Accelerating Digitalization in Manufacturing Industries Primer for 2018

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Advances in AI, analytics, IoT and 3D printing are transforming the business of manufacturing industries. This research will help CIOs drive the acceleration of new processes, technologies and ecosystems to improve organizational flexibility and agility in an era of digital business.

Scope

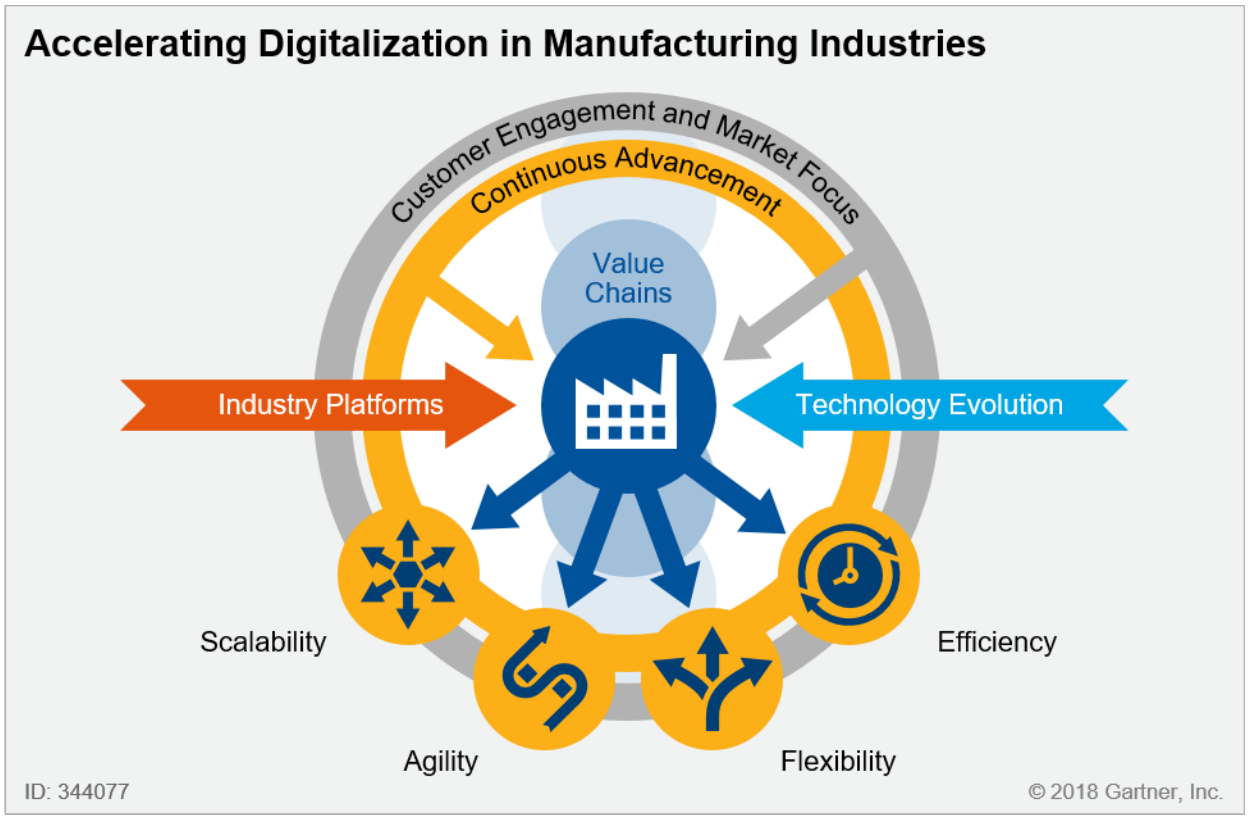
This research will help CIOs in manufacturing industries apply digital technologies to expand IT- and data-enabled value chains throughout the digital business life cycles of their enterprises.

CIOs looking to boost manufacturing productivity and agility can use this initiative to:

- Improve digital business alignment and transformation
- Advance product life cycle management toward digital threads and digital twins
- Provide the robust infrastructure that supports 3D printing's (3DP's) unique requirements
- Scale product positioning for consumer goods
- Increase business acceleration through Industrie 4.0 and industrial Internet of Things (IIoT) frameworks
- Explore innovation and disruption in the automotive industry

Analysis

Figure 1. Accelerating Digitalization in Manufacturing Industries Overview



Source: Gartner (February 2018)

The foundations for the fourth industrial revolution[1] are firmly in place. Various forces will impact how enterprises plan, make and distribute goods. These include new forms of data analytics and collaboration, advances in technologies and techniques, globalization of trade, and broad societal trends like autonomous service environments. Digitalization and data transparency in value chains are disrupting traditional sourcing, production and logistics. Smart data will offer visibility into processes and interactions across the organization and the ecosystem, enabling both flexible pricing/tendering and on-demand delivery. Meanwhile, the exponential increase in data is challenging traditional notions of data governance as IT operations move closer to the market and customers.

CIOs in manufacturing industries accelerating transformation use digital technologies, platforms and ecosystems to modernize traditional manufacturing value chains. In IT, this is often referred to as "Advanced Manufacturing." Advanced Manufacturing requires broad visibility and interactions because, while certain trends such as automation, artificial intelligence (AI) or data analytics can be identified, no single technology underpins the concept. Rather, advanced manufacturing draws together a number of new and disruptive technologies in an ecosystem that enables digital business and process transformation.

Greater investments in new platforms are needed to support digital operations, data ownership and data exchange. To capitalize on the knowledge created through analytics, CIOs in manufacturing are creating various innovation strategies, including centers of excellence, thereby driving cultural change. The impact of digitalizing manufacturing has been widely discussed in stakeholder gatherings such as the World Economic Forum. CIOs are increasingly driving data-rich architectures that can capture, store and analyze advanced manufacturing workflows in secure and interactive patterns across various locations. These considerations also formed the basis of the Industrie 4.0 (Note 1) strategy.[2]

In this context, CIOs in manufacturing industries need to understand how to enable digital business and leverage the disruptive technologies that can improve competitiveness in a rapidly evolving ecosystem. With this research, CIOs will be better able to design and deliver digital platforms through industrial data governance.

Top Challenges and How Gartner Can Help

The manufacturing industry is transforming. It is becoming more digital, forcing CIOs to change direction and drive initiatives together with manufacturing process owners. CIOs provide access to the datasets across their organization's entire value chain, including product life cycles, operations and market demand. This access offers organizations a number of proven benefits, including improved controls, greater flexibility, increased agility and expanded product lines. To achieve these benefits, CIOs must empower higher levels of scalability, agility, flexibility and efficiency (SAFE) throughout the entire organization. They can do this by adopting a broad approach to advanced or disruptive technologies, such as 3DP, automation, AI and data analytics.

What common platforms, trends and strategic technologies are driving the manufacturing industry?

CIOs working with other leaders across their organizations must understand digital business and how to launch digitalization initiatives throughout their manufacturing industry and ecosystem. To accelerate digital transformation, CIOs need to support best practices for innovation and standardization for scale. They will also require in-depth knowledge of government initiatives such as Industrie 4.0 (Note 1) and Made in China 2025. These initiatives will help manufacturers establish the starting points for digitalization. They are equally applicable to organizations with strong digitalization visions and to small and midsize business (SMB) manufacturers.

CIOs must also understand the governance structures required to create sustainable implementation strategies, as well as the common platforms that underpin advanced manufacturing opportunities, in conjunction with HR, CRM and ERP. To integrate data flows between IT and operational technology (OT), CIOs will need to apply data orchestration technology and harvest data from both IoT systems and building information management (BIM) systems. However, it is equally important for CIOs to know the potential of key technology enablers for delivering organizational speed, agility and innovation. Thus, CIOs will need to explore emerging technologies such as AI, machine learning (ML), automation and smart machines. They will also need to understand the role of digital twins and 3DP (also known as additive manufacturing).

Further, the increase in data, provided in part by smart machines and IoT, is allowing manufacturers to deliver greater efficiencies and to offer a more unique experience to customers. Capitalizing on these benefits, however, will require metrics collection, a new approach to data governance, and a much stronger focus on modeling, business intelligence (BI) and data analytics. Organizations will need to learn how to implement measures at the digital platform level. They will need to adopt best practices for scaling their knowledge base and for improving the skills of their workforce. Finally, they will need to understand metrics across both their hierarchical levels and their industry partners.

In this context, CIOs have the opportunity (and responsibility) to review how their IT and data strategies contribute to the entire cross-organizational value chain of Industrie 4.0-type advanced digital platform design.

Planned Research

- Examining how engineering and IT can best collaborate to achieve success with Industrie 4.0
- Exploring the role of blockchain in manufacturing industries
- Delivering best practices on digital business execution in manufacturing

What concepts and methods from other industries can be transferred and applied to the manufacturing industry?

Many of the most transformative advances from the manufacturing industry have been applied to other industries. For instance, CRM originated in the consumer packaged goods (CPG) industry. This cross-industry paradigm is set to continue, as manufacturers adopt disruptive capabilities from other industries and apply them within their organizations and ecosystems. One example is the onset of Tesla, which is changing the way that the automotive industry is building electric vehicle ecosystems. In general, change will occur due to technologies. Some will be processes, and some will be management tools. However, all of these technologies will contribute to the evolution of digital business within the manufacturing industry. Smart harbors and airports are examples of outside approaches that can be ported to the manufacturing industry. These approaches utilize IoT and other technologies to track efficiency and build operational excellence.

A number of transformative technologies are already migrating to the manufacturing industry and having a disruptive effect. Examples include adaptive security, AI, smart machines, robotics, IoT, database management and orchestration, and system integration in communications management.

Planned Research

- Examining the role of advanced analytics in CPG manufacturing
- Assessing revenue growth management
- Outlining best practices in industrial data governance
- Examining how advanced manufacturing impacts IT operations planning and management

How can I deliver winning products and portfolios with product life cycle management?

Product life cycle management (PLM) is one of the foundations of manufacturing, encompassing the development, launch, in-market management and retirement of products. However, PLM is constantly in development, driven by the following:

- New products
- Evolving technologies, such as computer-aided design (CAD), 3DP and IoT
- Changing processes, such as incremental development process planning approach (IDPA)

Underpinning all of this is a backbone of data. Manufacturing CIOs looking to leverage the advantages of PLM need to understand how to capture and utilize new sources of data for BI and analytics. Key PLM technologies will include augmented reality and digital twins, which virtually simulate physical products for development, testing and monitoring. While these technologies may be utilized in specific use cases or in R&D environments, organizations need to leverage PLM best practices to learn how to scale PLM in midsize operations.

Planned Research

- Assessing the role of BIM in PLM
- Utilizing a market guide for PLM in discrete manufacturing
- Describing best practices for PLM cloud solutions
- Examining the impact of 3D scanning for PLM
- Examining the capability of digital twins and the skills required to use them

How can I drive growth with sales and marketing technologies in consumer goods?

Consumer behavior and preferences underpin many of the advances in marketing. There are a number of technologies that CIOs in manufacturing organizations can leverage to add value and drive growth in both physical products and digital services. These technologies include revenue growth management that takes a cross-dimensional view of not only trade promotion, pricing, and advertising, but also brand and category management.

For example, consumer demands for customization continue to grow, due to new paradigms in customer engagement enabled by social media and IoT. CIOs of manufacturing enterprises are meeting these demands by utilizing new tools, such as 3DP. These tools enable more agile production environments and unique products.

Additionally, consumers are far more engaged when it comes to the traceability of goods, especially in the food sector. Track and trace begin in the supply chain and end on the shelves. CIOs in manufacturing organizations can meet demands for end-to-end traceability and improve consumer engagement by utilizing quick response (QR) codes, AI and IoT to provide granular, real-time

information. These advances, coupled with enhanced CRM technologies, can enable better customer experiences.

Retail execution solutions help the manufacturing sales force assess store performance in the areas of display, availability, pricing and promotion. As the image technology used in mobile devices becomes available for solution design, the paradigm of real-time image capture and analysis is fast approaching. With this in place, sales associates can exponentially increase their in-store effectiveness. The path to video monitoring and alert-based actions is also imminent, further extending the impact of image recognition.

In the area of trade promotion management and optimization, the practical use of advanced analytics continues to influence the roadmap of solution providers. Companies actively using these technologies will be able to evaluate multiple factors, including brand, category, supply chain, cost to serve and pricing. Additionally, the practice of revenue growth management (RGM) is a logical extension of trade promotion optimization, and winning manufacturers will find the right blend of planning and analytics. This is not a one-size-fits-all discipline and should be as agile as the goals of the organization. Influencing factors include trade budget, stock-keeping unit (SKU) portfolio, regional presence and company goals.

Planned Research

- Analyzing top trends in consumer goods
- Examining the effectiveness of retail execution solutions
- Creating an RGM maturity model
- Exploring next-generation AI in retail

What innovations are impacting the automotive industry and smart mobility?

From the earliest days of Henry Ford's production line to the modern era of Toyota's lean principles, the automotive industry has been in the vanguard of many innovations. Today, product designs in automotive industries are moving away from a physical platform and toward a mobility service platform operating in a far more autonomous environment. This new platform encompasses the entire ecosystem by leveraging sensing data from vehicles, the urban environment and suppliers. Automotive manufacturers will need to expand their purview to include different partners that utilize a suite of digital enabling technologies.

Moreover, as vehicles (especially electric cars) become more connected and then more autonomous, innovations such as IoT and AI will further impact the automotive manufacturing industry. New data-sharing models and new security and tracking technologies will become commonplace. At the same time, mobility as a service — built around autonomous and connected vehicles — will disrupt traditional ownership and operation models.

From a broader perspective, automotive manufacturers will need to respond to environmental factors, including the future evolution of cities and the advent of an automotive and electric grid

ecosystem. All of this will engender the rise of mobility data value. It will also increase demand for new compliance and data models that are embedded into the manufacturing process.

Planned Research

- Assessing the impact of connected-car platforms
- Examining the evolution of electric vehicles
- Examining the impact of over-the-air updates
- Exploring mobility scenarios and smart mobility

What are the additive manufacturing opportunities and use cases?

You, or someone you know, may be wearing a 3D-printed item — a piece of jewelry, a dental crown, a hearing-aid shell. Or, you may be using an item that was made with a 3D-printed mold. For example, competitors Align Technology and ClearCorrect produce more than 200,000 unique, 3D-printed molds for their clear plastic dental braces every day. Can you imagine making that many molds by hand every day? The business model for these multinational organizations could not exist without 3DP as a core capability.

3DP is an additive technique that uses a device to create physical objects from digital models. The term "3D printing" gained popularity about five years ago, as the general media hype around the technology grew. However, many people prefer to use the term "additive manufacturing," because it reflects not only the technology, but also the prototypes, tools, jigs, fixtures and finished products that enterprise-class 3D printers are producing daily.

3DP is now a viable option for many manufacturing organizations. Enterprise 3D-printer capabilities are expanding, hardware and software capabilities are evolving, and the range of usable materials is consistently growing. Nevertheless, in most instances, 3DP has not yet replaced conventional high-volume production methods. Moreover, in many of these instances, such replacement is not imminent. Additive manufacturing is gaining the most traction among organizations that create product life cycles spanning the design stage to the production process. This is largely due to 3DP's use cases for fast prototyping and function simulation, often in conjunction with digital twins. However, the ROI calculations for 3DP are best realized when additive manufacturing is integrated into the end-to-end manufacturing value chain, which includes aftermarket and servicing elements.

CIOs and IT professionals are using business models to engage their colleagues throughout the enterprise, to advance the organization's goals, and to test new business designs before going to market. Business models offer these CIOs and IT professionals insight into the potential uses of 3DP technology.

Planned Research

- Creating new manufacturing business models with 3DP
- Assessing the cost curve and ROI of additive manufacturing

- Utilizing a CIO implementation guide for 3DP technology
- Examining the role of hybrid manufacturing in 3DP

Related Priorities

Table 1. Related Priorities

Priority	Focus
CIO Mastery of Leadership, Culture and People Dynamics	The CIO mastery of leadership, culture and people dynamics initiative unlocks the professional, organizational and performance practices to meet changing business, societal and technology demands.
Cross-Industry Innovation and Disruption	This cross-industry research will show CIOs how to participate in the creation of business and customer value by combining innovations, processes and technologies from multiple industries.
Modernizing Integration Strategies and Infrastructure	This integration initiative deals with the strategies, practices and technologies needed to build a pervasive, enterprisewide integration capacity that serves as the foundation for digital business.
Manufacturing Operations Strategy and Performance	Gartner's 2018 manufacturing operations strategy and performance research will provide guidance on developing, implementing and executing a digitally driven manufacturing operations strategy.
Data Management Strategies	This initiative tracks, explains and advises on organizational roles, architectures, practices, technology trends and vendor offerings for data management.
Leading IT in a Midsize Enterprise	Leading IT in a midsize enterprise focuses on delivering research with context and scale to guide midsize organizations on the most effective strategies, tactics and technology investments.
CIO Leadership in Governance, Strategic Execution and Operational Performance	Leadership in governance, strategic execution and operational performance targets establishing situational governance to drive strategic execution and operational performance excellence.
Building and Expanding a Digital Business	Digital business is the creation of new business designs by blurring the digital and physical worlds. Digital business involves the interaction of people, businesses and intelligent "things."
CIO Design of Bimodal and Other IT Operating and Organizational Models	Design of bimodal, IT operating and organizational models covers how IT capabilities are orchestrated to successfully execute enterprise strategy.
Supply Chain Strategy, Leadership and Governance	Designing strategy, optimizing networks, developing the organization and managing performance must work interdependently to execute an efficient demand-driven supply chain.
Internet of Things	Internet of Things (IoT) enables business value creation by reducing operational costs, better managing risk or developing new revenue streams via digital business models and advancing technologies.

Source: Gartner

Suggested First Steps

"Hype Cycle for Process Manufacturing and PLM, 2017"

"Mastering the Role of Products in the Digital Era"

"Debunking Myths and Misconceptions About Industrie 4.0"

"The Global Impact of Industrie 4.0 Enables and Accelerates Worldwide Digital Business Success"

"2017 CIO Agenda: An Automotive Perspective"

Essential Reading

"Roadmap for CIOs to Harmonize Applications for a Digital PLM Platform"

"Use Scenarios to Plan for Autonomous Vehicle Adoption"

"Market Guide for 3D Print Service Bureaus"

"Market Guide for 3D Printer Manufacturers"

Evidence

[1] There are many discussions on the fourth industrial evolution. A very prominent one is led by Professor Klaus Schwab, founder and executive chairman of the World Economic Forum. He has been at the center of global affairs for over four decades. He believes that we are at the beginning of a revolution that is fundamentally changing the way we live, work and relate to one another. See "The Fourth Industrial Revolution, by Klaus Schwab," World Economic Forum.

[2] Platform Industrie 4.0 is a network of organizations that strive to create a common understanding of Industrie 4.0. For example, Platform Industrie 4.0 promotes reference architectures and test environments so that companies can test their Industrie 4.0 strategies. See "IIoT World Tour Event — San Francisco," Industrie 4.0.

Note 1 Industrie 4.0 and Industry 4.0

The term "Industrie 4.0" originated in Germany in 2012. It was the name of a critical initiative from Germany's Federal Ministry of Economic Affairs and Energy, to address the fourth industrial revolution. Since then, Industrie 4.0 has become a global discussion, representing advanced manufacturing and industrialization strategies based on digital business platforms and ecosystems (see "The Global Impact of Industrie 4.0 Enables and Accelerates Worldwide Digital Business Success"). Today, more and more publications refer to it as Industry 4.0.

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