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Industry 4.0

An Introduction

Understanding Industry 4.0

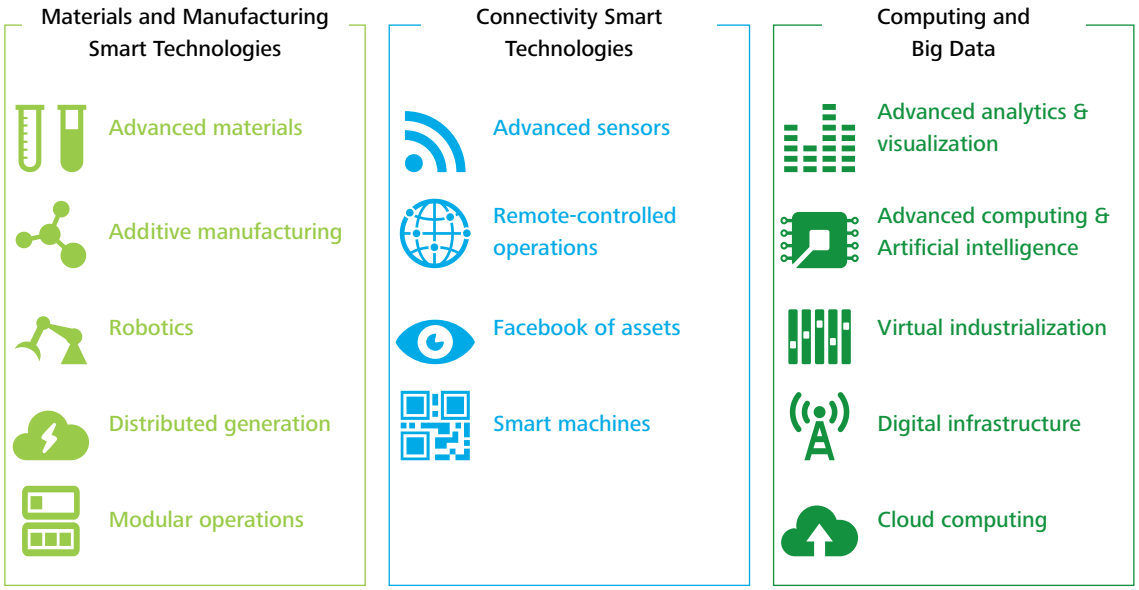
Manufacturing has undergone several eras of change from the first industrial revolution (use of steam power and mechanical production), to the second (use of electricity and mass production) and a third era defined by increased automation of manufacturing processes due to the use of information technology (IT). A fourth era of change – Industry 4.0 – is driven by trends on connectivity, service orientation, advanced materials and processing technology, and collaborative advanced manufacturing networks; networks of advanced manufacturing devices controlled by computers combining them into a physical – digital environment. This change includes the entire value chain from raw materials to end use to recovery, impacting business and support functions too (e.g. supply chain, sales).

Industry 4.0 creates new design principles along which the industry can organize itself, these include: increased interoperability between manufacturing networks through increased connectivity, virtualization of manufacturing processes by linking sensor data (from monitoring physical processes) with virtual plant and simulation models, decentralized decision making, real-time capability to collect and analyze data and provide insights, flexible adaptation to changes by reconfiguring individual modules and an increased services orientation. Consequently, Industry 4.0 will create opportunities for new business models, solution offerings, and new products.
As manufacturers consider reasons to pursue an Industry 4.0 strategy, at some point in the future, the transition will challenge an organization's ability to adjust. These challenges will come in many forms, likely linked to the incorporation of new IT capabilities, the impact of exponentially increasing amounts of data from sensors and connected devices in the operating environment, suppliers, and from the distribution network as we see the emergence of self-regulating and adapting supply systems. At the same time, risks will emerge related to data security associated with increased connectivity.

What is changing?

Advances in materials and manufacturing technologies are linked to those in computing and data management as well as by developments in connectivity (e.g. internet protocol (IP) version 6).

Smart technologies are potential disruptors of manufacturing industry cost curves and gateways to new competitive space



New materials and processing technologies are making manufacturing more efficient while increasing the ability to customize allowing the industry to quickly become more agile, flexible, and decrease scale requirements. Machines are moving from collections of separate devices to singular collaborative networked systems which can accept and communicate data allowing for operational improvements to occur both automatically, or through user intervention. Finally, an increasing wealth of data coupled with techniques for processing to extract insights, opens-up new ways to optimize operations, and enables improved planning and predictive capabilities to optimize production and reduce down time.

Industry 4.0 opportunities

Going forward, it will be essential for companies to focus on creating value networks rather than value chains – utilizing strategic alliances and partnerships effectively to create competitive advantage. To do so, they must understand where value is generated and how it is shared. The manufacturing industry is already seeing early examples of new business models and partnerships creating impact through solutions that enhance value beyond the manufactured product alone:

- Integrated networks for product design: a national automotive manufacturer and a government agency used crowdsourcing to design customized vehicles with minimal investment in a reasonable timeframe. By releasing off the shelf specifications for materials, the design process lasted 4-6 months, which was on schedule and under budget.
- Advanced materials permit new product designs: a global manufacturer designed a continuous, hybridized additive manufacturing process embedding functional elements into in-mold labeling material. This process increased the rapid prototyping and scalability of objects for mass production securing process patents to gain competitive advantage.
- High Performance Computing and Simulation: using supercomputing to accelerate the product design process, the company was able to run simulations and test new ideas reducing time-to-market from 5 years to 2 weeks.

Beyond product design and development, other companies are providing manufactured goods bundled with services to customers. Other companies are experimenting with hardware on a rental basis, providing maintenance and upgrades as part of the fee, which is similar to software and cloud providers in the technology industry.

- Using data to improve maintenance: using advanced sensors a global industrial conglomerate is monitoring sensor data to predict when maintenance is necessary enabling optimized flight scheduling and reduced engine recovery times for customers.
- Reducing unplanned downtime: a global chemicals company is utilizing predictive analytics to understand maintenance and reduce unplanned outages. This has led to an 80% reduction in unplanned outages and $300k per extruder in annual savings.
- Sustainable production enabled by data: a global industrial conglomerate is using additive manufacturing and crowdsourcing/gamification to redesign jet engine components. Reduced material in the new design resulted in more energy efficiency and lower product cost.

New organizational demands

The convergence of new technologies and capabilities places new demands on manufacturing organizations. Consider the impact of the increasing use of sensors to capture data. As sensors proliferate the value chain, they will also become smaller, less expensive, faster with lower power consumption, and less overhead impact on equipment, leading to greater proliferation, and the availability of massive amounts of new data. To handle this will require changes in IT, more and diverse data structures, which will require scalable, highly available and secure platforms, based on open standards. While the transfer of strategic information between components and various members of the value chain will pose new data and network security considerations.

Manufacturers will not only need to attract employees who are comfortable and skilled to operate new technologies, but will face increasing competition for data scientists and database managers skilled in interpreting and leveraging intelligence from new data streams. Manufacturers will also need to identify entrepreneurial talent internally and externally to work in emerging, dynamic business environments considering opportunities holistically across the business, and be prepared to act outside of traditional organizational silos.

Organizational change management will become a critical capability required for success. Employee morale and team commitment may be affected by adjustments to business models and the skill requirements associated with digital technologies. A successful organization will focus on collaboration, system interoperability, closing "digital" skill gaps, and an early focus on change management.

A broad solutions-driven approach

Given the broad business implications of Industry 4.0, manufacturing organizations must think holistically, incorporating both an inside-out and an outside-in perspective. Ad-hoc exploration and implementation of new technologies and processes will not be enough, it will require a structured approach focusing on creating tangible value. Consider, for example, the innovation process which will need to involve more external parties taking an ecosystem perspective of customers, suppliers, and their R&D partners. Since Industry 4.0 is near the front-end of the innovation curve, it will take a benchmarking exercise to determine relative maturity towards perceived best-in-class capabilities. Such an exercise will need to support identification of the strengths, weaknesses, and gaps in the areas critical to success in an Industry 4.0 environment. To develop Industry 4.0 initiatives, manufacturers will need to bring IT, production, operations, engineering, and R&D capabilities, working together outside of traditional organizational structures. This joint-cooperation coupled with an agile approach, using design-led thinking and an iterative process, can enable rapid prototyping of Industry 4.0 products and business model concepts. Considering typical organizational challenges, and the tendency to stick to clear processes in fear of endangering the utility of entrenched assets, manufacturers should consider introducing projects in small pieces – rather than a single, big shift – making it possible to experiment with asset and talent requirements.

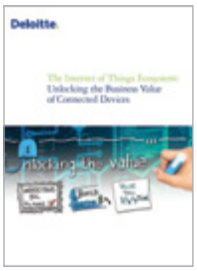
How we can help

The potential for far reaching transformation as Industry 4.0 evolves requires the capabilities to solve problems from end-to-end – horizontally and vertically within and outside an organization. Focused Industry 4.0 efforts, will require a perspective that cuts across each of these dimensions, which is informed by deep industry knowledge, technology expertise, strategy and business model expertise and an equally informed external ("outside-in") perspective built by experience across multiple industries and market sectors. At Deloitte, we have worked with a wide range of manufacturing companies, including in highly specialized industries such as aerospace & defense, automotive, chemicals, and high tech, as well as supporting global manufacturers in consumer products, retail and telecoms. We have the experience in supporting clients with systems-level innovation through our Advanced Materials Systems (AMS) framework – and we regularly support clients in both large and small transformational efforts spanning the business, technology, and human resources. We maintain a common focus regardless of context – identifying and solving business issues, delivering measurable financial impact – a proven approach which enables prioritization and justification of investments and creates true business impact.

The preceding document is an introduction to the topic of Industry 4.0. Deloitte regularly analyzes the global manufacturing industry, publishing related reports on industry transformation and its impact on business models and organizational requirements.

Interested in specific elements of Industry 4.0? Please see some of Deloitte's other perspectives on:

The future of manufacturing: Making things in a changing world



The Internet of Things ecosystem: Unlocking the business value of connected devices

3D opportunity: Additive Manufacturing paths to performance, innovation, and growth

Cognitive technologies: The real opportunity for business

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