



2022 Connected Industry Report

The quest for 'digital vitality'



Contents

- 1. Foreword**
- 2. How a post-pandemic world re-energizes innovation and impacts business outcomes**
- 3. A look at the emergence of the Connected Industry**
Enhancing industrial competitiveness; improving people's lives
- 4. The quest for 'digital vitality'**
Considerations for mastering the digital-physical choreography
- 5. The technology engines of 'digital vitality'**
IoT
Edge-to-cloud
5G connectivity
Data Intelligence
Artificial Intelligence and Machine Learning
- 6. Spotlight on: healthcare and manufacturing**
- 7. Designing solutions to win the game**
- 8. NTT's approach to powering digital vitality**
- 9. Closing thoughts**
- 10. Research methodology**
- 11. About NTT**
List of contributors





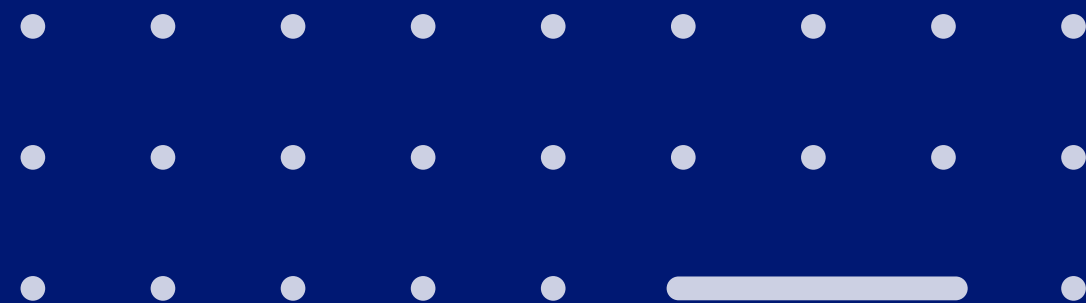
The Era of 'Connected Industry'

Industry 4.0 was a term that described the move to increase efficiency and process optimization in the manufacturing industry – from design and production to retail trade and maintenance – by activating data and connecting intelligence across the entire value chain.

Today, 'Connected Industry' is an expanding vision where the full spectrum of technological innovation, including IoT, 5G connectivity, data management, artificial intelligence (AI) and machine learning (ML) derived from the Fourth Industrial Revolution (4IR), benefits all industries and the world at large.

It's a framework in which enterprises and governments engage cooperatively to create new added value and solutions to business and societal challenges through the connectedness of various facets of modern life, including people, machines, systems and companies.

And it's manifesting in an ultra-smart hyper-connected approach to technology that's human-centric and solution-oriented. It's an environment that fosters new levels of cooperation and collaboration between individuals and companies through the ultra-fast dissemination of insights and skills.



Foreword

As we emerge from more than two years of unprecedented disruption, we find ourselves living in a world of digital saturation.

Here, the physical and digital are more symbiotic and interdependent than ever before.

We've entered the age of the Connected Industry – where new value is being created through digital networks between people, companies, devices, machines and places.

Framed around the Internet of Things (IoT), edge-to-cloud, 5G connectivity, data management, AI and ML and security, connected industries are imagining new solutions to social and environmental challenges.

The era of the Connected Industry presents a non-negotiable base that protects business survival. Any organization seeking not just to survive pandemic-induced disruption but also thrive must get intentional about building their digital vitality.

To thrive in the era of the Connected Industry, organizations need to become digitally primed. This requires thought, courage, diligent practice and constant experimentation and iteration.

Ultimately, 'digitally vital' organizations will emerge as the most prosperous, sustainable and resilient, continuing to stay ahead of the game despite changing world conditions.

The era of the **Connected Industry presents a non-negotiable base that protects business survival.** Any organization seeking not just to survive **pandemic-induced disruption but also thrive, must get intentional** about building their digital vitality.

Digital vitality is the only path to prosperity and resilience. But becoming a truly digitally 'vital' business requires diligent practice and constant exploration and iteration. It's an ongoing process that leverages outcome-based innovation to continually optimize and differentiate the business.

While capitalizing on the potential inherent in the world of the Connected Industry is an exciting prospect, it must be orchestrated responsibly, safely and with a focus on the human experience to maximize the desired business outcomes and minimize risk while also keeping costs under control.



Momentum to digital vitality is accelerating

Here, the role of a dedicated ‘high-performance conditioning partner’ becomes amplified. Think of the relationship dynamic between an elite athlete and their coach. The athlete is focused on the game, on winning that gold, on outperforming their competition. Their coach uses their access to the latest insights in nutrition, muscle mechanics, rehabilitation, etc., to ensure the athlete’s body and mind are primed for peak performance.

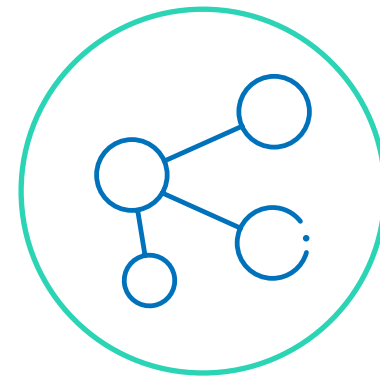
The coach is the committed steward for the athlete’s continuous high performance in the face of a constantly evolving and advancing line-up of competitors.

Read on as we explore how industries are investing in building their digital vitality in a hyper-connected world – and harnessing innovation in ways that have more impact than ever before.



Rika Nakazawa, Group Vice President, Connected Industry

Key enablers to fuel your engine



IoT

2 in 5

IT teams are already leveraging **IoT** as part of a **data capture and customer intelligence program**



Edge-to-cloud

71.7%

of CIOs say **cloud solutions** are being prioritized, establishing it as **the overall top technology initiative** for the next 12-18 months



5G connectivity

66.6%

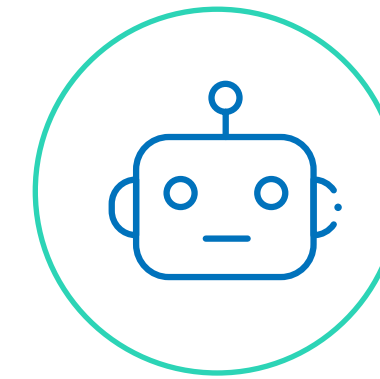
of organizations plan to have implemented **Private 5G network** within the next 18 months



Data intelligence

#1

development priority for CIO/CTOs to enable future technology and business strategies is **data mgt (incl. visualization and analytics)**



AI & ML

52.1%

of organizations say that more than half of all customer interactions will be managed via **robotics and AI automation** within the next 12 months

Choreographed



= Connected Industry

Agile | Secure | Continuous intelligence | Augmented technology



How a post-pandemic world re-energizes innovation and impacts business outcomes

We recently asked CEOs how well their organization was able to pivot its strategy in response to the pandemic. Only half strongly agreed that they were successful.

And now, as they look to a future beyond the pandemic, their top business drivers in the coming 18 months are improving agility, resilience and the business’s ability to respond to change. With this, their focus on technology enablement has intensified, with 95.4% saying that their organization has become more reliant on technology since the start of the healthcare crisis. This is a sentiment that’s echoed by those working in business and IT roles:

- **62.3%** of CIOs agree strongly that the pandemic has had a transformational impact across the entire organization.
- **89.2%** of business and IT leaders agree the pandemic caused significant changes to their operating processes.
- **91.4%** agree that now enabling business efficiency is a key driver of their technology strategy (with 49.2% agreeing strongly).

Yet only two in five strongly believe they have optimized solutions available to meet the organization’s immediate objectives. There’s a clear gap between aspiration and execution ability. Before having the appetite to imagine the art of the possible and operationalize their vision, organizations need to adjust their mindsets and consider how they engage in ongoing innovation ‘conditioning’.

- **91.7%** agree (55.3% strongly) that innovation and access to advanced technologies, including AI, IoT and ML are key to their technology strategy.
- But just **47.7%** of CIO/CTOs strongly agree that their organization is proactive at managing its technology infrastructure.

Research undertaken by NTT, as well as our conversations with clients indicate that now, their priorities commonly fall into one of eight business outcome areas:

Business outcome areas driving the quest for digital vitality



Our research evidences that attention is now less on cost reduction and more on experience-based outcomes that will drive more sustainable revenue and increased long-term profitability and business resilience.

Business objectives

Key enablers

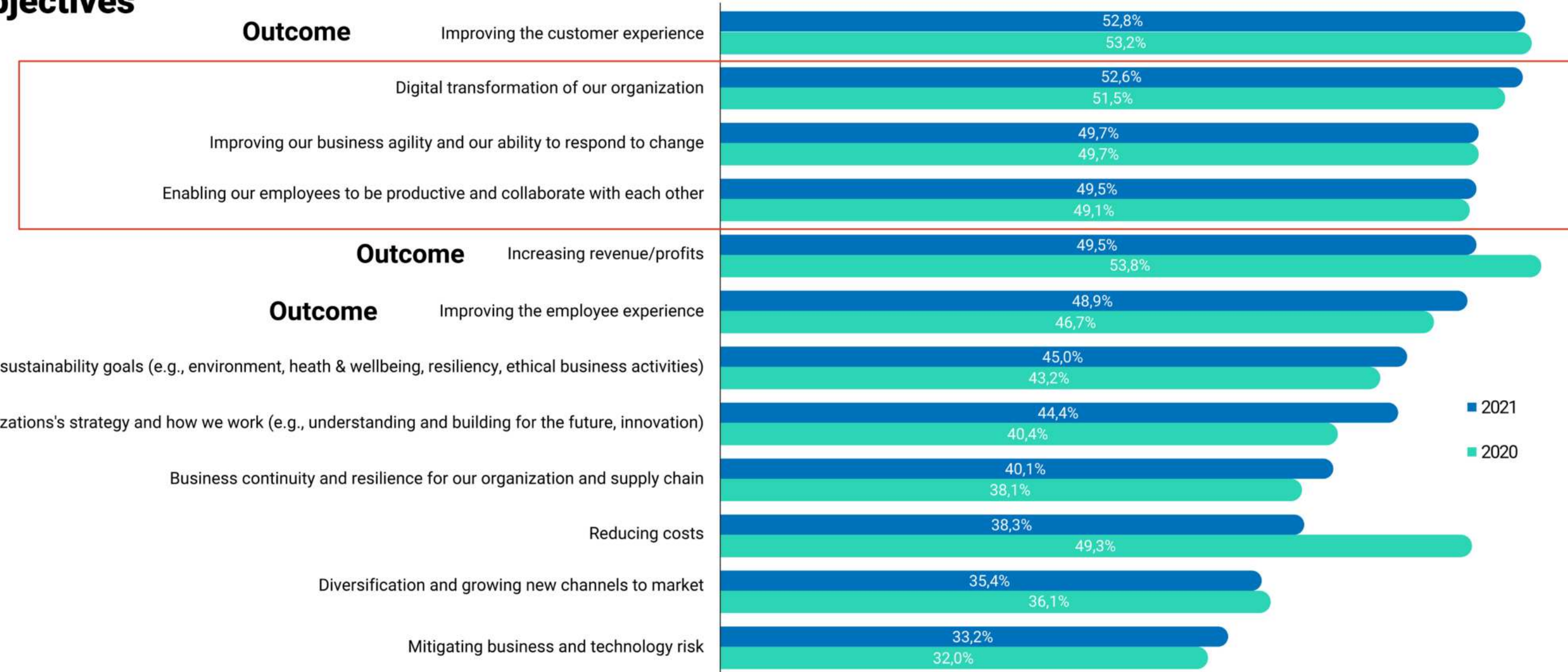
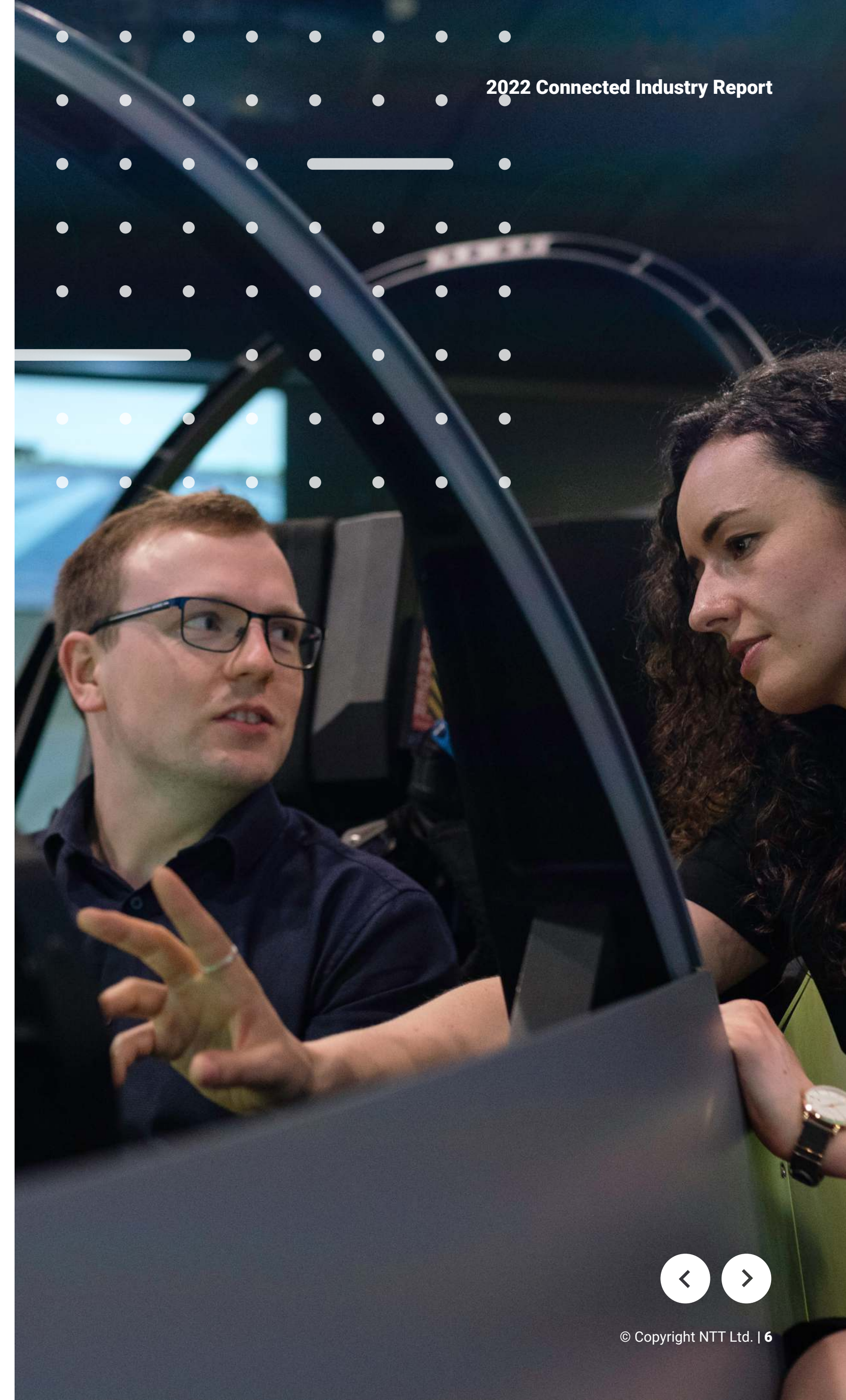


Figure 3: Less than one in three organizations believe their customers would rate their CX as excellent
How do your customers rate your CX capability? n=1,359



Sustainability – an underlying imperative

Hybrid operating models have introduced new challenges to traditional and physical workplace sustainability initiatives, but our research indicates many organizations are stepping up focus and efforts to drive positive change.

Almost two-thirds (61.4%) of CEOs say they're aligning business and workplace strategies to the UN's Sustainable Development Goals.

Energy efficiency and digitization to reduce carbon footprints are among the top priority areas informing organizations' focus on sustainability.

Source: NTT Ltd, 2021 Technology Strategy Research

Yet only 2 in 5 strongly believe they have optimized solutions available to meet the organization's immediate objectives. There's a clear gap between aspiration and execution ability.

A look at the emergence of the Connected Industry

Historically, Industry 4.0 was represented by rapid change in manufacturing operations productivity and quality, powered by digital connectivity between machines. Now, investment in the interplay of data, 5G connectivity and operational intelligence is essential to achieving high-performance outcomes across multiple sectors beyond manufacturing – including the public sector, like cities and schools.

The benefits derived from the next generation of Industry 4.0 solutions are also expanding to healthcare, energy, logistics and resources. These industries have new opportunities to create value by connecting people, companies, customers, devices, machines, platforms, systems and sites by capitalizing on the rise of IoT, edge-to-cloud, 5G connectivity, data management, AI and ML and security.

When these technological advances are united in a physical-virtual ecosystem, they hold promise to provide solutions to new business, social and environmental challenges and unleash unprecedented human creativity and innovation. This is the world of the Connected Industry.

Enhancing industrial competitiveness; improving people's lives

Manufacturing and healthcare are two industries that are emerging as Connected Industry 'lighthouses', illuminating what's possible – and critical.

In the realm of manufacturing, humans and machines are working cooperatively on the factory floor in ways never before imagined. Together, they're streamlining and accelerating the manufacturing process to deliver exponential output, quality, efficiency and sustainability gains. This allows manufacturers to ensure the highest standards of plant safety while reducing their power consumption and minimizing carbon emissions across the value chain.

More advanced automation and intelligent systems are also transforming the healthcare experience for providers and patients alike. Now, it's possible to uncover data insights that deliver improved quality, drive productivity, increase cost-effectiveness and ensure optimum care reliability at a time where skills in the industry are scarcer than ever.

And all this isn't just happening in buildings and sites. As organizations in these sectors revisit their policies given changing workstyles, the technology dynamics have expanded further, and they now also need to securely support a range of employee profiles and work location preferences. That's still a challenge for many, with just 54.6% of organizations currently saying their employees have access to technology that fully enables and augments **hybrid workplace performance**.



The quest for 'digital vitality'

The challenge in achieving true **digital vitality** is nimbly choreographing the dynamics between the physical and digital worlds – focusing on the interplay between data, 5G connectivity and intelligence.

CIOs globally rank digital transformation results as the #1 indicator of strategic performance.

Source: NTT Ltd, 2021 Technology Strategy Research

Considerations for mastering the digital–physical choreography

As they set out on their journey to achieve digital vitality, organizations need to be mindful of the potential risks and dependencies. With everything now so interconnected, if one part stops or fails, everything in the fabric or chain could potentially be disrupted.

It's a team sport in the executive suite

Many organizations are also struggling to understand how best to align internally around priorities at the C-level to appropriately evolve their digital transformation blueprint. Are there competing priorities among stakeholders? Aside from the CEO, what do the CIO, COO, CFO, CDO and CMO specifically care about? What's top of mind for leaders in the digital, strategy and innovation offices? Does everyone have a clear and common understanding of what we mean by value and priorities? Is it profit? Compliance? Risk mitigation? Talent retention?

True digital vitality will remain out of reach if it's approached in an unstructured and uncoordinated fashion. Only once there's clarity and alignment among all stakeholders will it be possible to navigate the innovation roadmap.

Thoughtful, creative and iterative use of technology is the path to overcoming digital fatigue, breaking boundaries and cultivating 'digital vitality.' It's the key to simplifying the ecosystem and connecting all the moving parts coherently.

Compiling and diligently following a structured 'digital playbook' will earn you the right not just to play, but to win.

Only **48.3%** of CIOs say that the organization's overall technology strategy is fully aligned with the business's strategy needs.

30.8% of CIOs say lack of strategic vision/leadership is a main cause of misalignment.

Digital fatigue

At the same time, in most organizations, there's a degree of 'digital fatigue' – the pandemic forced people and businesses to invest funds, energy and processes into digitalization. Many organizations are asking themselves, 'How do we sequence and navigate all of this? As we come up for air, how do we adopt and adapt to the huge enterprise investments that have been made in technology?'

Why Connected Industry

- 1 Industry 4.0 traditionally characterized by rapid change in manufacturing operations productivity and quality resulting from the integration of new technologies – IoT, Cloud Computing, Analytics, AI and ML.
- 2 COVID-19 has accelerated digital saturation across communities, businesses and countries making the interconnection between people, machines, devices and places ever tighter across all industries.
- 3 Investment in the interplay of data connectivity and operation intelligence is ever more critical to high performance outcomes beyond industrial sectors – expanding across to logistics, energy, resources, healthcare and cities.
- 4 Across all industries, enabling technologies and approaches such as Private 5G, IoT, data management, AI and ML are rising to the top of strategic digital transformation agenda.



The technology engines of digital vitality

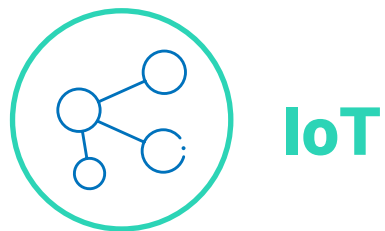
Technology is the engine that integrates the physical and digital worlds across industries globally: people, devices, machines and places.

According to NTT's recent survey of IT decision-makers and influencers, the pursuit of **digital vitality** shows up in an increasing interest in key technologies. Right now, CIOs' top areas of focus to enabling future technology and business strategies and their key existing priorities are:

- IoT
- Edge-to-cloud
- Mobility (including 5G connectivity)
- Data management (visualization and analytics)
- AI and ML

Additionally, optimizing cloud solutions, including edge-to-cloud strategies, ranks as the CIO's number one priority of existing technology initiatives.

We'll explore these transformative technologies and some key use cases in the sections that follow.



IoT

Connected industries come in two forms: We have the Internet of People (where we connect with one another by talking on the phone, messaging or through social media and other digital channels).

Then there's the Internet of Everything Else, which is about connections between machines, sensors and all manner of other devices. One key element of connected industries is the integration of traditional operational technologies (OT) with IT.

Organizations in all industries are looking for ways to use IoT to address key priorities such as reducing cost, improving sustainability, ensuring compliance, improving customer experience and ensuring worker enablement and safety in a low-touch, automated fashion.

CIOs rank IoT as the #1 technology priority to improve customer experience.

Source: NTT Ltd, 2021 Technology Strategy Research

There are three steps to achieving business outcomes with IoT:

- First, digitizing the physical environment or the digital edge (collecting your data)
- Next, contextualizing and analyzing your data (turning it into trusted, useful information)

Digitizing the physical

An example of digitizing the physical would be setting up an environment sensor that measures temperature/humidity or air quality or a smart meter that transmits readings and eliminates the need to have a person read it, write it down on a piece of paper and then input it into a system.

To transmit the data on the digital edge, there are multiple connectivity options such as Private 5G, 4G, LPWAN, Wi-Fi, Zigbee, etc. The key is to adopt the right technology option(s) for the environment (e.g., factory, mine, hospital) and the use case requirements (e.g., the need for a long battery life or bandwidth-intensive video.) This enables a wide range of use cases, including everything from simple sensors that monitor whether a door is open or closed, automated robots and vehicles to computer vision for monitoring machine defects, for example.

Off-site options that extend to downstream elements and allow you to connect and gain visibility of your wider supply chain include fleet management and asset tracking technologies, LTE sensors and public 5G connectivity.

Once these sensors have gathered data on your behalf, they need to automatically transmit it via a network.

Almost 2 in 5 IT teams are already leveraging IoT as part of a data capture and customer intelligence program.

Source: NTT Ltd, 2021 Technology Strategy Research

But at this stage, all you really still have are discrete data points: You've used X gallons of water this month; the boiler is running too hot; your metal cutting machine will need a new blade next week; this is where your container is in the middle of the Pacific Ocean.



Adding the context

So, the next step is to add some context to this raw data to turn it into information that makes sense and that you can trust by analyzing it – either at the edge (where it's collected) or after transmitting it to the cloud (either public or private). The explosion of data makes the edge more important in the age of the Connected Industry. A typical smart factory generates five petabytes of data a week and this will only increase in the near future. A clear strategy on what should be processed at the edge versus what needs to go to the cloud needs to be established.

IoT connectivity is a top 5 focus consideration for refreshing network infrastructures.

Source: NTT Ltd, 2021 Technology Strategy Research

Once the data is in the cloud, it needs to be filtered and contextualized to convert it into trusted information. Data is more powerful in the presence of other data and combining various inputs such as temperature sensors with door open/close sensors and weather data can be more useful in understanding, for instance, that a loading dock door has been left open during August in Texas and the temperature is quickly rising in a perishable food storage facility.

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Taking action

Once you know what it makes sense to focus on, it's no good if you simply sit on that information. To use an example from our personal lives: if you get information that it's going to rain heavily this weekend, your life will be easier if you make a point of pulling out your umbrella and putting it in your car or letting your friends know that you'll be postponing your Sunday barbeque.

Turning data into action requires integrating it into other systems. For example, if you get an alert that there's a water leak in your basement, you need to log a call or raise a trouble ticket with your building maintenance team. In the industrial context, this would require automatic integration of an alert with a case management system such as ServiceNow to ensure an imminent technical failure gets attended to as a priority before it results in unwelcome shop floor downtime.

While the capabilities of IoT are well accepted, the challenge is to have a clear business outcome and return on investment. This is what makes the upfront strategy so important. Does putting a sensor on an exhaust fan to see if it's working really offset the labor required to walk by and inspect it manually? It would if there were hundreds of them on a rooftop requiring a master mechanic to spend half his day doing an inspection when you're short on technical personnel.

Note that the end user has to be at the center of the solution, so human-centric solution design is a necessity. How will the user interact with the information? Will they be overwhelmed with having to open another app or screen on their laptop or phone? Does the solution consider accessibility for diverse workforces (ages, language, etc.)?

The solution doesn't end with the deployment. As part of the agile innovation approach, you need to review whether it's delivering on your stated business objectives. Have your assembly line downtime levels decreased? Is your occupational safety record improving? How are you tracking in terms of your facility's carbon footprint?



Securing the edge – by design

The more devices you introduce into your environment, the greater your level of potential vulnerability and risk. So, the end-to-end solution should have security and privacy by design across all layers.

In addition to ensuring your security procedures and protocols extend all the way to the edge, it's a good idea to consider Private 5G connectivity, given that it's inherently more secure. Unlike traditional Wi-Fi networks (which only require a password to access), only users with an authenticated SIM card can log on to a Private 5G enterprise instance.

In healthcare facilities, it's critically important to shield life-saving equipment and devices from cyberattacks. But other industries are also at risk. For example, imagine that you have an industry-grade metal stamping machine in your manufacturing facility. Naturally, it's vital that the machine is shut down securely when your maintenance team goes in to clean out the residual metal chips at the end of every day. You wouldn't want to even contemplate the consequences of a malicious actor gaining access to your network, turning on the machine and causing a potentially devastating industrial accident.



Edge-to-cloud

The rise of connected machines and devices, a distributed workforce and new digital customer channels has seen huge strides towards edge devices.

Workloads and data processing are now also moving to the edge. The challenge is to connect edge devices and things (within smart workplaces, smart hospitals, smart manufacturing), then connect the edge to the cloud and then into and across the different clouds. All while ensuring security and governance, either at the edge, in the data center and in the cloud. Orchestrating this requires three essential network modernization considerations:

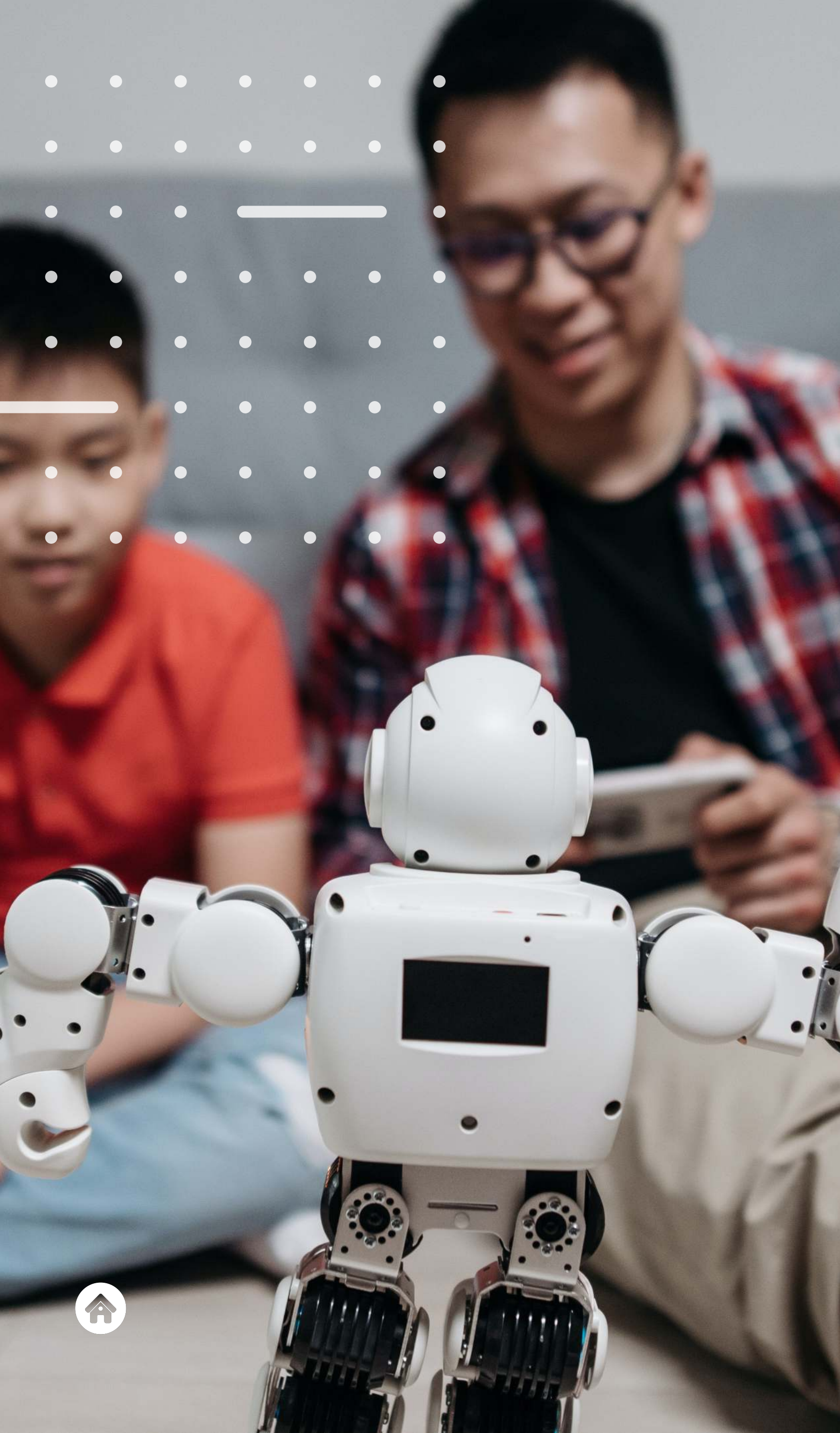
1. Connecting within the cloud

While cloud has emerged as one of the biggest digital transformation enablers, it's also challenging to connect to and operate as part of a cohesive IT infrastructure.

The myriad of public, private and on-premises platforms hosting internal and external applications, as well as huge volumes of data, causes many headaches. The same can also be said for the infrastructure that supports applications, which enables them to run successfully and to be consumed by users wherever they are.

A poorly architected and managed network will lead to failure, irrespective of how good the application or cloud platform is. To be successful, the right thought processes around cloud are required. It isn't simply an execution venue for your applications; it's an operating model.





Network technology, management techniques and financial models have evolved dramatically since the advent of cloud. And what worked pre-cloud in the era of non-programmable infrastructure isn't going to cut it in today's cloud-based, programmable infrastructure environment made up of software-defined architecture, platform delivered management services and automation.

Network modernization and optimization is a significant opportunity to improve how your network underpins your entire environment and enables your business outcomes.

2. Connecting the edge to the cloud

As more applications, users and devices utilize cloud and connect to your network, the less traditional WAN infrastructure is able to cope.

It's under intense stress and unlikely to handle the volume of traffic generated by cloud services or the performance needed by real-time applications. In today's modern, software-driven business environment, agility, scalability and better user experiences are non-negotiable.

A network under pressure can lead to a combination of rising costs, poor visibility and inadequate performance. Moreover, as traffic patterns go directly to the internet or cloud, rather than through the traditional data center, outdated components and software within mature WAN infrastructure provide an easy opportunity for online attackers to breach networks.

Implementing a software-defined network, for example, can support your new world of work by virtualizing connections between systems and networks, replacing physical connections with software.

It's agile enough to underpin your organization's cloud-first approach to applications, as well as the varying data sovereignty, application performance requirements and diverse traffic types you require.

A properly implemented SD-WAN applies software-defined techniques across your entire global WAN network infrastructure to create a flexible, secure overlay network.

3. Connecting within the edge

The continued explosion of data and devices, coupled with mobility, immersive collaboration, video, IoT and big data trends has placed greater pressure on networks and is why we're seeing more and more organizations rearchitecting their campus and edge networks.

This provides an opportunity to consider new technologies and techniques like automation, assurance and 5G and how they could deliver a more effective network platform.

The use of cellular technologies is well known and growing rapidly for IoT solutions, but there are some use cases for broader use of cellular, and in particular, Private 5G.

And while there are cost, performance and management factors to consider, more and more, we're seeing both Wi-Fi and 5G work together to provide 5G connectivity for their respective use cases but working together seamlessly.

We'll discuss 5G in more depth in the next section.





5G connectivity

5G connectivity is about the network, whether that be a traditional WAN or LAN, Wi-Fi, or 5G and Private 5G that connects all IoT devices and transfers the data they generate.

First, a closer look at 5G and Private 5G connectivity:

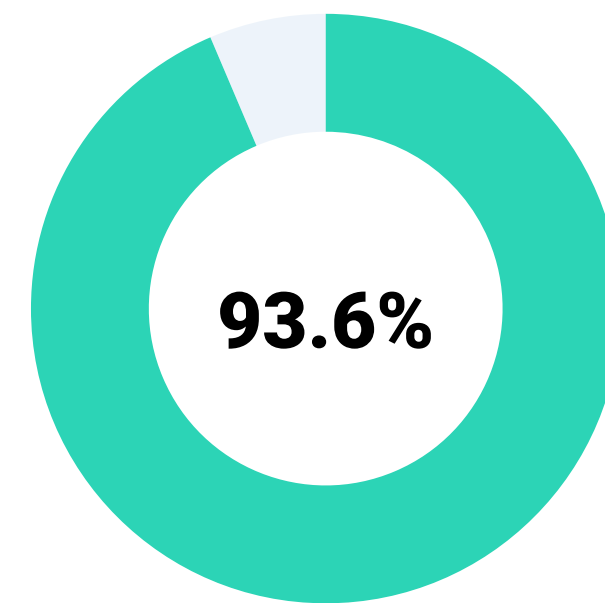
5G is particularly effective in managing the handover between access points. For example, the typical handover between two wireless access points is several seconds, possibly up to 10 or 20 seconds. With a 5G network, the process happens in less than 10 milliseconds. This is obviously advantageous when you're running mission-critical applications that require excellent quality of service or if you're running time-sensitive applications.

Exclusivity and control

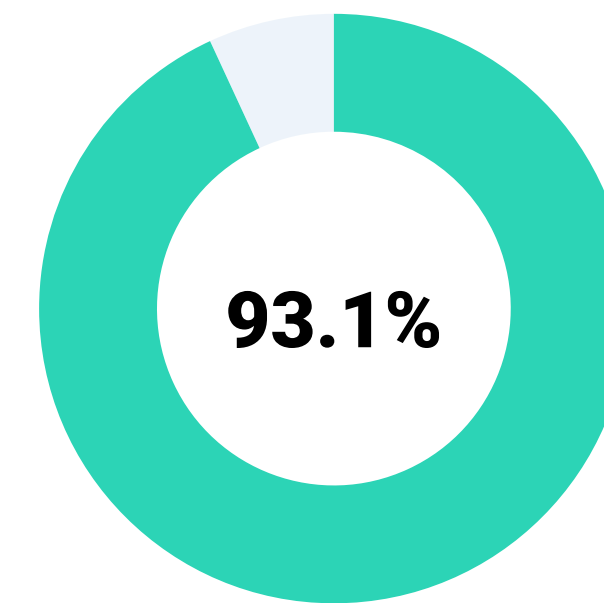
Private 5G networks are deployed entirely on the enterprise side. Spectrum needs to be allocated to the enterprise, which is allocated by a country's regulatory authority body. Availability of spectrum and its frequency ranges differ across countries. Once spectrum is allocated or made available, the enterprise is then the only body authorized to broadcast on their allocated range, and no other entity will have access to it.

Essentially, Private 5G networks act as an extension of the enterprise LAN network that uses 5G technology to enable that extension and connect users and devices to that LAN. The network is completely under the control of the enterprise, and all data stays on site and all existing enterprise security policies and procedures are applied to the 5G network. This is in contrast to telecoms networks that are generally designed to support larger groups of users with diverse needs.

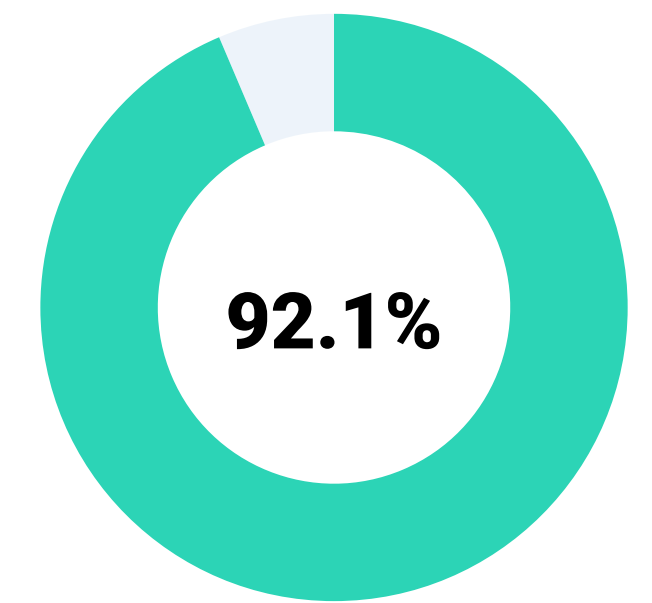
5G deemed crucial to enabling digital transformation



agree **(51.9% strongly)** that 5G will become a critical part of operations in the next 5 years



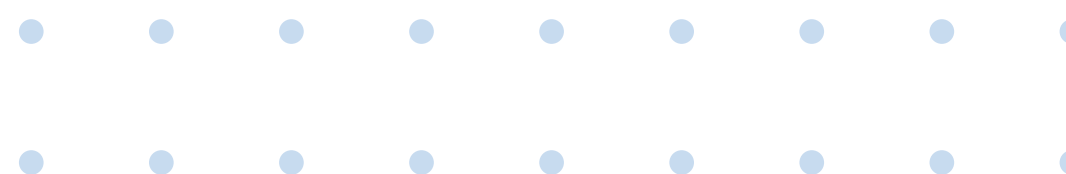
agree **(51.4% strongly)** that harnessing 5G technology is critical to enabling the organizations digital transformation strategy



agree **(40.7% strongly)** that leveraging private 5G technology is a strategic priority for senior leadership

Source: Economist Impact Executive Survey Report, Sponsored by NTT

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There are compelling reasons to consider a Private 5G network in industrial environments. First, they offer a means to add an additional layer of security to facilities. As we touched on earlier, not only is 5G inherently more secure than other, more traditional forms of connectivity such as 4G and Wi-Fi, it's also easier to integrate with more modern security technologies.

5G is a powerful option for large outdoor and indoor areas, such as factories, warehouses, shipping ports, mines and certain healthcare facilities. Such environments are heavily mechanized and dense with IoT devices, many of which are highly mobile. Then there are the range benefits of 5G to consider. For example, in manufacturing, 5G could provide better coverage in locations where heavy machinery may interfere with Wi-Fi radio frequency signals or large-scale sites such as airports and open cast mines where consistent coverage is needed

5G is a powerful option for large outdoor and indoor areas, such as factories, warehouses, shipping ports, mines and certain healthcare facilities. Such environments are heavily mechanized and dense with IoT devices, many of which are highly mobile.

Private 5G in action

Let's explore some of the use cases for Private 5G in industrial settings:

In distributed factory environments, many workers move large distances as they perform their tasks, often using mobile devices, such as tablets, to monitor their orders and workflows.

Many of the IoT devices in these environments run on machine vision-enabled applications. Some will be devices that monitor equipment and machinery efficiency, output and quality. Others may be ones focused on health and safety, continually scanning the environment to ensure workers are wearing the correct personal protective equipment such as hard hats and safety boots and vests, issuing automatic alerts in the event of non-compliance.

They all generate huge amounts of data – including continuous video – which needs to move reliably between machines and into the cloud for processing. Then it needs to be fed into AI and ML systems to drive automated workflows and predictive machine maintenance to prevent critical outages.

In the realm of manufacturing and agriculture, it's becoming commonplace to use autonomous guided vehicles (AGVs) or robots to perform mundane, repetitive or potentially dangerous tasks instead of humans.

Enlisting remote support from engineers and subject matter experts is also growing in popularity in many industry environments. Technologies such as augmented and virtual reality can accelerate the execution of remote technical maintenance, repairs and auditing. It's possible for on-site technical personnel to be assisted by remote colleagues, who can see the status of the activity in real-time but never need to physically visit the site themselves.

In healthcare settings, large volumes of data need to be moved from scanning devices and equipment into a cloud environment. There, AI and ML algorithms (rather than physicians) can perform the first-level analysis of X-rays and other digital images, which speeds and simplifies the process of providing patients with a medical diagnosis.

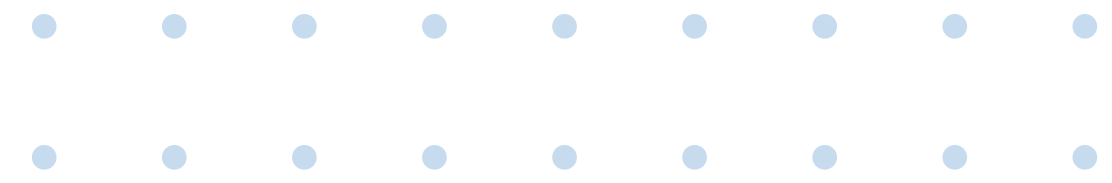
None of this can happen without reliable, low-latency and high throughput data connections that have an extensive range and are supported by robust SLAs such as that offered by Private 5G.

Almost **one in three** organizations (30.1%) have implemented or are piloting Private 5G networks; another 13.9% are considering it.

Two-thirds (66.6%) plan to have implemented Private 5G network within the next 18 months.

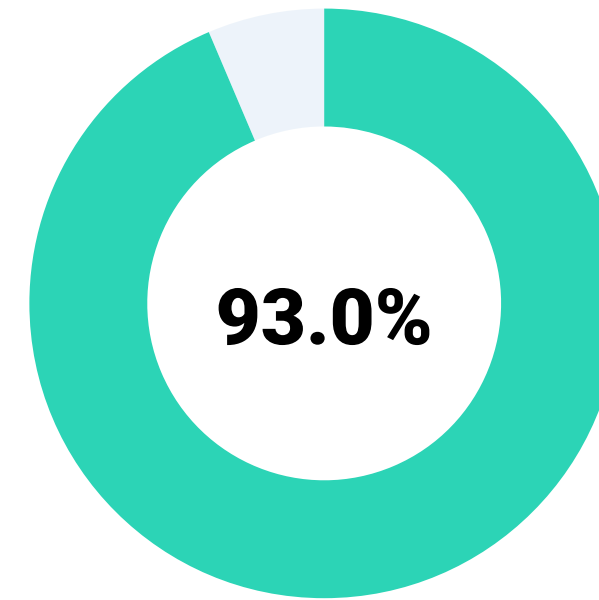
Over half (52.4%) have opted and/or will opt for an outsourced private network, with most leaning towards a managed services provider.

Source: Economist Impact Executive Survey Report, Sponsored by NTT

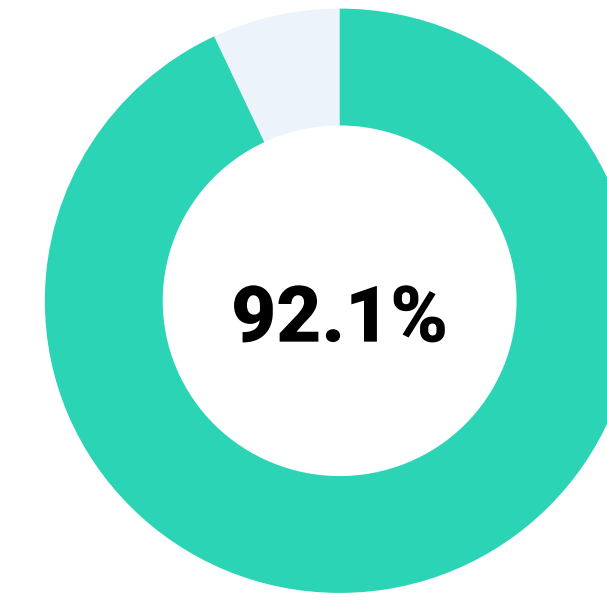


A differentiator, that's becoming an industry standard

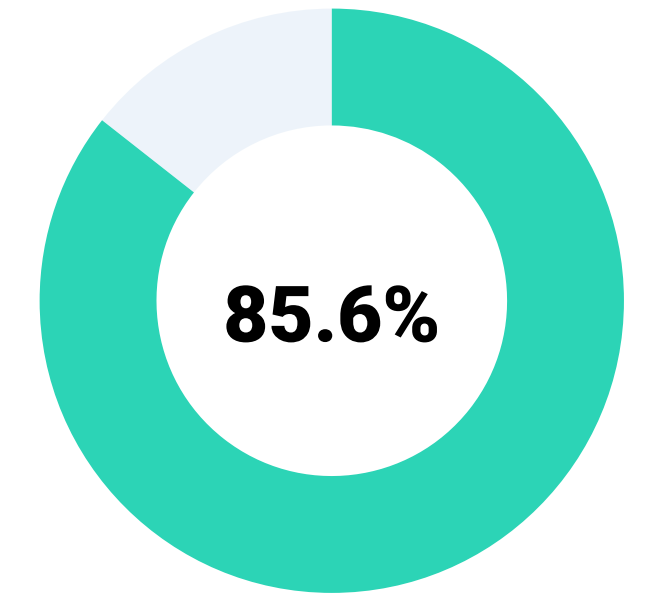
The case for 5G and private networks



agree **(44.9% strongly)** that organizations leveraging 5G will have a competitive advantage in the industry



agree **(45.3% strongly)** that private 5G will be an industry standard within 5 years



agree **(40.7% strongly)** that private 5G networks are a substitute for Wi-Fi networks

Source: Economist Impact Executive Survey Report, Sponsored by NTT

CEO's rank mobility including 5G connectivity as a top 3 technology priority to help enable future technology and business strategies.

Source: NTT Ltd 2021 Technology Strategy Research





Data Intelligence

The increasing use of audio and video devices, automation and the growing instrumentation of industrial enterprise facilities mean that the amount of data they're generating continues to grow exponentially. Most organizations collect data from devices from many different vendor solution sets, each serving a different internal line of business or functional area.

Now, the question is how do you give context to your data sets, merge them with other internal systems such as your ERP and potentially also those of external partners or suppliers and then identify the correlations between what's happening in different parts of your factory floor, mine site, shipping port or healthcare facility?

Data management, analytics and visualization have been around for some time, but they've largely been carried out in non-real-time.

The true real-time imperative

The definition of real-time data in many enterprises has evolved from monthly or weekly reports down to daily and sometimes multiday updates driven by regular batch updates.

But today, that's too slow. We're living in a world that requires a true real-time enterprise – especially in the industrial data space.

One of the drivers for true real-time is customer demand. We live in an instant economy. We all use our smartphones to purchase goods and services and we expect every part of the supply chain to work seamlessly behind the scenes to ensure our orders are swiftly processed and fulfilled.

When we make payments, we expect them to happen instantly – the days when we accepted that it might take a few days for a payment to clear are long behind us.

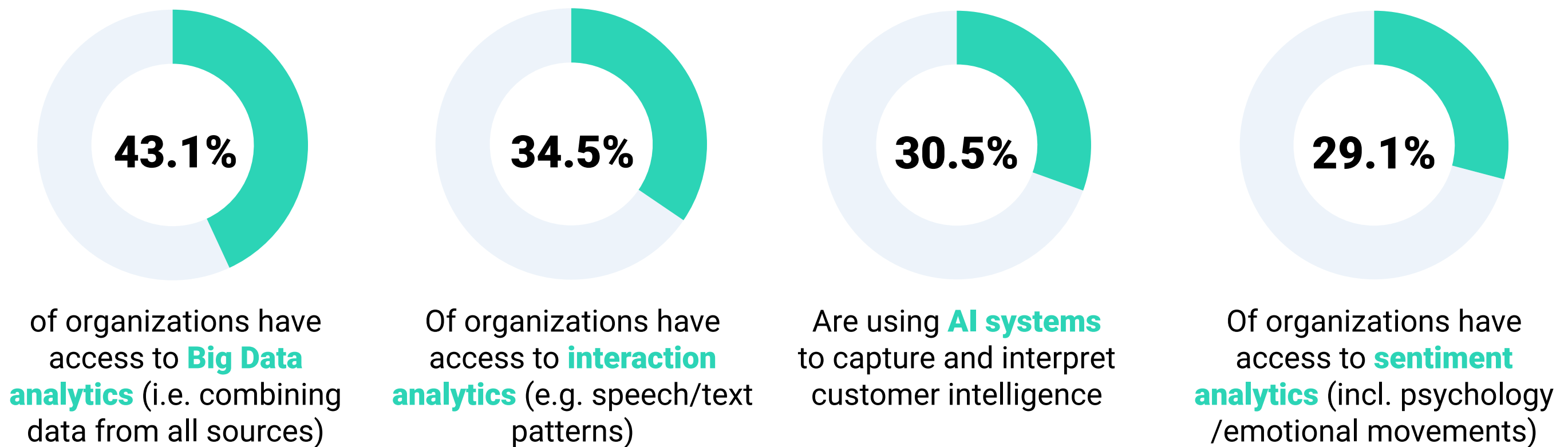
However, many of our enterprise data management tools and teams haven't yet moved to true real-time; they're still working in a batch model.

The vast majority (92.4%) of businesses now say data analytics is important to the organization's technology strategy.

Source: NTT Ltd 2021 Technology Strategy Research

So, now organizations need to uplift their data management capabilities from both a tools and skills perspective.

Organizations are failing to leverage modern data analytics systems for differentiating intelligence



Source: Economist Impact Executive Survey Report, Sponsored by NTT



Continuous intelligence

Gartner has coined the term ‘continuous intelligence’ to describe this state. It’s understood as an ongoing stream of intelligence (as opposed to just analytics or data) that’s being updated 24/7 and allows organizations to act on things that are happening within their operations using advanced automation and with a lower requirement for human intervention.

Not all industries are there yet. Many organizations are still running on-site operations control centers that require operators to walk the floor and check different sensors and machines and manually take measurements.

The model we’re moving to is one where people can log in from anywhere at any time to see the real-time status of the organization’s operations.

But while the enabling technologies are here, the skills required to understand and work with them are scarce in the market. It’s difficult for someone who has worked in a traditional batch data integration and management role within the walls of an enterprise data center to transition into a true real-time operational environment.

Security and compliance also need a rethink in this new data management paradigm. Once you start capturing more data in completely new locations, you increase your potential attack surface.

Security: beyond the firewall

And while enabling easy, remote and real-time access to enterprise systems from anywhere in the world delivers more flexible options in managing your operations, it can potentially introduce new security and compliance risks. If an unauthorized party were to successfully access that environment, they could also get full access to all that information from anywhere in the world. Previously they may have needed to compromise physical access controls and break into a building located at an enterprise site.

Right now, data privacy and compliance are the top challenges impacting data analytic capabilities and just 47.0% of organizations say they can access the required analytics on technology and security management performance.

Here again, the skills required to oversee this new operational model and plug any security gaps are hard to find. Most data professionals are accustomed to working within the traditional enterprise firewall, which, when correctly configured and managed, provides a strong line of defense. Thus, security has never been a huge area of concern for data management professionals in the traditional operations model.

But once we start extending data management beyond the enterprise firewall and out into the field or onto the factory floor to gather and process data – as well as to and from the cloud – security needs to be fundamentally reviewed. Now, organizations need to architect for security from the ground up.

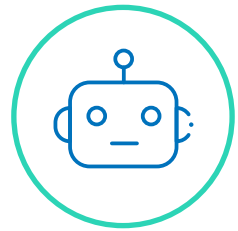
This includes establishing precisely what data your machines and devices are capturing, which data you really need to use and which data should (and should not) pass through different parts of the environment.

Data management and security teams need to work together more closely to identify potential vulnerabilities and develop new risk mitigation and data governance strategies.

In most cases, this introduces a significant training and upskilling challenge. It’s a complex one to solve and many organizations are looking to engage with a managed services provider with the right level of experience in securing this new data management model.

Right now, data privacy and compliance are the top challenges impacting data analytic capabilities and just 47.0% of organizations say they can access the required analytics on technology and security management performance.





Artificial intelligence and machine learning

As we touched on earlier, in the new, connected industrial world, one of the most pressing challenges is making your AI and ML operational in true real-time using your data pipelines.

Now, data scientists must use data sets to build predictive models that can surface useful predictions on performance or outcomes.

CEOs' top 3 benefits of AI and robotics

- 1 Improved efficiency (core business process automation)
- 2 Improved analytics
- 3 Increased speed of contact resolution

Source: Economist Impact Executive Survey Report, Sponsored by NTT

AI and ML meet DevOps

However, those activities still tend to be somewhat niche. Too often, a single specialist performs the task in a development environment or even on their own laptop, and they're the only one who knows how to execute it.

This makes the intelligence difficult to operationalize and embed in the entire enterprise data pipeline.

To address the problem, there's increasing attention on AI-Ops and ML-Ops, which essentially bring many of the concepts of DevOps to bear on the worlds of AI and ML.

The outcome is a model that can be embedded in the data pipeline that nobody then touches – it runs in the background day in and day out.

More than two in four (41.9%) of CIOs list lack of skills (e.g., data science/programming capability) as a main challenge.

Source: NTT Ltd, 2021 Technology Strategy Research

Again, this introduces a resource challenge because enabling this type of work requires a different type and combination of skillsets, including data engineering, data science and DevOps.

If this; then that

The true value is realized when you plug these intelligent capabilities together and turn them into action within your enterprise systems. Having predictive, real-time 'if this; then that' intelligence helps you drive the operational output, quality and efficiency outcomes you're seeking.

Let's consider how this plays out in an industrial setting. It could involve automating the process of making small adjustments to certain parameters on how machines are operating. It might be the ability to automatically trigger a service call to send out a technician to make a change that needs manual intervention. Perhaps it's an auto-generated alert to a shop floor operator to go and take a closer look at a piece of equipment. Or it could be the ability to flag the fact that a detected outage is going to create a downstream supply chain challenge – information that can be quickly communicated to those responsible for the affected downstream areas so they can proactively adjust or compensate for the interruption.

In this model, machines and humans work symbiotically to deliver maximum speed and efficiency – each performing the tasks to which they're best suited.

Achieving a fully optimized environment takes time and iteration.

- **Step one** on the agile innovation curve is monitoring your IoT environment to gain visibility of your operations.
- **Step two** involves doing some data analysis and trying out ways to optimize performance based on what you can see.
- In **step three**, you start to use some AI and ML to make those 'if this, then that' predictions and use them to initiate automated actions.
- And **step four** is enabling new products and business models based on data, AI and automation.



If you're setting out on this journey, be mindful that it may not be possible to jump straight to step four. Evolving capabilities over time will build the confidence of all the affected stakeholders in the business – and the wider supply chain ecosystem – to ensure that everyone is comfortable that the ultimate automation is indeed going to deliver the desired outcomes.

More than one in five organizations say robotics/AI are delivering beyond expectations for leaders is over 1 in 4.

Source: NTT Ltd, 2021 Technology Strategy Research

Be discerning with data; tune the machine

It's also important to be discerning with your data. Machine learning models need a level of expert input and tuning to define the most useful information and how it should be used. We can't assume that if we simply throw enough data at it, the model will figure it out.

You need to curate the data, tune the machine learning models and put some guardrails around their behavior to get the optimal outcomes.

Spotlight on: healthcare and manufacturing

The pandemic advanced the advantages of Industry 4.0 enablers into other industries. When it comes to comparing progress towards digital vitality in different sectors, our experience and recent conversations with clients indicate that manufacturing and healthcare are taking the lead and transforming fastest.

That's because digital technologies are solving some of the salient challenges that COVID-19 introduced for these two verticals. For example, in healthcare, remote medicine is being used to address skill shortages and automation of recurring tasks provides a much-needed path to free up time and focus of providers on care and improving the patient experience. In factory shop floors, robotics is saving man-hours and reducing energy consumption as well as CO2 emissions.

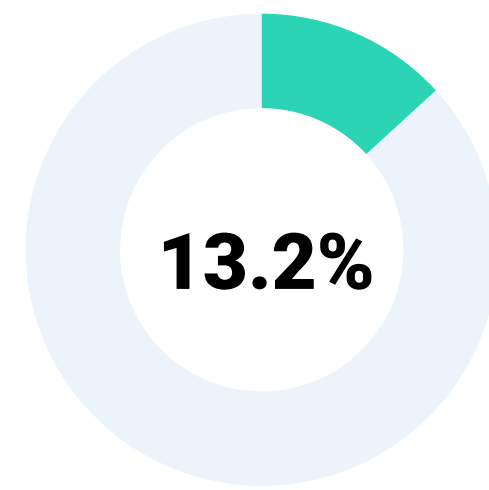
Not only do smart digital devices make work happen faster and more accurately, but they're also inherently more robust and easier to maintain than traditional machines and tools. Now, the requirement for these assets to be shipped to facilities to be upgraded or reconditioned, thanks to the software embedded in them.



Manufacturing is taking the lead

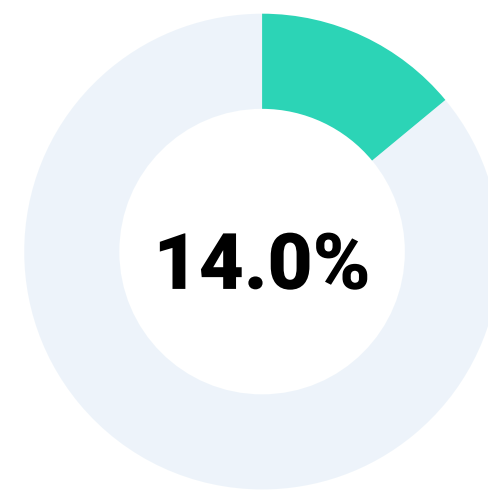
Organizations are failing to leverage modern data analytics systems for differentiating intelligence

Harvesting data



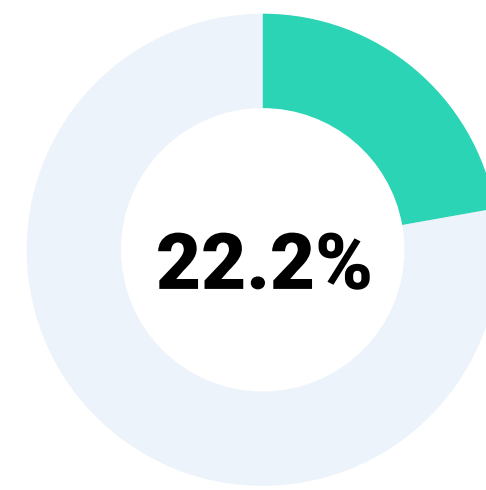
ahead of global benchmarks on developing **data management (incl. visualization & analytics)** to enable future business and technology strategies

5G connectivity



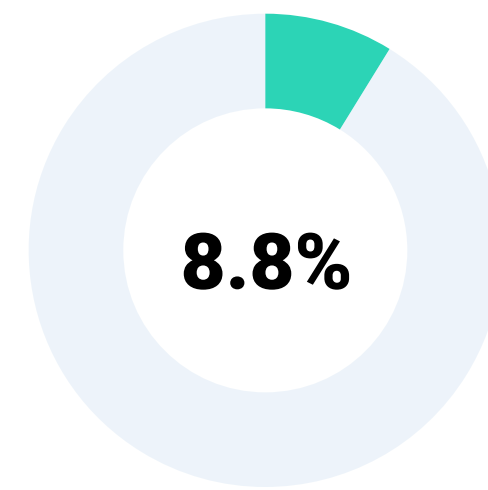
ahead of global benchmarks on developing **mobility (incl. 5G)** to enable future business and technology strategies

AI and ML



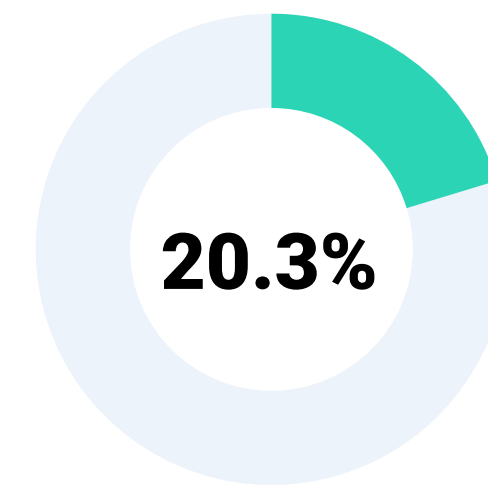
ahead of global benchmarks on developing **AI and ML** to enable future business and technology strategies

IoT



ahead of global benchmarks on developing **IoT** sensors to enable future business and technology strategies

Cloud



ahead of global benchmarks on prioritising **cloud solutions** in the next 12-18 months

To enable applications such as augmented reality at our mining and processing sites we require widespread, high-speed 5G connectivity. **A private 5G network is a great way we can do this cost-effectively and NTT was our first choice to pilot a design,** prove the technology and show the value. With a 5G network we're able to continue to seek out innovative solutions to some of our most pressing challenges.

Chuck Holley, Global Manager of IT Network Infrastructure

Manufacturing outperformed global benchmarks on **successfully pivoting strategy** in response to the pandemic by 10.5%.



Designing winning solutions

Just consider this statistic: Only 20.6% of organizations state that they have optimized digital transformation.

But at NTT, we take the view that there's no such thing as an optimized digitally transformed state. It's an ongoing and iterative journey.

And that means that high performance comes with ongoing conditioning. The digital transformation that advances the high-performance state is not an end point.

The shortage of skilled workers impacts productivity but also makes it difficult for organizations to transition quickly to new technologies.

Advancing digital transformation is forecast to accelerate the impact and absence of technology capabilities in the next two years.

Organizations currently anticipate a need for new skills in the following areas:

- Cybersecurity/threat intelligence – 63.3%
- AI/ML – 59.9% say skill needs will increase
- Data scientist/analyst – 56.0%

No surprise then that organizations are prioritizing partnering.

From transaction to trust

NTT's recent research reveals that 92.2% of organizations agree that a trusted technology partner is a key foundation for technology strategies.

But what is a trusted partner? We believe the dynamics of the most mutually rewarding client-service provider relationships include a move beyond transaction to trust.

Just 43.3% of CIOs agree strongly that technology partners understand their business strategy and what they are trying to achieve.

Source: NTT Ltd, 2021 Technology Strategy Research

We prefer to speak of a 'conditioning partner'. An independent third party that manages the conditioning for their client to achieve or maintain high performance as an enterprise by staying on top of their communications, 5G connectivity and data intelligence game.

Just 48.3% of CIOs say that their organization has the required IT vision to deliver against the business strategy.

Source: NTT Technology Strategy Research, Jan 2021

Think of it this way: think of an elite athlete from any sport that you follow or might play yourself. Even when they're breaking world records, they still have their elite coaches with whom they regularly engage to learn the best tactics to deploy to drive consistently high performance. Such a coach is responsible for staying up to date on the latest in muscle mechanics, rehabilitation and nutrition, etc. – all the elements that come together to ensure optimal performance while considering all the possible outcomes.

So, a conditioning partner doesn't just focus on the deployment of technology or engage in transactional outsourcing. They focus on ongoing, iterative and agile co-creation of value with their client, coordinating available leading digital technologies.

Advancing your 'digital vitality' means exploring the art of the possible through collaboration with providers that are committed to your journey via a thoughtful, pragmatic roadmap – all with a diligent focus on the outcomes for the business.

Top 3 priorities when making IT decisions:

- 1 Security
- 2 Innovation level approach (enabling digital transformation)
- 3 Costs

Source: NTT Ltd, 2021 Technology Strategy Research



NTT's approach to powering digital vitality

NTT helps its clients master the choreography between the physical and digital worlds through an agile innovation approach that's akin to high-performance conditioning.

The foundation of our **Agile Innovation Framework** is an empathetic understanding of the situation our clients operate in and a shared vision of the goals they're aiming for.

Before any solution is considered, our agile innovation consultants explore current challenges, business priorities and opportunities in workshops with our client's senior leaders, workforce and customers. By combining strategic top down-direction with a bottom-up approach, the team assures that interests are aligned, and a solid foundation exists for collaboratively implementing solutions that users love and make a real difference to the business.

We often see that the focus topics have substantially shifted from what they were a year or two ago. We understand that the pandemic heightened the requirement for businesses to respond effectively to rapidly changing situations if they are to survive and thrive in today's – and tomorrow's – fluid market environments.

We also examine our clients' operating models, seeking out opportunities to deliver value through connecting more devices and people, gathering more data and feeding that data into the relevant systems securely and quickly. There, it must be analyzed in true real-time and turned into prescriptive actionable intelligence that goes beyond merely boosting efficiencies but equally sparks ideas for innovation.

We emphasize that the path to success is adopting emerging technologies while concurrently optimizing existing assets and infrastructure. It's not a simple lift and shift operation.

Much more, we continue to witness a delicate choreography which sequences many changes in a short time while maintaining balance with day-to-day operations.

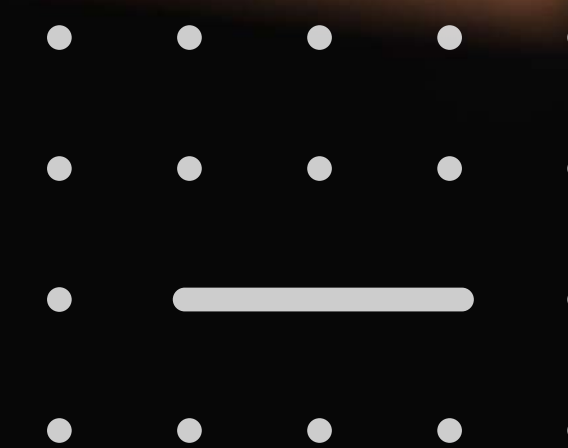
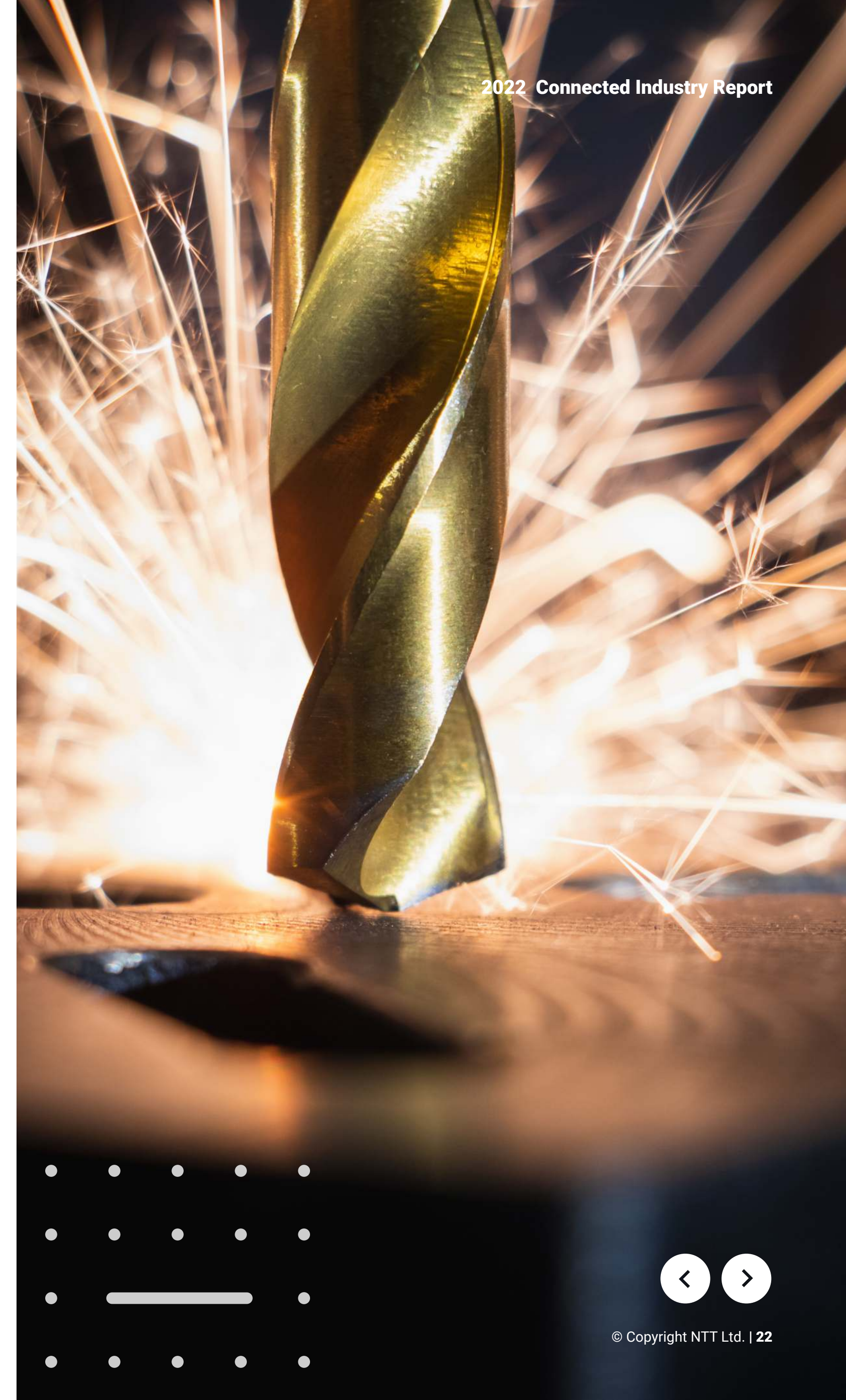
An important part of this exercise is assessing our clients' current digital physiology across multiple operational dimensions and how this informs the ways they can harness key technologies – what we call our Digital Vitality Index.

The **Digital Vitality Index** illuminates the fundamentals of how and where the client has leveraged digital capabilities and processes, or their absence. Combining this baseline with the **Agile Innovation Framework**, we determine a viable path to achieving the client's objectives through mapping key technologies to relevant KPIs. The framework charts a pilot-to-scale roadmap that demonstrates the value of a suite of technologies across a broader digital transformation strategy.

As we conclude a successful pilot, together with our client, we develop industry **Playbooks** that inform the ways that relevant outcomes can be achieved in additional sites or facilities across our client's global footprint. These Playbooks help our client's speed to market in deploying innovative technologies and processes to ensure that the initial investment optimally scales.

The combined elements of this framework support the 'high-performance conditioning' model we mentioned earlier – where enterprises consistently and constantly manage applied innovation and track how digital capabilities yield critical business outcomes.

The Digital Vitality Index illuminates the fundamentals of how and where the client has leveraged digital capabilities and processes, or their absence.



Closing thoughts

Building and sustaining a thriving Connected Industry enterprise is both an art and a science.

Global pandemics, political instability, sudden economic downturns, disruptions in the supply chain – these events all carry the weight of the unexpected and not only impact ongoing operations but also the transformation journey.

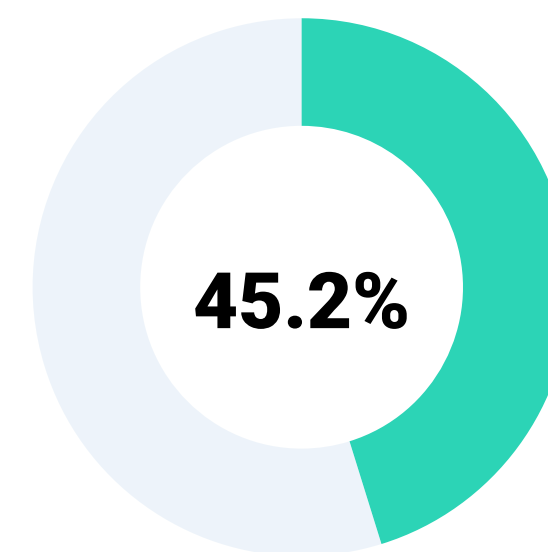
Truly digitally vital organizations will continue staying ahead of the game despite changing world conditions.

With the relevant enabling technologies ready to be accessed and a high-performance conditioning partner at their side, their transformation journey will lead to new heights and new frontiers that advance prosperity for all.

Earn the right to win

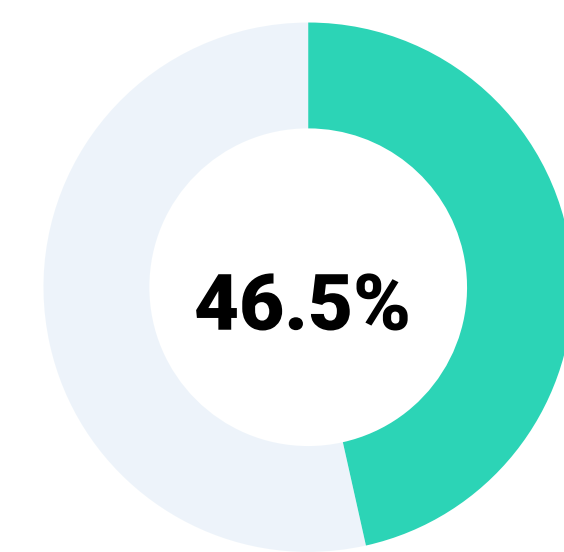
Some organizations are more aggressively accelerating their digital modernization

Leaders



of CIOs believe **emerging technologies, including IoT, 5G, and edge computing**, will have most impact on reshaping and improvement of their organization's CX capabilities in next 18 months

Laggards



Agree same, but see it as a part of a longer term 5-year plan

Where do you want to be?



Research methodology

Insights driven by data

Research approach

The 2022 Connected Industry Report is based on primary research data sourced via a random sample of online panel participants. All participants were decision-makers or influencers involved in shaping and design of their organization’s technology strategy and/or private 5G network approach.

The Report was formed around two research elements.

1. NTT Ltd, 2021 Technology Strategy Research: conducted for NTT Ltd. by Jigsaw Research, an international strategic-insight agency with an exclusively senior team and compiled in three phases during 2021.

Comprising more than 1,000 interviews, the sample spans more than 20 countries, 14 industry verticals and was spread evenly across C-level, director/head of, and senior management roles. It includes executives and representatives from c-suite, technology, cybersecurity, and business operations.

2. Economist Impact Executive Survey Report, sponsored by NTT Ltd: conducted by The Economist Group in late 2021.

Comprised from 216 interviews, in 7 industry verticals, across four key markets. 62.5% of respondents were from the c-suite, with 9.7% at EVP/SVP/VP and 27.8% from head of/director roles.

The report is designed to offer context on the research data results as well as subject-matter insights and recommendations on best practices from people who work in the industry. These experts have a first-hand view of how the industry is changing, where it’s headed and what this means for organizations.



The Economist data referenced in this Report is featured in an executive survey report developed by Economist Impact and is supported by NTT. The views and opinions expressed in that publication are those of Economist Impact and do not necessarily reflect the view and policies of NTT.

Research methodology

Data integrity, validation and analysis are performed by our research partners in conjunction with NTT Ltd.'s specialist in-house Primary Research and Benchmarking Team. Data and outliers are validated in accordance with standard research industry rules, disciplines, and best-practice approaches.

Research data

All the 2021 NTT Ltd Technology Strategy Research data used in the 2022 Connected Industry Report can be accessed via our online [Benchmarking Data Portal](#).

About NTT

NTT Ltd. is a leading, global technology services company. To help our clients achieve their digital transformation goals, we use our global capabilities, expertise, and full-stack technology services delivered through our integrated services platform.

As their long-term strategic partner, we help them enhance customer and employee experience, transform their cloud strategy, modernize their networks and strengthen their cybersecurity. And across their transformation priorities, we automate their business processes and IT, drawing insights and analytics from their core business data. As a global ICT provider, we employ more than 50,000 people across 57 countries, trading in 73 countries and delivering services in over 200 countries and regions. Together we enable the connected future.

Visit us at services.global.ntt

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