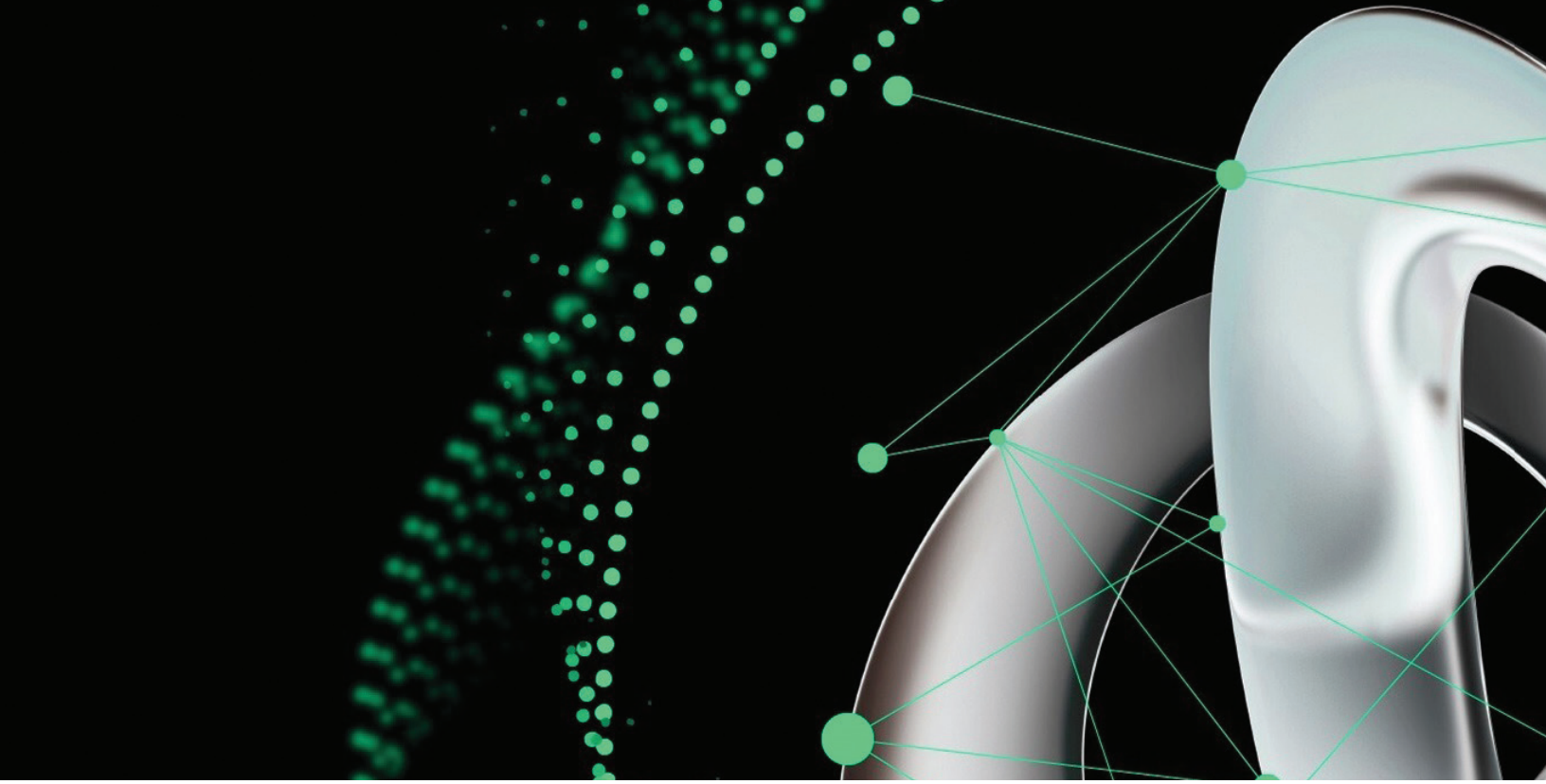


SIEMENS DIGITAL INDUSTRIES SOFTWARE

Digital Part Production

Mastering the precision of the perfect part

Executive summary

New complex machine introductions present a significant challenge to machine builders. Today's highly complex industrial machines require many parts with more challenging geometries, and each part possessing dozens if not hundreds of features. Digitalization of manufacturing is critical to addressing these machine complexities, including advancing technologies, compressed schedules and global competition, creating multifunctional, complex parts.

Digital Part Production (DPP) solutions provides companies with advanced tools to meet these demands, including connecting applications and processes using a comprehensive digital twin. This simplifies data transfer and duplication tasks, providing flexibility, precision, shorter cycle times, enhanced collaboration and automates it across multiple processes. These attributes integrate into an information-sharing feedback loop throughout the organization and production process to deliver greater operational efficiencies and better shop management.

Introduction

One of the most significant challenges machine builders face today is the rising complexity surrounding new machine introductions in response to increased customization needs. More than ever, customers require highly customized products that are designed to meet their specific needs - one size does not fit all. Driven by consumer demand for customization, machine builders must create modular, multifunctional machines that can bend, cut and weld steel, supporting a broad range of sophisticated part variations, with each part having complex geometries with tighter tolerances and smaller lot sizes.

Inevitably, the demand for highly configurable machines drastically reduces machine component lot sizes. The conventional approach to part production is proving too cumbersome and error-prone with rising complexity and escalating number of part designs. Traditionally it has been composed of stand-alone, disconnected software tools that require multiple data translations between them, leading to errors, ultimately resulting in high amounts of scrap and expensive delays for machine builders.

At the same time, new, low-cost players are entering the market, unhindered by traditional manufacturing practices. As a result, they can develop machines faster and at a fraction of the price and use new technologies to deal with increasing product complexity. Moreover, manufacturing information flow is becoming more complex as authoring and collecting data occurs across a greater diversity of personnel and processes in organizations – both automated and manual – with the challenge to combine it all.

All this together leaves OEMs with the option to adapt now or face an eroding market share.

Without a digitalization strategy across the machine builder's organization and coherent data structure, the results can vary. But it is essential to leverage this information for sound decision-making. Otherwise, it can lead to mistakes and waste across the entire product lifecycle.

The dilemma is how to manage all these customer expectations for diverse materials, part types and deadlines while trying to automate the many processes between engineering and manufacturing.

Introducing digital part production

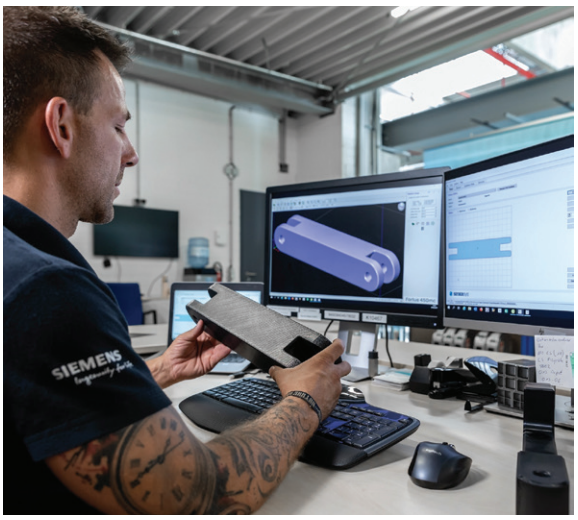
There is a need for an integrated digitalization solution to drive through the whole manufacturing process. Based on a comprehensive digital twin, this approach enables machine builders to master the precision of the perfect part while offering greater operational efficiencies and the ability to manage their shop floor better.

DPP offers new engineering and manufacturing practices to keep pace with this growing complexity, driving the highest possible production throughput and quality part production.

It connects the entire production process digitally, improving the collaboration and automating many of the processes between engineering and manufacturing on the shop floor. It also creates a powerful digital thread, merging the digital and physical world to create a continuous digitized communication process and feedback loop to understand how each change to a part's design impacts the larger manufacturing process.

This approach automates the entire part production development, based on a comprehensive digital twin of the product combined with a digital twin of the production that optimizes resources, controls and production cost while achieving the highest quality. Having these digital twins allows companies to simulate design and manufacturing even before fixtures have been built and materials are being cut. Now it is possible to connect the entire production operation, cut data transfers and duplication, improve collaboration and automate all processes.

To achieve this, DPP is built around three key differentiators: highly automated CAM, synchronized part production and additive manufacturing. Relying on *highly automated CAM*, the machine builder and their suppliers can easily reuse proven data to automate the programming and enhance the machining process to deliver consistent results. Whereas *synchronized part production* increases operational efficiency, using one integrated system to design, production simulation and machining parts. Finally, machine builders turn to robust industrialized *additive manufacturing* to create highly complex geometries that would be difficult or impossible to achieve with traditional manufacturing methods.



Highly automated CAM enhances part quality

To stay competitive in today's global market, machine builders and their suppliers adopt highly automated CAM to efficiently create exceptional quality components. It links engineering to manufacturing planning and execution, fully merging the digital and physical processes by combining an accurate digital twin of the part with a precise digital twin of the machining process, connected by a digital thread that unifies the entire production process. Now previously siloed teams are fully aligned, accessing the same up-to-date information, helping the team deliver an estimated 30-40 percent improvement in overall efficiency, getting higher quality products out the door faster to customers.

Integrated CAD, CAM and CNC tools cut data transfers and duplication automate shop floor processes and reduce the risk of costly and time-consuming mistakes. It relies on feature-based machining that uses PMI captured during the design's 3D modeling phase to automatically program and optimize machining methods, helping boost quality and efficiencies. The system analyzes the part, finds the features, picks the right cutting tools and creates the complete machining processes. This saves time and delivers consistent quality across the machined parts.

Another critical piece of highly automated CAM is deploying a digital twin of the machine setup to virtually optimize and validate the machining process to avoid costly errors in production, effectively eliminating waste on the shop floor. The digital thread connects the systems, machines and people, helping automate the entire end-to-end process: from design and simulation to machining and system assembly, reducing manual interaction and minimizing mistakes.

Improve efficiency with synchronized part production

Successfully introducing sophisticated variations into a product supply chain requires synchronizing component part production to minimize inventory and costs. Only by connecting the entire production process digitally can machine builders meet their customers' schedule, cost and quality demands.

Synchronizing customer-configured component part production enables a flexible, transparent, data-driven decision-making process. It offers one environment for seamlessly integrated part preparation, programming, scheduling and production, improving collaboration across the machine builder's organization. Synchronization is possible due to the comprehensive digital twin – a 3D model that simulates the machine's parts. Now all stakeholders can grasp how each change to part design impacts the whole manufacturing process, as any changes made to the model automatically update in the

CAM. Also, it allows design engineers to use manufacturing information for their design early in the engineering process.

When synchronizing part production, it fast tracks the time from order to production, connecting the design model and simulation models with the shop floor to quickly resolve or prevent production issues. To achieve this, the comprehensive digital twin of the parts automatically captures design simulation and machine data into a central repository, thereby synchronizing the whole CAD, CAM and CNC process to reduce overall time to deliver while maximizing production capacity. Having a flexible scheduling tool that pulls all the recipes (bill of process) from the digital twin determines the best path forward. Analytics built on an accurate production model helps generate a better schedule than one built on a manual interpretation of production.

To fully merge the digital and physical world, the next step is adopting a closed-loop manufacturing process to enhance resource utilization in the factory by determining the best path for resources and machines. This approach relies on analytics to gain insights from the physical machine to provide the closed-loop feedback to ensure a fully optimized process. Then a continuous digital thread tracks information from engineering through manufacturing, planning and execution for streamlined scheduling, while ensuring control traceability and quality within tight delivery schedules.

By adopting these capabilities to synchronize component part production, machine builders can optimize their manufacturing supplies, minimize costly changeovers and better anticipate and mitigate the impact of unforeseen critical situations.

Adopting a digital twin, continuous digital thread and closed-loop manufacturing process enables the correct data to get to the right people at the right time, leading to greater production of higher quality parts without increasing resources or extending schedules.

Now it is possible to gain complete visibility into the production status and schedule to know the optimum solution for production and ensure operational efficiency.

The End-to-End management of Manufacturing processes including Quality will reduce the introduction of Engineering changes. Well-structured Work Instructions can guide Operators step by step, helping new human resources in the ramp-up phase. The loop between Engineering and Manufacturing is closed thanks to the escalation of Shop-floor issues to Design Department leading to actions and improvements.

Now it is possible to create a digital twin that encompasses the generative design and additive manufacturing process. As a result, part manufacturers can take advantage of a continuous thread of information from engineering through manufacturing, planning and execution to ensure optimized scheduling, control, traceability, quality and eventually compress the product delivery schedule.

Power of additive manufacturing

Highly automated CAM and synchronized part production help streamline the design and manufacturing of custom parts, whereas additive manufacturing enables machine builders to create complex geometries that differentiate them from the competition. As a result, machine builders can effectively deploy additive manufacturing to address the constant need for customization, smaller lot sizes and pressures to get to market faster. Additive manufacturing (AM), or 3D printing, can create complex geometries otherwise difficult or even impossible to achieve with traditional manufacturing methods. Designers can model parts that perform and function better. A great example is cooling channels in molds for complex plastic parts. The engineers want those channels as close to the cavity where the material must be cooled. But a drilling operation only allows straight cooling channels. AM enables the design of cooling channels that deliver optimized cooling. However, these strong yet light designs can meet the highest requirements, enabling machine builders to offer innovative solutions at better price points.

For additive manufacturing, it is vital to rely on the digital twin and the attendant digital thread to fully capitalize on the flexibility of additive. The digital twin consistently records and tracks the design and crucial manufacturing data throughout the entire life cycle of the part. Therefore, a required digital thread is essential to collect data at each stage of the design and each part of the additive manufacturing process through to the final decommissioning of the part.

Conclusion

As global competition grows and industrial equipment becomes more complex and customized, it becomes vital to maximize productivity and avoid costly time-consuming mistakes. To thrive in today's highly competitive market, leading companies are discovering that the future success of digital part production lies in adopting new technologies, like highly automated CAM, synchronized part production and additive manufacturing, built around a comprehensive digital twin and digital thread.

It is now possible to standardize manufacturing processes, connect people, systems and machines to create a single source of truth for the whole lifecycle, improving information sharing and collaboration. Machine builders can automate shop floor decision making, minimize scrap and improve part quality to lower costs and risks. By merging the digital and physical, they can identify potential issues in the real world using accurate simulations in the comprehensive 3D digital twin. The result is shortened lead times, reduced set up with integrated, automated CAD/CAM/CNC programming and eliminating manual data transfers and duplications that often lead to costly mistakes, ensuring high-precision quality parts quickly.

Digital Part Production automates the overall production process to drive end-to-end manufacturing while boosting quality and reducing time to market. Master the precision of the perfect part with Siemens Digital Part Production.

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