DIGITAL INDUSTRIES SOFTWARE

The growing importance of the digital enterprise across the A&D industry

Leveraging integrated solutions across the product lifecycle to embrace digital transformation

Executive summary
Today's aerospace and defense companies are at the forefront of two historic trends: unprecedented innovation and increased complexity. To get ahead of these trends, aerospace and defense (A&D) companies must embrace digital transformation to be more productive, innovate faster and achieve program execution excellence. This will ensure programs deliver on technical requirements, cost and schedule.

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Introduction

Digital transformation is permanently changing the way industries across the globe conduct business. The aerospace and defense industry is no exception. In fact, A&D is innovating and combining technical innovations in ways never seen before to transform commercial aircraft, space travel and defense. And it's this digital revolution that has spurred the emergence of companies involved in electric aircraft, electric vertical take-off and landing (eVTOL) aircraft, supersonic aircraft, next generation fighter jets and new space applications for tourism, satellites and space exploration.

The advantages of digital transformation are quickly showing the difference between companies that advance in a competitive marketplace and companies that fall behind. Digitalization is not just about creating or sharing data, it's about seamless data integration earlier in the process and analyzing the data in a virtual context for better and more predictive decision making, when the cost of change is lower.

Digital transformation in the A&D industry helps companies improve program performance – whether it's enabling faster time-to-market, cutting costs or adding the latest capabilities. It's about unlocking innovation so teams can move faster. It's adding productivity enhancements, such as managing change, in every phase of the product development lifecycle. And today more than ever, it's providing the tools for increased collaboration internally at large manufacturing organizations, externally with suppliers, and more broadly, across the entire value chain.

The Siemens Xcelerator business platform of software, hardware and services is an application development platform that empowers customers to rapidly meet changing business models with flexible, accessible and scalable applications. Siemens Xcelerator not only encompasses the industry's most comprehensive digital twin, but brings together a series of connected solutions throughout all phases of A&D mission development.

Trends driving the need for more digitalization

The A&D industry finds itself at the forefront of one of the most transformative periods in history. This movement to a more digitalized enterprise is without precedent. It's important to understand the trends and challenges facilitating the need for more digitalization.

- **Pressure to reduce program costs and schedule**
  Original equipment manufacturers (OEMs) and their suppliers are challenged to bring new products to market faster while meeting technical, cost and schedule objectives. To compound this scenario, a growing number of competitors are bidding on fewer programs which makes winning the next program even more important. Methods and practices to share and collect information just a short time ago are no longer applicable today. In fact, in a recent survey by Lifecycle Insights, 56% of of respondents said that each engineering discipline (mechanical, electrical, electronic, software) have their own set of software tools and systems.
- **Increasing program complexity**
  The end customer is demanding greater innovation and improved performance. As companies seek to improve performance, they rely on more integration, electrification and software. The greatest impact is when a design issue is discovered late in the development process. This causes exponential impacts to costs while creating delivery risks. Existing risk management approaches and lack of collaboration between business functions have led to suboptimal decisions. Meanwhile, supply chain disruptions continue to be prevalent, causing additional delays and significant revenue losses.
- **Increasing demands for sustainable solutions**
  Today there is a concentrated effort toward the decarbonization of commercial aircraft, a shift to become more carbon neutral. The emergence of electric propulsion is a direct result of many new green energy programs. Electrification has replaced the traditional mechanical, pneumatic and hydraulic systems and structures that have been in aircraft for decades. This changes the skills, tools and approaches needed today. Electrification will only increase over the years as it improves aircraft system reliability and maintainability.
- **Continued supply chain interruptions**
  In recent years, the A&D industry has faced unprecedented supply chain disruptions that cause late deliveries, revenue losses and frustration among customers. Additionally, a lack of collaboration between business functions has led to more disruptions and less streamlined processes.
- **A shrinking workforce**
  Ongoing supply chain-related challenges are only getting worse with continued workforce shortages. While there are unprecedented demands for increased productivity from a shrinking pool of A&D engineers, there is an increasingly urgent need to collaborate and communicate effectively within engineering teams and across the ecosystem.

It's not just commercial companies that are embracing digitalization. Equally important to the trends mentioned is how the United States Department of Defense (DoD) is addressing digital transformation. The DoD refers to the digitalization as digital engineering and in the document "Digital Engineering Strategy" released in April 2022, the DoD discusses the planning, development and transformation of an end-to-end digital enterprise across all departments. For the DoD, this is an opportunity to go faster and reduce the acquisition costs of new programs to stay competitive in a market of ever-changing global geopolitical requirements.

Digitalization in aerospace and defense

Siemens Digital Industries Software is helping customers across the aerospace and defense industries meet their rapidly changing needs through flexible, adaptable and scalable software and business solutions. We've been leveraging our expertise gained by applying our digital solutions, which includes our comprehensive digital twin, into some of the most innovative companies to assist in the design and manufacture of world-class products and processes.

The comprehensive digital twin

The comprehensive digital twin merges the virtual and real world, blurring the boundaries between engineering and process domains. It enables a complete digital transformation in discrete and process industries. Siemens is the only partner with domain knowledge in all disciplines of the digital enterprise:

The three configurations of the Siemens comprehensive twin include:

- **The digital twin of product** predicts physical appearances and other attributes such as performance characteristics before the actual product is built. This goes beyond 3D computer-aided design (CAD). The Siemens digital twin of product virtualizes machine learning (ML), generative design and product lifecycle management (PLM), to name a few examples.
- **The digital twin of production** allows for the optimization of the physical layout of production. This digital twin takes into account a variety of considerations for production capacity, virtual commissioning and utilization of resources for a more optimized throughput.
- **The digital performance twin** provides insight and optimization of in-service operations to include abilities to predict maintenance aspects and validate what was produced versus what was initially designed.

The Siemens digital twin allows for the virtual testing or the "fly before you build" approach which enables users to confirm product performance and identify changes before the product is built. This approach reduces cost and schedule impacts, as well as limiting the risk to test programs. It also improves the effectiveness of a test program as users quickly understand where to focus testing to address areas of greatest concern.

To leverage the full potential of a digital twin, is to maximize its ability to think and understand the impact of changes at the earliest stage of concept and design from one connected twin to another, or from one connected system to the next within the product development ecosystem. This type of functionality requires a powerful, integrated and continuous exchange of digital information.

The goal of digital transformation is to leverage the comprehensive digital twin to ensure optimization across the entire lifecycle.

Siemens Xcelerator software for industry
The Siemens Xcelerator software for industry portfolio is a fundamental component of the overall Siemens Xcelerator open digital business platform. The portfolio brings together significant Siemens Digital Industries Software offerings. It includes integrated technologies, solutions and services covering key areas from mechanical, embedded software, electronics and simulation to manufacturing, collaboration, operations and an app development platform for industrial IoT and cloud computing.

With our solutions connected by "digital threads," task automation is achieved and functions are interconnected, integrated and linked so users can quickly access, share and manage program details across the entire product lifecycle – at any time, from any location.

Siemens Digital Industries Software provides the technical foundation to support our comprehensive digital twin and digital thread. The Siemens Xcelerator includes Teamcenter® software, for example, which weaves a digital thread and creates a digital backbone of information connecting people with data and applications for real-time, real-world decision making.

Digital transformation solutions

Commercial aerospace and defense companies are embracing new technologies in ways the industry has never seen before. Siemens' program execution excellence, whether for a commercial or defense program, is based on the goal of improving technical performance, program cost, and program schedule – all while managing or mitigating risk.

To complement the comprehensive digital twin and facilitate program excellence, Siemens offers solutions across seven key product development disciplines that are critical across the A&D product development processes. These "digital threads" serve as the enablers for digital transformation.

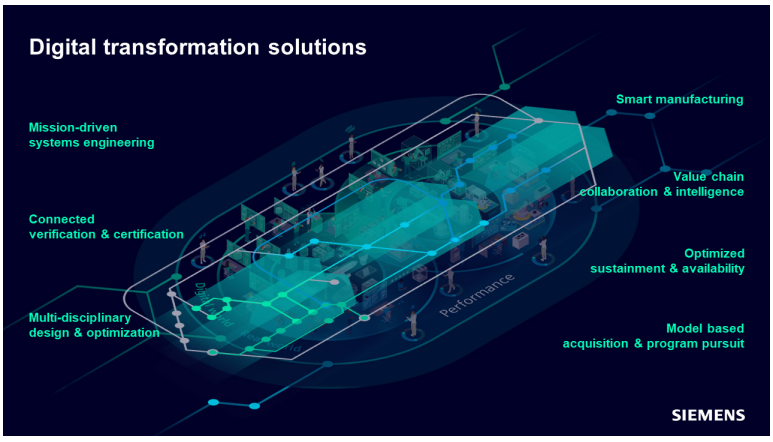


Figure 2. Siemens solutions enable digital transformation across the complete product lifecycle, automate tasks, help users innovate faster and empower engineers to focus their time where they can provide the most value.

Digital transformation solutions for A&D:

Mission-driven systems engineering
This is the digital transformation of systems engineering across the product lifecycle. This approach ensures end-user mission success by managing the technical baseline from the business understanding of the mission, to the end-user execution of the mission. It enables the unique ability to optimize at the system level far beyond an individual domain or part and across the entire product lifecycle, helping to ensure mitigation of risks at the earliest stages of product development.

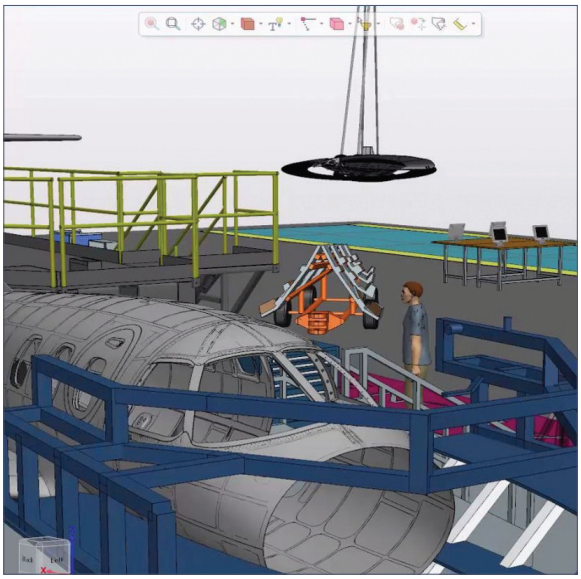
Connected verification and certification
Siemens solutions for connected verification and certification enable manufacturers to meet proof of compliance and regulatory certification faster with confidence through accurate documentation, thorough end-to-end traceability, continuous visibility, and a link between virtual and physical testing. This enables faster verification that design meets requirements regardless of regulatory entity or customer, including commercial, space or defense.

Multi-disciplinary design and optimization
This comprehensive design solution integrates critical aspects of product development, including mechanical, electrical and software design – and bring the design to life. Customers can leverage Siemens Xcelerator open digital business platform to connect high- level architecture with mechanical design tools, while ensuring a connection between design and simulation, to achieve certifiable designs quickly. By leveraging powerful simulation tools and shifting to an interdisciplinary closed-loop design approach, customers can optimize product performance. A holistic view of the multidisciplinary product design and access to data in one place brings the design to life.

Model-based acquisition and program pursuit
This set of solutions provides a systems-based approach to project program planning by integrating cost, schedule, risk and technical requirements into a fully planned and budgeted program management solution. This thread provides an integrated view across all domains.

Smart manufacturing
Digital transformation of the entire production process helps deliver a flexible, connected factory of the future. A model-based manufacturing plan allows you to deliver designs that are right when built the first time. Virtually validating the plan increases confidence in both design intent and that the manufacturing plan will meet program cost and schedule. By increasing flexibility and visibility, this solution also helps continually optimize products and processes.

Value chain collaboration and intelligence
This solution digitally transforms the entire supply chain and provides real-time market insights to help manufacturers understand changing supply chain dynamics, such as part and material availability. This coupled with the most comprehensive digital twin drives an integrated model-based approach. It also creates flexibility to make informed decisions earlier and increase resiliency across the value chain.



Optimized sustainment and availability
This solution optimizes support system data to ensure access to most accurate, as-certified and as-serviced configuration data to keep fleets in service. By integrated certification reliability criteria and failure triggers with operational and maintenance requirements in the design – at the earliest stages – manufacturers can limit failure rates while enabling predictable in-service maintenance schedules.

Conclusion

Digital transformation today affects every A&D business or organization disrupting current leaders and creating new opportunities for the swift and innovative. While these opportunities are exciting, they present numerous challenges. The technology required to initiate new programs increases the level of complexity and integration along with the regulatory requirements necessary for success. We are also aware of the cultural or institutional challenges that accompany transformational change.

Siemens Digital Industries Software has carefully aligned itself to help customers meet the current and evolving conditions associated with the adoption of the digital enterprise. The Siemens Xcelerator portfolio is the mechanism and means to achieve this goal. It provides OEMs and, their suppliers and partners with the foundation to build and scale to a fully advanced digital enterprise that leverages the comprehensive digital twin across key industry processes aimed to achieve the full benefits of digital transformation.

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For additional numbers, click here.

Siemens Digital Industries Software helps organizations of all sizes digitally transform using software, hardware and services from the Siemens Xcelerator business platform. Siemens' software and the comprehensive digital twin enable companies to optimize their design, engineering and manufacturing processes to turn today's ideas into the sustainable products of the future. From chips to entire systems, from product to process, across all industries, Siemens Digital Industries Software – Accelerating transformation.

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