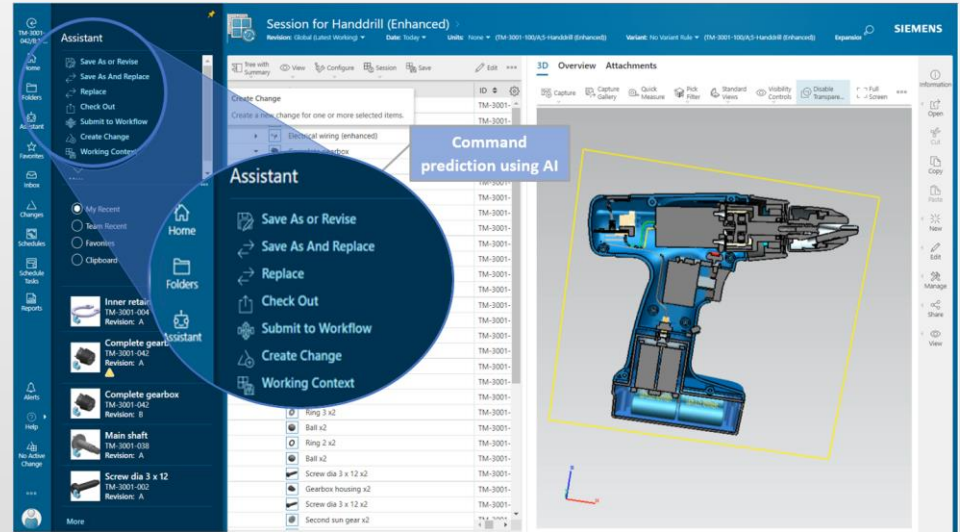
Ease of Onboarding Users

Ease of use is critical to achieving maximum productivity and adoption of any PLM environment. With Teamcenter X, users are provided with an easy-to-use interface that helps with onboarding and increased productivity. The user interface (UI) is designed with many elements to help users get to the desired information faster, help users work smarter, and enable them to collaborate with ease throughout the enterprise. Teamcenter X incorporates a visual UI to navigate users through their products and processes.

Teamcenter Assistant, which is part of the UI, incorporates Artificial Intelligence (AI) elements like command prediction that learn as a user, or team, works. Siemens Digital Industries Software reports that this can reduce mouse clicks up to 30%. This AI driven interface provides helpful tooltips to guide users along the way and can help them get up and running quickly, as well as work smarter. The following figure illustrates Teamcenter Assistant.

Teamcenter X customers can work with Siemens to use the Mendix low code application platform and microservices to create their own unique composite applications and integrations across their extended enterprise value chain. This

enables them to maintain a tailored interoperable, easily accessible open ecosystem of applications and models connected to a comprehensive digital twin.



Teamcenter Assistant Uses AI to Guide Users and Reduce Mouse Clicks

Image courtesy of Siemens



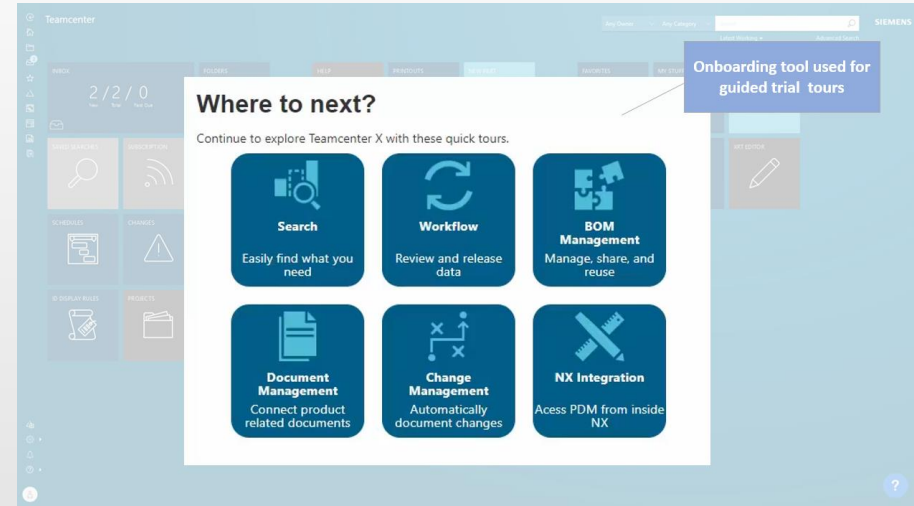
Trying Out Teamcenter X

Explore and learn for free

Explore Teamcenter X Before You Buy

Siemens helps companies try out Teamcenter X and determine if it is right for them by providing a free 30-day trial. This *Try Before You Buy* approach includes a mechanical CAD integration, and it doesn't require any set up or installation. Trial users are guided through key PLM use cases with an onboarding tool that helps them quickly understand Teamcenter X capabilities and value. They also have the option to explore Teamcenter X on their own, outside of a guided tour. CIMdata sees this free trial as an effective way to demonstrate Teamcenter X's value, allowing any company to explore Teamcenter X at their own pace without a financial commitment.

The top figure describes features of the Teamcenter X free trial offer.



Teamcenter X Trial Offer

Image courtesy of Siemens

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Teamcenter X is a modern PLM solution

Manufacturers in all industries are dealing with complex, fast changing times. Success requires continuous and, more and more often, rapid innovation for every part of their business. Accelerating the opportunity for innovation requires modern solutions architected to evolve as business, IT, and technology strategies evolve. To achieve this, customers need a modern PLM environment built on a flexible, adaptable, scalable architecture that enables creation of an open ecosystem of connectivity with other business systems, applications, partners, and connected devices, whether run on-premise, in the cloud, or at the edge. Such open ecosystem capability helps implementation of a true extended enterprise, lifecycle digital thread and comprehensive, actionable digital twin. This allows a company to focus on how to best innovate and enhance their business (products and processes) at their pace while getting the most out of their investments.

Teamcenter has been a leading PLM solution for years. Part of the reason it has maintained its status is the continual investment Siemens puts into it. It has grown significantly in breadth and depth over the years through continuous innovation driven by customers. Teamcenter X is a significant evolution of the Teamcenter family embodying all the capabilities on-premise Teamcenter is known for—optimized for cloud delivery, scalability, and performance.

A core part of Siemens' Xcelerator portfolio, Teamcenter X is a modern, complete, fully functional, SaaS implementation of Teamcenter designed to enable companies to create and maintain an interoperable, highly accessible, and open ecosystem of applications and models. Teamcenter X provides the Product Innovation Platform that forms the foundation of a Manufacturing

Enterprise innovation platform (MEIP). Teamcenter X's cloud delivery enables companies to startup, grow and scale as rapidly as their business needs demand, all within a highly secure environment, managed and updated automatically by Siemens.

Finally, CIMdata views Teamcenter X as a modern PLM solution that can enable companies to effectively create a comprehensive, actionable digital twin and manage the complete product lifecycle from creation through production and service across a heterogenous value chain. Manufacturing enterprises, whether big or small, facing today's complexity challenges should include Siemens Teamcenter X in their evaluation of solutions for implementing a modern, future-ready PLM environment.

Simplified, proven,
future-ready cloud
SaaS PLM



Instant-on
PLM



Grows
with you



Mendix cloud
platform

Visit [siemens.com/teamcenterx](https://www.siemens.com/teamcenterx) to find out how you can get started with Teamcenter X today

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