On the board's agenda | US
Industry 4.0

Introduction

The integration of digital and physical technologies is accelerating, enhancing companies' ability to increase operational excellence and grow in ways that may not have been possible just a couple of years ago. This phenomenon, known as Industry 4.0, suggests a new revolution that enables smart, connected technologies to transform organizations, operations, and the workforce by increasing information flow, creating new insights, and revolutionizing business models.

A key role of any board member is to provide strategic oversight in the form of forward-leaning perspectives to help the organization build and maintain competitive advantages in the face of increasingly rapid technological change. The purpose of this

article is to help board members understand Industry 4.0 and its potential to create value for their organizations, while providing considerations for oversight.

What Is "Industry 4.0"?

The word "industry" and the term "industrial revolution" conjure up images of plants, machinery, and equipment. While these and other hard assets remain critical components of our economy, we are experiencing a new industrial revolution in which our economy is increasingly comprised of both physical technologies, such as sensors, robotics, 3-D printing, and wearables; and digital technologies, such as artificial intelligence (AI), analytics, and visualization. ❯

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Industry 4.0 in action

An apparel and accessories company looked for ways to address growing manufacturing and retail challenges, such as rapid shifts in demand and global fragmentation of production. They did so by building smart factories in two pilot locations in Europe and North America. Located close to the point of customer demand, the new smart factories are more responsive and adaptable to new trends, and allow products to reach customers faster than would be possible with traditional factories—an estimation of less than a week, rather than up to three months. The facilities leverage multiple digital and physical technologies, including a digital twin[1], digital design[2], additive manufacturing[3], and autonomous robots.[4] The company plans to use these smart factories as pilots, applying lessons learned to future facilities in new geographies.

For more information, see *The smart factory: Responsive, adaptive, connected manufacturing*.

It is this marriage of physical and digital technologies that we refer to as "Industry 4.0". Industry 4.0 has its roots in manufacturing and supply chain, but it extends well beyond those areas and has implications for many other sectors, such as financial services, where it can enable organizations to reach new customers and new markets, or better manage their processes. Accordingly, board members in every industry need to be aware of Industry 4.0 and consider its implications for their organizations' strategies, operations, and otherwise.

Not your grandparents' industrial revolutions?
Industry 4.0 bears some resemblance to previous industrial revolutions. For example, it is having a significant impact not only on the means of production, but also on the economy and society at large; it appears to be advancing very quickly; and it can be both nebulous and disconcerting.

However, Industry 4.0 appears to differ in some respects from our ancestors' industrial revolutions, in that it may create a more permanent state of exponential change, including ongoing disruption and digital transformation, and a need to remain flexible and adaptive.

Pluses and minuses
On the plus side, Industry 4.0 can facilitate the creation of digital enterprises that are interconnected and capable of more holistic, better informed decision making. It also can facilitate greater responsiveness and customization by collecting data from physical systems and analyzing and using those data to drive intelligent action in the physical world.

On the other hand, the technologies that comprise Industry 4.0 can come with some challenges. Among other things, they necessitate ever-faster responses and fully-connected organizations can be more vulnerable to cyber threats.
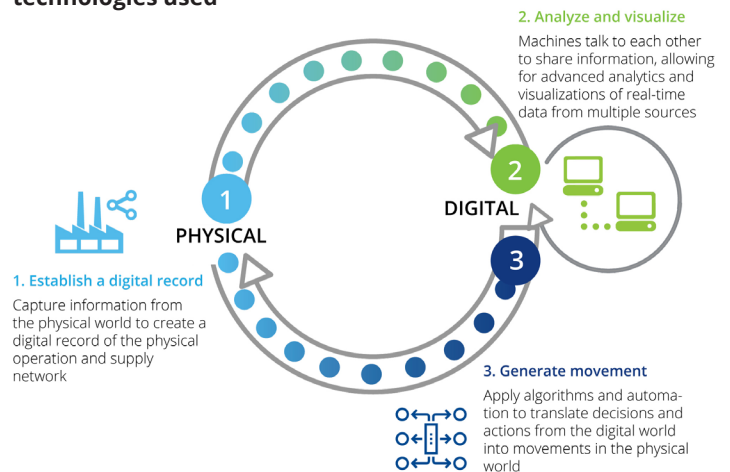
How it works

While the technologies that power Industry 4.0 can seem impossibly complex, the process by which it works is really quite simple. In essence, the power and value of Industry 4.0 lies in flows of information, and the ability to integrate digital information from many different sources and locations to drive the physical act of doing business. In this way, information flows in an ongoing cycle, where data from one process informs the next.

Throughout this cycle, data flows continuously, providing digital information about actions taking place in the physical world. That information is then analyzed and used to drive new actions. This information flow occurs through an iterative series of three steps, referred to as the physical-to-digital-to-physical (PDP) loop (see figure 1). This ongoing loop incorporates the use of many physical and digital technologies, including analytics, additive manufacturing, robotics, high-performance computing, natural language processing, artificial intelligence and cognitive technologies, advanced materials, and augmented reality.[5]

- Physical to digital: capture information from the physical world and create a digital record from physical data

- Digital to digital: share information and uncover insights using advanced analytics, scenario analysis, and AI

- Digital to physical—*the essence of Industry 4.0*: apply algorithms to translate digital-world decisions to effective data, to spur action and change in the physical world

Most organizations already have some part of the first two stages of the PDP loop—the physical-to-digital, in the form of connected assets, and the digital-to-digital, in the form of analytics—in place. However, it is the third stage—acting upon those digital insights back in the physical world—that can unlock the boundless possibilities of Industry 4.0. Indeed, it is the completion and continuation of this ongoing loop that enables organizations to be more responsive, flexible, and adaptive to the rapidly changing conditions around them; to make more informed decisions; and to better predict and respond to future scenarios.

Figure 1. The physical-digital-physical loop and the technologies used

2. Analyze and visualize
Machines talk to each other to share information, allowing for advanced analytics and visualizations of real-time data from multiple sources

DIGITAL

PHYSICAL

1. Establish a digital record
Capture information from the physical world to create a digital record of the physical operation and supply network

3. Generate movement
Apply algorithms and automation to translate decisions and actions from the digital world into movements in the physical world

Source: Center for Integrated Research.

Deloitte Insights | deloitte.com/insights

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1. *Industry 4.0 and the digital twin: Manufacturing meets its match*, https://www2.deloitte.com/insights/us/en/focus/industry-4-0/digital-twin-technology-smart-factory.html.
2. *3D opportunity and the digital thread*, https://www2.deloitte.com/insights/us/en/focus/3d-opportunity/3d-printing-digital-thread-in-manufacturing.html.
3. Deloitte Insights has published a broad series of perspectives on additive manufacturing in its *3D opportunity* series; see https://www2.deloitte.com/insights/us/en/focus/3d-opportunity.html?icid=left_3d-opportunity.
4. *Robots uncaged*, https://www2.deloitte.com/insights/us/en/focus/signals-for-strategists/next-generation-robots-implications-for-business.html.
5. Deloitte Insights has published detailed analyses on a number of these technologies; see www.dupress.deloitte.com.

Opportunities and strategic considerations

The integration of physical and digital technologies has the possibility to open new doors and generate new opportunities for companies. The ability to combine data and learnings in new ways and make better, more informed decisions at a faster rate, can provide distinct advantages for those companies that are able to harness the power of Industry 4.0. Some of those opportunities may include the following:

- **New products and services** may be created with the combination of technologies like sensors, wearables, analytics, machine learning, and advanced manufacturing techniques. The use of insights generated through the feedback loop can also allow for improved designs of current products and services.[6] In some cases, new business models may be created as companies amass data and are able to move into adjacent markets, markets that may not have been economically feasible before, such as small business banking or micro-lending in financial services, or provide services in addition to their physical products.

- **Improved productivity of supply chains, assets, and labor** is an area ripe with opportunity. Adapting to incorporate learnings from data in real time can reduce asset idling and maximize utilization. It also presents the opportunity to more effectively manage supply chains and material costs by reducing the potential for waste and making scheduling more reliable. Labor may become more efficient as technology makes tasks easier and frees workers for additional or new tasks.

- **Increased understanding of customer needs** and a stronger connection with the customer are by-products of Industry 4.0. Intelligent products and services gather information that can be added back into the feedback loop to enrich understanding of how products and services are used. A tailored user experience and customized marketing may encourage deeper loyalty and provide opportunities for follow-on sales.[7]

- **Opportunities to develop the workforce of the future** are likely to arise as demands for talent with new skills are created by Industry 4.0. The integration of physical and digital technologies creates new types of jobs but also provides the opportunity to enhance existing jobs and make tasks easier.[8] Training will inevitably be needed to empower the workforce to flex their skills to meet new demands and incorporate new technologies into tasks.

- **Risk reduction** is perhaps one of the most important opportunities presented through Industry 4.0. Gleaning insights from formerly disparate sources of data earlier and faster could provide opportunities to mitigate weaknesses in the supply chain, better evaluate vendors or manage material costs, or better analyze and secure transaction data.

However, with opportunity comes risk. When exercising oversight responsibilities, board members should consider the following strategic factors:

Industry 4.0 in action

As part of their goal of constant improvement, Formula One teams deeply leverage a broad variety of advanced manufacturing techniques, from additive manufacturing[9] to the digital thread[10]—some of which haven't yet rippled out to mainstream manufacturers. These technologies, in turn, change how the race teams must operate as a company. Thus, Formula One race teams are already leveraging Industry 4.0 technologies and evolving their products, supply chains, and manufacturing operations in ways that mainstream manufacturers may see several years down the line. Maclaren Racing has full traceability of every part they make or buy, and runs as many as 50,000 simulations of data for every driver, team and past event they can gather prior to a race. Maclaren also runs sophisticated models of their race cars, known as digital twins.[11] These digital twins enable the company to test a broad range of parameters to see how the vehicle may react, and run driver simulations. Further, the Maclaren Racing Team also uses connected digital and physical technologies to monitor the operation of the car, running data during practice sessions to gather real-time information that enables continuous design improvements and learning that can be fed back into future iterations of the machine.

For information, see *Racing the future of production: A conversation with Simon Roberts*.

- Placing too much focus on the achievement of short-term metrics and not enough on investing in a longer-term, more strategic vision that responds to competitive disruption.[12]

- Silos or a lack of coordination within the organization, particularly if it is multi-national, may inhibit the ability to embrace the power of Industry 4.0 and act on insights.

- If the organization examined the gaps between its existing capabilities and strategic objectives to determine where targeted investments should be made.

- How the organization is introducing change management efforts and continuous learning initiatives to counter trepidation in the workforce associated with new technology integration. Boards may also consider if the skill sets of senior leadership support and enable adoption of Industry 4.0 technologies in their organizations.

- If the organization has implemented a secure, vigilant, and resilient cybersecurity strategy to mitigate the potential for cyber incidents or data spills associated with the digitization of business and accumulation of sensitive data. Fully-connected organizations can be at a greater risk from cyber threats and the consequences of an attack could be far more extensive.[13]

6. *Forces of change: Industry 4.0,* p. 6 https://www2.deloitte.com/content/dam/insights/us/articles/4323_Forces-of-change/4323_Forces-of-change_Ind4-0.pdf.
7. *Forces of change: Industry 4.0,* p. 6, 10 https://www2.deloitte.com/content/dam/insights/us/articles/4323_Forces-of-change/4323_Forces-of-change_Ind4-0.pdf.
8. *Forces of change: Industry 4.0,* p. 9, 10 https://www2.deloitte.com/content/dam/insights/us/articles/4323_Forces-of-change/4323_Forces-of-change_Ind4-0.pdf.
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10. *3D opportunity and the digital thread,* https://www2.deloitte.com/insights/us/en/focus/3d-opportunity/3d-printing-digital-thread-in-manufacturing.html.
11. *Industry 4.0 and the digital twin: Manufacturing meets its match,* https://www2.deloitte.com/insights/us/en/focus/industry-4-0/digital-twin-technology-smart-factory.html.
12. *The Fourth Industrial Revolution is here-are you ready?,* p. 7 https://www2.deloitte.com/content/dam/insights/us/articles/4364_Industry4-0_Are-you-ready/4364_Industry4-0_Are-you-ready_Report.pdf.
13. *Industry 4.0 and cybersecurity: Managing risk in an age of connected production,* p. 2 https://www2.deloitte.com/content/dam/insights/us/articles/3749_Industry4-0_cybersecurity/DUP_Industry4-0_cybersecurity.pdf.

Conclusion

The increasing prevalence and influence of Industry 4.0, combined with the board's fiduciary obligation to oversee company strategy and operations, suggests that directors need to understand Industry 4.0 and provide oversight for the company's ventures into it. To effectively function in an Industry 4.0 environment, directors should consider the following actions:

- Understand the applications of various technologies (including what they can—and cannot—do) and potential impacts on the organization's business and how they could complement strategy.

- Develop an awareness of how physical and digital technologies work together to drive value and translate decisions into the physical world.

- Challenge management to assess digital maturity and understand what can (and cannot) be done with resources already in place; consider engaging expert resources.

- Encourage the organization to start small, proving the concept and building a business case for further investment that may unlock further success and drive exponential growth.

- Help management achieve the right balance between short-term results and longer-term value creation/strategy.

- Understand—and help management to understand—that some failure is expected; encourage management to try new things while maintaining oversight.

- Encourage iteration—technology is evolving fast and there is room to apply learning and integrate it into strategic decision-making.

- Help the company recognize opportunities for innovation in its industry.

- Challenge management on where to invest in new technologies and what technologies best fit the company's forward-looking strategy by tapping new sources of talent (while noting that talent can also be a risk), reaching underserved markets, using predictive tools to help improve processes and reduce risk, connecting supply chains, and creating new ecosystems.

- Remain vigilant over potential side effects and risks, such as talent shortages and cyber threats.

For more information about Industry 4.0 go to *Forces of change: Industry 4.0*. ▶

Questions for the board to consider:

1. What physical and digital technologies does the company use? Are these technologies working together?

2. To the extent that our physical and digital technologies are not working together well or optimally, what remedial actions are we taking or considering?

3. What impacts can we expect from the integration of our physical and digital technologies on our strategy, operations, workforce, customers, supply chains, etc.? How are we planning to deal with these impacts?

4. How are we addressing risks associated with Industry 4.0, such as cyber threats and algorithmic risk?

5. Are we considering new, developing technologies and how they might impact our business?

6. Are we moving at the proper speed, or have we committed to spending more money before we have "proof of concept"?

7. How are we planning for the possible failure of a new technology or our use of it?

8. Do we have a handle on changing talent needs as we move further down the path of Industry 4.0?

9. Where are we vis-à-vis our competitors in our integration of physical and digital technology?

10. Do we have the right board members to oversee Industry 4.0 and the changes it is likely to make going forward?

Industry 4.0 technologies can create significant opportunities in multiple industries beyond manufacturing, including financial services. Advanced technologies can lower barriers to entry for smaller-scale retail banking initiatives and micro-finance programs, enabling financial services organizations to reach and serve new customers—both in new populations and new geographies. Further, Industry 4.0-driven capabilities such as machine learning and AI can enable financial institutions to better tailor interactions and services to customers' specific behaviors and needs.

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