COMMENTARY

CIMdata®

SMEs: Using Digital Manufacturing to Survive and Thrive

Key takeaways

In today's global competitive markets, it is increasingly difficult for small-to-medium size manufacturers (SMEs), such as part manufacturing companies, to survive as the manufacturing and supply chain challenges become more complex.

SMEs, even those with 25 or fewer employees, can now adopt modern digital manufacturing technologies and solutions once reserved for large enterprises to get the most out of their limited resources and remain competitive.

Siemens Xcelerator portfolio enables creation of a digital thread and management of the product data and processes that span the complete production process, allowing manufacturers of all sizes to execute their digital manufacturing initiatives more effectively.

An SME case study illustrates how a machine shop has utilized digital technologies to grow its business. Using advanced manufacturing processes powered by Siemens' technology, they now operate up to 25% more efficiently while delivering better products and maximizing available resources.

Introduction

Major trends disrupting the manufacturing industry have driven the need for increased investments in digital technologies to modernize production facilities and processes among companies of all sizes. Challenges in increasing product complexity, resource availability, operational flexibility and speed, and supply chain create additional headwinds for SMEs that must compete in highly competitive global markets.[1]

Concepts such as Industry 4.0, smart manufacturing, the Internet of Things (IoT) and Industrial IoT (IIoT), the move to smart, connected products, and digital transformation, among others, were once reserved for large enterprises. Today, an increasing number of SMEs are evaluating how they do business and the digital technologies they need to employ. CIMdata has seen strong growth in recent years by SMEs

[1] Research for this commentary was partially supported by Siemens Digital Industries Software

implementing digital technology and practices and believes that this digital transformation trend will continue.

The demand for increasingly complex products, coupled with ongoing supply chain disruptions and new environmental regulations, makes it harder than ever for SMEs to keep pace in today's competitive markets. However, by using digital manufacturing solutions even small enterprises can enable efficient automation throughout their production processes, both in programming and on the shop floor, to increase productivity and remain competitive.

Unfortunately, many SMEs have not been able to survive in today's rapidly evolving, competitive global marketplace. Statistics show that approximately 20% of SMEs fail within the first year and only 30% survive for 10 years or longer. So why are SMEs and their survival important? In many countries, SMEs account for over 95% of firms and 70% of all jobs. A key factor impacting survival of manufacturing SMEs, is their ability to digitally transform their business and operate more effectively.

Worldwide, manufacturers are working to digitalize, a trend that continues to accelerate, and many SMEs are at risk of being left behind. Typically, small firms remain less digitalized than medium-size firms—and medium-size firms less than large firms. A major reason for this is that digital manufacturing solutions have been difficult to scale down (both in scope and cost) for SMEs. But even for SMEs, digital transformation is becoming a matter of survival. Over the past few years, thousands of SMEs have struggled to adapt to the new realities, including product complexity, cost reduction, and digitalization's onslaught. If SMEs don't digitally transform their business, they will be less able to profitably produce the new, more complex products their customers are demanding.

SMEs face many constraints, including:

- Inability to hire the numbers of experienced personnel they need
- Limited financial funding and budgets
- Constraints on their physical facilities—space, machinery, operational costs, etc.

Using digital technologies and creating digitalized business environments can enable SMEs to address these challenges, compete more effectively, and survive and thrive in the global marketplace.

Digital Manufacturing Delivers Business-Critical Benefits

Digital manufacturing is the application of software systems comprised of programming, simulation, 3D visualization, analytics, and collaboration tools to plan, manage, and execute manufacturing processes and factory operations. Digital manufacturing technologies link systems and processes across all programming and production areas to create integrated manufacturing, from design to commissioning, executing production and on to servicing the final products. It includes virtual commissioning and accurate simulation of CNC machines, robots, entire production lines, safety, human ergonomics, etc.

Long-term benefits from manufacturing digitalization cannot be achieved without a comprehensive digital manufacturing strategy. By modeling and simulating processes and production lines and creating a digital thread from design to planning and production, it is possible to improve the quality of manufacturing decision-making, optimize production facilities and throughput, generate cost savings, utilize resources more flexibly, and reduce time to market.

New and innovative technologies, such as additive manufacturing and advanced robotics, are impacting how technology providers create, and SMEs implement digital manufacturing to remain competitive. Several trends are driving end-to-end digitalization using comprehensive production digital twins. In the

case study below, W. A. Pfeiffer demonstrates how investing and applying digital technologies has produced a tangible return by implementing a modern digitally driven manufacturing environment.

A key goal for many CIMdata clients is integrating product development with manufacturing using digital data. Digital manufacturing is built on a digital thread of related product definition and production process information. An effective digital manufacturing thread coupled with a production digital twin drive the digital manufacturing strategy. Techniques such as automated CNC programming using Computer-Aided Manufacturing (CAM) software and seamlessly transferring the instructions to machine tools are the core of digital manufacturing for machine shops. These methods shorten the product production timeline and enable the re-use of company expertise and increase production quality.

CIMdata Definitions

Digital Thread—The communication framework that allows a connected data flow and integrated view of an asset's data (i.e., its digital twin) throughout its lifecycle across traditionally siloed functional perspectives.

Digital Twin—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.

Many SMEs are eager to implement these new digital technologies to create more efficient manufacturing processes and generate a competitive advantage. A digital thread can enable an SME to produce a digital manufacturing model to generate, simulate, analyze, and predict operational performance before investing in physical production.

Using digital twins of production and the production facility and processes enables accurate simulation and prediction of the physical twin's behavior (and that behavior is used to update and verify the models and processes). Data captured from the physical twin can be replayed within the digital twin to predict problems and to develop solutions that are then tested on the digital twin, shortening time-to-value and reducing the risk of harming or delaying the operation of physical assets and products.

Digital manufacturing solutions help SMEs refine and align their manufacturing processes and optimize the use of their production resources. Data from engineering to production, test, and quality are available in a single, logical repository giving better collaboration for design engineers, manufacturing engineers, and CNC programmers so they can speed up and optimize manufacturing.

Siemens' Digital Manufacturing Solution

Siemens' digital manufacturing solutions are part of Siemens' Xcelerator portfolio—a comprehensive, integrated portfolio of software, services, and an application development platform. It is designed to help companies of all sizes become digital enterprises by providing solutions that can be incrementally acquired, personalized, and adapted to fit their specific business needs. Xcelerator components enable combinations of software and IoT-enabled hardware, including machine tools, to be accessed and integrated.

Importantly, Xcelerator is delivered as an integrated, modular portfolio of compatible solutions so that a company of any size doesn't need to commit significant financial resources up front—they can grow at their own pace. The solutions can be extended incrementally, in scope and scale, on-demand, and SMEs can build, at their own pace, more complete digital manufacturing environments to remain competitive with larger enterprises. SMEs can use only what is needed, when it is needed, to create and personalize the new digital environment to their unique business needs.

As the Xcelerator platform grows over time, most of its solutions will ultimately be available as a service. This will reduce operational complexity, high upfront software and infrastructure investments, and

aggravation by giving SMEs access to the latest available technology when and where they need it, with operational expenses based on consumption.

Customer Example

Headquartered in Germany, W.A. Pfeiffer is a small, highly successful company using advanced digital manufacturing technology. With a staff of only 29 people, Pfeiffer manufactures milled and turned parts for machinery, medical applications, and the optical industry. Owner Mr. Andreas Pfeiffer says "Parts continually become more and more complex while higher demands on production quality are being made. At the same time, our customers expect us to be able to produce small batch sizes quickly and cost-effectively. Our challenge is that we cannot simply add new capacities here at the site because we no longer have any free space." To grow, W. A. Pfeiffer invests in new technologies. "The goal is to achieve higher production automation and end-to-end connectivity so that we can reduce set-up times and minimize throughput times," Mr. Pfeiffer explains.

W. A. Pfeiffer has been a long-time user of Siemens manufacturing technologies—starting with SINUMERIK controls in the 1980s. They have continued to invest incrementally in digital manufacturing technologies and solutions that Siemens offers. Siemens software solutions currently deployed include Teamcenter, NX, and Mcenter (formerly SINUMERIK Integrate). Siemens Opcenter APS is used for integrated order planning, see detailed information on resources, and improve customer and supplier relationships. It also has improved their internal communications. An end-to-end digital process chain has now become a reality at W. A. Pfeiffer. Data is managed centrally from order acceptance to invoicing, and duplicate entries are eliminated.

W. A. Pfeiffer's integrated process begins with incoming customer orders. The order is created in ERP and Teamcenter at the same time. Teamcenter imports the design data for the product to be manufactured. Needed materials are then ordered, and due dates are planned using the Opcenter APS software. "All tools work together seamlessly, which makes it much easier to coordinate," says Mr. Pfeiffer.

Data is then transferred from Teamcenter to NX. The 3D models are prepared in NX for NC programming, and fixture components are either selected from the library or designed. The machining operations are then programmed in NX CAM, using the CAD data.

NX allows programmers to quickly define machining operations by working in the context of the digital model. Using advanced toolpath technologies helped W. A. Pfeiffer reduce the machining cycle by 25%, while extending tool life.

G-code-driven simulation in NX leverages the machine's digital twin to verify the generated operations. This helps programmers analyze and optimize operations before they transfer them to production. The digitally validated programs ensure error-free and highly efficient part production on the shop floor.

Workers can access all functions directly in production via mobile terminals. This direct connection between planning and production continues through to CNC control. The machine programs generated by NX CAM are transferred to Manage MyResources via Teamcenter, along with lists of tools. The physical tools are managed, balanced, and, if needed, assembled and measured using Manage MyResources. The data package is then transferred to the machine controller. After a test run by the operator, the job order goes into production.

"You have much more information in the set-up phase. There are fewer ambiguities, I can immediately see which tools I need, which tools are available in which quantity, which materials I need," Mr. Pfeiffer says. "This allows us to machine the components with minimized set-up work."

For W. A. Pfeiffer, the investment in the new software has already paid off. "Just by analyzing our processes during the implementation, we were able to improve many processes. We no longer have duplicate data storage; we have much better transparency across all processes," says the entrepreneur. "In the past, employees in production often had to ask: Where are the components? Which CNC machine should I use? What kind of cutting methods should I use to manufacture this component with minimum tool wear efficiently?" Streamlining boosted productivity. We can now answer all this with the information that the software solution provides us. I expect that we will be able to reduce setup times by up to 50% overall," concludes Mr. Pfeiffer.

See a video interview of Mr. Pfeiffer discussing the benefits his company has achieved at https://youtu.be/GCOwWKy--dk.

This is just one example of how a SME has used Siemens Xcelerator to configure a custom digital manufacturing solution to enable themselves to survive and be more successful in their markets.

Conclusion

Business pressures are forcing companies, especially SMEs, to change the way they create, manage, and leverage all their assets—human, physical, and financial. The digital thread and digital twin are concepts that SMEs are now able to implement within their environments, where and when needed, to effectively connect existing applications, data repositories, and development and manufacturing processes.

Using a digital thread-driven digital manufacturing environment enables an SME to operate more efficiently and more quickly to deliver better products with a higher value add to their customers. W. A. Pfeiffer successfully demonstrates that SMEs can actively make changes and grow and evolve their digital manufacturing environment and processes, preserving their competitive market edge and driving their business's expansion.

Siemens Xcelerator portfolio enables the digital environment that spans the complete design and production processes, allowing manufacturers of all sizes to create and execute their business-specific digital manufacturing initiatives more effectively. It is designed to be integrated and adopted in affordable increments. SMEs only have to invest in what they need, when they need it, and then can grow their digital manufacturing environment in small, affordable increments as their business evolves, as shown in the case study about W.A. Pfeiffer. Companies of all sizes, especially SMEs, looking to improve their digital manufacturing environments and programs should include Siemens solutions in their evaluation.

About CIMdata

CIMdata, an independent worldwide firm, provides strategic management consulting to maximize an enterprise's ability to design, deliver, and support innovative products and services by identifying and implementing appropriate digital initiatives. For nearly forty years, CIMdata has provided industrial organizations and providers of technologies and services with world-class knowledge, expertise, and best-practice methods on a broad set of product lifecycle management (PLM) solutions and the digital transformation they enable. CIMdata also offers research, subscription services, publications, and education through certificate programs and international conferences. To learn more, visit www.CIMdata.com or email info@CIMdata.com.