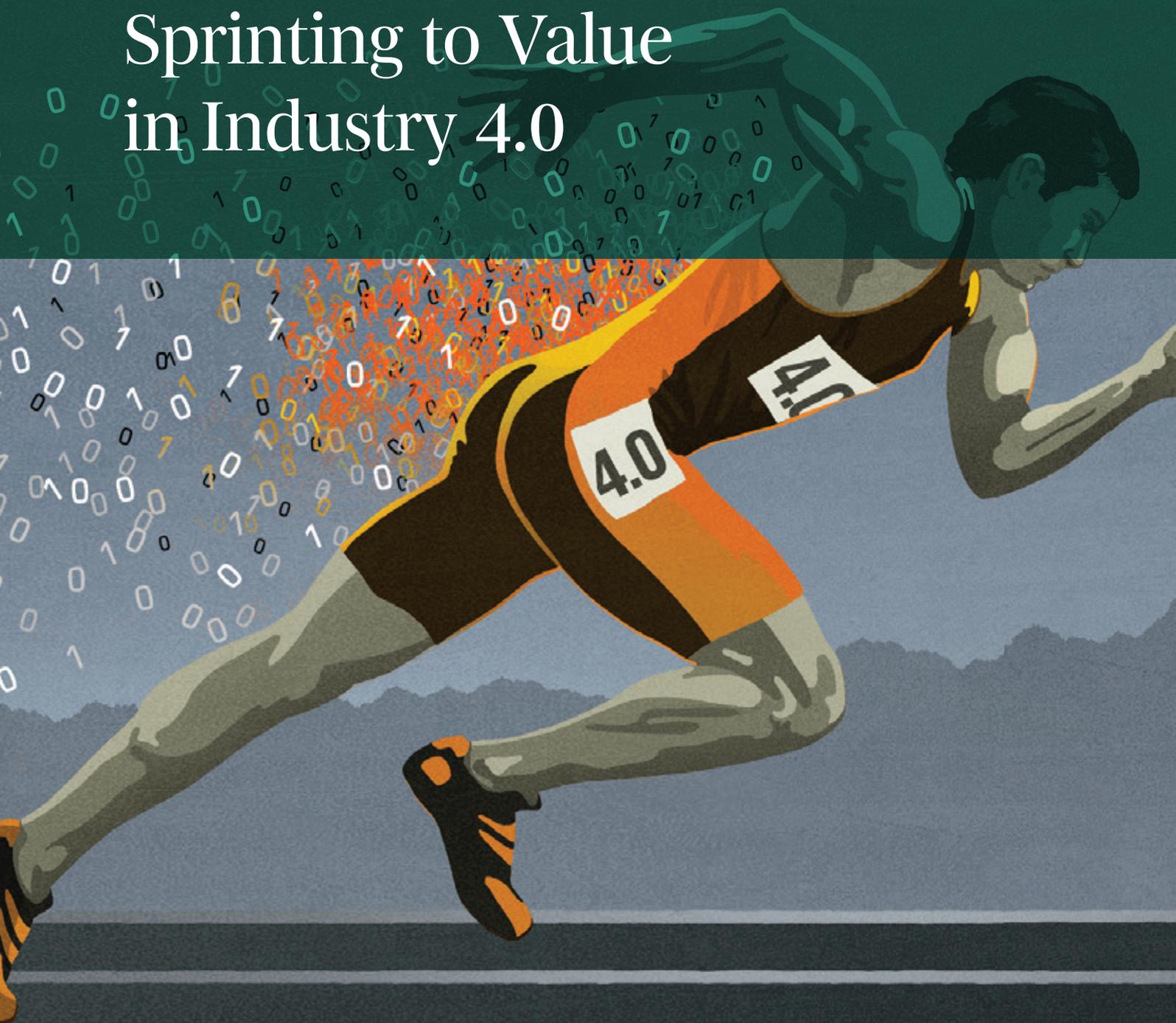


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Sprinting to Value in Industry 4.0



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Sprinting to Value in Industry 4.0

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AT A GLANCE

US manufacturers recognize the potential of new digital industrial technologies to create value, but they have yet to fully appreciate the scope and magnitude of the opportunity or find the path to success. Companies must set ambitious goals and capture value rapidly over the course of a multiyear transformation. The winners will approach the race to Industry 4.0 as a series of sprints but manage their program as a marathon.

CONFLICTING SIGNALS EARLY IN THE RACE

A BCG survey found that Industry 4.0 is a priority for US manufacturers but not an imperative. Value is expected to result from productivity and cost improvements, but less so from revenue growth. Implementation is underway, but the pace is uneven across technologies. Strategy, processes, culture, and talent are all seen as challenges, but companies have yet to find solutions.

RUN SPRINTS, BUT MANAGE A MARATHON

A cross-functional innovation team should conduct bold experiments, iterate fast, and rapidly scale up new solutions. Hands-on experience is essential for managers. A strategic plan should guide the effort, but companies should start small. Battle-tested program-management techniques can keep the effort on track.

TO IMPROVE PERFORMANCE AND gain a competitive edge, manufacturers must adopt the new digital industrial technologies that are collectively known as Industry 4.0. Leading manufacturers are already applying these advances in order to bring products to market faster, reduce their cost bases, and build new revenue streams. The value created by Industry 4.0 vastly exceeds the low-single-digit cost savings that many manufacturers pursue today. The new technologies promise to revolutionize manufacturing, thereby shifting the competitive balance among countries and transforming the industrial workforce. (See the sidebar “Industry 4.0 Revolutionizes Manufacturing.”)

The race is on to adopt Industry 4.0. Earlier this year, a BCG study found that companies in the US and Germany have implemented Industry 4.0 at approximately the same pace. (See *Time to Accelerate in the Race Toward Industry 4.0*, BCG Focus, May 2016.) To gain further insights about the status of Industry 4.0 adoption by US manufacturers and the challenges they face, BCG surveyed 380 US-based manufacturing executives and managers at companies representing a wide range of sizes in various industries. Although the majority of respondents said that they are prioritizing Industry 4.0 adoption, we found conflicting views on a number of issues. Most companies have implemented only one or two isolated aspects of Industry 4.0, such as robotics or big data. The real value is achieved when manufacturers maximize the impact of these advances by combining them in a comprehensive program. Our findings point to the need for US manufacturers to gain a deeper understanding of how they can apply Industry 4.0 and accelerate the pace of adoption. The winners will approach the race to Industry 4.0 as a series of sprints but manage their program as a marathon.

The winners will approach the race to Industry 4.0 as a series of sprints but manage their program as a marathon.

Conflicting Signals Early in the Race

Our survey findings suggest that although US manufacturers recognize the potential of Industry 4.0 to create value, they have yet to fully appreciate the scope and magnitude of the opportunity or find the path to success:

- **Industry 4.0 is a priority, but not yet an imperative.** Overall, 53% of respondents said that adopting Industry 4.0 is a priority. Specific industries showed even greater enthusiasm. Respondents in cost-sensitive industries—such as semiconductors, electronics, and oil and gas—are most eager to move forward: 80% said that Industry 4.0 is a priority. Even so, most respondents in the full sample do not regard Industry 4.0 as a competitive threat to their organization. This ambivalent view was highlighted when respondents were asked to rate Industry 4.0 on a scale where 0 signified “hype” and 10 signified “real.” The

INDUSTRY 4.0 REVOLUTIONIZES MANUFACTURING

Industry 4.0 refers to the convergence and application of nine technologies: advanced robotics; big data and analytics; cloud computing; the industrial internet; horizontal and vertical system integration; simulation; augmented reality; additive manufacturing; and cybersecurity. Companies unlock the full potential of Industry 4.0 by coordinating the implementation of those technologies—for example, by deploying sensors to collect data within a secure cloud environment and applying advanced analytics to gain insights. (See *Industry 4.0: The Future of Productivity and Growth in Manufacturing Industries*, BCG Focus, April 2015.)

In this way, a manufacturer can create an integrated, automated, and optimized production flow across the supply chain, as well as synthesize communications between itself and its suppliers and customers. This end-to-end integration will reduce waiting time and work-in-progress inventory and, ultimately, may even make it possible for manufacturers to offer mass customization at the same price as mass production.

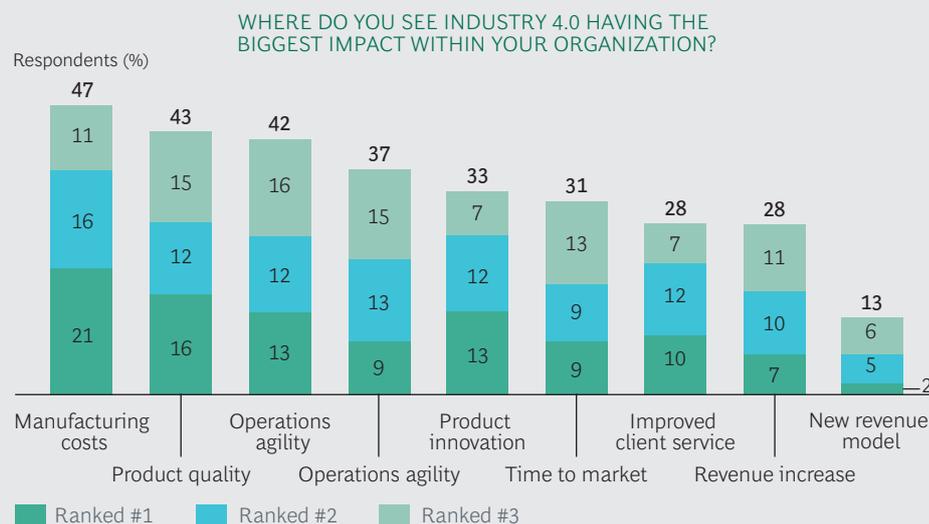
As adoption proceeds, the labor cost advantages of traditional low-cost locations will shrink, motivating manufacturers to bring previously offshored jobs back home. Manufacturers will also benefit from higher demand resulting from the growth of existing markets and the introduction of new products and services.

The profile of the workforce will also change. The critical Industry 4.0 jobs—such as for data managers and scientists, software developers, and analytics experts—require skills that differ fundamentally from those that most industrial workers possess today. Manufacturers will need to take steps to close the skills gap, such as retraining the workforce and tapping the pool of digital talent. Moreover, manufacturers will need to create new jobs to meet the higher demand. (See *Man and Machine in Industry 4.0: How Will Technology Transform the Industrial Workforce Through 2025?*, BCG Focus, September 2015.)

median response was 5, indicating general uncertainty as to whether the benefits of Industry 4.0 outweigh the challenges in capturing them.

- **Value is expected to result from productivity and cost improvements, but less so from revenue growth.** Among our respondents, 89% see an opportunity to use Industry 4.0 to improve manufacturing productivity. They expect to capture the greatest value from reducing manufacturing costs (47%) and improving product quality (43%) and operations agility (42%). But fewer see opportunities to generate increased revenue (28%) or develop a new revenue model (13%). (See Exhibit 1.) In our view, companies should focus on both cost and revenue improvements as potential sources of value.
- **Implementation is underway, but the pace is uneven across technologies.**

EXHIBIT 1 | Respondents Expect Cost Improvements to Create More Value Than Revenue Growth



Source: BCG's 2016 Value from Industry 4.0 survey.

Note: Because of rounding, not all numbers add up to the totals shown.

We asked respondents to rate the extent of their implementation of each technology encompassed by Industry 4.0 on a scale where 0 signified “not implemented” and 4 signified “fully implemented.” They indicated the highest levels of implementation for cybersecurity (65%), big data and analytics (54%), and cloud computing (53%). They indicated the lowest levels of implementation for additive manufacturing (34%), advanced robotics (32%), and augmented reality (28%). Although implementation of advanced robotics is off to a slow start, respondents indicated that they intend to give greater priority to this technology during the next two to three years.

- Obstacles are evident, but solutions are elusive.** Respondents cited defining a strategy as the biggest challenge in initiating efforts to adopt Industry 4.0, followed closely by rethinking their organization and processes. With respect to implementing Industry 4.0 across the organization, 40% of respondents cited changing the culture as the biggest challenge. Many respondents consider finding the right talent, internally or externally, to be a constraint. Indeed, regardless of company size, respondents cited hiring talent and acquiring new capabilities as the most critical enablers for Industry 4.0 adoption. As one executive explained, “The needed capabilities don’t currently exist in our company, and we believe they’ll be hard to find.”

Industry 4.0 in Action: The Value Is Real

The survey findings show that many US manufacturers are moving too slowly to adopt Industry 4.0. Few companies have implemented the full suite of technologies, and some are still debating the degree of impact that these technologies could have on their businesses. But companies that take a wait-and-see approach to adoption

do so at their peril. Having supported major digital transformation efforts and validated the benefits of vendors' technologies, we can attest to the tremendous value generated by Industry 4.0. Indeed, in an era of stagnating productivity, Industry 4.0 stands out as a means of generating significant productivity gains. (Look for our forthcoming report, *Productivity Now: A Call to Action for US Manufacturers.*)

Numerous examples demonstrate the wide variety of ways in which manufacturers are using Industry 4.0 to create value.

Industry 4.0 stands out as a means of generating significant productivity gains.

Improving Quality. A *Fortune* 500 company's assembly line produced more than 40 product variations. The complexity resulted in considerable rework and long, inconsistent production cycles. Operators' efforts to improve quality and consistency were impeded by the need to review static, hard-to-follow printed instructions. To overcome these obstacles, the company deployed augmented reality at workstations. The technology automatically shows workers the appropriate standard operating procedures for assembling each product as it passes through the assembly line. After deploying the technology, the company improved its ability to get the product right on the first effort by more than 10 percentage points.

Streamlining Processes. To streamline labeling and inspection processes on 10,000 SKUs across six assembly lines, an electronics manufacturer installed collaborative robots, or cobots. Some cobots were deployed for a tedious pick-and-place task, while others were fitted with vision systems on their robotic arms to inspect parts. Working alongside factory workers, the cobots doubled labeling speed from 125 parts per hour to 250, and in one work cell alone, reduced the required floor space by 200 square feet.

Reducing Development Costs and Lead Time. A manufacturer of truck engines asked its engineering team to cut development costs and shorten the lead time for producing large engines. The team utilized a 3D printer to create a prototype for a water pump housing used to perform heat and pressure testing. The use of 3D printing reduced tooling time from 20 weeks to 2, and decreased tooling costs from \$10,000 to \$770.

Accelerating Market Entry. A major industrial goods company sought to accelerate the penetration of its products in developing markets while adhering to strict quality standards. It implemented a platform for horizontal and vertical system integration, which allowed it to manage manufacturing processes, synchronize the availability of materials, and use a standard bill of materials globally. The new system enabled the company to reduce quality claims by 90% and increase production throughput by more than 25%. These improvements allowed the company to gain market share by aggressively rolling out new products.

Creating New Services. A global tire manufacturer combined several of the technologies encompassed by Industry 4.0—the industrial internet, cloud computing, and big data and analytics—to develop an innovative service offering. The manufacturer installed wireless sensors on its tires to gather data in real time on tire pressure, temperature, speed, fuel consumption, and location. The data flows into a proprietary cloud platform for analysis. Fuel experts then interpret the information to

accurately measure a tire's performance and make recommendations to the fleet manager regarding fuel consumption. The manufacturer also uses the data to charge customers for tires on the basis of the distance travelled. This "tires by the mile" initiative is generating new revenue for the company.

Achieving a Step Change in Efficiency. A global automotive equipment supplier faced increasing labor costs in developing countries and a scarcity of skilled labor in developed countries. With support from BCG, the company defined its digital strategy. It figured out which isolated digital initiatives were already underway and identified new initiatives to potentially pursue. The additional initiatives included using data to monitor and optimize the efficiency of production processes and to detect incidents in real time. The company then selected the top priorities for achieving its strategic vision. It conducted small programs, known as lighthouse projects, to rapidly test these initiatives and showcase the value that digital can bring. The company also defined a roadmap for deploying these initiatives at scale across the entire organization. The project achieved total cost savings of approximately 10%.

Run Sprints, but Manage a Marathon

Although companies should consider an Industry 4.0 transformation holistically—in terms of both the technologies and the organizational scope—they should avoid trying to do everything at once. The best approach is to create a cross-functional innovation team and empower it to conduct bold experiments, iterate quickly, and scale up new solutions across the organization as soon as they are validated. Providing hands-on experience is essential for helping managers understand the state of the art in Industry 4.0 and the innovative ways they can apply these technologies in their plants. Companies should define a strategic plan to guide the effort but start small, with lighthouse initiatives that demonstrate the potential. And they should deploy battle-tested program management techniques to keep the large-scale, multiyear effort on track. The following is a step-by-step approach to capturing value rapidly and managing a long-term transformation.

Create a cross-functional innovation team. Companies need to create a cross-functional innovation team that is free to act independently from the main organization. In the initial phase of incubating ideas, the innovation team should adopt a "fail fast" approach, conducting a series of controlled experiments that aim to achieve rapid strides in value creation instead of incremental improvements. Innovation teams should include members from a wide variety of disciplines. It is essential to include product designers, data scientists, digital specialists, and user experience experts, among others, in addition to representatives from business units, R&D, and marketing.

Take a technology trek. To gain a better understanding of what Industry 4.0 can help an organization achieve, top managers should visit technology companies. The goal of these technology treks is to see firsthand how innovations can support a company's business objectives. BCG has facilitated such trips for many companies. For example, managers from a Texas-based construction company took a three-day technology trek to visit startups developing digital innovations for their industry. "It

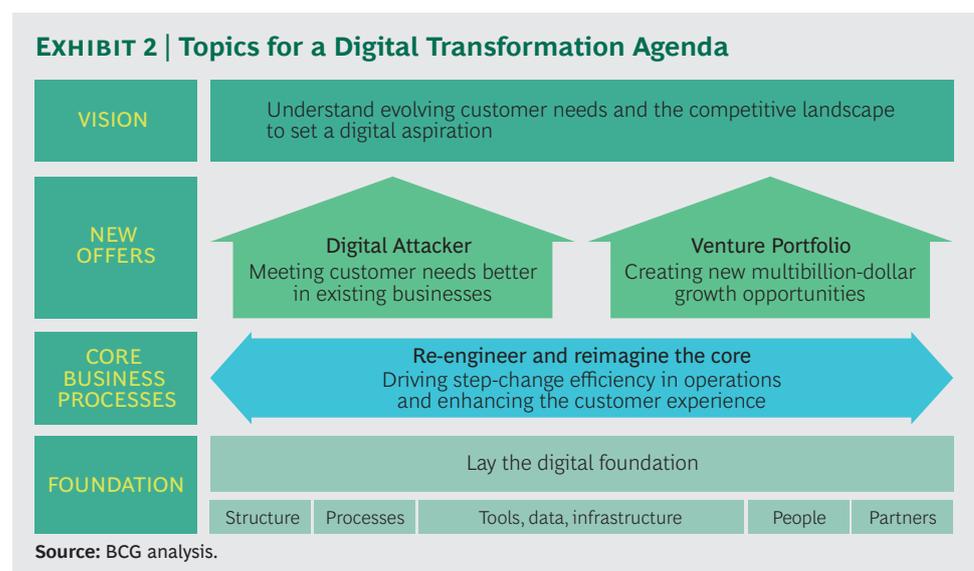
Companies should define a strategic plan to guide the effort but start small, with lighthouse initiatives.

was great to interact with some of the startups active in our industry, and we made valuable connections,” said one manager.

Gain hands-on experience in a digital factory. Managers should also gain hands-on experience in how Industry 4.0 technologies can be deployed. To give managers an opportunity to work with and test new technologies, BCG has created model digital factories within its Innovation Centers for Operations. During a customized visit to a model factory, managers participate in capability-building sessions, discussions with Industry 4.0 experts, and hands-on testing of technologies to see the related benefits. BCG has set up the centers at several locations in Europe and North America.¹

Define a plan for digital transformation. Adopting Industry 4.0 is just one part of a broader digital change effort. To launch the transformation, a company must define a vision, understand its readiness and capabilities, explore the opportunities to start new ventures, and reengineer its operations. (See Exhibit 2.) The company will also need to address strategic questions relating to each of the following issues:

- **Defining the Vision.** Is digital a threat or an opportunity? How is the market evolving, and what are our competitors doing? Should we create new businesses or improve our current cost position?
- **Launching New Offers.** How do we define a portfolio of new digital business opportunities? How do we create a business case for investing in digital growth?
- **Strengthening Core Business Processes.** How can we use digital to get better yield from our organization? How can we optimize our operations using Industry 4.0?
- **Building a Strong Foundation.** How does the current organization compare with the vision for its future? How do we acquire and nurture the capabilities required to close the gap?



Develop and execute lighthouse projects. Companies should use lighthouse projects to demonstrate the value of digital technology and motivate the organization to pursue an Industry 4.0 transformation. An industrial goods company, for instance, wanted to apply Industry 4.0 in its effort to reshore its manufacturing facilities to the US from countries with low-cost labor. The company used the digital transformation of a specific plant as a lighthouse project. The integrated approach combined the use of cobots, advanced analytics, and automation. The project has provided a call to action for a digital transformation across the organization, and the company is assessing the broader deployment of these improvement initiatives.

Use battle-tested techniques to manage the transformation. While lighthouse projects are critical to getting started, extracting maximum value from Industry 4.0 requires a large-scale effort. Over the course of a multiyear endeavor, the company needs a well-orchestrated program to manage the iterative process of identifying and launching new initiatives. Battle-tested techniques for managing a large-scale program include creating a combination of processes and technologies, known as a control tower, to monitor progress and providing significant training to help the organization “think digitally.” The company will also need a recruiting strategy that enables it to hire new employees with the relevant digital skills.

The Imperatives for Success

Industry 4.0 could truly transform the way companies operate and enable them to tap into new sources of value. To achieve this transformation, companies must follow a set of imperatives:

- Gain an in-depth understanding of how Industry 4.0 can create value in the specific context of your operations. Identify ways to reach the next frontier of value creation instead of pursuing incremental improvements.
- Articulate a bold vision for how you will apply digital technologies, and establish ambitious, step-change objectives across the organization. Independent initiatives scattered throughout the company, without clear vision and coordination from the top, will not produce significant, long-lasting benefits.
- Immediately start retraining the workforce and hiring new workers to fill talent gaps. Companies that have yet to focus on capability building will need to play catch-up to remain competitive.
- Capture value through rapid sprints, but manage the effort holistically with a long-term perspective.

By addressing these imperatives through a well-designed and rigorous transformation program, companies can achieve rapid improvements that create value and motivate the entire organization to realize the vision of Industry 4.0.

NOTE

1. For more information about Innovation Centers for Operations, please visit www.bcg.com/expertise/capabilities/operations/innovation-center-operations.aspx.

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About BCG's Innovation Centers for Operations

BCG's Innovation Centers for Operations (ICO) form a network of Industry 4.0 model factories in France, Germany, and the US. The model factories, offered by BCG in collaboration with best-in-class partners, allow clients to experiment and assess Industry 4.0 solutions—such as collaborative robots, 3D printing, augmented reality, and big data—with real assembly and production lines, as well as visionary technology demonstrators. Our objective is to improve companies' competitive advantage by realizing benefits in productivity, quality, flexibility, and speed. The centers reinforce our commitment to innovation, Industry 4.0, and the use of advanced technologies in operations.

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