Modern Solutions Help Solve Manufacturing's Toughest Challenges

Manufacturing companies are facing unprecedented challenges. New business models, mass customization, the deployment of intelligent machines, and faster production based on a consumer-driven perspective are clear signs that the industry is rapidly changing. These changes are positioning manufacturers to seize new opportunities that can increase output and profitability.

As manufacturing looks to evolve, overcome existing and emerging challenges, and capitalize on new opportunities enabled by Industry Revolution 4.0, it must rely on modern technologies and digital processes.

Seize Innovations Enabled by Industry 4.0 or Be Left Behind

The global manufacturing industry has evolved profoundly over the last 20 years. One thing is certain–more change is coming. It is being ushered in by Industry 4.0, which is a shift toward increased automation, advanced analytics, and data optimization. Industry 4.0, also known as the Fourth Industrial Revolution, encompasses cyber-physical systems, internet of things (IoT), cloud computing, cognitive computing, and more.

Industry 4.0 reflects the digitization and wide range of changes across manufacturing. It includes innovative technologies and capabilities such as sensors, interconnectivity, and data analysis. When brought into manufacturing, they allow mass customization, integration of the value chain, and greater efficiencies. The capabilities help manufacturers produce a higher quality product, oftentimes faster, at a lower cost.

As manufacturing heads into the future, Industry 4.0 could be a powerful driver of economic growth. Capgemini predicts it will add between $500 billion and $1.5 trillion in value to the global economy between 2018 and 2022. Industry 4.0 enables:

- A shift toward more robotics and automation
- New ways for humans and machines to interact
- Exchange and optimization of growing data volumes
- Increased connectivity to the point nearly every machine is connected

Industry 4.0 has encouraged manufacturers to invest in IoT sensors and technologies. IoT-enabled solutions enhance predictive analytics and other capabilities. This brings plant-wide benefits, including the key ability to anticipate component or machine failures in advance. Knowing when a machine needs maintenance or replacement parts avoids disruptions caused by an unplanned shutdown and can save money by preventing emergency or larger-scale repairs.

Many manufacturers now use predictive analytics, artificial intelligence (AI), and machine learning on IoT and machine sensor data to monitor systems. Ever-growing data volumes are too vast for humans to analyze, yet AI and machine learning algorithms can quickly detect anomalies and either fix them or alert operators. With Industry 4.0, companies can also expect vertical and horizontal system integration. This allows firms, suppliers, and even customers to be more tightly integrated as a result of robust data sharing.

Industrial Revolutions

Manufacturing is now experiencing its fourth industrial revolution. The four encompass:

- 1765. First industrial revolution saw widespread advances in mechanization and machines using water and steam. This period introduced the steam engine.
- 1870. Second industrial revolution sparked advancements in technologies using electricity, gas, and oil. The internal combustion engine was created during this time.
- 1969. Third industrial revolution is noted for innovations in electronics, telecommunications, and computers. This resulted in the pervasive use of personal computers.
- 2011. Fourth industrial revolution involves wide-spread use of advanced technologies. Industry 4.0 produced cloud computing and other high-tech capabilities.
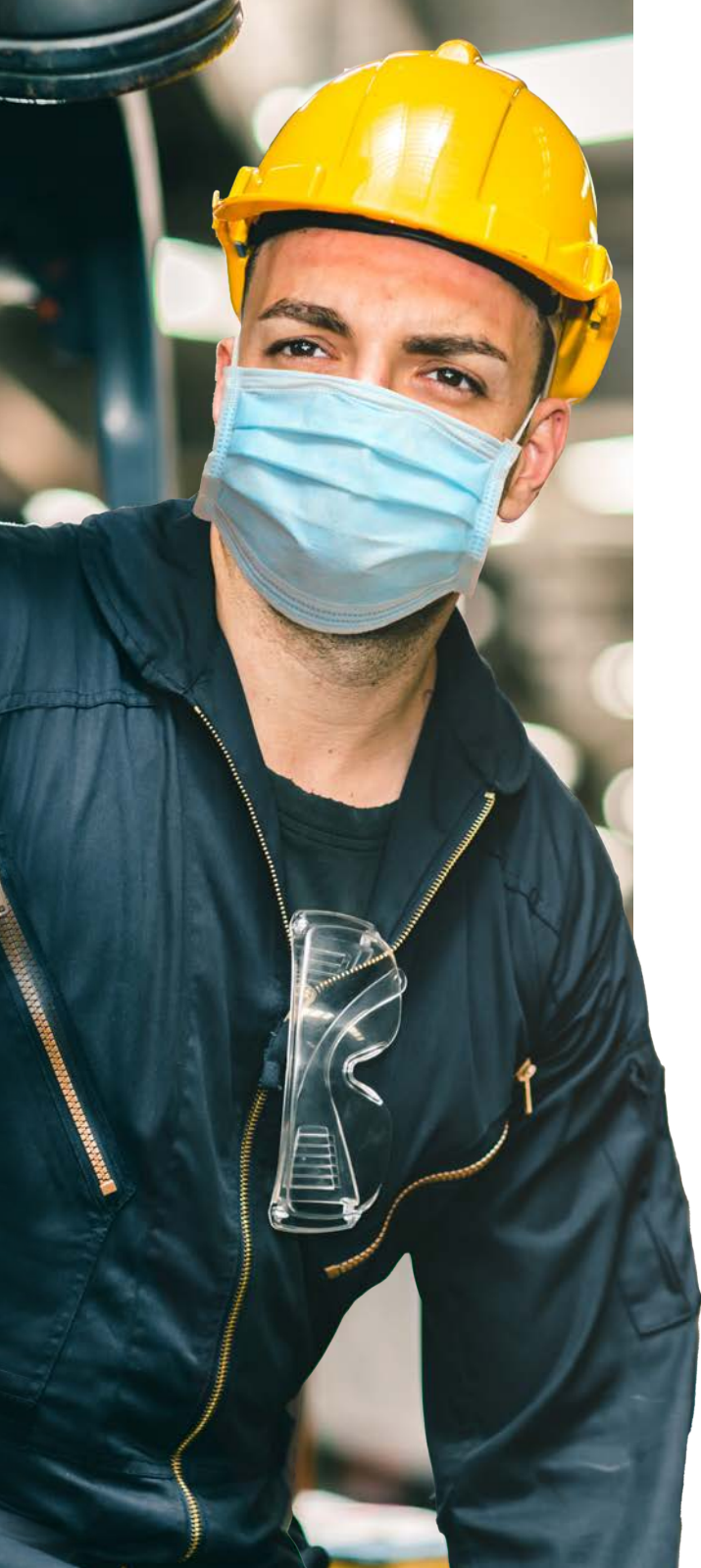
Covid-19 Showcased Manufacturers' Agility

COVID-19 highlighted both the challenges and opportunities manufacturers face during a major disruption, such as a global pandemic or a "black swan" issue. COVID-19 impacted almost every aspect of manufacturers' business, including disrupting the supply chain, causing spikes in prices for materials, and implementing social distancing requirements on the factory floor.

About 78 percent of manufacturers expect COVID-19 to have a financial impact on their business, according to a member survey by the National Association of Manufacturers. In addition, 53 percent anticipate a change in operations and nearly 36 percent face supply chain disruptions, the survey noted.

The pandemic highlighted the importance of manufacturers to be able to quickly pivot in their operations to meet national and global demand for products that could save lives. Many manufacturers increased production to meet the need for medical-related products in response to COVID-19, while others quickly changed their production entirely.

For example, many global automobile manufacturers converted their plants from producing cars to making masks or much-needed ventilators. Major companies in the U.S., Europe, and Asia stopped manufacturing vehicles to help stop the spread of the coronavirus in their plants, but continued to produce vital medical equipment.

The challenges presented by the coronavirus, coupled with ongoing issues like lacking the digital tools and infrastructure needed for modern production, also opened opportunities. Manufacturers explored new solutions that led to increased automation, robots that work alone and others that collaborate with humans, autonomous materials movement throughout the plant, and end-to-end digitization.

Diversifying Supply Chains

COVID-19 caused unprecedented disruption to supply chains. With some materials shipped globally and manufacturers operating on just-in-time inventory strategies, any interruption to supplies can have an immediate impact.

The supply chain unpredictability ushered in by the coronavirus caused executives to rethink operations. Some looked at diversifying their supply chains, such as relying on more suppliers, switching to national-based suppliers, and increasing inventories.

Manufacturers were also challenged to gain new visibility and predictive abilities across the end-to-end supply chain. Finding new ways to optimize data, predictive analytics, and digital processes will give manufacturers increased visibility, tools, and insights into their supplies.

A Look Into Manufacturing's Top Challenges

One of manufacturers' top challenges stems from transformations made over the last several decades. Automation, robotics, and highly specialized processes require more investments not only in technology, but in employee skills. A persistent skills shortage could put $2.5 trillion in economic output at risk over the next decade, according to BMC Software Industry Reporting.

Magnus Akesson, CIO and VP of GE Power Manufacturing and Repair Operations, has spent more than 20 years in IT and manufacturing roles. He believes some manufacturing challenges remain immutable, such as keeping people safe and creating a work environment where employees can excel and gain fulfillment. He's witnessed the rise of technology and the vast potential of AI, machine learning, automation, and big data.

"The overarching change that every manufacturer must embark on, even the industrial ones that operate in a B2B setting, is to be obsessed about creating a supply chain that is truly customer driven," Akesson said. "From there, you need to respond to the ever-increasing demands of a real-time, sensor-driven, and autonomous supply chain through complex networks. You must reduce your batch size, shorten your lead times, enable mass customization, stay asset lean, and remain vigorous about cost. Increasingly, I see process innovation through information and operations technology as a critical enabler to make this transformation happen."

In other words, creating a transcendent customer experience, powered by automation everywhere and guided by data-driven decision making, will lead to a sustainable competitive advantage in the market. Tyler Merritt, a West Point graduate and former special-operations aviator, is CEO of Nine Line Apparel. The U.S.-based manufacturing company has had a compound annual growth rate (CAGR) of 29 percent since 2016. Merritt instilled customer-centric, agile, and data-driven business practices into the company's culture.

Nine Line Apparel's focus on these core values enabled a rapid transformation during the early days of COVID-19. The pandemic caused manufacturers to face a variety of urgent challenges relating to the volatile, uncertain, and complex realities of the global economic response. While many businesses were shuttered, Nine Line Apparel found a solution. It repurposed production lines, forged partnerships, and contributed to the sourcing, production, and distribution of 100 million items of personal protective equipment (PPE). The company made the rapid pivot from being a clothing manufacturer to a PPE manufacturer at a breakneck speed.

It did this by embracing enterprise DevOps tenets across the product development pipeline. Nine Line Apparel partnered with several companies to serve as the packaging and fulfillment arm of an effort that ramped up the distribution of cloth masks from zero to 700,000 per day–over the course of just one week.

Additionally, Nine Line Apparel created dozens of prototype N95 replacement masks. It optimized hundreds of supply chain, design, and testing requirement variables before selecting a product. A typical three- to five-year process was compressed into eight weeks. Leveraging technology, failing fast, and continuous integration allowed the company to fulfill a critical need in a time of disruption.

Bringing Skilled Labor Into Manufacturing

Finding skilled labor is another pain point. An industrial relations senior executive with more than 30 years of manufacturing experience, who did not want to be named due to the sensitive nature of his work with employees and unions, said the greatest challenge facing the industry is sourcing the needed labor force.

Today's manufacturing requires a breadth of tactile and technical skills–everything from running a lathe and a continuous improvement project to analyzing a data set to prevent defects. While finding the right set of skills is one challenge, maintaining the labor force at a competitive wage on a global, macroeconomic scale is another. It's one reason off-shoring has become prevalent during globalization from the 1980s until the present day.

In that sense, employers face a two-fold dilemma–optimizing the cost structure with the right set of labor inputs and delineating work that is more effectively done by some form of automation. This includes having humans perform manufacturing tasks that only humans can do.

Data-driven manufacturing and automation everywhere have great potential to rebalance the cost equation and enable the reshoring of cost-effective, critically important manufacturing capabilities. Creating transcendent customer experiences for internal and external stakeholders should be a key consideration of every manufacturing operation. Determining the employer value proposition, why employees pick one firm over another, and designing work at the intersection of customer, company, and employee value will help garner competitive advantage.

Top Opportunities Across Manufacturing

Modern technologies and advanced capabilities such as AI, machine learning, and digitization can help manufacturing solve many of its toughest challenges. These technologies and capabilities enable new levels of automation. They also allow manufacturers to identify potential problems before they become an issue, have a better line of sight across the entire business from the supply chain through distribution, and uncover new opportunities for improved efficiencies.

For example, advances in AI and digital transformation act as driving forces behind many modern manufacturing IT strategies. To scale adoption and implementation across the entire enterprise, manufacturers must maintain the pulse of their most critical infrastructure. Digitized processes, including digitization of the supply chain, help manufacturers respond faster to opportunities and gain increased agility. This opens capabilities to increase cost controls, achieve operational excellence, and deliver insights and support faster.

Thomas O'Brien, CEO of Axion BioSystems, Inc., is optimistic about the current manufacturing environment. "The great opportunity is the ongoing ingenuity of the American entrepreneur," he said.

Axion Biosystems's products are used in stem cell research, drug development, and cell and gene therapies to treat diseases. The company's core belief is that software-enabled applications are the future. It has invested heavily in building hardware and software applications that create synergies– the software modules and applications amplify the benefits of the hardware.

The company strives to create transcendent customer experiences by ensuring its products are easy to use, convenient, and agile. This leads to ease of use, convenience for the customer, and ultimately, barriers for the competition.

"My answer to gaining sustained competitive advantage in the market is to develop highly differentiated products where you control the outgoing quality of the systems while building a highly efficient supply chain," O'Brien said. "We live in a global economy and attempting to reverse that in any meaningful way is futile."

Twelve years ago, Axion BioSystems started in the life sciences market as the number three competitor. It now occupies a dominant first place position. "Our life science tools business was built around improving the customer experience," O'Brien points out.

Akesson sees tremendous opportunities for manufacturers requiring technical and human capital capabilities to harness advanced analytics on the shop floor. "The overall technology, compute power, and algorithms have matured at a stunning speed, and it seems anything is possible these days," he said. However, having only sensors on manufacturing equipment is meaningless without the requisite understanding of the "so what" and "what next" questions.

Nathan McCormick, SVP of operations at Eos Energy Storage, said, "It's an exciting time to be in manufacturing in the United States. We are starting to see a reshoring of manufacturing, driven by several factors, including business continuity planning. Eos is an example of this. We shifted from a supply chain of 70 percent non-U.S. content, to 70 percent U.S. produced content which made our supply chain much more resilient."

Reshoring was underway prior to COVID-19, and the pandemic accelerated certain aspects of it. In fact, the 2019 Reshoring Index from Kearney was positive for the first time since 2011, indicating net reshoring to the U.S. Reshoring necessitates greater cooperation between IT departments and the manufacturing groups they support.

"IT people can't be sitting in a back room. They have to be out on the floor," McCormick said. "They should participate in lean action workouts, and they should understand the pain points of the factory firsthand."

The industrial relations senior executive agrees, adding, "IT for the sake of IT is a waste of resources. IT needs to understand and work with the processes of the operation." Corporate functions must have a "tech savviness," and the often centralized role of IT needs to evolve, he said.

Akesson goes even further. "There is no longer 'business and IT.' IT is becoming the business. If you start out with strong technical skills, you must understand the functional aspects of manufacturing," he said.

Manufacturers are converging their lines of business. This requires breaking down silos in favor of cross-functional teams whose work may not directly benefit the mangers they report to in the company. "Everything starts with people," Akesson said. "People who are committed to learning and continuous improvement of process, and who have the will and determination to leverage technology to deliver better outcomes, will be successful in transforming manufacturing."

ADE Capabilities Open Opportunities for Global Manufacturers

An autonomous digital enterprise (ADE) is any organization, including a manufacturer, that's built to successfully navigate and succeed in today's digital era by increasing agility, becoming more customer centric, and acting on analytic insights (Figure 3). An ADE manufacturer integrates intelligent, interconnected, technology-enabled, value-creating systems that operate with minimal human involvement across every facet of the organization and its ecosystem of partners.

The ADE methodology consists of five core technology components to enable manufacturers to improve their businesses and reach new successes both now and into the future:

1. **Transcendent Customer Experience**. Create real connections by making technology feel more human and giving employees the resources they need to deliver better customer experiences. Manufacturers benefit from an integrated ecosystem of customer experience tools to understand the entire customer journey and capture value from journey-related investments. Companies can shift from being reactive to being proactive while leveraging advanced analytics to ensure superior customer experiences every time.

13

2. **Automation Everywhere.** ADE companies share one key characteristic—customer interactions and operations are automated. This lowers costs, reduces errors, enables faster execution, reduces mundane tasks for employees, and offers other benefits. These companies embrace technology that works with, not replaces, humans. Hyper-automation uses machines to automate processes by following a set of procedures.

3. **Enterprise DevOps.** Extend the principles of software DevOps to surrounding processes, including release planning, change management, product operations, and more to optimize the rapid, continuous delivery of software applications and services. Enterprise DevOps is a set of continuous improvement principles, as well as cultural and behavioral changes, that rely on a frictionless environment for success.

4. **Data-Driven Business**. A data mindset and analytical capabilities will be the most significant factors in determining future success for manufacturers. Being data-driven means capturing more data from more sources, including IoT, social media, and the plant floor. Using advanced analytics will deliver more value from the data.

Manufacturers can also create predictive models to optimize, improve, guide, and execute actions while leveraging the right set of technologies for the business use cases under consideration.

5. **Adaptive Cybersecurity.** Evolve security processes to include functions that can automatically sense, detect, react, and respond to access requests, authentication needs, outside and inside threats, and meet regulatory requirements. Adaptive cybersecurity combines AI-enabled solutions with a crowdsourcing environment, employs security-integrated DevOps, uses cloud-native infrastructures and services, and adopts mature access and authentication practices with a zero-trust framework.
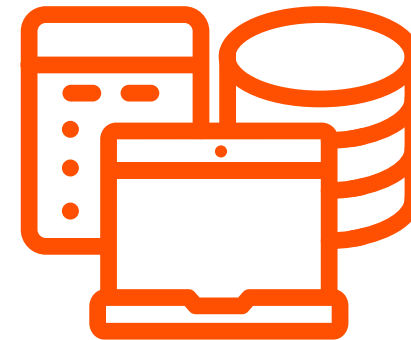
Figure 3: 5 Components of an Autonomous Digital Enterprise

Driving Improvements Across All Operations

Manufacturing entails much more than making physical products. Ever-changing customer demand, the nature of product design, and the economics of products and supply chains have forced a monumental shift in the way manufacturers conduct business. Implementing technology that helps manufacturers identify what customers want, streamline product design, improve agility, solve challenges, and enable other business benefits is more important than ever.

BMC Software helps manufacturers implement the right solutions to help every aspect of their operations, from monitoring capacity and risk to achieving their digital transformation initiatives. The technology helps them achieve, for example, a fit-for-purpose foundation for new service deployments. BMC enables this through a combination of capacity management, discovery and dependency mapping, availability monitoring, application workflow orchestration, and automation across the enterprise.

By adding the combined power of AI and analytics to IT Operations, manufacturers can harness the potential of machine learning and other advanced capabilities while driving new iterative improvements to the ways they work.
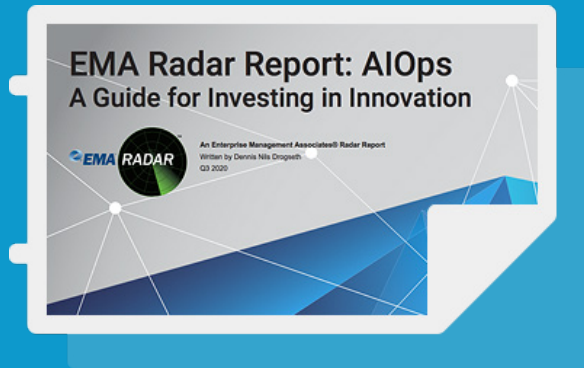
What's Driving the Real Value Added by Manufacturing?

The real value added by manufacturing was 3.5 percent higher in 2018 than in 2007. This was driven by a growth in durable goods. An increase in computer and electronic products boosted the total value added in durable goods and in manufacturing overall during this period.

Other durable goods industries also contributed to the growth:

- Motor vehicles, trailers, and parts
- Other transportation equipment, including aerospace products and parts
- Railroad rolling stock
- Ship and boat building
- Primary metals, such as the manufacturing of iron, steel, and aluminum

Not all industries saw growth. Those that saw a decrease in real value-added growth in durable goods include furniture and fabricated metals products.