



6 Factors for a Successful Digital Manufacturing Transformation

6 Factors for a Successful Digital Manufacturing Transformation

Karel Eloot, Senior Partner,
McKinsey & Company

The global race for innovation leadership in digital manufacturing is picking up pace: two thirds of industrial companies worldwide say that digitizing the production value chain is one of their highest priorities. To achieve this goal, successful companies are trying to ride the tail winds of three major trends that are reshaping the global manufacturing landscape:

Imagining the industry of tomorrow when introducing new tools and agile ways of working. Leaders are almost three times more likely than laggards to use advanced tools such as Augmented Reality and Virtual Reality, and two times more likely to require that underlying enabling software (e.g., IoT platform software) specifically supports advanced endpoints. In addition, leaders are five times more likely to have a digital transformation group in place, embracing ‘agile’ in multidisciplinary teams as the new way of working.

Building and leveraging the power of new players, partnerships, and ecosystems. Leaders are almost three times more likely than laggards to choose technologies allowing for third party developer ecosystems and use external software and application development instead of keeping it in-house.

Creating new revenue streams through innovative value-added services and new business models. These include pay-by-usage and subscription-based models for equipment and machinery, the provisioning of technology platforms to connect data and players, as well as new business models that translate intellectual property, data, and insights into revenues and profits.

The visible successes of industry leaders have led to a renewed sense of optimism in the West after a temporary increase in skepticism toward digital manufacturing in 2016. In China and India, two markets that never saw the same dip in confidence as in the West, the early evidence of the power of digital manufacturing has further fueled optimism around the potential to close the gap with the West.

After peaking in 2017, optimism toward the potential of digital manufacturing has plateaued in China, yet it remains at a fairly high level. Enthusiasm in China has fueled significant government investments, as evidenced by the ambitious “Made in China 2025” policy. The initiative targets ten industries for substantial improvements in technological advances and global competitiveness. In industrial robots, for example, the goal is for Chinese companies to make up half the domestic market by 2020 and 70% by 2025, by which time local robotics firms should be able to compete with global players.

Encouraged by the early successes of industry leaders and the policies of some governments, manufacturers around the world are investing. Successful companies leverage a broad range of digital manufacturing use cases across three areas to capture bottom line impact:

Connectivity. Enabling the flow of relevant information to the right decision makers in real time. Examples include digital performance management and the use of augmented reality to communicate interactive work instructions and SOPs.

Intelligence. Applying advanced analytics and artificial intelligence to an array of data to generate new insights and enable better decision making. Examples include predictive maintenance, digital quality management, and AI-driven demand forecasting.

Flexible automation. Leveraging new robotic technologies to improve the productivity, quality, and safety of operational processes. Examples include autonomous guided vehicles and using cobots for assembly processes.

Despite this focus and enthusiasm, McKinsey's collaboration with the World Economic Forum on the "future of production" has shown that many companies are experiencing "pilot purgatory" in which they have significant activity underway, but are not yet seeing meaningful bottom-line benefits from this. They are struggling to scale up from a portfolio of pilots and proofs of concept to a comprehensive digital manufacturing transformation that fundamentally changes the course of the business and organization.

McKinsey's 2018 survey of global manufacturing companies reveals an interesting mix of organizational commitment and clear progress on one hand and stagnation in digital manufacturing on the other hand. Two key findings characterize the industry's development over the past 12 months.

Although a clear majority of manufacturing companies have already successfully piloted digital solutions...

A multitude of use cases have been successfully applied across discrete and continuous manufacturing industries to increase revenues, reduce cost, and build new business models. In car manufacturing for example, several disruptive digital solutions such as digital twins, predictive maintenance models, and digital quality systems have been able to unlock the value of safety, quality, and productivity in stamping, body and paint shops, and in final assembly.

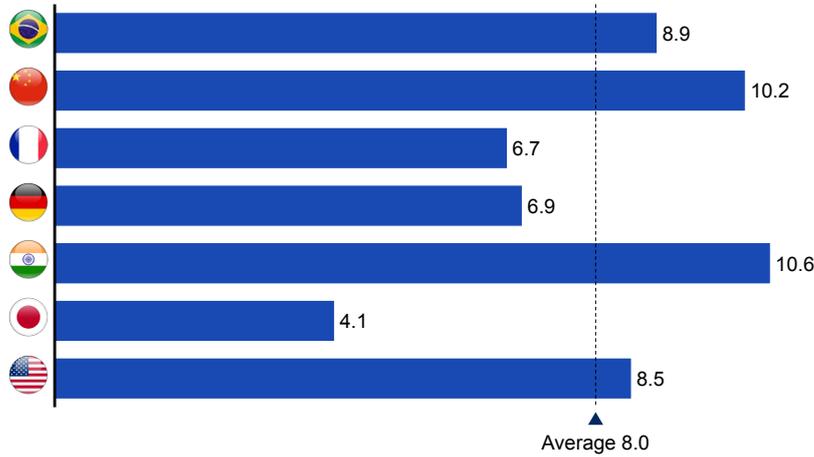
Substantial value can also be captured in process industries. In a lime kiln, for example, a combination of better sensing, data aggregation, and analysis, combined with advanced decision making and actuation, resulted in 6% fuel cost savings and a 16% increase in lime throughput.

In many cases, companies are piloting multiple digital solutions simultaneously. The global average is eight solutions, but the number varies widely by country. While Indian manufacturers report, on average, piloting more than ten digital manufacturing technologies at any given time, companies in Japan are, on average, piloting only about four.

Exhibit 1 Although companies are actively piloting several Industrial IoT solutions...

How many different IIoT solutions are you already piloting in your organization?

Number of different solutions



- Number of solutions piloted varies across countries, with **China and India clearly above average**
- Organizations in **Western Europe seem to be more conservative**
- **Japan appears to be lagging behind**

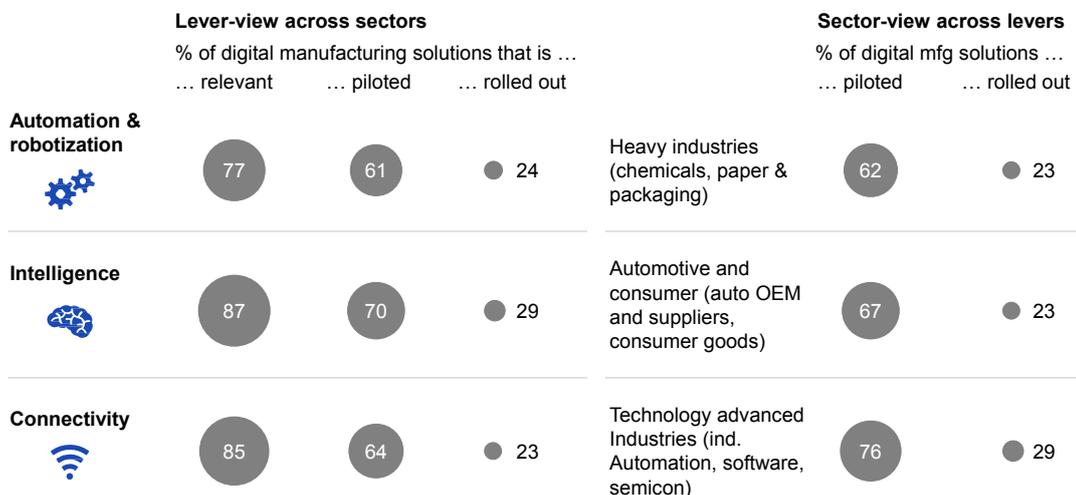
SOURCE: McKinsey Industry 4.0 Global Expert Survey 2018

What's more, an analysis of implementation success over time reveals that significantly more companies are reporting successful piloting. Yet while success rates in implementing digital manufacturing solutions increased rather strongly in China, the USA, and even Japan, piloting success among German companies has stagnated.

... most manufacturing companies are stuck in "pilot purgatory" and find advancing beyond the pilot phase a big challenge

Even when companies report significant numbers of pilots, most cite significantly less progress in terms of broader rollout. In fact, the gap between piloting and rollout is significantly larger than the gap between perceived relevance and piloting, suggesting that scaling is a bigger hurdle than getting the ball rolling.

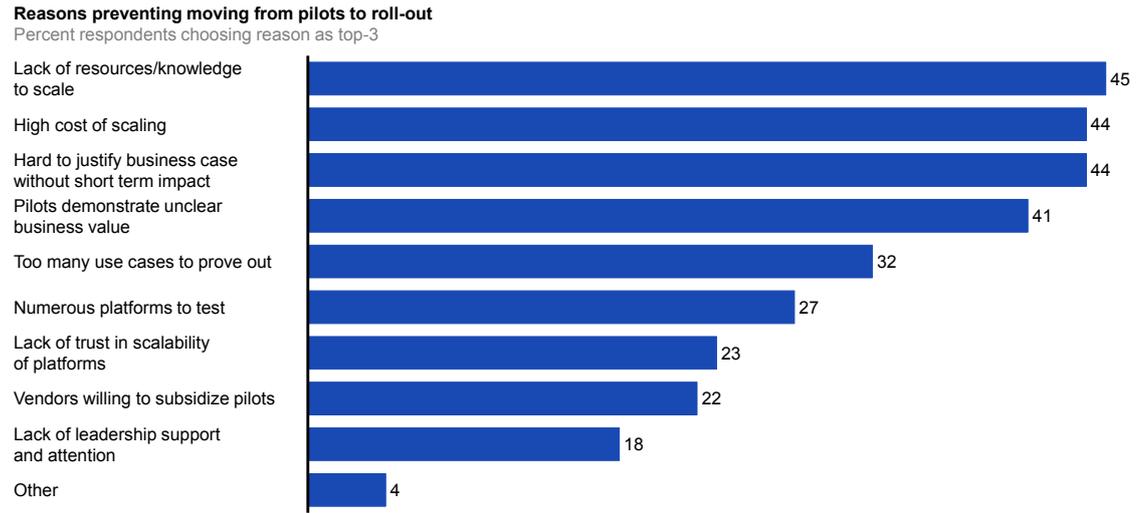
Exhibit 2 ... going from pilot to a company-wide rollout is another issue ...



SOURCE: McKinsey Industry 4.0 Global Expert Survey 2018

An analysis by sector shows that the newer, more technologically advanced areas of the manufacturing sector (for example, industrial automation) are further ahead in the implementation of digital manufacturing than older, more established areas such as paper and packaging.

Exhibit 3 ... due to difficulties in value alignment, cost of resources and efforts needed

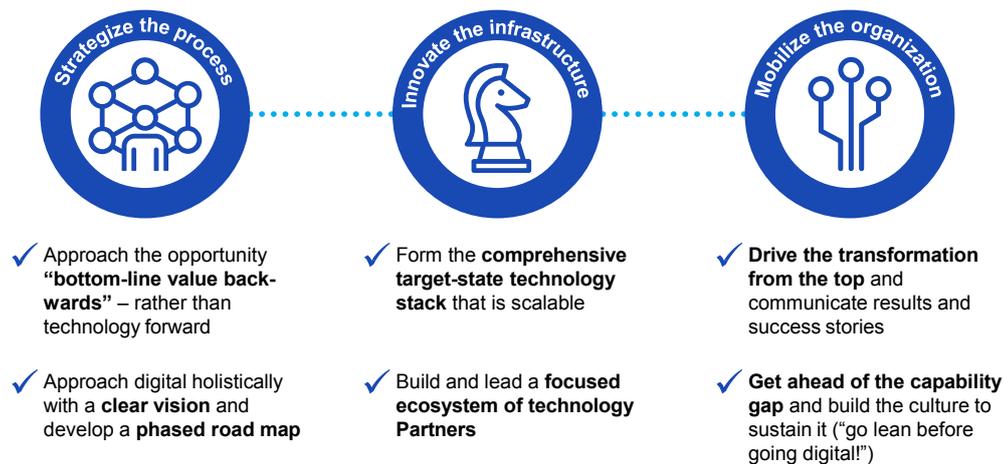


SOURCE: McKinsey and Company in collaboration with the World Economic Forum

How companies can escape “pilot purgatory” and successfully digitize their manufacturing operations

What we have learned from our research – which is also supported by our client experiences and industry observations – is that companies often make the same missteps when it comes to digital manufacturing strategy and implementation. In order to escape pilot purgatory and to capture and sustain the value from digital technologies, we recommend that organizations focus on six success factors across three categories.

Exhibit 4 To escape this pilot purgatory, there are six key success factors



SOURCE: McKinsey Industry 4.0 Global Expert Survey 2018

Strategize the process

Without a focus on solutions that have a high impact on the bottom line, organizations end up pursuing a digital manufacturing journey that is financially not feasible. The following success factors are directly tied to the ability of manufacturers to establish a solid business case for the implementation of their digital manufacturing solutions.

Success factor #1: “Approach the opportunity “bottom-line value backwards””

With the plethora of digital manufacturing solutions on the market, it is easy for companies to be led by what is exciting. Beginning with a clear view on how digital manufacturing solutions can address operational pain points, creating competitive advantage and driving bottom line impact is key to ensuring tangible returns:

Determine the value-creation potential. Implementation costs are only justifiable if the payoff is significant. 61% of respondents see lack of ROI as a major obstacle when implementing digital manufacturing solutions at scale. Understanding the company-specific situation will be key in determining the potential value at stake of an digital manufacturing transformation.

Success factor #2: “Establish a clear vision for digital manufacturing and a phased road map to get there”

The concern that a lack of vision is a significant obstacle to digital transformation has grown over the last year. In 2017, only 15% of survey respondents saw a lack of vision as a significant obstacle. Today, that share has climbed to 59%. Three principles can help manufacturing companies create a real vision for digital manufacturing:

Think holistically. Look down the road – i.e., past an immediate fix – and beyond your company – i.e., into the context of the entire ecosystem – and make technology decisions based on what will build a long-term competitive advantage.

Showcase the benefit. No matter how comprehensive or holistic, a vision without organizational buy-in will likely fail. Making the benefit of a particular technology clear to all is critical, yet only 25% of respondents have set up digital manufacturing integrated pilots as showcases to train and inspire the organization. By creating one or more “lighthouse” facilities that showcase the integrated picture of how individual use cases combine to create truly transformative outcomes can help companies build a clear and unified vision for digital manufacturing. Selecting subsequent use cases that generate the desired value can solidify a company’s buy-in around the aspirational vision for digital manufacturing.

Create an ROI road map. To achieve the highest ROIs that come from scaling, the complexities of the technology and use cases, the level of process and cultural change needed, and the sizable investment required must be carefully managed. To this end, transformation requires a road map. The road map should be based on both a clear definition of the size and nature of the business opportunity and a precise understanding of the IT and operational technology (OT) architecture and resourcing requirements. The good news is that today, more than 58% of respondents report that they have a robust road map for implementation – compared to only 33% in 2017.

Innovate the infrastructure

With the strategy and business factors sufficiently addressed, companies can focus on both the critical influences of the technology stack and the importance of an effective technology ecosystem.

Success factor #3: “Form the comprehensive target-state technology stack”

Digital manufacturing is, by definition, “technology driven,” but more than 44% of respondents point to IT deficiencies as a main challenge in successfully implementing those initiatives. In defining the optimal technology stack, manufacturing companies should keep five principles in mind:

Comprehensive. Definition should include a look at all five layers: collection, connectivity, data, analytics, and applications. It should also be specific to your operational model.

Scalable. A critical element for scalability is the data ingestion pipeline complemented by analytic capabilities.

Analytics enabled. Systems (software and infrastructure) provide the material, but analytics provides the insights that, ultimately, generate the value. Only 20% of organizations have set up a data lake across their network in more than 50% of their plants, and only 25% use an advanced analytics platform at scale.

Integrated. Digital manufacturing implementation requires that the relevant information from operational technology (OT) and information technology (IT) be integrated. Successful IT/OT convergence creates the delivery engine that will develop use cases that meet a manufacturer’s business needs.

Secure. Cybersecurity must be actively addressed by, for example, analyzing the connections and adaptability between legacy and future systems.

Success factor #4: “Build and lead a focused ecosystem of technology partners”

The entire technology stack process – from development to rollout – must be tightly managed to ensure cohesion and seamlessness. Manufacturing companies should keep sight of three aspects of the process as they move forward:

Architecture complexity. Manufacturers face challenges navigating the complex landscape of solution providers. When building in the necessary components to the technology stack, machinery players will want to leverage industry standards as much as possible to ensure cross-organization interoperability.

Partnerships. Select a few partners that go deep in both functional and integrative expertise; co-developing when possible. More than 40% of respondents prefer to build their IT/OT systems in-house or tailor them based on external sources. This contributes to the need to bridge a wide range of systems that includes ones developed in-house, purchased from vendors, or co-developed.

Agile execution. Manufacturing companies should drive execution of their digital manufacturing initiatives with an agile mindset across software and analytics. Beyond building the right external partnerships, they need to build the capability for internal collaboration across functions and break down organizational silos.

Among the IT deficiencies, only 20% of manufacturers have built network-wide data lakes in more than half of their plants.

Mobilize the organization

Digitizing the production system represents tremendous change. While technology is the obvious tool of a digital transformation, two success factors speak directly to the importance of people in the success of the change initiative.

Success factor #5: “Drive the transformation from the top”

Capturing the full value creation potential from digital manufacturing requires a consistent approach. Two principles help ensure this outcome:

Executive-level leadership and P&L commitment. Top teams should appoint a clear, executive-level transformation leader and consider taking the whole top team to digital immersion sessions and “go-and-see visits” in order to acquire the necessary capabilities and adopt new ways of working. In this regard, manufacturing companies have a way to go, given that only about one third of respondents report that their organizations have appointed a C-level individual responsible for driving their digital manufacturing efforts. Ensuring a sufficient pace and widespread adoption of digital manufacturing also requires the commitment of P&L owners.

Integrated decision making. A fragmented or disjointed application of digital technologies will undermine the ultimate success of digital manufacturing. Coordination across all plants, geographic locations, and functions along the value chain is essential. At this point, only one third of respondents report having a coordinated digital manufacturing effort globally.

Success factor #6: “Get ahead of the capability gap”

Successful companies recognize the importance of new skill sets in their approach to digital transformation as well as the importance of an organizational culture that facilitates development:

Encourage innovation. A digital transformation has the best chance of succeeding in an environment that encourages creativity and supports innovation. To this end, companies can, for example, leverage the innovation challenge concept to foster and accelerate the creation of new ideas. Comprising the four modules of “pitch night,” “innovation challenge,” “partner challenge,” and “academy challenge,” this concept relies not only on leveraging a company’s external ecosystem to generate ideas or on tapping into the ideas of its employees but also on ideation and co-creation with suppliers and external experts as well as on promoting innovation by organizing a challenge with academic partners.

Focus on talent. Building among staff the capabilities to address the challenges of digital manufacturing is linked to both individual digital manufacturing use cases as well as to the overall transformation. Ensuring the necessary skills and capabilities can come through a combination of internal training, the acquisition of new talent, and collaborations with tech-solutions providers and research and academic institutions. More than two thirds of respondents see attraction, management, and the retention of top talent as the main challenge about digital manufacturing implementation.



Karel Eloot is a Senior Partner at McKinsey & Company, based in Shanghai. He leads McKinsey’s Operations Practice in Asia, and co-founded McKinsey’s Digital Capability Center in Beijing.

This article is based on a new report published by McKinsey’s Digital Manufacturing Practice. For a PDF of the full report, please visit <https://www.mckinsey.com/business-functions/operations/our-insights/how-digital-manufacturing-can-escape-pilot-purgatory> ■

