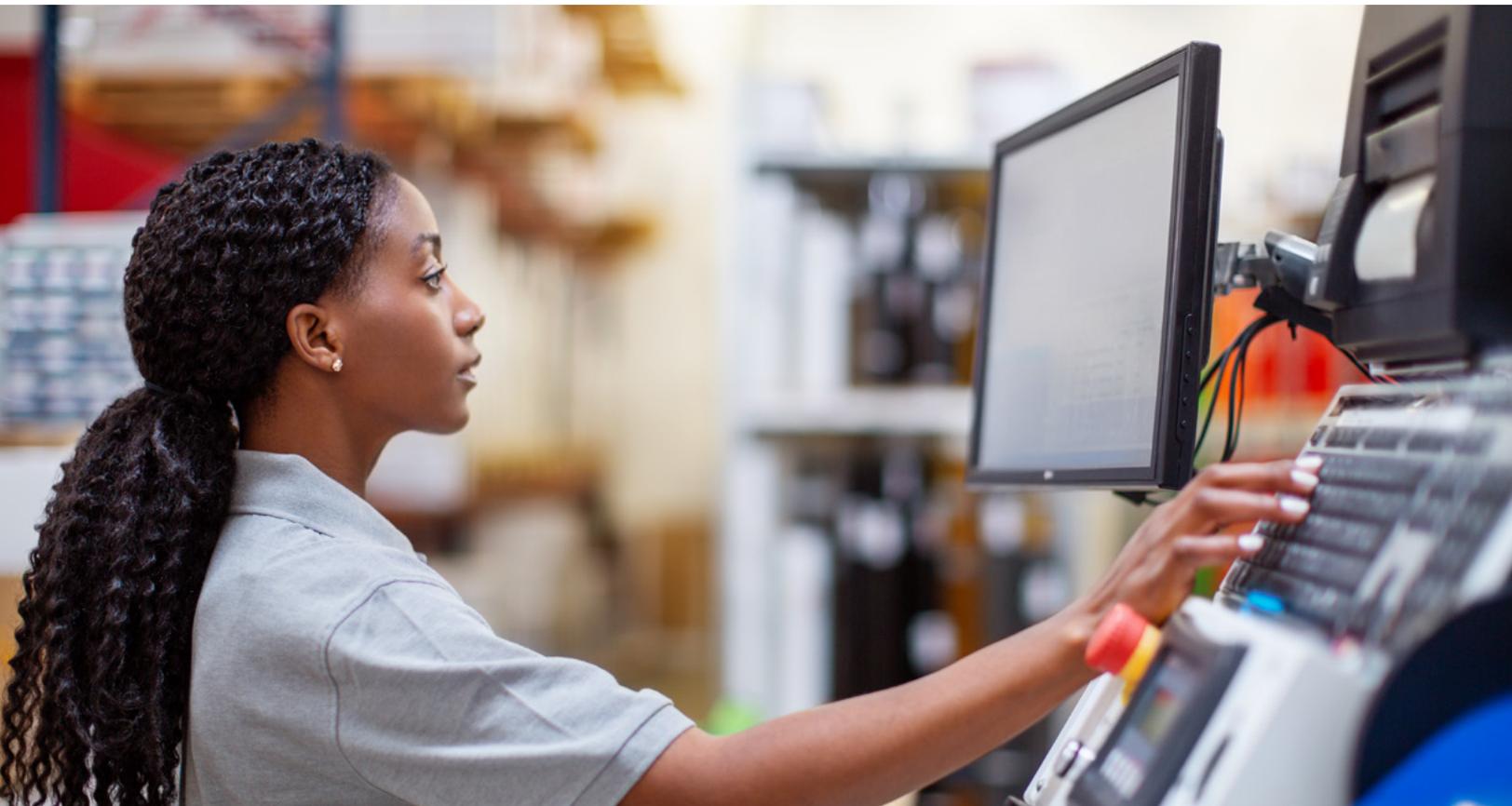


Operations Practice

Preparing for the next normal via digital manufacturing's scaling potential

Achieving digital at scale can give European manufacturing the resilience and flexibility it will need to speed its recovery after the coronavirus crisis—and beyond.

by Enno de Boer, Søren Fritzen, Rehana Khanam, and Frédéric Lefort



The coronavirus pandemic is changing manufacturing operations to a degree never before seen. As organizations and leaders seek to ensure the health and safety of their people, they are also reacting to supply-chain shifts that are impacting sourcing and distribution logistics. Supplier resilience is being brought into sharp focus, and labor shortages are bringing many production lines to a halt.

However, the crisis will eventually resolve, at which point production facilities will need to move quickly to respond to new sources of supply and shifting customer demands. It is these types of pressures that make digital capabilities so critical, providing flexibility and resilience manufacturers need to mobilize and operate in unfamiliar territory.

Yet most companies that have attempted enterprise-wide “digital transformation” have failed to capture the full business opportunities available from new technologies. What lessons can manufacturers learn from the few organizations that have succeeded in moving from successful small pilot projects to scaling digital innovations across their production networks?

Our latest research and experience have allowed us to uncover new insights into the challenges and success factors in implementing digital manufacturing at scale. Moreover, our work has also found that European manufacturing is lagging behind the rest of the world. Only 17 of the 44 members of the Global Lighthouse Network¹ (manufacturers that have been recognized as leading the way in their adoption of digital technologies) are in Europe, and only three of these are using fourth industrial revolution (4IR) tools across their end-to-end value chains.

Some of this seeming hesitation may be because many European manufacturers operate on brownfield sites. The task of enhancing legacy processes, systems, and machinery with 4IR tools can seem more daunting than building a digital production facility from the ground up. However, there is a risk that much of European

manufacturing may fall so far behind that they will prove unable to recover the ground lost to more technologically-advanced manufacturers elsewhere.

The time for organizations to act and to implement digital is now. Our research has revealed five fundamental principles that translate into tangible actions for scaling and sustaining digital technologies, regardless of a manufacturer’s starting point.

Industry 4.0 can unlock significant value

A select group of industry-leading manufacturers are using digital transformation to develop new or enhanced ways of operating their businesses, using a variety of Industry 4.0 capabilities:

- Data, computational power, and connectivity, such as sensors, the Internet of Things, cloud technology, and blockchain
- Analytics and intelligence, ranging from big data and advanced analytics to artificial intelligence and knowledge-work automation
- Human-machine interaction, including virtual and augmented reality, robotics and automation, robotic process automation (RPA), and chatbots
- Advanced production methods such as additive manufacturing and use of renewable energy

The benefits these companies have recorded include 30 to 50 percent reductions of machine downtime, 15 to 30 percent improvements in labor productivity, 10 to 30 percent increases in throughput, and 10 to 20 percent decreases in the cost of quality. These breakthroughs create impact across the value chain that may be even more important, if harder to measure: increased flexibility to meet customer demand, faster

¹ The Global Lighthouse Network is an ongoing research project of the World Economic Forum, in collaboration with McKinsey.

speed to market, and better integration within the supply chain.

Although all of the manufacturers we assessed are transitioning to digital manufacturing, they are not deploying these technologies at the same rate. In fact, most organizations find themselves stuck in “pilot purgatory,” with no clear approach for quickly scaling up innovations across the manufacturing network. Our latest research confirms that at least 70% of manufacturers are languishing in pilot purgatory, according to the findings from the Global Lighthouse Network.

Culture is generally considered to be among the most significant challenges to scaling. Additionally, companies’ path to success at scale is often hindered by the absence of several fundamentals, including:

- **Strategic direction** regarding where and how digital manufacturing will bring real business value, as well as the incentives for people to make it happen
- The **required capabilities**—technical, managerial, and transformational—to truly understand and execute the changes
- **Robust data and IT infrastructure**, which instead are often patchy and become a bottleneck for scaling successful pilots

A scaling approach based on five principles

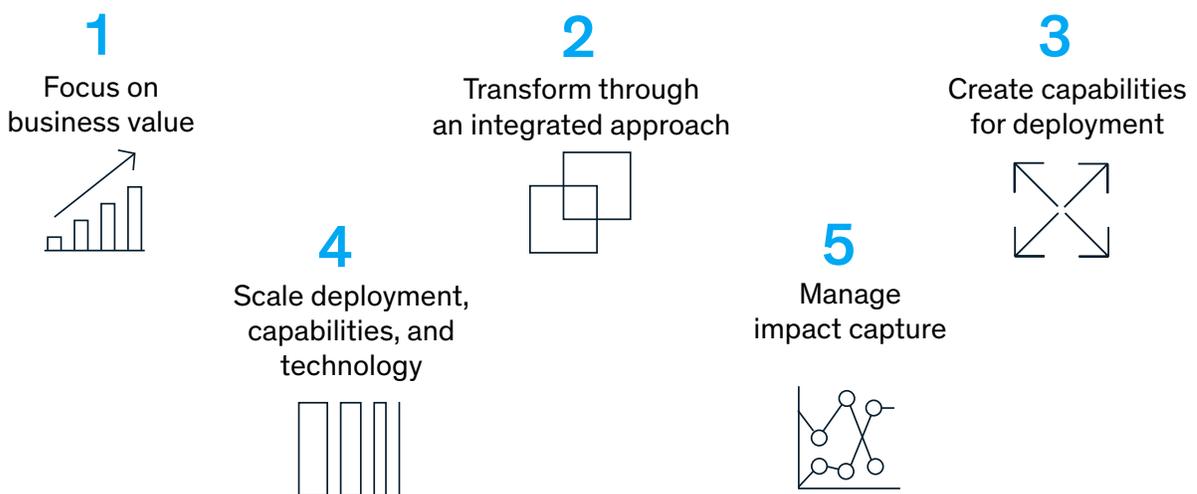
How can a manufacturer successfully scale digital manufacturing across a global network and capture its full potential? Our latest research and experience show that a transformational approach should be based on five fundamental principles (Exhibit 1).

Focus on business value

To succeed, the scaling of digital manufacturing must originate from the company’s digital strategy, with clear financial and operational-performance aspirations. These aspirations must in turn become formal targets linked to real business needs and cascaded throughout the organization.

Exhibit 1

For digital transformation to achieve scale and capture their full potential, organizations should follow five principles.



For example, at a global pharmaceutical company, various business units had been experimenting with digital innovations in their operations for some time—but few ideas achieved much impact beyond the individual unit. Company leaders recognized that they needed to clarify on a network-wide basis which digital solutions could contribute to the entire enterprise’s business needs and priorities—and, accordingly, where to focus the transformation efforts and how to implement at scale.

A three-month digital scan combined qualitative interviews with a quantitative assessment of prioritized sites. The effort helped the company achieve four critical objectives:

- Confirm where and how the value at stake in digital manufacturing can support real business needs
- Define a prioritized portfolio of digital solutions to scale
- Understand the level of readiness of its data and technology infrastructure across the network
- Understand the investment required in technical, managerial, and transformational capabilities

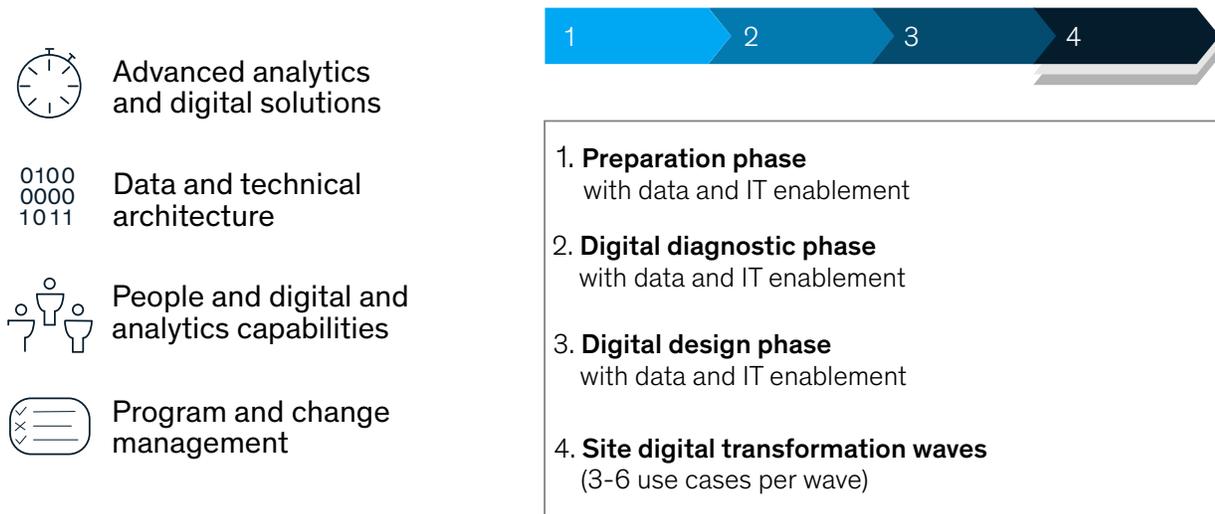
The company applied the insights from the scan to create an aligned, and value-oriented road map for rolling out the digital transformation across the network. The plan integrated both digital and traditional improvements, accounted for resources and technology requirements, and reflected a clear strategy for building capabilities at scale.

Transform through an integrated approach

To drive transformational change, a company must follow an integrated approach at each of its sites. The approach should address a comprehensive set of capabilities and follow a structured process (Exhibit 2):

Exhibit 2

Digital transformation at a site should address a comprehensive set of capabilities and follow a structured process.



- Design digital solutions built upon a repository of value-driven use cases. Deploy the use cases as “integrated bundles” to maximize return on investment (ROI), and center them around user journeys to enhance sustainability.
- Establish the data and technical architecture, in close collaboration with the IT function, to ensure scalable solutions for future roll-out. For example, horizontal scalability enables integration of more use cases into the architecture, while vertical scalability facilitates connecting more data, users, and sites.
- Invest and develop new roles and capabilities, and engage the existing line organization in a thorough reskilling and upskilling program.
- Establish a cross-functional set-up and follow an agile way of working. For example, build “minimum viable products” rapidly and iteratively while keeping things simple and learning along the way to make adjustments as needed.

Create capabilities for deployment

A well-thought-through operating model provides the basis for establishing the cross-functional setups and new capabilities that ensure effective deployment. To support both leadership and the front line through implementation, the company should build communities of practitioners including digital change agents, data scientists, data engineers, and IT architects. The company also needs “translators” to facilitate interactions between technical experts and businesspeople.

To maximize value from the transformation, the company should combine new and existing capabilities (Exhibit 3). For example, a global medtech company is using the new digital capabilities to enhance its existing lean-management and operational-excellence capabilities, rather than replace them.

This combination’s power becomes clear in the application of advanced analytics to improve manufacturing-line performance. The technology

cannot deploy itself: An experienced process engineer is needed, first to install sensors and then to use them in improving the process. It’s the engineer who develops a root-cause hypothesis for subpar performance and identifies possible countermeasures, working with a data scientist who uses advanced analytics and modeling to prepare, process, analyze, and interpret the data that the sensors produce. In addition, a domain expert with prior lean-management experience must serve as a translator who facilitates the interface between the line teams and the analytics and data experts. The translator glues together the new and existing capabilities, so that the team can interpret the results and make changes on the shop floor.

Most members of the team leading the transformation should be 100 percent dedicated to the effort over a fixed time period, applying a capability-building strategy that uses on- and off-the-job training with rigorous talent development. Organizations that have already codified their best capability practices into an existing manufacturing and supply chain academy can provide training for the new roles and skillsets that culminates in accreditation.

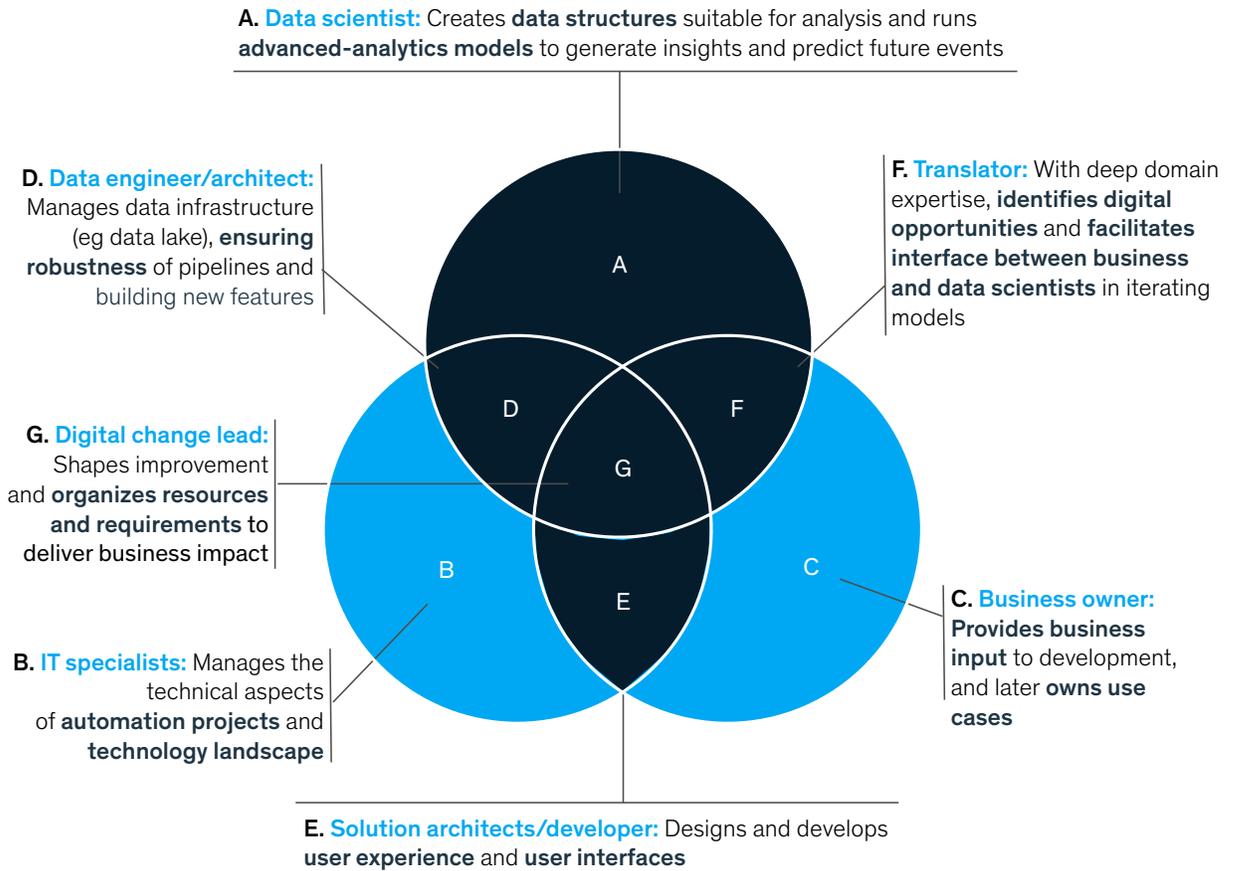
Scale deployment, capabilities, and technology

A company needs robust governance of innovation to develop value-driven use cases across its network on a continuous—preferably, industrialized—basis. The successful structures typically depend on some degree of centralization: an internal “lighthouse” site that has successfully implemented multiple 4IR technologies, for example, or an “agile studio” environment for experiencing agile working practices, or an “innovation hub” for ideation of new ideas. The insights these structures develop can then be replicated quickly across the business.

The structures also impose order, such as by categorizing use cases on the basis of maturity: in development, ready for industrialization, or scalable. It is important to have clear objectives and a set of rules on how to drive the development and scaling

To deploy the changes successfully, make structural investments into new capabilities.

■ New capabilities



In the future, these roles will represent **~1.5–2.5 %** of the operations organization, or 150–250 FTEs in 10,000-FTE operations organization

of the use cases, as well as promote positive collaboration across the network. Some sites will lead development, while others will industrialize use cases to be deployed at scale in the remaining sites.

The effort to deploy and scale the use cases should leverage the company’s shared library of approved applications and utilize formalized playbooks. For example, a global company identified priority use cases and was preparing to

roll out digital manufacturing across its network. It invested in a joint effort by practitioners at selected sites and its global center of excellence (CoE) to capture and codify a use-case repository that included detailed how-to guides and tactical training material. The contents of the repository were made available for redeployment throughout the network.

The scale-up across the network should be formalized in a roadmap with adapted deployment

models that best fit the organization's context and needs, scaling mechanisms, and a resourcing strategy. The sequence and timeline of scaling should reflect the company's priorities with regard to which use cases to implement, where to implement them, and when to initiate implementation and scale up. The prioritization should take into consideration business needs, value at stake, potential ROI, and site readiness.

An organization can combine various roll-out options and tailor them based on its situation and maturity. These options include:

- A site-by-site rollout, with a dedicated team supporting each site's transformation and capability building
- Using an "academy" to transform multiple sites in parallel through structured on-the-ground capability building, with fieldwork to accomplish concrete changes between the training sessions
- A use-case propagation approach, in which specific, well-scoped initiatives are developed and rolled out across multiple sites, potentially in an accelerated fashion as no-regrets moves
- A hybrid model in which certain use cases have an accelerated roll out, while others are deployed more gradually in the context of a comprehensive site transformation

A digital CoE provides the required backbone for the digital transformation at scale and for supporting the sites. Early on, the company should clarify the CoE's overarching role at each stage of executing the road map. For example, to define the best value proposition for its CoE, a global company specified the following roles and responsibilities:

- Developing and codifying digital solutions, as well as new ways of operating in conjunction with the sites
- Providing and building digital capabilities at the site level and developing digital communities—

for example, leveraging a "see, do, teach" approach that includes capability accreditation

- Delivering on-the-ground support and coaching for digital deployment to sites' leaders, change teams, and front lines to help them reach their targets; this includes, for example, using common playbooks to support change management, capability building, and sustainability

Finally, another major enabler of deployment at scale is ensuring the accessibility and scalability of data within a flexible technology architecture. Most companies will need to develop and transition to a future-state data and technology architecture—including data capture, extraction, consolidation, systems, tools, and site hardware. To develop this architecture, a company needs an integrated view of the potential use cases and the required data and technology. It must also take a longer-term perspective to sustain this new architecture by anticipating potential future technology development and disruptions. All of these elements should be linked to a syndicated future-state data and technology architecture design.

Establishing an architecture to meet future needs

To implement its use-case road map, a global company designed a data and technology architecture using a minimum viable architecture (MVA) approach—including the required technologies and tool stack down to site level. The architecture anticipates the critical features required to support the use-case road map, making it easily extendable over time. It also systematically standardizes practices for extracting data from legacy systems, with the potential to automate data-quality validations and highlight gaps between the actual and required data quality early on. Additionally, the architecture enables future scaling by re-using data engineering and analytics components through a repository of codes, data pipelines, and apps.

In many situations, external vendors will play a prominent role in deploying technology at scale. A company must take a thorough approach to

engaging with vendors, including during the selection, assessment, and feasibility studies, as well as the day-to-day development and collaboration phases. To maintain transparency and proper governance for important decisions and interactions, a company needs to deploy a streamlined and consolidated approach to vendor management.

Manage for impact

Starting from day one, a company must ensure that it captures the operational and financial benefits to enable a self-funding digital transformation at scale. To manage for impact, a company needs strong governance of performance and health. This includes assigning clear ownership, responsibility, and accountability within the business units and among the P&L owners—not within the CoE.

By rigorously managing the delivery of impact, a company can reach the hard-to-achieve targets. Sustaining the impact requires managing the health of the transformation with respect to the various requirements we have discussed—such as scoping, resources and capabilities, change story and communication, leadership commitment, and transitioning to the future-state data and technology architecture.

To work in an agile and iterative way, teams must adhere to strict governance. This includes starting sprints with the top deliverables identified, and having daily check-ins to align on priorities and actions for the day. At the end of a sprint, teams should review progress and address roadblocks, as well as consider how well the team collaborated and the opportunities for improvement. Strong governance also includes regular steering committee meetings to review achievements and critical risks.

Among the best practices we have observed is using a playbook to codify the approach to scaling and sustaining the transformation. The playbook could include a how-to guide structured in phases and specifying activities and deliverables, as well as use-case guides for each digital solution, detailed with all supporting elements.

Finally, as with any at-scale transformation, it is crucial to remember that change management is an integral part of the effort. Implementing technology solutions alone will not elevate performance!

Summing up: Best practices derived from our research and experience

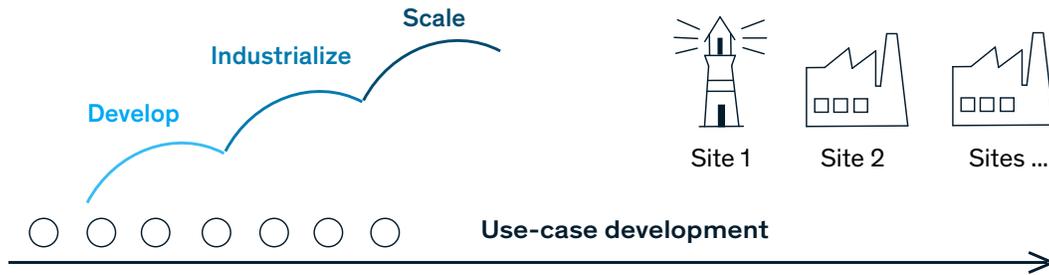
Exhibit 4 summarizes the key elements of the scaling approach and highlights best practices relating to each.

- **Development, industrialization, and rollout** usually start with a lighthouse (or set of lighthouses) to enable the development and industrialization of use cases. This also allows the organization to crack data-access challenges and begin to shape the technology architecture. The learnings are captured in a library of approved apps and playbooks that support the transformation, as well as in building the blueprint for the data and technology architecture needed in scale up.
- **Enablement and governance** are supported by a digital CoE that covers elements needed for sustainability, capability building and resourcing, and change management. The CoE is typically also a supporting mechanism for continuous codification and transfer of knowledge, data and IT-architecture requirements, use cases, and code when the transformation is eventually scaled up across a network.
- **Scale-up** is based on business needs and the value at stake, with prioritization made transparent on a well-defined roadmap. In scaling up, the company selects the most appropriate deployment models, whether site by site or use case (or a combination). It supports the efforts with playbooks and a “see, do, teach” approach to build capabilities and skills. As scale-up progresses, the learnings are continually codified back into the app library and playbooks and inform data and technology architecture needs.

The scaling approach covers rollout, governance, and value capture.

Develop, industrialize and roll-out

Use case development, industrialization and scaling



Accessibility and scalability of **data** and **flexible technology architecture**

App library and playbooks: use cases are identified, codified and made available for deployment. Components include:

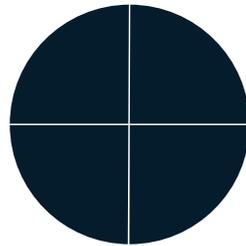
- Repository of use cases
- Use-case how-to guide
- Training materials

Data and technology architecture: transitioning to the future-state data and IT architecture

Enable and govern

Digital center of excellence (CoE): backbone for sites' deployment and transformation

Resourcing and capability-building strategy



Operating model and organization

Governance and metrics

Change management and communication

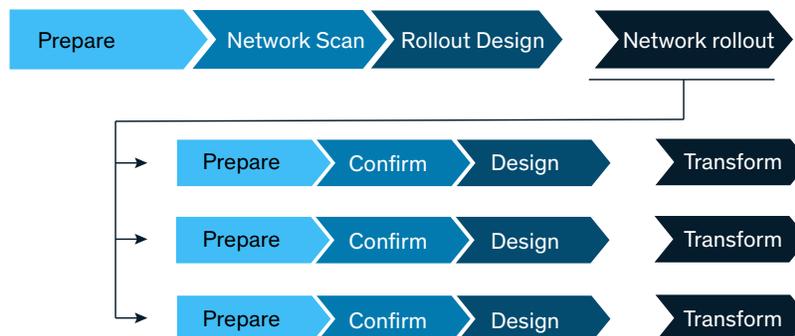


Continuous codification and transfer of knowledge, **Data/IT architecture** requirements and use cases/code

Scale up and capture value

Digital strategy based on **business needs** and **value at stake**

Sequence and timeline roadmap guiding scale-up prioritization



How should European manufacturing leaders prepare to transform at scale?

To assess a company's readiness to orchestrate a digital manufacturing transformation that integrates the five fundamental principles, leaders of manufacturing organizations should consider the following questions:

- Where would digital, robotics, and advanced analytics create the most value in your manufacturing network?
 - What is your current ambition level for a digital transformation? What impact do you aspire to in the short term and medium term, respectively?
 - How have you connected your digital strategy to your existing operations strategy?
 - How advanced is your organization in its journey from digital development and piloting to at-scale deployment?
 - Have you already established a lighthouse, agile studio, or innovation hub within your organization to support robust governance?
 - What successes have you achieved? Which factors have been critical to success?
- What main challenges are you facing? What mitigation actions are you working on?
 - How are you balancing the need for tangible change with the imperative for a quick return on investment?
 - To what extent are you combining transformations of your business, technology, and organizational capabilities?

For many manufacturers, the answers to these questions will point to the need for a thorough reconsideration of their approach to digital transformation. Those that act quickly to orchestrate and sustain a digital transformation will be better placed to respond to the long-lasting changes in the operating environment resulting from the coronavirus pandemic. Moreover, the flexibility and resilience that digital will add to operations as manufacturing ramps up again once the current crisis is over, will allow those organizations that transform successfully to gain a significant advantage over slower-moving competitors. Now is the time to get started.

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