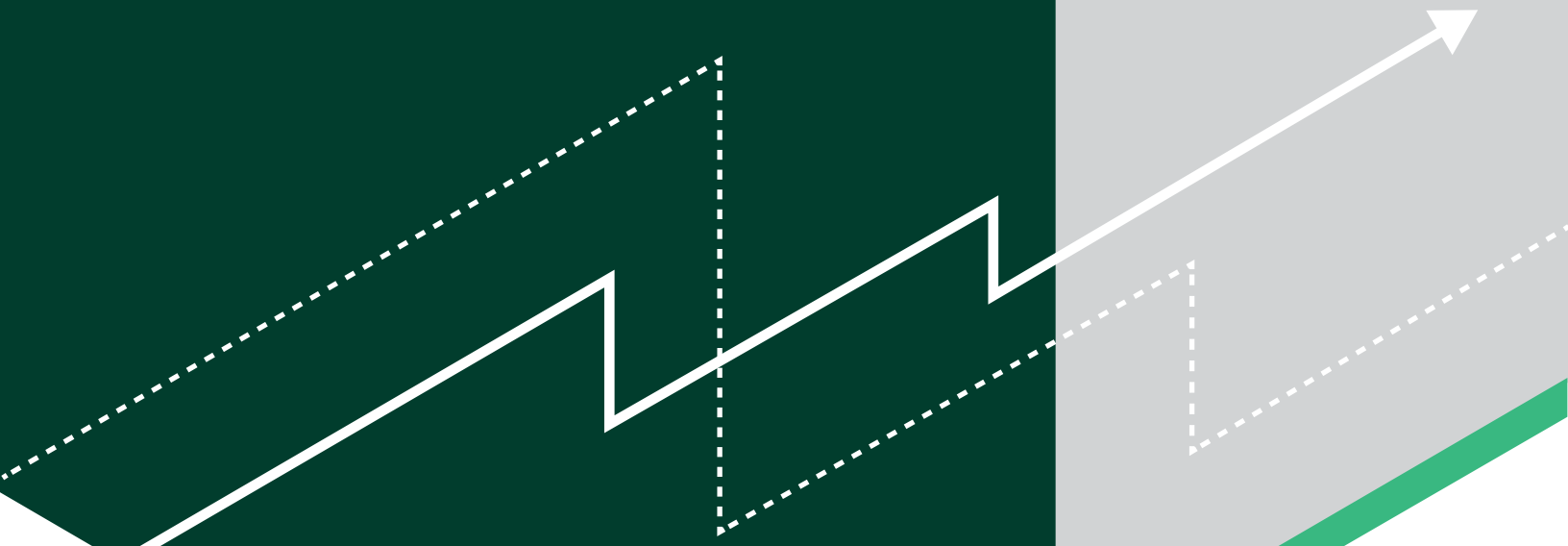
A Forrester Consulting
Thought Leadership Paper
Commissioned By PTC, Rockwell
Automation, And Microsoft

December 2020

Drive Transformational Outcomes At Scale

Break Through Pilot Purgatory And Capitalize On Impact With Speed And At Enterprise Scale



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More than 90% of manufacturing decision-makers believe that digital transformation is important for their organizations' success.

Executive Summary

As the digital transformation imperative gained momentum in the manufacturing industry over the past few years, enterprises of all shapes and sizes forged ahead, hoping to keep up with the expectations of their rapidly digitizing customers. For many, this meant a laser-focus on customer-facing processes, leaving investment in less visible internal processes to wither.

Manufacturers, which for so long had thrived by creating high-quality physical goods, have been able to hold the line until now, focusing on increased efficiencies to drive competitive differentiation. But as market conditions become increasingly volatile due to global competition, trade wars, and, more recently, the COVID-19 pandemic, and as customers continue to grow more demanding, manufacturers can no longer afford to stand ashore, dipping a timid toe into the waters of digital transformation. Yesterday's industrial giants must rethink the role of digital for their manufacturing operations if they want to survive.

PTC, Rockwell Automation, and Microsoft commissioned Forrester Consulting to evaluate the state of digital transformation in factories today. Forrester conducted an online survey with decision-makers in the US, Europe, and Japan to explore this topic.

KEY FINDINGS

- **Though critical, digital transformation programs struggle to gain traction in manufacturing.** Today, only 12% of manufacturing leaders say they have delivered digital transformation programs across their businesses. The rest are at some stage of planning, piloting, or limited rollout. The relative immaturity in this industry is not from a lack of desire: More than 90% believe that digital transformation is important for their success. This high level of interest is likely due to the enormous benefits these initiatives can unlock. Digital transformation programs deliver lasting quality, performance, and labor productivity improvements, as well as data, financial, and operational benefits.
- **Hindered by a technology hodgepodge, programs struggle to achieve scale.** Though some organizations struggle to move past the pilot stage, for most firms, the biggest barrier to digital transformation success is enterprisewide scalability. Because firms have mostly cobbled together a patchwork of solutions to solve one-off problems rather than address enterprisewide needs, most programs stall out, lose executive support, and fail to deliver repeatable and predictable transformational outcomes.
- **With the right digital transformation strategy, manufacturing can drive huge gains.** Despite slow progress, manufacturers are seeing benefits — such as improved manufacturing speed, agility, and innovative capacity — from their early efforts. And while ROI has been modest to date, nearly three-quarters of respondents expect significant returns within two years. But all of these expected returns are predicated on firms working through their scalability and tool problems. To succeed, manufacturers must focus on high-impact use cases and harness internet of things (IoT), analytics, and other technologies, both at the edge and in the cloud.

Slowly But Surely, Manufacturing Is Digitally Transforming

Manufacturing is at a crossroads. While traditional industrial firms may have originally found success by creating high-quality, low-cost objects efficiently via standardization, shifting customer expectations, increased competition, and a rapidly changing technological landscape require a drastic shift for continued success. Manufacturers must turn to digital to survive.

Fortunately, many manufacturers seem to understand this: 91% of respondents say digital transformation is important for manufacturing. But the CIO-led digital transformation of traditional manufacturing firms can't simply be about making existing industrial processes more efficient.[1] An increasingly complex multistakeholder ecosystem and volatile market conditions mean that manufacturers must move beyond the status-quo processes of yesterday and recognize the value of digital to drive a new expectation for value capture now and into the future.

What exactly is the state of manufacturing digital transformation today? We found:

- **Digital transformation truly is "transformational."** It's not difficult to see why the digital transformation decision-makers in our study see the value of these initiatives. When successful, digital transformation programs can touch every part of the organization. Manufacturing leaders in our study are aiming to improve quality, throughput, efficiency, workforce productivity, and security with their digital transformation initiatives (see Figure 1).

Although initial progress has been slow, confidence and progress in digital transformation is accelerating.

Figure 1

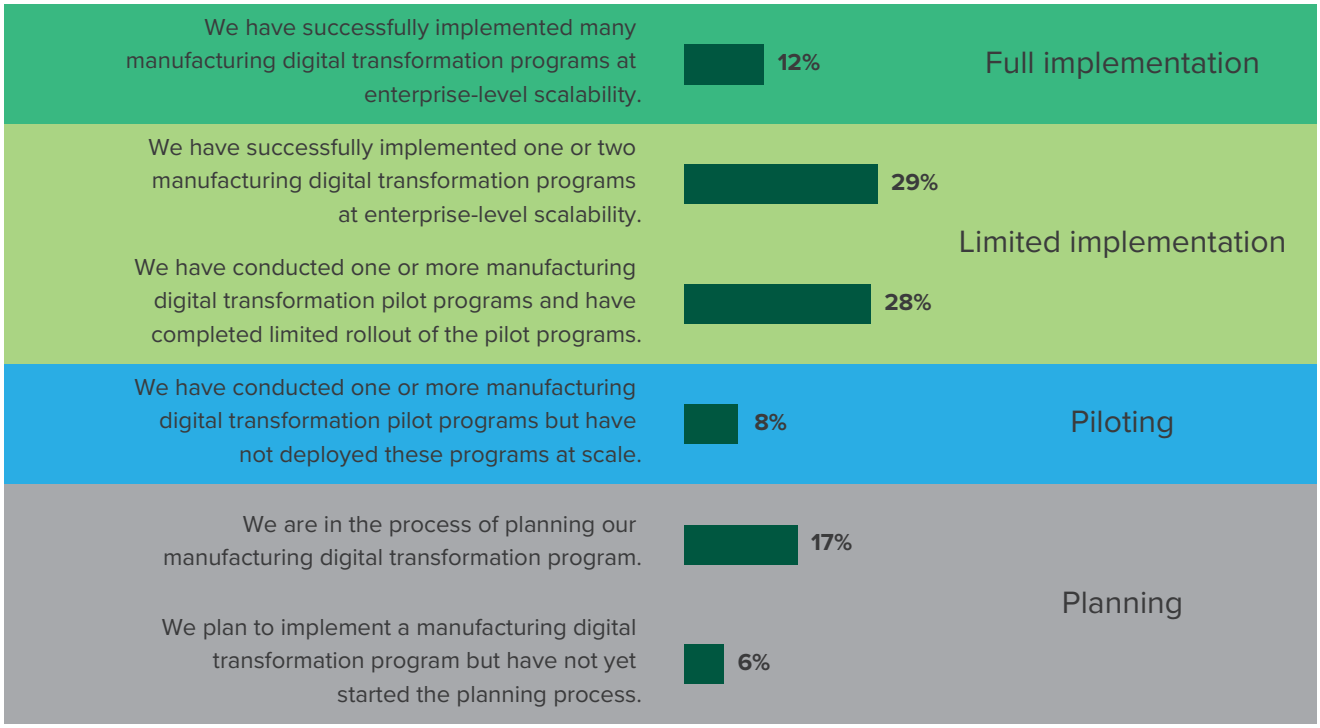
"What are the key goals your organization hopes to achieve through its manufacturing digital transformation initiatives?"

Base: 300 manufacturing digital transformation decision-makers
Source: A commissioned study conducted by Forrester Consulting on behalf of PTC, Microsoft and Rockwell, September 2020

› **Successful implementations are on the rise, but many are stuck in proof-of-concept (PoC) and scale purgatory.** Although organizations have lofty ambitions for their digital transformations, only 12% of manufacturing decision-makers say they have achieved enterprisewide scale with more than a couple of projects. The majority (57%) are in a limited implementation phase while the rest are in a piloting or planning stage (see Figure 2). Even those whose firms have managed to deploy a few programs enterprisewide remain stuck in the pilot phase with their other initiatives: Nearly half of decision-makers say their organizations have run 10 or more PoCs in the past two years, with an average of 18 PoCs run in that time period. However, on average, only 41% of PoCs have gone into some form of production. Firms will need to clear these piloting and scaling hurdles to deliver transformational impact.

Figure 2

"Which of the following best describes the status of your organization's manufacturing digital transformation program?"



Base: 300 manufacturing digital transformation decision-makers
Source: A commissioned study conducted by Forrester Consulting on behalf of PTC, Microsoft and Rockwell, September 2020

OPTIMIZATION SHAPES MOST CURRENT MANUFACTURING DIGITAL TRANSFORMATION EFFORTS

Digital transformation in manufacturing does not always resemble digital transformation in other industries. Manufacturing faces particular challenges that decision-makers are attempting to address with digital initiatives. Our study found:

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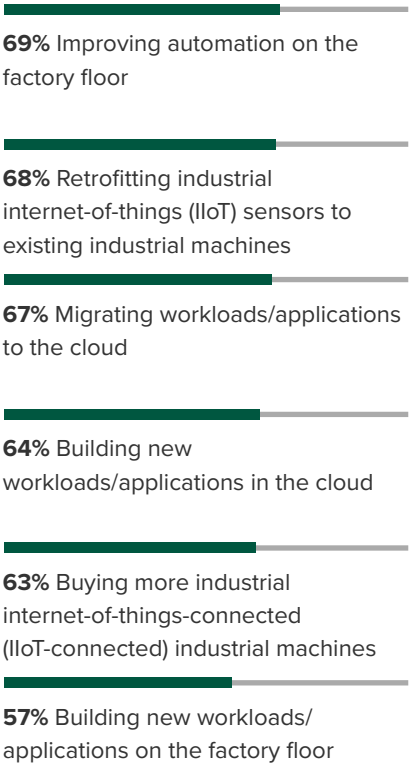
- **Current efforts focus on upgrading existing machinery and orchestrating existing manufacturing IT systems.** With massive investments in hardware and software already in place, manufacturing decision-makers are prioritizing upgrading the infrastructure they currently have rather than buying new. Over two-thirds of decision-makers report undertaking initiatives to retrofit industrial internet-of-things (IIoT) sensors to existing industrial machines or migrate existing applications to the cloud (see Figure 3). Digital transformation in factories often starts with leveraging IIoT capabilities to wrap and extend the business systems (IT) and operational systems (OT) that you already have in place, but also 1) modernizing, connecting, and leveraging the many sources of IT and OT data that exist; 2) normalizing that data for standard, real-time consumption across the enterprise; and then 3) applying the power of today's disruptive digital technologies (such as analytics) to unlock real-time and forward-looking insights to empower the entire production workforce.
- **A hybrid environment is key.** As one of the most transformational business-shaping forces in recent memory, cloud computing plays a crucial role in digital transformation efforts in all industries. Manufacturing is no exception: 71% of decision-makers report that their organizations are already undertaking cloud initiatives either by migrating workloads or building net-new. Decision-makers estimate that two years ago, 28% of manufacturing workloads were in the cloud. Today, that number has grown to nearly 40%, and business leaders estimate growth to 48% within two years (see Figure 4). However, this move to cloud does not indicate an abandonment of other deployment options as data centers and the factory floor will continue to play a key role going forward. Eighty-four percent of decision-makers say their organizations are already undertaking an initiative at the edge or in the data center. For most manufacturers, the factory floor must continue to play a role in their ideal scenarios.

What is the reason for this hybrid preference? Pragmatism. Simply put, not all deployment models are well-suited to all workloads. Looking to make the best use of specific location benefits, manufacturers are running workloads in the locations that make the most sense for their application and business requirements.

Figure 3

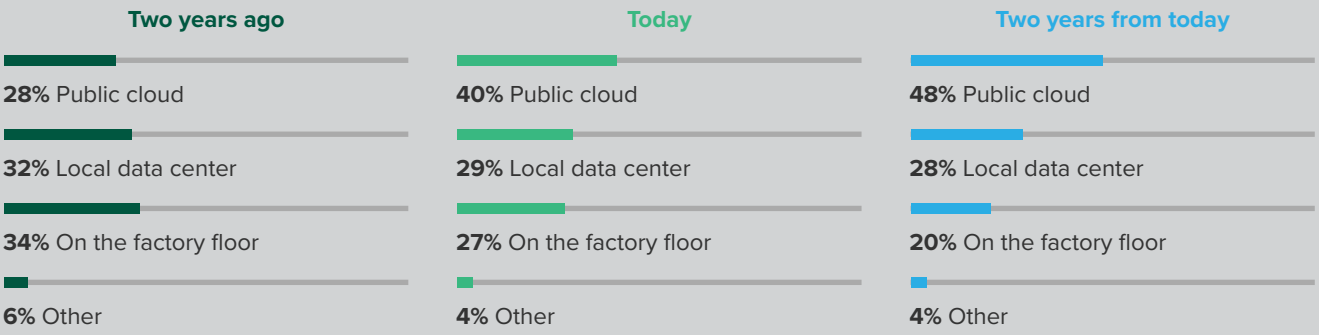
"Which of the following initiatives is your organization undertaking as part of your manufacturing digital transformation program?"



Base: 232 manufacturing digital transformation decision-makers at organizations that have at least rolled out DT pilot programs
Source: A commissioned study conducted by Forrester Consulting on behalf of PTC, Microsoft and Rockwell, September 2020

Figure 4

"Using your best estimate, what percentage of your organization's manufacturing workloads were deployed in production in the following areas two years ago?"



Base: Variable manufacturing digital transformation decision-makers at organizations that have at least rolled out DT pilot programs
Source: A commissioned study conducted by Forrester Consulting on behalf of PTC, Microsoft and Rockwell, September 2020

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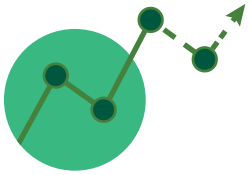
Technology Hodgepodge Threatens Scalability And Holds Firms Back

The inability to quickly scale new applications and improved workflows across the enterprise is a huge challenge for firms. Tasked with working within an existing system that is a complex, cumbersome, and piecemeal technology patchwork, pilots struggle to show results at scale and ultimately stall out. Manufacturing digital transformation leaders must find a way to overcome these issues or risk failing to keep up with customer expectations and falling behind competitors. We found:

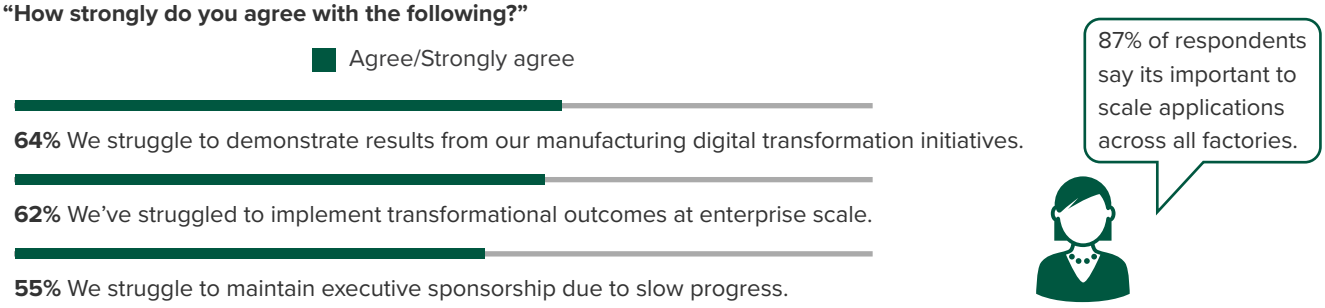
- **Organizations struggle to scale.** Even when initiatives can get past the pilot stage, enterprisewide rollout is a challenge: Though 87% of decision-makers say it's important to scale applications across all factories, 67% report struggling with scaling across the network of factories with local variations in IT and OT systems, making it the top challenge to digital transformation. Furthermore, only 16% of all PoCs have been rolled out enterprisewide over the past two years. This is a major issue as the only way to produce transformational value for the business is to scale across the enterprise. Successful single-site implementations may produce individual instances of positive outcomes, but they don't transform companies.
- **Sluggish progress and failure to demonstrate value lead to loss of support.** Decision-makers are frustrated by their inability to scale initiatives quickly: 82% say they need to move faster with their manufacturing digital transformation initiatives. When projects stall, decision-makers find it difficult to demonstrate results and, subsequently, to maintain executive support for projects (see Figure 5). In fact, 71% of those who say they struggle to demonstrate results from their digital transformation initiatives also struggle to maintain executive support, compared with just 18% of those who don't struggle to demonstrate results.
- **Failure is not an option.** All of these scalability challenges lead to a lack of compelling results; 62% of respondents report struggling to implement transformational outcomes at enterprise scale. But it's not just a failure to produce results; there are major negative business impacts at stake as well. Decision-makers report that if their organizations do not digitally transform their manufacturing processes, they risk delays in production, a lack of innovation, and an inability to keep up with customer expectations and competitors (see Figure 6).



When it comes to manufacturing digital transformation efforts, the capability to scale applications from one to 10 sites and from 20 to 2,000 users is the most challenging barrier to real transformation.

Figure 5

"How strongly do you agree with the following?"



Base: Variable manufacturing digital transformation decision-makers
Source: A commissioned study conducted by Forrester Consulting on behalf of PTC, Microsoft and Rockwell, September 2020

Figure 6

"What consequences do you believe your organization faces if it does not digitally transform its manufacturing processes?"

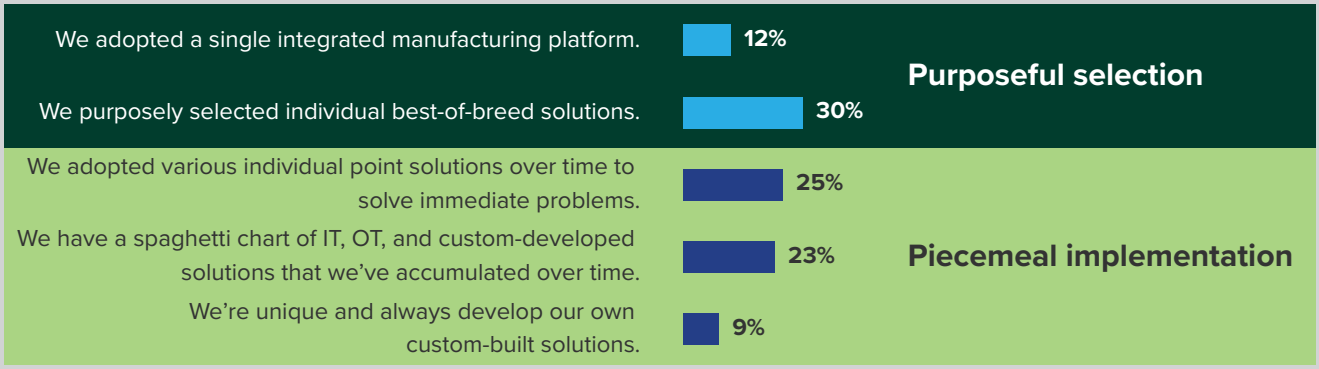
Base: 300 manufacturing digital transformation decision-makers
Source: A commissioned study conducted by Forrester Consulting on behalf of PTC, Microsoft and Rockwell, September 2020

A PROBLEMATIC TECHNOLOGY PATCHWORK MAY BE TO BLAME

Much of manufacturing organizations' inability to scale and innovate at the pace they need seems to stem from a poorly integrated, piecemeal technology ecosystem. Respondents in our study note that their biggest barriers to expanding digital transformation initiatives are limitations of their current infrastructure and an overly complex, expensive, and slowly evolving landscape of solutions. This is because most firms have accumulated a patchwork of various point solutions — both custom developed and purchased — over time rather than purposefully selecting best-of-breed solutions or opting for a single integrated platform (see Figure 7). Unsurprisingly, 69% of decision-makers say they've struggled to piece together the right elements from multiple vendors into a repeatable solution for the entire enterprise. These 69% have had substantially greater challenges when it comes to speed and scale (see Figure 8). While it's easy to secure the budget, mandate, and business case for a point solution, real transformational value comes when systems and processes escape the constraints of a single internal silo.[2]

Figure 7

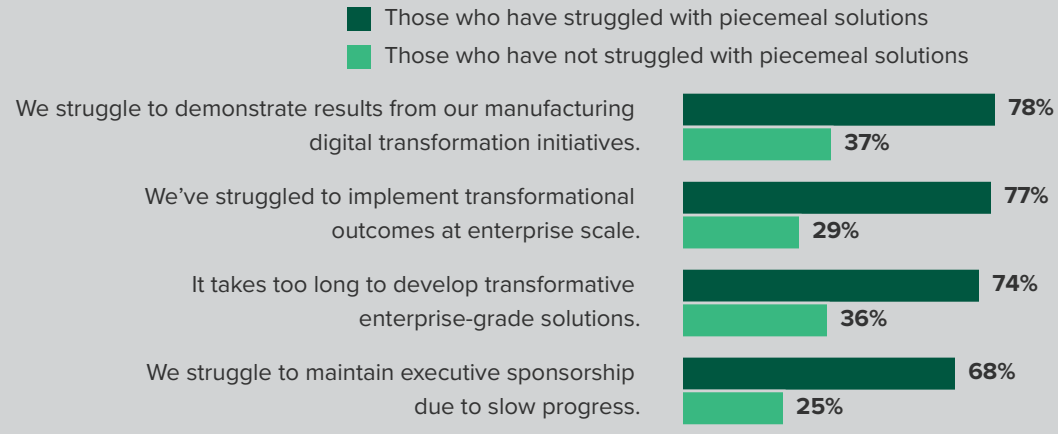
"Which of the following best describes how your manufacturing technology suite came together?"



Base: 300 manufacturing digital transformation decision-makers
Source: A commissioned study conducted by Forrester Consulting on behalf of PTC, Microsoft and Rockwell, September 2020

Figure 8

"How strongly do you agree with the following?" (Agree/Strongly agree shown)



Base: Variable manufacturing digital transformation decision-makers
Source: A commissioned study conducted by Forrester Consulting on behalf of PTC, Microsoft and Rockwell, September 2020

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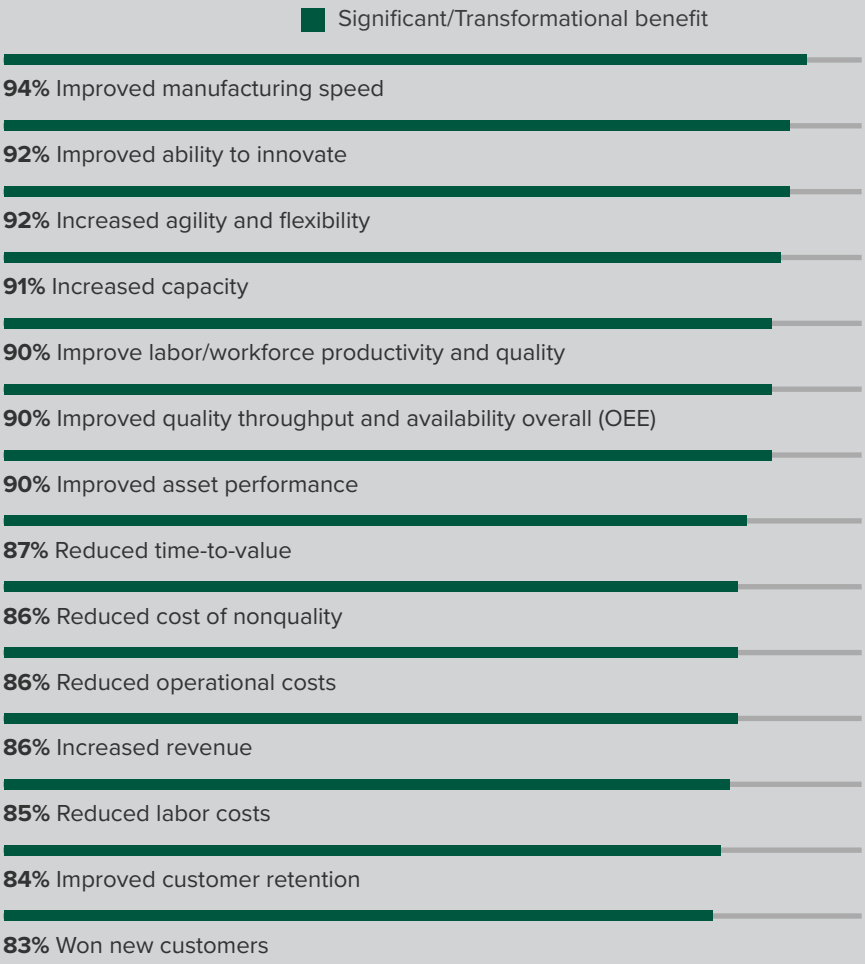
Embrace Unified Platform Technology And A Hybrid Architecture to Digitally Transform

Given the potentially dire consequences of failure, manufacturers must find a way to overcome their scalability and technology issues to drive successful digital transformation. By adopting connected devices, hybrid use of cloud and edge, and technology that helps with — rather than exacerbates — current struggles, manufacturers will see their digital transformation initiatives excel, preparing them for success today and into the future. Our study shows:

› **Digital transformation allows manufacturers to be faster, more agile, and more innovative.** Although progress can be frustratingly slow for many manufacturers, the digital transformation initiatives that organizations have managed to roll out have already produced substantial business benefits. More than 80% of business leaders report improved speed, innovation, agility, capacity, and workforce productivity — among a multitude of other benefits — from these early initiatives (see Figure 9).

Figure 9

"To what extent has your organization realized benefits in each of the following areas due to your manufacturing digital transformation initiatives?"



Base: 232 manufacturing digital transformation decision-makers at organizations that have at least rolled out DT pilot programs
Source: A commissioned study conducted by Forrester Consulting on behalf of PTC, Microsoft and Rockwell, September 2020

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› **Returns have been small to date, but growth is coming.** When it comes to overall ROI, current gains are small but promising: 81% of decision-makers report positive returns, but only a quarter have seen *significant* positive returns. However, as organizations improve their technology and begin to scale initiatives, decision-makers predict this number will grow considerably. Nearly three-quarters expect significant positive returns within the next two years (see Figure 10).

TO SUCCEED, MANUFACTURERS CAN'T GO IT ALONE

To achieve these significant returns on investment in the future, organizations need help from their vendor and partner ecosystems. For success in their digital transformation efforts, manufacturers need:

› **A hybrid architecture that incorporates cloud and edge.** Cloud is clearly important to the modern manufacturer. But decision-makers shouldn't forget about the critical role that edge must play as well. A significant portion of manufacturing workloads and applications — particularly those associated with production execution — are deployed at the edge (i.e., on the factory floor) today. And firms have found success with this approach: 89% of manufacturing decision-makers whose firms have built new workloads on the factory floor have found it valuable to their initiatives.

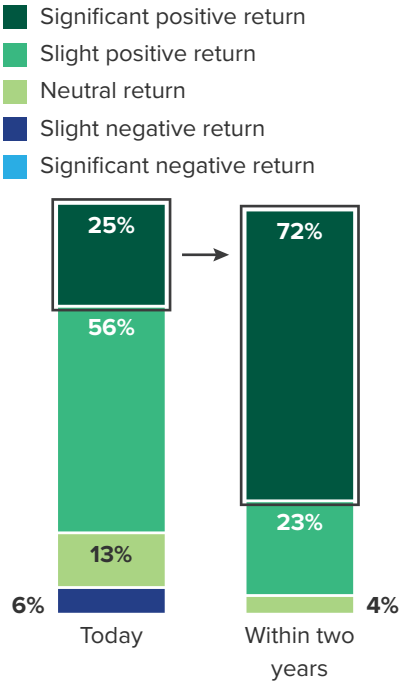
› **IIoT-connected machinery.** Retrofitting existing machines with IIoT sensors is a popular approach since it is less expensive than buying new equipment and relatively simple to implement. That's why 68% of respondents have opted for this tactic. And while it is helpful — 43% of manufacturers found this approach valuable — relying entirely on existing and aging machinery can put firms at a disadvantage. Purchasing new IIoT-connected industrial machines may require a substantial upfront investment, but it's far more valuable in the long run: 63% of the respondents whose firms purchased new machines found the initiative to be very valuable to their digital transformation programs.

› **A digital manufacturing platform.** To ease their tech issues, manufacturers are increasingly looking to cloud-based solutions. To be helpful, these tools must have strong security features and seamless integration with existing IT and OT tech stacks, allowing for faster deployment, easier scalability, and improved time-to-value. But to truly overcome their challenges and succeed in this hybrid future, manufacturers need a unified digital manufacturing platform. These platforms are capable of delivering additional benefits to integrated operations, security, and scalability (see Figure 11).

The key to achieving an integrated digital enterprise is the combination of proven high-value use cases built on a normalized data abstraction layer and deployed on a unified enterprise hybrid cloud infrastructure. This allows value to be captured at scale with speed.

Figure 10

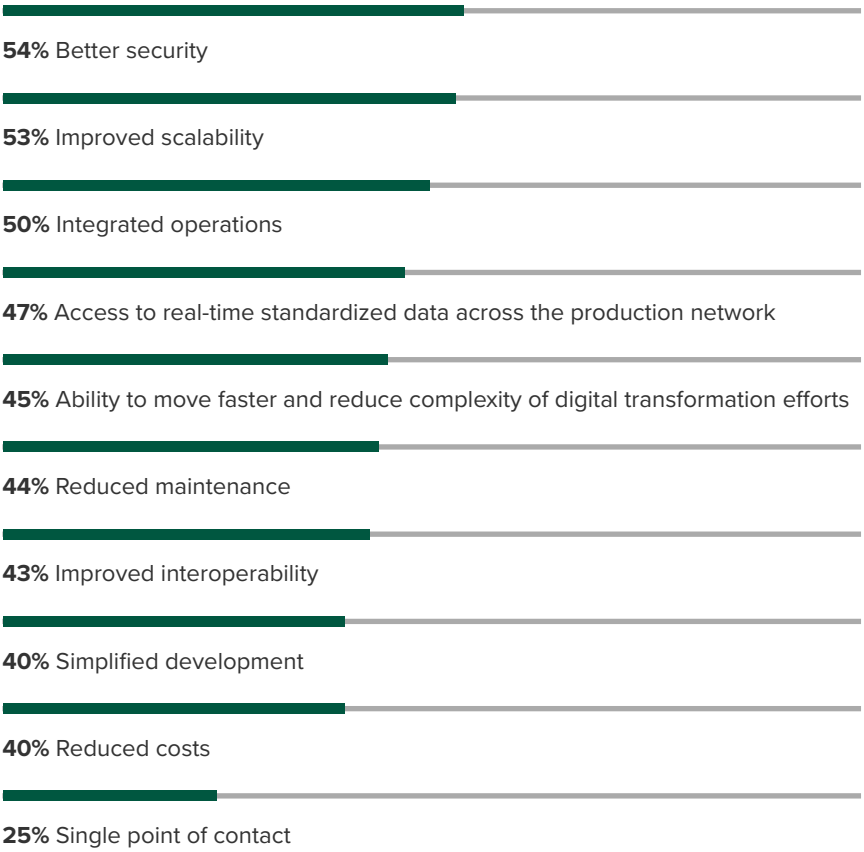
"What return on investment has your organization seen on its manufacturing digital transformation efforts thus far? What return on investment do you expect to see within the next two years?"



Base: 232 manufacturing digital transformation decision-makers at organizations that have at least rolled out DT pilot programs
Note: Percentages may not total 100 because of rounding.
Source: A commissioned study conducted by Forrester Consulting on behalf of PTC, Microsoft and Rockwell, September 2020

Figure 11

"What benefits do you see in having a unified digital manufacturing platform that runs in the cloud and on the factory floor?"



Base: 300 manufacturing digital transformation decision-makers
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Key Recommendations

Operation executives recognize the importance of balancing grease and code, embedding digital systems into their traditional manufacturing processes and assets. These changes make established processes more predictable and effective while creating opportunities to offer new digitally augmented services to partners and customers.

Secure executive sponsorship to drive wider adoption. Only 12% of respondents routinely implement digital manufacturing initiatives across plants, minimizing impact and value. Secure the support of senior champions to identify and scale line- and plant-level successes across the business.

Work with what you have. While much of the smart manufacturing hype relates to shiny, new industrial machinery laden with sensors, the reality for most manufacturers is that they must work with a mixed — and aging — fleet of assets. Retrofit sensors from original equipment manufacturers (OEMs) and suitably vetted third parties, and use machine learning to infer what's happening inside your older assets. Plan a rolling program of modernization for critical assets, but understand that there's value to gain from digitizing around the infrastructure you already have.

Avoid cloud and edge dogma, selecting the right tool for the job. Should you work in the cloud or at the edge? Yes. This is not a binary choice. The reality for most manufacturers is that neither cloud nor edge can give them everything they need on its own. Don't be distracted by endless debates about which is better, and don't be constrained by where your workloads sit today. Understand the strengths and limitations of each, and accept that the pragmatic choice will be a hybrid environment that combines both.

Combine top-down direction with bottom-up pragmatism. An enthusiastic executive sponsor will help your digital manufacturing initiatives spread from site to site. But you also need hands-on involvement down on the shop floor. Tech-heavy bright ideas from the head office rarely survive contact with the realities of the production line. Involve your first-line workers early and often, empowering them to try new ideas and giving them the executive support to drive change.

Focus on the most impactful and repeatable use cases. Manufacturers struggle to get past pilot programs because they are not sure where to start or how to capture impact at scale. This research highlights the top three key goals manufacturers hope to achieve through their manufacturing digital transformation initiaves: 1) improving quality, throughput and availability of resources (OEE); 2) improving workforce productivity and quality; and 3) increasing revenue/margin. Focus on use cases that drive transformational impacts like these across the production network, validate the impact, and leverage the C-suite to remove hurdles that prevent achieving that impact at scale.

Appendix A: Methodology

In this study, Forrester interviewed 300 manufacturing digital transformation decision-makers in the US, the UK, Germany, and Japan to evaluate the state of manufacturing digital transformation. Questions provided to the participants asked around their organizations' current states, challenges, and future plans when it comes to digitally transforming their manufacturing operations. Respondents were offered a small monetary incentive as a thank you for time spent on the survey. The study began in August 2020 and was completed in September 2020.

Appendix B: Demographics

Firmographics

Region

US **33%**

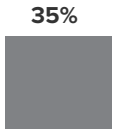
UK **17%**

Germany **25%**

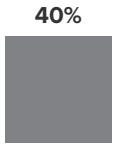
Japan **25%**

Manufacturing type

25% Hybrid manufacturing (combination of process and discrete)

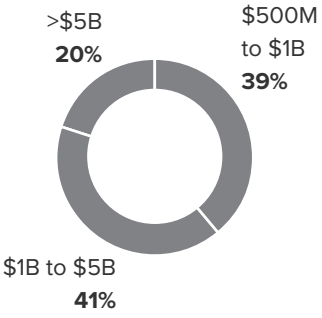


35% Process manufacturing



40% Discrete manufacturing

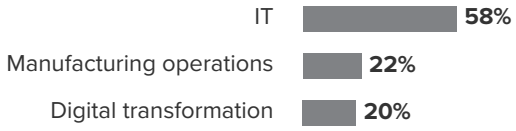
Company revenue



Base: 300 manufacturing digital transformation decision-makers
Source: A commissioned study conducted by Forrester Consulting on behalf of PTC, Microsoft and Rockwell, September 2020

Respondent Demographics

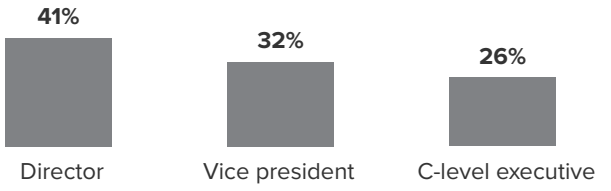
"Which of the following best describes your current position/department?"



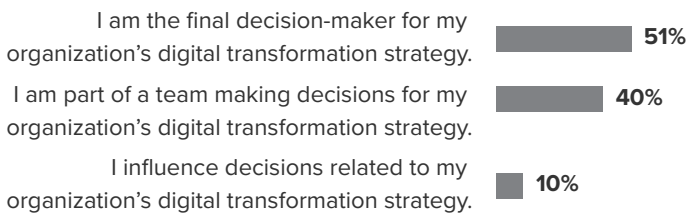
100%

Responsible for enterprisewide digital transformation initiatives

Respondent level



"What is your level of responsibility when it comes to your organization's data and analytics strategy?"



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Note: Percentages may not total 100 because of rounding.
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Appendix C: Endnotes

[1] Source: “From Grease To Code: Industrial Giants Must Bet Their Futures On Software,” Forrester Research Inc., April 24, 2019.

[2] Ibid.