SIEMENS

DIGITAL INDUSTRIES SOFTWARE

Four keys to more predictable, flexible A&D manufacturing

How smart manufacturing solutions enable rapid, right first-time production

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SERIES INTRODUCTION

Reducing risk, cost and time-to-market with **smart manufacturing solutions**

If your aerospace and defense (A&D) company is like most, the goal of your manufacturing operations has not changed. But everything else has. You still want to achieve on-time, on-budget delivery of products that consistently meet certification. But today you're trying to reach this goal while managing the complexities of electrification, increased software integration and connected products, sustainable parts, labor shortages, supply chain interruptions and new processes to deliver on these innovations. Without a drastic change in your approach to product and process development, your target timelines or budgets are no longer attainable.

Yet forward-looking A&D companies have found a way to still realize these objectives. They have stopped performing linear, document-driven processes. They no longer have siloed teams working independently in each manufacturing discipline. Instead, through intelligent manufacturing solutions for digital transformation of their manufacturing processes, they are implementing concurrent, collaborative manufacturing development.

When we say "**intelligent manufacturing**" or "**smart manufacturing**," what do we really mean? And what does it mean to digitally transform manufacturing? It means leveraging an open, flexible ecosystem to help accelerate production ramp-up and deliver complex products faster with right first-time quality. It helps you achieve a seamless, consistent alignment of the as-built product with the as-designed product.

If this intelligent manufacturing concept has you picturing a "big bang" mega-project, we are glad to report that this is not the case. This series of ebooks will help you develop a road map and identify the best starting point to meet your business needs. The road map will set you on a path to realize significant benefits with each incremental step you take.

The solutions for intelligent manufacturing are built upon the unique, flexible and open Siemens Xcelerator business platform. They offer you the opportunity to deliver smart manufacturing efficiencies in three key areas of your business:

Developing a model-based plan
Uniting the virtual and real worlds to validate the plan
Optimizing products and processes

EXECUTIVE SUMMARY

In this first ebook of our three-part series, we discuss how to achieve right first-time production and efficiency and how to develop a model-based manufacturing plan. Starting with the end in mind is foundational to this approach. You will develop a smart plan before considering any physical commissioning. By modernizing your manufacturing process to connect the data of all engineering disciplines to the knowledge of the shop floor, a model-based manufacturing plan will lead you to on-time, flawless product launches.

To deliver today's innovative, complex A&D products in a way that meets certification, time and budget requirements, engineering must be connected to the shop floor. Without digital communication between the two, A&D manufacturers often discover design or manufacturing issues late in the process, leading to expensive fixes, missed delivery dates, the inability to demonstrate compliance and even failed programs.

On the other hand, by facilitating collaborative, connected design and production planning efforts, a digitally connected smart manufacturing enterprise can achieve truly flawless product launches. Creating this model-based manufacturing plan enables you to predict processes so you can anticipate problems and resolve them before production begins. If you are eager to achieve rapid, right first-time production, this ebook informs you about smart manufacturing solutions that help make it happen.

Accelerating production start-up

Many companies that deliver complex parts and products for the A&D industry face an ongoing dilemma. They have to accelerate product development and production ramp-up to meet the requirements and expectations of A&D customers. But they cannot achieve this speed using their traditional approach and legacy systems. Such an approach may increase cycle times, costs, quality issues and more.

A new approach, powered by intelligent manufacturing solutions, resolves the dilemma and gives manufacturers a competitive advantage. This is what Siemens Digital Industries Software customers are reporting to us as they digitally transform their businesses. For example, a leading supplier of civil and military launch solutions has established a common digital product development and realization platform that **reduces both development time and recurring costs by 50 percent**.

Smart manufacturing built on Siemens' digital solutions offers much-needed speed and agility to an industry facing unprecedented market demands. By setting your sights on right first-time production from the very beginning of your product and process planning, you will more easily orchestrate:

- Increased product complexity and systems integration
- Accelerated innovation toward greater sustainability
- Smooth supply chain flow despite more and greater supply disruptions
- Increased workforce productivity to help offset skilled labor shortages that continue to plague the A&D industry

This is what **model-based manufacturing planning** is all about. It encourages and enables downstream teams to access product data, including design specification changes, anytime, anywhere. Model-based manufacturing planning connects the data of all engineering disciplines to the knowledge of your shop floor. The benefit of this connectivity is the ability to accelerate production start-up.

Let's briefly review the difficulties created by traditional planning and legacy systems, then define both the model-based manufacturing planning approach and the keys to successfully implement this phase of intelligent manufacturing for your company.

Understanding limitations of traditional approach and supporting systems

No matter how effective, innovative and rigorous the digital design of your A&D product, business success hinges on accurately building what you designed, as you designed it. The inherent limitations of traditional manufacturing planning place this success in grave danger.

Engineering disconnected from the shop floor makes the translation of digital information into an actual, physical product slow and unreliable. According to a Lifecycle Insights Report from 2023, a full 40 percent of A&D chief engineers surveyed report that the physical parts they make do not conform to the digital design. Even more, 63 percent say they spend significant time proving conformance of physical parts to compliant designs.

Compartmentalized software systems, albeit individually powerful, can optimize only one aspect of the product. Some 56 percent of surveyed chief engineers say that each engineering discipline has its own software tools and systems. Communicating all needed information from these disconnected systems to manufacturing planning is time-consuming and error-prone and the siloed design pieces are often difficult to integrate into a cohesive manufacturing plan.

Traditional linear product and production development starts the manufacturing plan only after the product definition is finalized, extending development time and production ramp-up. It is also not flexible enough to integrate changes into your plans in a timely manner. Yet this slow, linear approach is what most legacy systems are designed for.

Late detection of problems occurs because the traditional approach does not provide a virtual means of detecting them. One original equipment manufacturer (OEM) reports that 80 percent of defects are discovered and remedied late in the development process, resulting in high costs and limited flexibility in how to address the issues.

Traditional configuration management and change management cannot efficiently handle today’s norm of building multiple configurations for various global customers while accommodating changing regulations, supply chain disruptions and more. According to 44 percent of A&D program managers, it is extremely difficult to assess if design changes will affect the verification process.

Using **smart manufacturing solutions** to overcome these challenges

The goal and promise of smart manufacturing solutions for your digital transformation are to deliver faster product development that also guarantees each product you deliver conforms to the approved design.

Smart manufacturing with intelligent systems provides **visibility** across all engineering disciplines, including manufacturing engineering. Instead of optimizing each engineering aspect in isolation, this approach ensures the compatibility and complementarity of all your product's systems as well as the complex interactions between them.

While developing model-based manufacturing plans, your team will communicate design intent early in the manufacturing planning process, allowing them to plan with the end in mind. They will conduct problem-solving early in the development process, actualizing the **shift left** concept (shifting problem-solving to the left of the product development V-model). This enables you to predict processes so you can anticipate problems and resolve them before the first product is built – even before the production facility is outfitted and configured.

Smart manufacturing technologies use these capabilities to facilitate early collaborative engineering and allow you to conduct much more of the manufacturing planning process in the virtual realm faster and at a much lower cost than any physical prototyping, validation or commissioning.

Bottom line? Model-based manufacturing planning enables you to attain **right first-time production**.

Now that we have outlined what you will achieve by performing model-based manufacturing planning on intelligent manufacturing systems, we turn to how you will achieve it. Success involves four keys to more predictable, flexible A&D manufacturing.

USE CASE

Sierra Dream Chaser

To build and test the Dream Chaser, the world's only winged commercial space plane, **Sierra Space Systems** is implementing Siemens' smart manufacturing solutions as part of the company's next-generation digital engineering program. This smart manufacturing approach provides two key targets of visibility including shorter development time and reduced cost. Digital continuity links structural, thermal, mechanical, electrical and software design with vehicle manufacture and requirements verification as well as complete lifecycle maintenance.

For more information read the blog or listen to the podcast.

KEY #1

Connect engineering with the shop floor

To accelerate product development and production ramp-up while ensuring your customer's requirements and expectations are consistently met, the first key is to provide a common digital backbone between engineering domains and manufacturing planning. This is accomplished by maintaining end-to-end digital manufacturing continuity.

Digital continuity streamlines information exchange across domains no matter where the information is created. Connecting the full lifecycle of engineering to manufacturing, this continuity speeds cross-domain dialogue and activities while ensuring accuracy and version control.

By using end-to-end digital manufacturing continuity, those responsible for manufacturing planning will gain full visibility into product design at the earliest requirements stage. This advanced visibility changes how people work on your A&D products, supporting greater communication, collaboration and the innovative serendipity of multidomain efforts.

KEY #2

Provide **information transparency** to allow simultaneous product and process design

The visibility created by end-to-end digital manufacturing continuity allows manufacturing planning to shift left so that your team can simultaneously design the product and the manufacturing process. Concurrent design enables you to prove concept viability and identify issues and risks earlier, which reduces manufacturing change requests that impact cost and schedule.

With a smart manufacturing approach, your manufacturing engineers gain full access to product engineering information through the **comprehensive digital twin**, a highly realistic virtual representation of the product, production processes and systems. As the primary "model" behind model-based manufacturing planning, the digital twin is tightly connected to the digital tools that enable you to design and simulate manufacturing processes virtually. As a result, you will meet requirements and address constraints before producing any physical prototypes.

As a centralized source of truth, the comprehensive digital twin ensures that all stakeholders are working on comprehensive, up-to-date data. It also allows you to reuse data, which leads to greater confidence in your manufacturing plan. The digital twin provides access to accurate insights generated during product design, which you can convert to actionable information during product development.

USE CASE

Rafael Advanced Defense Systems

Rafael Advanced Defense Systems has implemented smart manufacturing solutions that support concurrent engineering of the company's military and defense technologies from the early prototype stage. The software offers stakeholders reliable access to up-to-date data, accelerates new product introduction and results in right first-time production quality and efficiency.

USE CASE

Global defense manufacturing company

A large defense manufacturer is utilizing the digital twin and intelligent manufacturing tools to implement continuous feedback through the product lifecycle and even into sustainment, then back to design to enable product optimization. Each stakeholder and domain benefits from standardization of the digital twin, which enables data to be consumed throughout the complete product lifecycle. The company is cultivating a culture of continual innovation, realized through a digitally connected environment that enables them to predict and identify issues that may come up in the future.

KEY #3

Enable **virtual process planning**

The ability to identify and resolve issues *virtually* before they occur physically on the shop floor is the heart of intelligent manufacturing. A connected smart manufacturing solution enables you to fully employ the virtual realm to simulate, predict and optimize products and manufacturing processes before you invest in shop floor tooling and configuration efforts.

Beginning with the end in mind, your manufacturing engineers and planners develop a virtual model-based manufacturing plan. They can design digitally against the virtual manufacturing plan to optimize, test and adjust processes, tooling and lines – all in the virtual realm.

With model-based manufacturing planning, early consideration of production and process alternatives allows you to gain confidence that the product will meet design intent and your manufacturing plan will meet your program cost and schedule. Conversely, as your manufacturing engineering team develops the manufacturing plan, the closed loop of smart manufacturing communicates these insights to product designers and engineers, so you can improve the product based on manufacturing requirements.

KEY #4

Leverage planning flexibility to achieve **manufacturing agility**

Product development in aerospace and defense is such a lengthy process, it is no wonder that this industry experiences numerous design, materials and regulatory changes on an ongoing and accelerating basis. Because a model-based manufacturing plan is closely tied to product design, your planning can more easily pivot and efficiently incorporate changes. You maintain quality and traceability while reducing risk.

Model-based manufacturing planning streamlines activities like change management by enabling direct cross-domain feedback loops. The resulting transparency between design and manufacturing accelerates the introduction of new materials and processes that target your sustainability goals. It enables you to incorporate disruptive technologies (like electrification) more quickly, speeding the transition from your virtual “drawing boards” to your production lines. In other words, the intelligent manufacturing approach brings unprecedented manufacturing agility to your production facilities.

USE CASE

Global aircraft engine manufacturer

A major aircraft engine manufacturer has reduced the time it takes to incorporate an engineering change into shop floor operations **from weeks to less than a day**. The company has implemented intelligent systems for smart manufacturing to achieve centralized engineering efforts for different plants and quickly resolve shop floor issues.

Building a **seamless transition** from engineering to manufacturing

The aphorism “knowledge is power” is newly applicable in our age of digital transformation. Aerospace and defense manufacturers achieve powerful business advantages as they share engineering and manufacturing knowledge across end-to-end digital manufacturing continuity.

By employing Siemens’ smart manufacturing solutions to create a model-based manufacturing plan, your company will advance toward the **A&D factory of the future**. Your team will gain a greater understanding of the cost and impact of design changes. You will build complex products faster. You can accelerate production ramp-up and take a critical step toward a smart manufacturing ecosystem that drives continuous improvement of products and processes.

About Siemens Digital Industries Software

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.

For more information on Siemens Digital Industries Software for A&D, visit our website or follow us on LinkedIn and Twitter.

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