



# We are living in a digitally disrupted world

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Will the inundation of digital data power your business, or wash it away?

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Data levels are rising. The pipelines are in place, and the valves are starting to open. Manufacturing companies now face a stark choice: harness the power of data to redefine their offerings and transform the speed, efficiency, and flexibility of their operations, or lose out to competitors that do.

In recent years, the digital data generated across manufacturing value chains have grown dramatically in volume and variety. Those data come directly from smart products, customers, suppliers, enterprise IT systems, connected production equipment, the core manufacturing processes, and a host of external sources.

But the sheer scale of the influx has threatened to overwhelm organizations. The cost and complexity of storing, communicating, and analyzing the data generated in production environments has left most companies taking advantage of only a tiny fraction of them, whether in

running and supporting their operations or in making decisions for the wider business.

That situation is changing fast. The cost of sensors, network hardware, computing power, data storage, and communication bandwidth have all fallen dramatically. The performance of data-analysis systems has increased, thanks to advances such as in-memory databases and artificial-intelligence techniques. Cloud computing systems and standard interfaces have made powerful applications cheaper and faster to implement at scale. Wireless communication and handheld or wearable devices have made access easier at the manufacturing front line or in the field.

No part of the modern manufacturing organization will be remain untouched by this flood of data, and digital-manufacturing techniques keep getting better while costing less. These twin realities are redefining the business case for digital solutions everywhere.

## New insights to drive operations performance

To be competitive, manufacturers need to control their costs, maximize their productivity, and eliminate errors. Digital technologies are yielding significant improvements in all three dimensions, both inside the organization and with outside partners.

### Maximizing productivity

Digital tools are boosting frontline productivity by giving production staff immediate, effortless access to the information they need to do their work. At one global aerospace company, staff on a wiring-harness production line use augmented-reality glasses to guide assembly operations. The innovation reduced the time taken to complete each harness by 30 percent and cut the error rate from 6 percent to zero.

The ability to monitor and analyze multiple machine variables allows companies to find previously hidden ways to improve the performance, reliability, and energy efficiency of their assets. An established European maker of specialty chemicals used neural-network techniques to improve its industry-leading performance, reducing raw-material waste by 20 percent and energy cost by 15 percent (see “Automation, robotics, and the factory of the future” article on page 67).

Sensors can also deliver vital insights into machine health, showing when bearings require lubrication or are wearing out, for example. This allows companies to undertake preventative maintenance, reducing downtime and extending the life of their assets.

Advanced data-analysis techniques are helping companies better understand and control the intricacies of their production processes. The result is better consistency, higher productivity, and superior quality. One major biopharmaceutical company used such techniques to tackle highly variable yields in vaccine production, leading to a major expansion in production capacity with no additional capital outlay.

### Breaking barriers, inside and outside the company

Companies have used digital models of their products to accelerate and improve design and development for many years. Now those techniques are being extended to incorporate models of the entire production process. These “digital twins” allow companies to optimize plant layouts and to design, test, and validate production operations before any manufacturing equipment is in place. This is especially relevant in prototyping new products, when experts from product design, procurement, and manufacturing test a new design’s manufacturability and solve quality and productivity issues upfront.



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The insights provided by advanced digital technologies don't stop at the factory gate. The Internet allows companies to integrate their own operations, and those of their customers and suppliers, to an unprecedented degree. One major oil company now monitors all its offshore drilling and production operations in the Gulf of Mexico from a single control room, for example. Manufacturers of equipment for aerospace, mining, and construction sectors use data generated by their products during operation to inform aftersales service and support activities—and to inform the design of future product generations.

Automotive companies are taking advantage of data generated both upstream and downstream to manage and predict future demand in hitherto unseen levels of detail. By combining information on supplier activities (even several tiers up the chain) with social-media-generated consumer insights, automakers can now better predict which options customers are more likely to choose. Getting that calculation right significantly reduces lead times and inventory costs.

### Greater flexibility

Digitization doesn't just allow companies to get more out of their existing production processes. It is also changing the way manufacturing is done.

### Robotics and automation

Cheaper, more powerful, and more highly integrated robotics and automation systems mean that much work that was once done by people can now be completed by machines. That is enabling some manufacturing activities to move closer to their customers, while also reshaping manufacturing in low-cost regions. China, a country that built its manufacturing base on a ready supply of low-cost labor, is expected to have one-third of the world's industrial robots by 2018.

Companies also have more choice in how they apply robotic systems. While an increasing number of manufacturers are choosing an extremely high

degree of automation, operating “lights out” factories with hundreds of robots and a handful of human operators, the development of new safety technologies means robots can also be deployed on production lines alongside human operators (see “Automation, robotics, and the factory of the future” article on page 67).

### Production agility

Advanced digital manufacturing systems also transform the agility of production systems. Operating characteristics that were once hardwired into machines or set manually by operators can now be encoded digitally and adjusted at will.

The implications for manufacturers are profound. Production lines can continually adjust their speed to match changing customer demand. Multiple products can travel down the same lines in arbitrary sequences without the need for manual tool changes. And products can be customized on the fly to meet specific consumer requirements. One food company developed an online configurator allowing customers to personalize the design of its packaging. The technology boosted sales by 20 percent among users of the service.

### 3-D printing

In traditional, high-volume manufacturing techniques, the final geometry of components is determined by the shape of the molds and dies used to form them. Some advanced manufacturing technologies allow even this information to be moved from the physical to the digital realm. Additive manufacturing systems, once the preserve of prototyping and very-low-volume production applications, are now being used to produce unique products in the hundreds or thousands. 3-D printers have been used to manufacture more than 80,000 titanium hip-joint implants, for example. Car manufacturers have already used 3-D printing technologies for motor-sports applications and the production of spare parts for out-of-production models. Many are now investigating the application

of the technology in serial production applications to define the variant as close as possible to the point of fit, saving significant logistics cost.

3-D printing technologies are also letting manufactures create products that could not be manufactured at all using conventional technologies. In the pharmaceutical sector, for example, researchers are experimenting with such systems to manufacture pills with a geometry that fine-tunes the delivery of a drug to suit the needs of specific patients.

### Disruptive business opportunities

Digital technologies are creating entirely new business opportunities and challenges for manufacturers. Digitization is eroding traditional barriers to entry in many sectors, enabling the development of entirely new categories of products and creating new alternatives for customers.

Current trends in the automotive industry provide a glimpse of the potential scale of the disruption from these effects. The growing importance of software in the vehicle itself is creating opportunities for new competitors to enter the industry— such as Google, creating new product offerings built on its digital expertise. Other new entrants are changing the business model entirely, with ride-hailing giants Didi Chuxing and Uber allowing customers to access mobility as a service. Established carmakers are scrambling to keep up

with this rapidly changing situation, stepping up their internal R&D efforts in the digital space and making a spate of acquisitions and investments in companies with expertise in autonomous driving or mobility as a service.

Among traditional manufacturing companies, meanwhile, digital technologies are creating opportunities for new product types and new value propositions. Manufacturers of electric motors, bearings, and other basic building blocks of manufacturing technology are helping their customers reduce energy costs, increase uptime, and extend product lifetimes through the integration of smart sensors and monitoring technologies, for example. Alongside the hardware, many are also offering the expertise needed to monitor, analyze, and interpret the resulting data, a shift that creates useful ongoing service revenues and builds a closer and more strategic relationship with customers.



Today's flood of digital data is reshaping the manufacturing landscape forever. While long-established territories may disappear, new ones are emerging all the time. We hope that they will help you navigate the threats and opportunities facing your business in this turbulent time.

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