McKinsey&Company

JUNE 2015

Manufacturing's next act

Cornelius Baur and Dominik Wee

Industry 4.0 is more than just a flashy catchphrase. A confluence of trends and technologies promises to reshape the way things are made.

Mention "Industry 4.0" to most manufacturing executives and you will raise eyebrows. If they've heard of it, they are likely confused about what it is. If they haven't heard of it, they're likely to be skeptical of what they see as yet another piece of marketing hype, an empty catchphrase. And yet a closer look at what's behind Industry 4.0 reveals some powerful emerging currents with strong potential to change the way factories work. It may be too much to say that it is another industrial revolution. But call it whatever you like; the fact is, Industry 4.0 is gathering force, and executives should carefully monitor the coming changes and develop strategies to take advantage of the new opportunities.

Coming to terms

Start with some definitions. We define Industry 4.0 as the next phase in the digitization of the manufacturing sector, driven by four disruptions: the astonishing rise in data volumes, computational power, and connectivity, especially new low-power wide-area networks; the emergence of analytics and business-intelligence capabilities; new forms of human-machine interaction such as touch interfaces and augmented-reality systems; and improvements in transferring digital instructions to the physical world, such as advanced robotics and 3-D printing. (The four trends are not the reason for the "4.0," however. Rather, this is the fourth major upheaval in modern manufacturing, following the lean revolution of the 1970s, the outsourcing phenomenon of the 1990s, and the automation that took off in the 2000s.)

Most of these digital technologies have been brewing for some time. Some are not yet ready for application at scale. But many are now at a point where their greater reliability and lower cost are starting to make sense for industrial applications. However, companies are not consistently aware of the emerging technologies. We surveyed 300 manufacturing leaders in January 2015; only 48 percent of manufacturers consider themselves ready for Industry 4.0. Seventy-eight percent of suppliers say they are prepared.

Consider an example of each disruptive trend:

- *Big data.* An African gold mine found ways to capture more data from its sensors. New data showed some unsuspected fluctuations in oxygen levels during leaching, a key process. Fixing this increased yield by 3.7 percent, worth up to $20 million annually.

- *Advanced analytics.* Stronger analysis can dramatically improve product development. One automaker uses data from its online configurator together with purchasing data to identify options that customers are willing to pay a premium for. With this knowledge, it reduced the options on one model to just 13,000—three orders of magnitude fewer than its competitor, which offered 27,000,000. Development time and production costs fell dramatically; most companies can improve gross margin by 30 percent within 24 months.

- *Human-machine interfaces.* Logistics company Knapp AG developed a picking technology using augmented reality. Pickers wear a headset that presents vital information on a see-through display, helping them locate items more quickly and precisely. And with both hands free, they can build stronger and more efficient pallets, with fragile items safeguarded. An integrated camera captures serial and lot ID numbers for real-time stock tracking. Error rates are down by 40 percent, among many other benefits.

- *Digital-to-physical transfer.* Local Motors builds cars almost entirely through 3-D printing, with a design crowdsourced from an online community. It can build a new model from scratch in a year, far less than the industry average of six. Vauxhall and GM, among others, still bend a lot of metal, but also use 3-D printing and rapid prototyping to minimize their time to market.

These changes and many others like them are sure to be far reaching, affecting every corner of the factory and the supply chain. The pace of change, however, will likely be slower than what we've seen in the consumer sector, where equipment is changed frequently. The coming of steam power and the rise of robotics resulted in the outright replacement of 80 to 90 percent of industrial equipment. In coming years, we don't expect anything like that kind of capital investment. Still, the executives surveyed estimate that 40 to 50 percent of today's machines will need upgrading or replacement.

Lightning in a bottle

To capture the potential, manufacturers can consider three moves. Primarily, companies can gather more information and make better use of it. An oil-exploration company collected more than 30,000 pieces of data from each of its drilling rigs—yet 99 percent of that data was lost due to problems of data transmission, storage, and architecture. The tiny trickle of data it did capture was incredibly useful for managers. But so much more can be done. The executives we surveyed said that correcting these data inefficiencies should improve productivity by about 25 percent.

With production data now available for the asking, executives rightly wonder about how to begin. Which data would be most beneficial? Which data leakages are causing the most pain? Which technologies would deliver the biggest return on investment for a company, given its unique circumstances? To sort through the choices, manufacturing leaders can use a "digital compass" (exhibit). The compass consists of eight basic value drivers and 26 practical Industry 4.0 levers. Cross-functional discussions that will help companies find the levers that are best suited to solve their particular problems.

One kind of lost value that is sure to interest manufacturers is process effectiveness. Industry 4.0 offers new tools for smarter energy consumption, greater information storage in products

Exhibit The 'digital compass' helps companies find tools to match their needs.

[1]Maintenance, repair, and operations.

McKinsey&Company

and pallets (so-called intelligent lots), and real-time yield optimization. Swiss giant ABB used the latter in an Australian cement kiln. A computer-based system mimics the actions of an "ideal" operator, using real-time metrics to adjust kiln feed, fuel flow, and fan-damper position. The company found that the new tools boosted throughput by up to 5 percent.

The bigger picture

Strategists should also take Industry 4.0 into account as they contemplate the company's future directions—the second way to capture the potential. The traditional manufacturing business model is changing, and new models are emerging; incumbents must be quick to recognize and react to these new competitive challenges. More specifically, executives must consider the following options—and watch for others that may be deploying them. Eighty-four percent of the manufacturing suppliers we surveyed expect new competitors to enter the market soon.

- "Platforms," in which products, services, and information can be exchanged via predefined streams. Think open-source software applied to the manufacturing context. For example, a company might provide technology to connect multiple parties and coordinate their interactions. SLM Solutions, a 3-D-printer manufacturer, and Atos, an IT services company, are currently running a pilot project to develop such a marketplace. Customers can submit their orders to a virtual broker platform run by Atos. Orders are then allocated to SLM's decentralized network of production sites, and subsequently produced and shipped to the customer. Some companies are also trying to build an "ecosystem" of their own, as Nvidia has in its graphics-processor business. It provides software developers with resources, and offers start-ups help to build companies around Nvidia technologies.

- Pay-by-use and subscription-based services, turning machinery from capex to opex for manufacturers. Rolls-Royce pioneered this approach in its jet-engine business; other manufacturers have followed suit.

- Businesses that license intellectual property. Today, many manufacturing companies have deep expertise in their products and processes, but lack the expertise to generate value from their data. SAP offers consulting services that build on its software. Qualcomm makes more than half of its profits from intellectual-property royalties. Manufacturers might offer consulting services or other businesses that monetize the value of their expertise.

- Businesses that monetize data. The SCiO, a Kickstarter project, is a low-cost, pocket-sized spectrometer that uses near-infrared technology to assess the composition of materials. It is expected to cost $250, whereas traditional machines cost upward of $10,000. Every time a SCiO is used, it contributes to a large database of scanned materials, helping to make the machine more accurate. To be sure, it is a consumer product, and not yet ready for industrial use. But industrial models are on the way. Kaggle, a distributed network of about 270,000 data scientists, has already helped more than 20 Fortune 500 companies solve their toughest data problems.

To get the most out of Industry 4.0 technologies, and to get past square one with a digital business model, companies will have to take a third step: prepare for a digital transformation. Manufacturers should begin today to join the hunt for the best digital talent, and think about how to structure their digital organization. Data management and cybersecurity will be critical problems to solve. Many companies will find that a "two speed" data architecture can help them deploy new technologies at the speed required, while also preserving mission-critical applications. ☐

Cornelius Baur is a director in McKinsey's Munich office, where **Dominik Wee** is a partner.