

A Forrester Consulting
Thought Leadership Paper
Commissioned By Analog Devices
February 2021

Seamless Connectivity Fuels Industrial Innovation

Industrial Connectivity Leaders From Around The
Globe Share Their Perspectives

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Today's and tomorrow's manufacturing leaders are tossing aside processes designed to ossify cost control, efficiency, and predictability, and replacing them with those that emphasize flexibility, innovation, and resilience.



Executive Summary

There is a pressing and largely unmet need for reliable network connectivity in harsh, complex, and sometimes remote manufacturing environments. Network reliability is key to turning industrial data into insights that lead to smart decision-making and ultimately, to better business outcomes. For many manufacturers, operational processes have historically been designed with the assumption that staff will be on-site all the time. The disruptions of the COVID-19 pandemic, along with the evolution of advanced network connectivity and connected assets and technologies, have accelerated long overdue modernization and digitization efforts across the manufacturing industry. Today's and tomorrow's manufacturing leaders are tossing aside processes designed to ossify cost control, efficiency, and predictability, and replacing them with those that emphasize flexibility, innovation, and resilience.¹

In October 2020, Analog Devices commissioned Forrester Consulting to evaluate the state of industrial modernization, including the efforts to improve network reliability. To explore this topic, Forrester conducted an online survey with 312 senior manufacturing leaders who are responsible for defining industrial connectivity strategy at their organizations. Additionally, we performed a maturity analysis that grouped respondents together based on them having low, medium, or high levels of organizational maturity. Higher maturity firms were determined by the level of strategic importance that respondents placed on their innovation efforts, in driving the business towards becoming more agile, insights-driven, and digital first. As one might expect, high maturity firms are further along in their innovation journeys, having already invested more heavily in connectivity. This includes investing in connected assets and technologies, as well as the wired and advanced wireless networks (including 5G) to support them.

KEY FINDINGS

- › **Competitive advantage is born from the ability to reliably turn industrial data into actionable and trusted insights.** Most respondents, regardless of maturity level, realize that being a manufacturing leader requires harnessing real-time and actionable insights to both inform key business decisions and to appropriately secure data.
- › **Innovation is hindered by a lack of talent and interoperability.** Forrester research has found that a shortage of talent is often a bottleneck for manufacturing modernization.² The same holds true for our surveyed respondents. Many firms lack the in-house expertise to deploy advanced networks for their connected factories. Harnessing the insights needed to innovate is also challenging due to legacy equipment communicating in siloed, proprietary channels.
- › **The future is bright for manufacturers that concurrently evolve their security and network reliability strategies.** Industrial connectivity leaders recognize that improving network reliability is crucial to unlocking useful insights in real time and at scale. As firms invest in improving industrial connectivity, in part by deploying 5G, they recognize both the security benefits and the struggle inherent to evolving security practices accordingly. For many, this is due to a lack of internal talent and/or external partners.

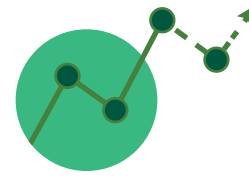
The Connected Factory Demands Technology And Network Improvements

In asset-intensive industries such as manufacturing, the industrial internet of things (IIoT) provides a connection between physical objects and digital systems elsewhere in the business. This connection delivers remote monitoring and visibility, and, when combined with technologies such as machine learning, it can unlock more advanced capabilities, such as predictive maintenance or data-driven, as-a-service business models. In surveying industrial connectivity leaders, we found that:

› **Connectivity is the foundation for the insights that drive innovation.**

When comparing the technology investments that companies are currently prioritizing (see Figure 1), with the types of technology that currently support factory environments (see Figure 2), it is apparent that a two-way relationship between connected assets will build the foundation for harnessing emerging technologies. Mature companies are farther ahead than their less mature counterparts, with 85% of high maturity firms reporting that IIoT technologies currently support much of the factory floor — compared to 66% of medium maturity firms and 17% of low maturity firms. IIoT is the top technology investment priority for low maturity firms, implying that they are on a similar but slower journey. As manufacturers seek to connect more assets, it is clear they expect to do so over a hybrid wired/wireless network. Investing in both wired (e.g., industrial ethernet) and wireless (e.g., 5G) connectivity is a critical priority for most medium and high maturity companies.

The top two technology investment priorities for high maturity industrial leaders are: 1) leveraging insights from connected assets for cloud-based analytics (77%) and 2) real-time monitoring of equipment and productivity (76%). The majority of high maturity firms also seek to invest more in augmented reality (AR) and virtual reality (VR), as well as artificial intelligence (AI) and machine learning (ML). Forrester predicts that COVID-era acceleration of key emerging technologies (like AR) will become sustained adaptive innovation in 2021 and beyond.³



Leveraging insights from connected assets for cloud-based analytics and real-time monitoring of equipment and productivity are critical investment priorities for high maturity firms.

Figure 1

“How does your company prioritize the following technology investments?” (Showing critical priority)



Base: 312 director + respondents responsible for defining industrial connectivity strategy at their organization
 Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

Figure 2

“This technology currently supports much of our factory.”

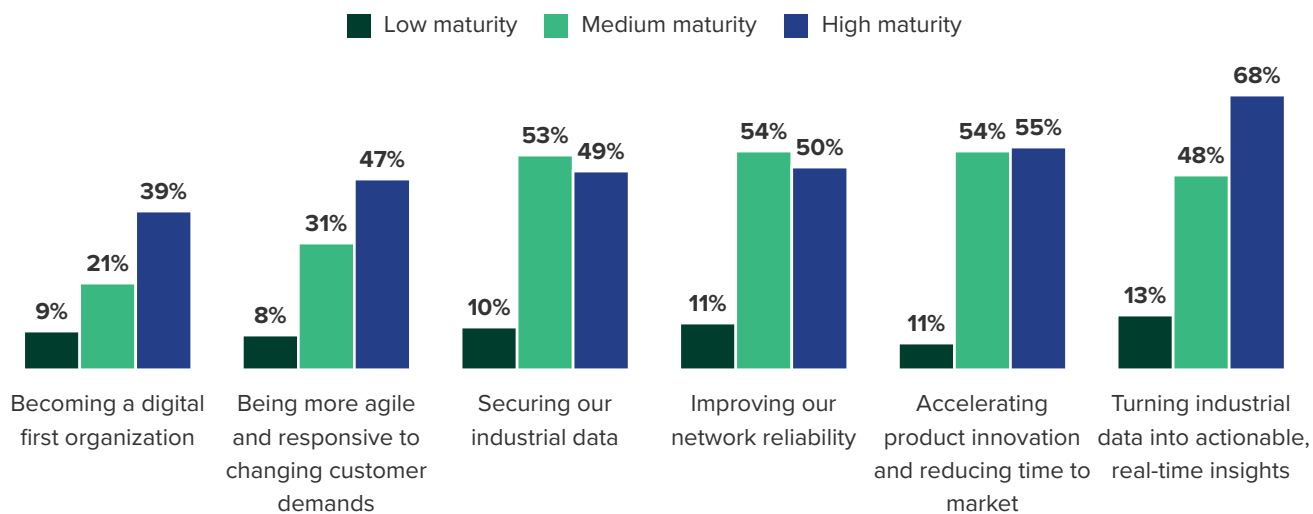


Base: 312 director + respondents responsible for defining industrial connectivity strategy at their organization
 Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

› **Becoming digital-first does not happen overnight.** Even the most mature respondents recognize that there is more work to be done. In fact, when compared to their competitors, only 39% of high maturity firms believe they do very well at being digital-first (see Figure 3). The numbers are even lower for medium and low maturity firms. Manufacturing by nature is asset-intensive, and becoming digital-first requires that physical and digital assets be connected over reliable and secure networks. This ultimately allows everyone — from the line worker, to the plant manager, to the senior executive — to access the trusted insights that will inform their critical business decisions. Sixty-eight percent of mature firms believe they do very well, when compared to their competitors, at turning industrial data into actionable real-time insights. With trusted insights at their fingertips, manufacturing leaders are better positioned to innovate faster and stay ahead of changing customer demands.

Figure 3

“In your opinion, how well does your organization do this relative to your competitors today?” (Showing “very well”)



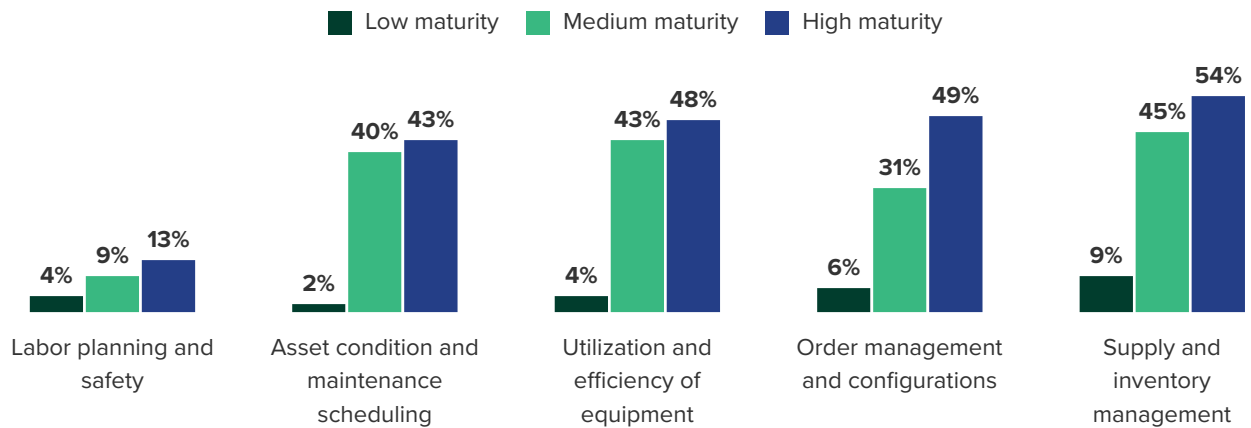
Base: 312 director + respondents responsible for defining industrial connectivity strategy at their organization
 Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

> **No use case is as complex as the human use case.** Manufacturers naturally tackle the most ubiquitous use cases first. Both high and medium maturity firms report that it is very easy to access insights to quickly make supply and inventory management decisions (see Figure 4). It is slightly more challenging for medium and high maturity firms to quickly make decisions around utilization and asset maintenance. So, what’s the trickiest use case? People. Very few manufacturing leaders — regardless of maturity — report that it is easy to make labor-planning decisions or reassign people resources with their existing systems.

As customers continue to demand more customization in the wake of the pandemic’s fundamental effects, it is more important than ever for manufacturers to not only efficiently manage their internal people resources but to also reconfigure their businesses to allow for customers’ increased flexibility and customization needs. High maturity firms are the most capable of handling small batch sizes (53%), quickly reconfiguring (45%), and customizing products (50%). They are also significantly more capable of consistently and reliably transferring data between systems. Manufacturers must have faith in the reliability of their data in order to risk taking on short-run production and more customized projects (see Figure 5).

Figure 4

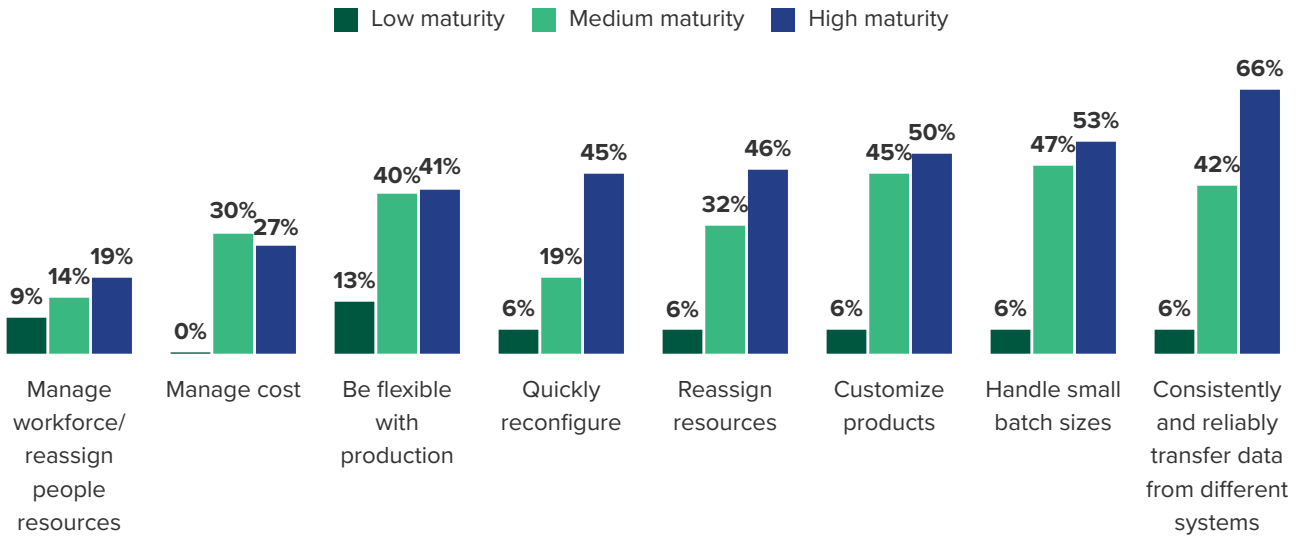
“How easy is it for you to access the insights you need to make decisions quickly in the following scenarios?”
 (Showing “very easy”)



Base: 312 director + respondents responsible for defining industrial connectivity strategy at their organization
 Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

Figure 5

“How easy is it for you to do the following with your existing systems?” (Showing “very easy”)



Base: 312 director + respondents responsible for defining industrial connectivity strategy at their organization
Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

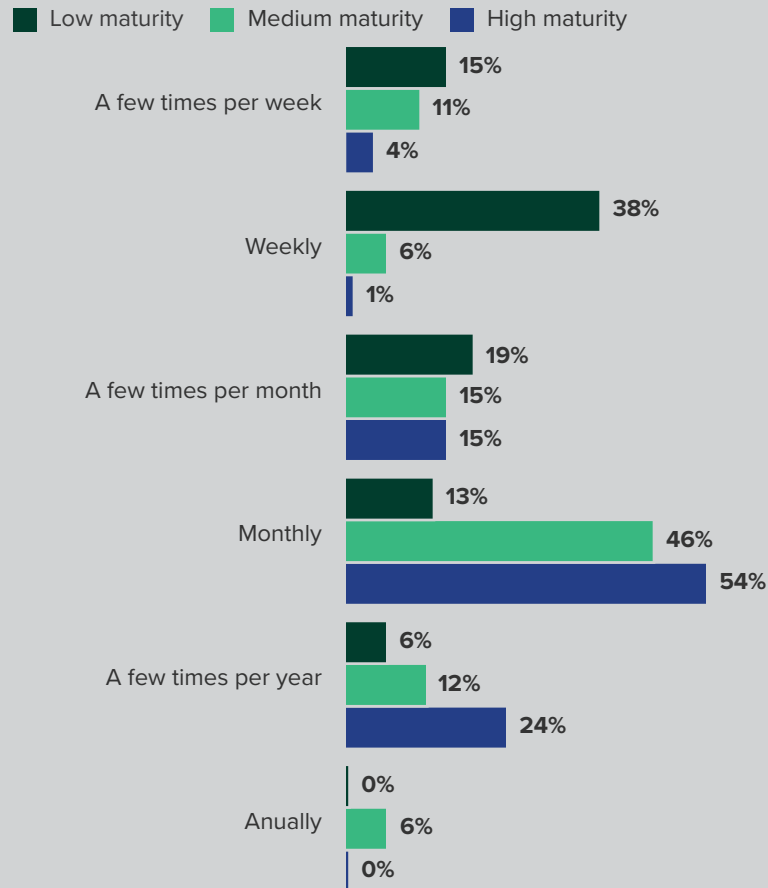
The Cost Of Poor Communication

As manufacturers report that investing in emerging technologies is a critical priority, modernizing their existing infrastructures can be a painful experience. Top pain points include:

- > **Unscheduled downtime is costly.** There is no avoiding unscheduled downtime in the complex and asset-heavy world of manufacturing. Fifty-three percent of low maturity firms experience unscheduled downtime at least once a week. Although it happens much less frequently for medium and high maturity firms, they do still experience occasional downtime as well (see Figure 6). There are many negative implications of unscheduled downtime. Low maturity firms care most about lost production, and medium and high maturity firms see a little farther down the road in the high costs of holding inventory. High maturity firms care a bit more than their less mature counterparts about the ultimate implications of downtime: decreased customer satisfaction (see Figure 7).

Figure 6

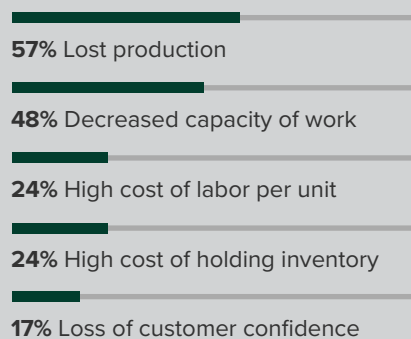
“How often do you experience unscheduled downtime of your industrial technology/equipment?”



Base: 312 director + respondents responsible for defining industrial connectivity strategy at their organization
 Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

Figure 7A

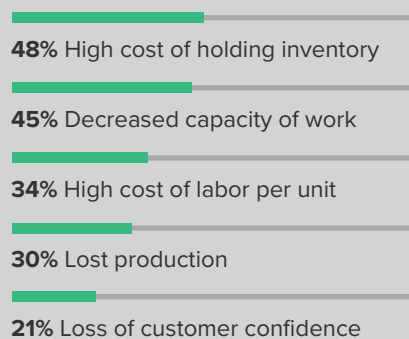
“What are the implications of unscheduled downtime to your company?” (Low maturity organizations)



Base: 47 director + respondents responsible for defining industrial connectivity strategy at their organization
 Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

Figure 7B

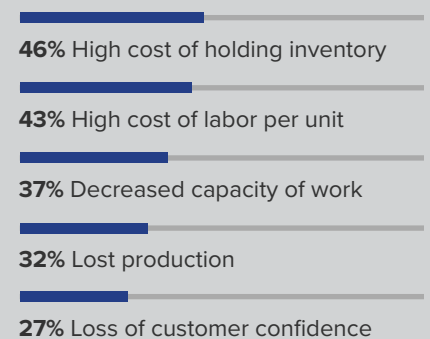
“What are the implications of unscheduled downtime to your company?” (Medium maturity organizations)



Base: 125 director + respondents responsible for defining industrial connectivity strategy at their organization
 Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

Figure 7C

“What are the implications of unscheduled downtime to your company?” (High maturity organizations)

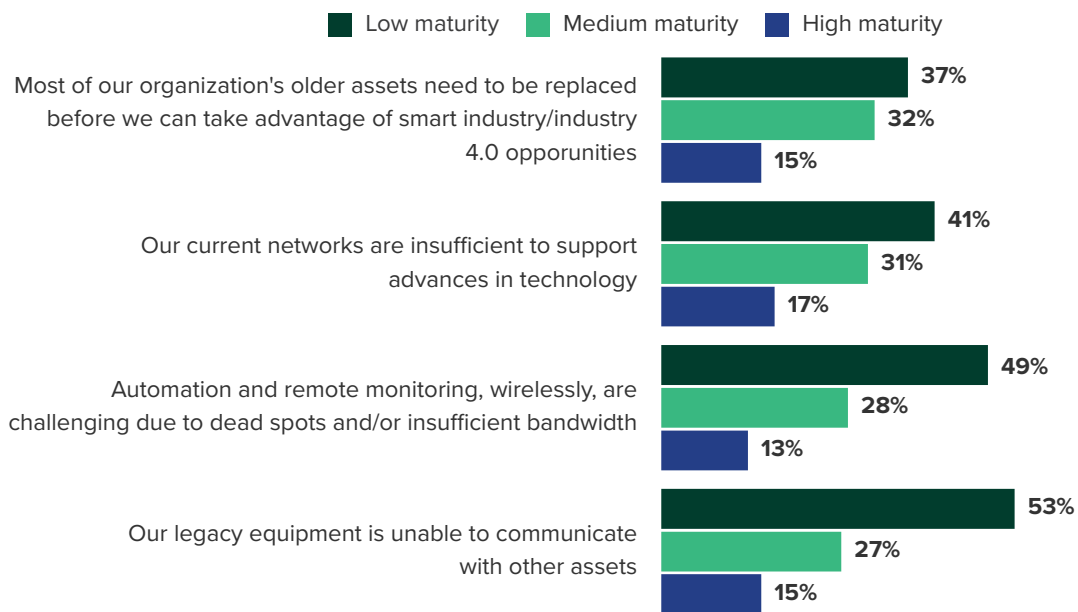


Base: 131 director + respondents responsible for defining industrial connectivity strategy at their organization
 Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

› **Legacy systems and networks fail to support a modern digital business.** Stomaching an equipment overhaul and/or upgrade is not easy, but the reality is that some older equipment is not capable of providing diagnostic data with the resolution, speed, and open standards that more modern systems expect. In fact, 53% of low maturity firms report that their legacy equipment is unable to communicate with other assets at all. As manufacturers seek to improve their automation and remote monitoring capabilities, doing so effectively is challenging due to wireless networking limitations. Forty-nine percent of low maturity firms and 28% of medium maturity firms report that wireless automation and remote monitoring is challenging due to dead spots and/or insufficient bandwidth (see Figure 8).

Figure 8

“Please rate your level of agreement with the following statements.” (Showing agree/strongly agree)



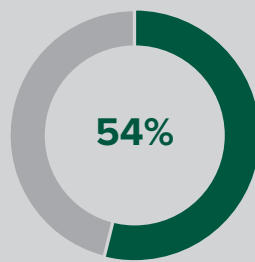
Base: 312 director + respondents responsible for defining industrial connectivity strategy at their organization
 Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

› **Lack of expertise slows network improvement efforts.** For low maturity firms, 47% believe they lack the in-house expertise to understand which connectivity technologies to invest in, and 54% say that a lack of a sophisticated cybersecurity strategy puts their businesses, customers, and employees at risk (see Figure 9). And they are not alone. While many respondents seek to improve their network reliability, in part by implementing advanced wireless networks like 5G, most lack the in-house expertise to effectively do so. The top challenge for medium and high maturity firms is their concern over security issues as they look to implement 5G. Although a 5G-connected factory ultimately provides more network visibility, equipment manufacturers for 5G have all interpreted the standards differently, causing implementation headaches for many security leaders.⁴

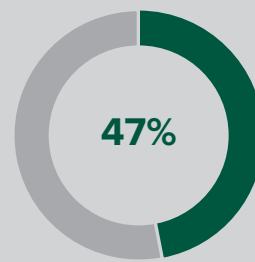
In order to accelerate their network improvement efforts, manufacturers must invest in recruiting or upskilling current connectivity and security talent, while also filling some gaps with the help of trusted external partners (see Figure 10).

Figure 9: Additional Challenges For Low Maturity Firms

“Please rate your level of agreement with the following statements.” (Showing agree/strongly agree)



“Our lack of a sophisticated cybersecurity strategy puts our business, our customers, and our employees’ safety at risk.”



“Our organization lacks the in-house expertise to understand which connectivity technologies to invest in.”

Base: 47 director+ respondents responsible for defining industrial connectivity strategy at their organization
Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

Figure 10

“What are the barriers to implementing advanced wireless networks (e.g., 5G) in your factory setting?” (Showing top 3)

	Low maturity	Medium maturity	High maturity
1	Our current equipment does not support the most recent wireless technologies (e.g., 5G).	We are concerned about security issues.	We are concerned about security issues.
2	We lack the in-house expertise.	We lack the in-house expertise.	We lack the in-house expertise.
3	It is too expensive.	We lack a trusted implementation partner.	We lack executive support.

Base: 312 director + respondents responsible for defining industrial connectivity strategy at their organization
Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

The Factory Of The Future Requires Seamless Connection



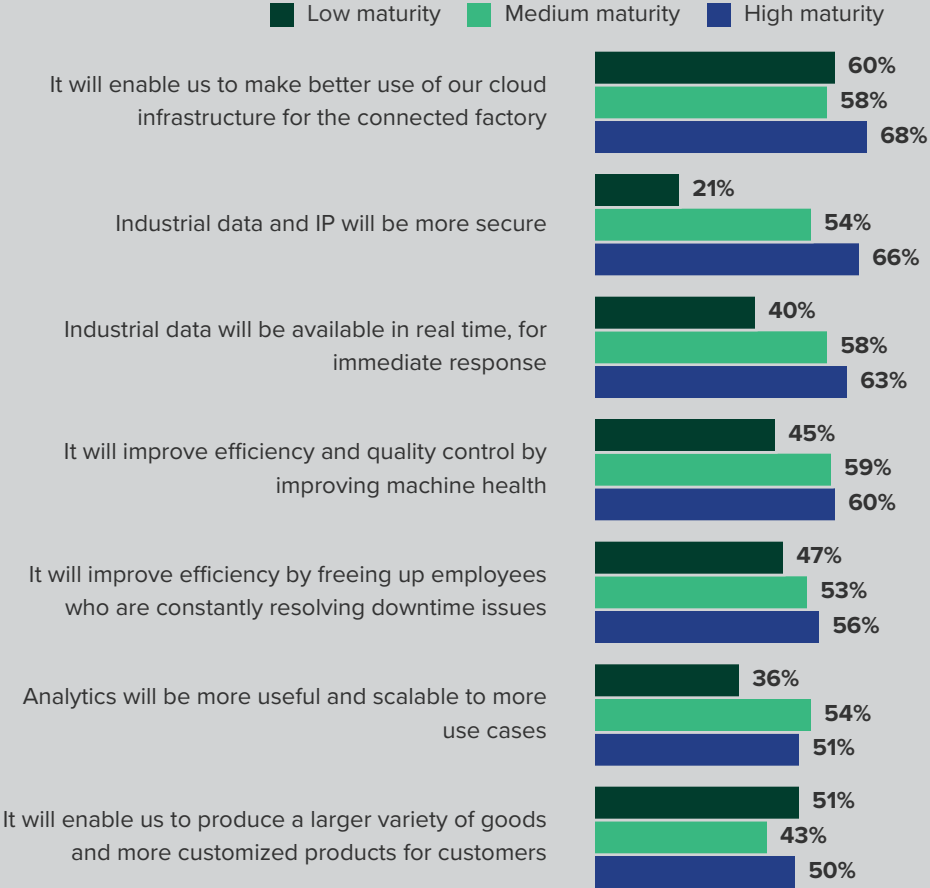
5G promises to deliver massive connectivity and impact the internet of everything. Many manufacturers turn to 5G in an effort to improve network reliability, as well as to harness more — and more advanced — IIoT use cases. As business and technology leaders work together to define the emerging tech use cases that are most valuable to their businesses, many will need to engage partners to guide their roadmapping efforts.

> **Seamless connectivity greases the wheels of innovation.** Industrial leaders at all maturity levels seek to improve network reliability (in part by implementing 5G networks) to make better use of their existing cloud infrastructures. Additionally, most high maturity (66%) and medium maturity (54%) firms look forward to the security benefits of network reliability improvements (see Figure 11).

High maturity firms unanimously agree that investing in industrial connectivity is crucial to unearthing insights that are necessary to informing their long-term competitive strategies.

Figure 11

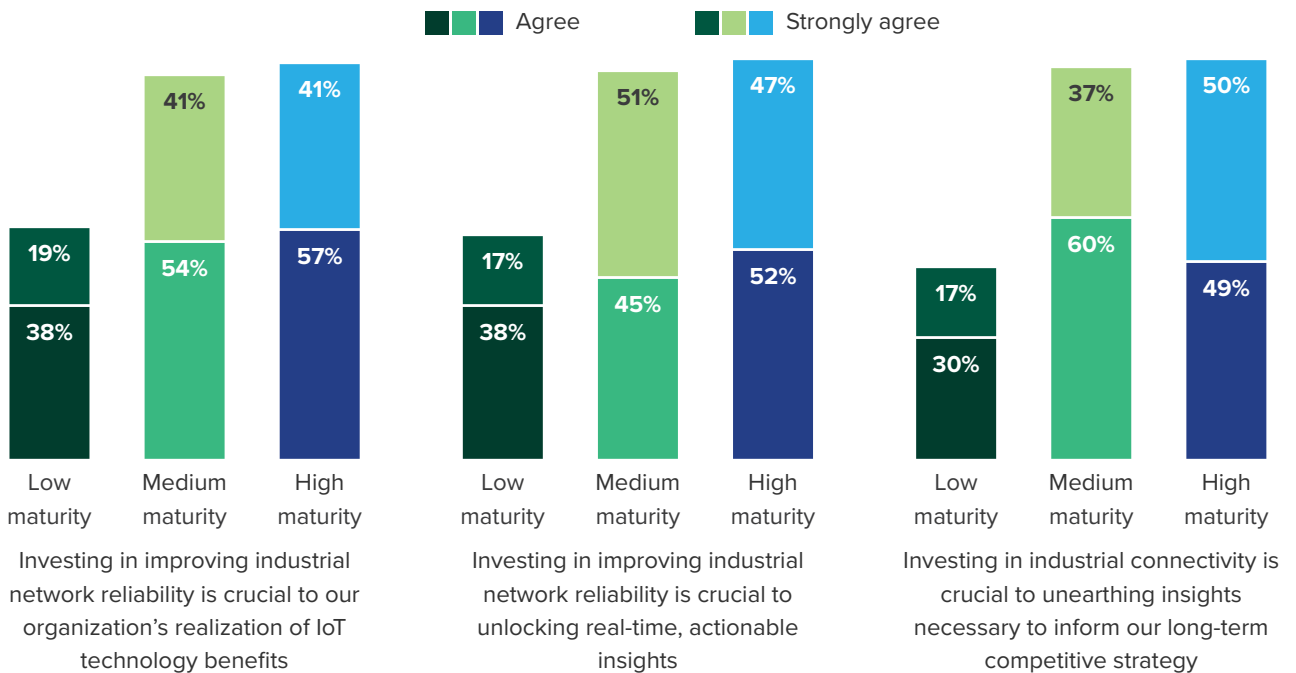
“How do you think improving network reliability (e.g., by implementing 5G wireless networks) will impact your business?”



Base: 312 Director + respondents responsible for defining industrial connectivity strategy at their organization
 Source: ADI Thought Leadership Study, a commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

One truly transformational aspect of 5G connectivity, in particular, is that it delivers low latency, opening up a world of use cases that existing paradigms — including cloud computing — cannot fully address on their own. For example, connectivity and latency requirements make it impossible to reliably move every workload off the factory floor and into the cloud. For security leaders, that means one of the hardest environments for visibility and protection will now be as connected as the rest of the enterprise.⁵ For business leaders, this means opening the door to both additional IIoT use cases and advanced insights to fuel continued innovation. In fact, 99% of high maturity leaders agree (with 50% of them strongly agreeing) that investing in industrial connectivity is crucial to unearthing insights that are necessary to informing their long-term competitive strategies (see Figure 12).

Figure 12: Drivers Of Improving Network Reliability

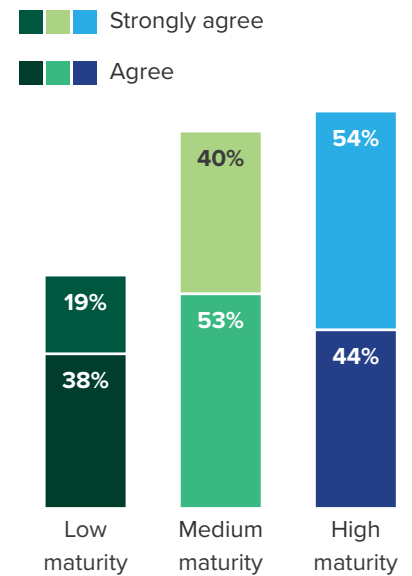


Base: 312 director + respondents responsible for defining industrial connectivity strategy at their organization
 Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

› **Non-public 5G networks will be a critical building block for many, but heed the knowledge gap.** While survey respondents were not asked about public vs. private 5G adoption, it is worth bringing in complementary Forrester research to address both the trend of private 5G deployments and the aforementioned security concerns of medium and high maturity firms. While the concept of non-public 5G networks is nothing new, the rise of IIoT and connected assets is driving companies to investigate the opportunities offered by installing private 5G networks in their factories. Non-public 5G networks promise better privacy, higher levels of data security and compliance, and better cellular network performance. Non-public 5G networks also offer safer and private features for dedicated user groups.⁶

› **Even the best still need help.** Manufacturers at every maturity level agree that investing in the right mix of internal talent and external partners is crucial to their digital transformation success (see Figure 13). With that said, manufacturers have very different needs depending on their maturity. Low maturity firms seek an end-to-end partner to shape technology investments and guide their automation and networking improvement efforts. Industrial automation and networking expertise matter most to medium maturity firms, but they also seek a partner to guide their strategy and roadmaps. High maturity firms care even more about engaging strategic partners with proven success in guiding industrial transformation efforts. As most high maturity firms understand the ROI of deploying 5G but struggle to scale (see Figure 12), a strategic partner could help move them from their initial implementations to enterprisewide value (see Figure 14).

Figure 13: Importance Of Talent

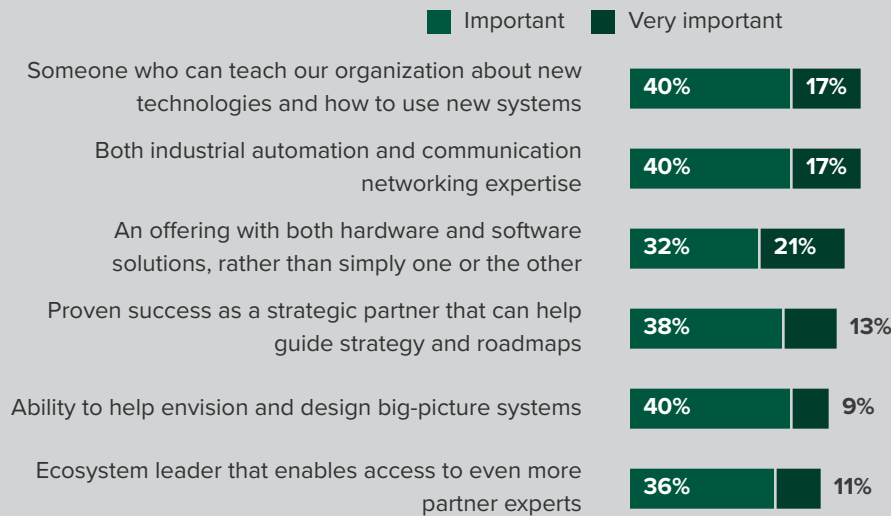


Investing in the right internal talent and/or external partners is crucial to our industrial digital transformation

Base: 312 director + respondents responsible for defining industrial connectivity strategy at their organization
 Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

Figure 14A

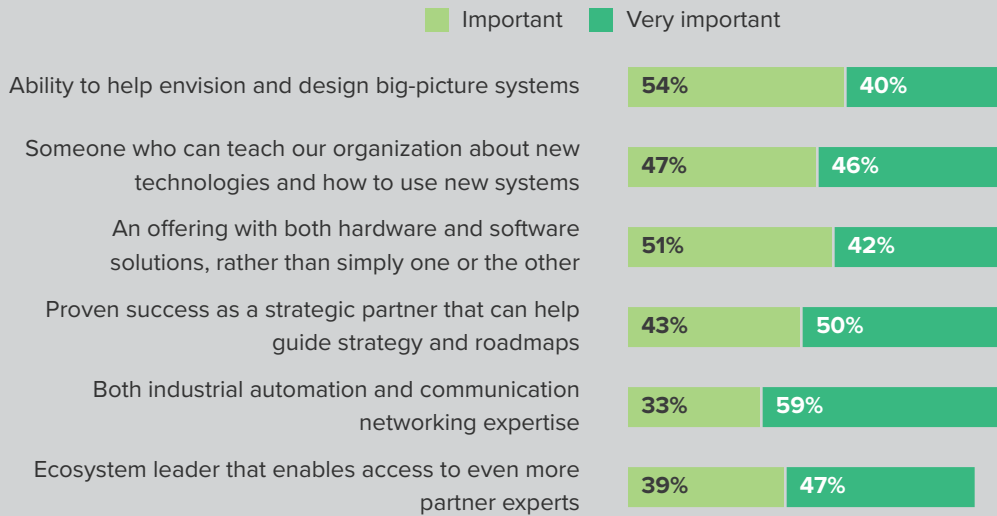
“How important are the following when selecting a connectivity partner?” (Low maturity organizations)



Base: 47 director + respondents responsible for defining industrial connectivity strategy at their organization
 Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

Figure 14B

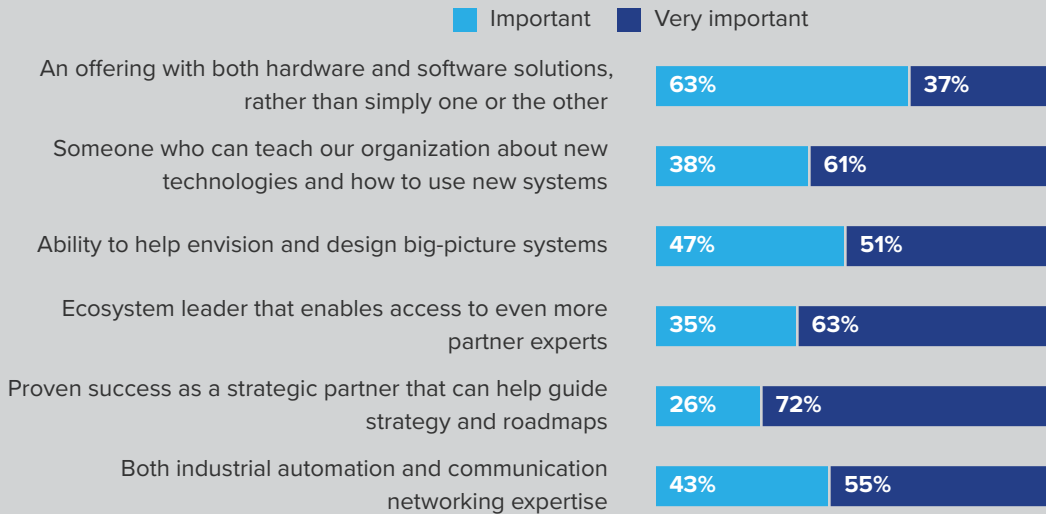
“How important are the following when selecting a connectivity partner?” (Medium maturity organizations)



Base: 125 director + respondents responsible for defining industrial connectivity strategy at their organization
Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

Figure 14B

“How important are the following when selecting a connectivity partner?” (High maturity organizations)



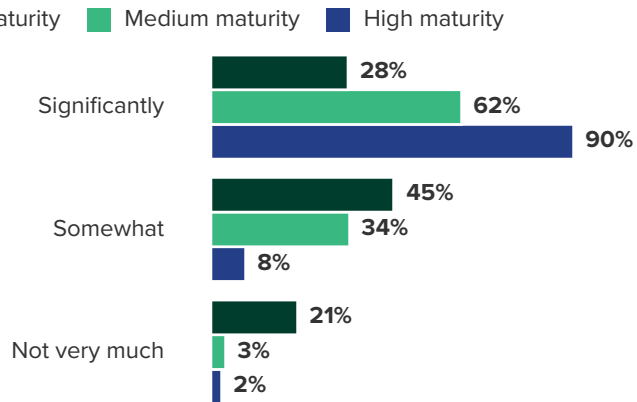
Base: 131 director + respondents responsible for defining industrial connectivity strategy at their organization
Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

› **Seamless connectivity is the goal, and a hybrid network is the reality.**

The digital transformation reality for most industries is a hybrid state of connectivity. This holds true for manufacturing, as most factories will continue to rely on both wired and wireless networks. Reliably extracting timely insights from advanced IIoT and other technologies requires seamless connectivity that is agnostic of network technology. As such, 90% of high maturity firms expect future systems to significantly rely on time synchronization between wired and wireless networks (see Figure 15).

Figure 15

“How much do you expect future systems to rely on time synchronization between wired and wireless networks?”



Base: 312 director+ respondents responsible for defining industrial connectivity strategy at their organization
Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

Key Recommendations

Forrester's in-depth survey of 312 industrial connectivity strategy leaders about the current state of industrial connectivity yielded several important recommendations:



Build a solid foundation for your tech investments. Manufacturers are in the midst of a shift from grease to code, implementing digital technologies to improve reliability, productivity, and profitability across their business. They're also increasingly interested in new business models such as product-as-a-service. But before any of this can happen, they'll need to connect their assets and invest in communications infrastructure that is capable of dependably carrying increasing volumes of data between factory machines and other parts of the business. Without predictable, dependable, and secure connections to the machines in your factory, your smart manufacturing vision will never be more than just a vision.



Have a security plan. Increased connectivity means increased risk: There's no way around it. But the transformational value of improved connectivity in the manufacturing sector cannot be ignored, so it's time to tackle the security risk head-on. Take the Wi-Fi password down from the noticeboard in the staff canteen, and then start thinking very differently about how machines, buildings, and data flows are protected. Zero Trust security principles should be at the heart of your approach to security moving forward, both on the networks inside your factories and in the way you share data with the head office, partners, suppliers, and the cloud.

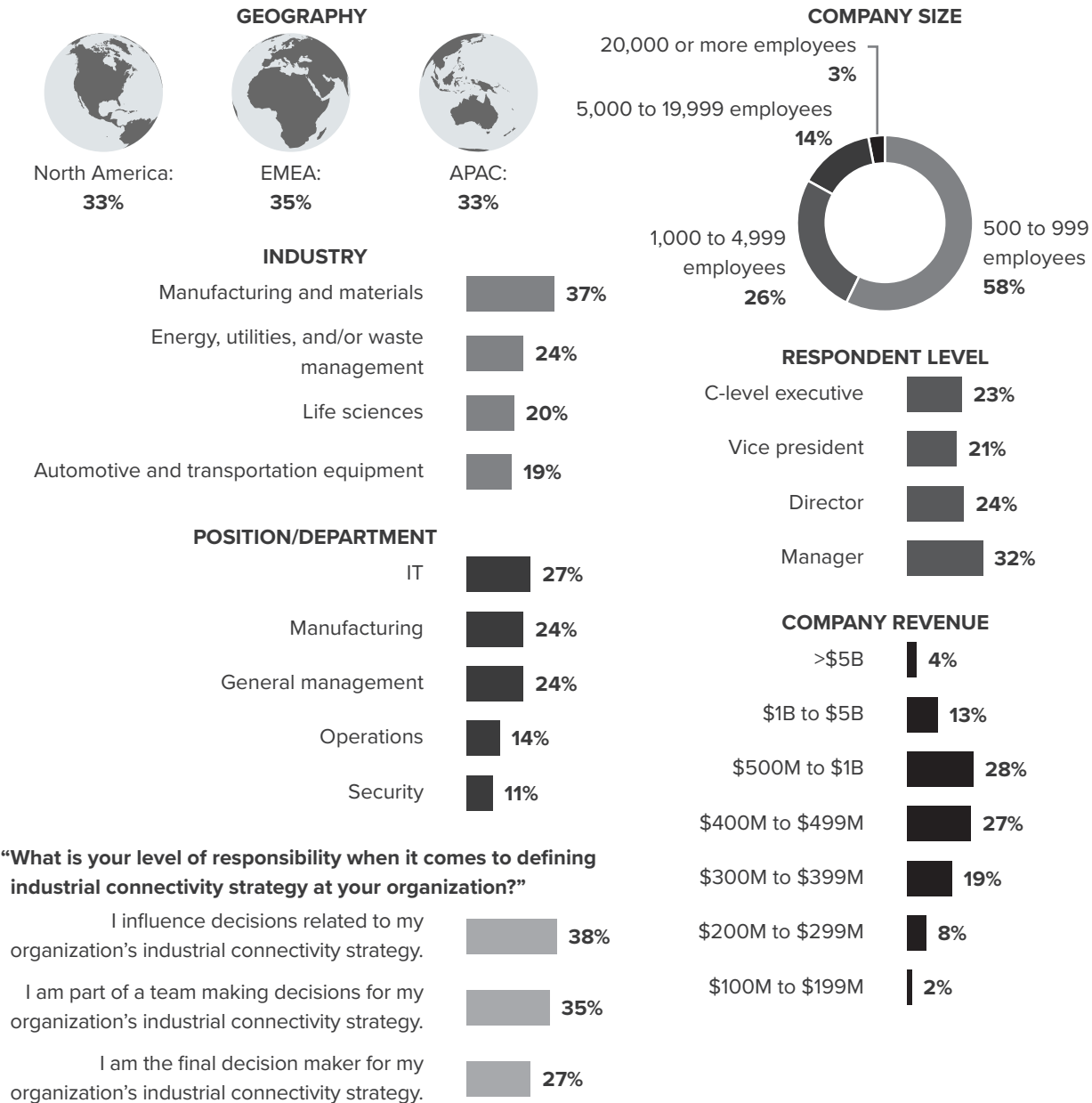


Know when to ask for help. Even the most mature manufacturing organizations are still learning how to operate safely and effectively in their increasingly connected environments. Cloud services are new to many, as are connected machines that call home to report faults. The benefits are significant, but so is the risk of doing it wrong. Now is not the time to be too proud to ask for help. Identify the gaps in your understanding, identify accredited partners with the knowledge and experience to help, and then let them help you and teach you.

Appendix A: Methodology

In this study, Forrester conducted a global online survey of 312 industrial connectivity strategy leaders. Survey participants included decision-makers in IT, operations, cybersecurity, and general management manufacturing roles. The study began and was completed in October 2020.

Appendix B: Demographics



Base: 312 director + respondents responsible for defining industrial connectivity strategy at their organization
 Source: A commissioned study conducted by Forrester Consulting on behalf of ADI, October 2020

Appendix C: Supplemental Material

RELATED FORRESTER RESEARCH

“The Forrester Tech Tide: Smart Manufacturing, Q2 2020,” Forrester Research, Inc., April 1, 2020.

“Predictions 2021: Smart Manufacturing,” Forrester Research, Inc., October 28, 2020.

“Private 5G Networks Promise Great Things In Industrial Automation; Don’t Let Security Integration Challenges Curtail Adoption,” Forrester Research, Inc., March 25, 2020.

Appendix D: Endnotes

¹ Source: “Predictions 2021: Smart Manufacturing,” Forrester Research, Inc., October 28, 2020.

² Source: Ibid.

³ Source: Ibid.

⁴ Source: “Private 5G Networks Promise Great Things In Industrial Automation; Don’t Let Security Integration Challenges Curtail Adoption,” Forrester Research, Inc., March 25, 2020.

⁵ Source: “Zero Trust Primer For 5G Security Use Cases,” Forrester Research, Inc., May 1, 2020.

⁶ Source: “Non-Public 5G Networks Will Be A Critical Building Block Of Your Enterprise,” Forrester Research, Inc., August 30, 2019.