



The Acceleration of Industrial Autonomy and Its Impact on Sustainable Manufacturing

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Introduction

In 2020, Yokogawa published the results of a survey that highlighted a significant shift to industrial autonomy, with as many as 89% of companies planning to increase the level of autonomy in their operations.

Building on the valuable insights of this research, Yokogawa commissioned a further study in 2021 to gain an in-depth industry perspective on how major manufacturing companies are implementing industrial autonomy. This report delivers the key findings and insights from the 2021 survey.

The Survey

The “Global End-user Survey on the Implementation of Industrial Autonomy” was conducted on behalf of Yokogawa by research company Omdia in September 2021 amongst **534 respondents from 390 companies across seven global markets and seven different industry sectors**, and comprised of 20 questions that probed for insights into:

- the impact of industrial autonomy
- levels of deployment
- readiness of technologies
- decision-makers
- impact on employment
- challenges faced

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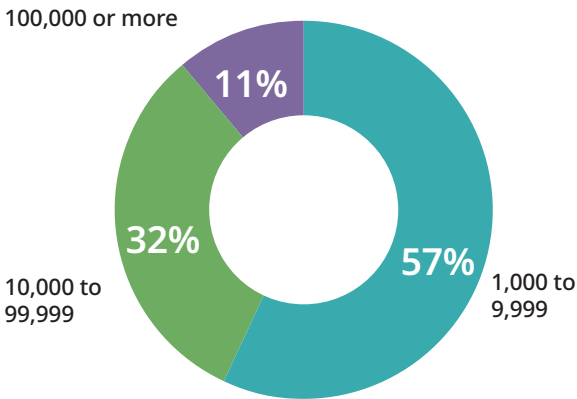
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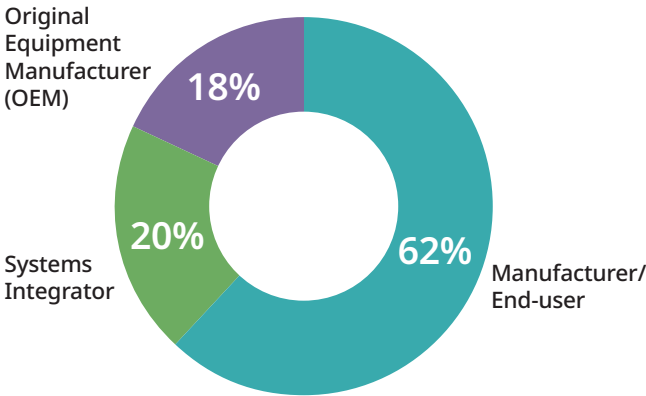
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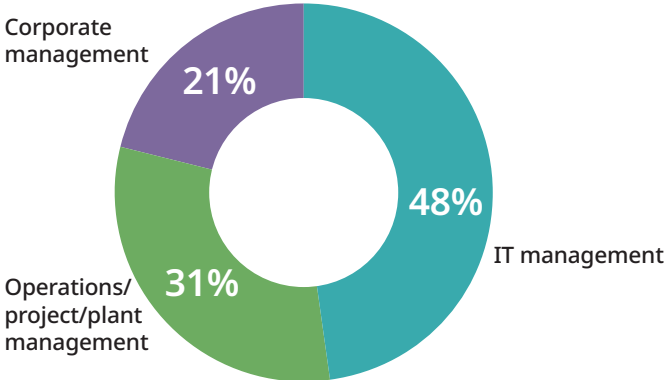
Company workforce size



Company type



Job function



n=534

Global Markets

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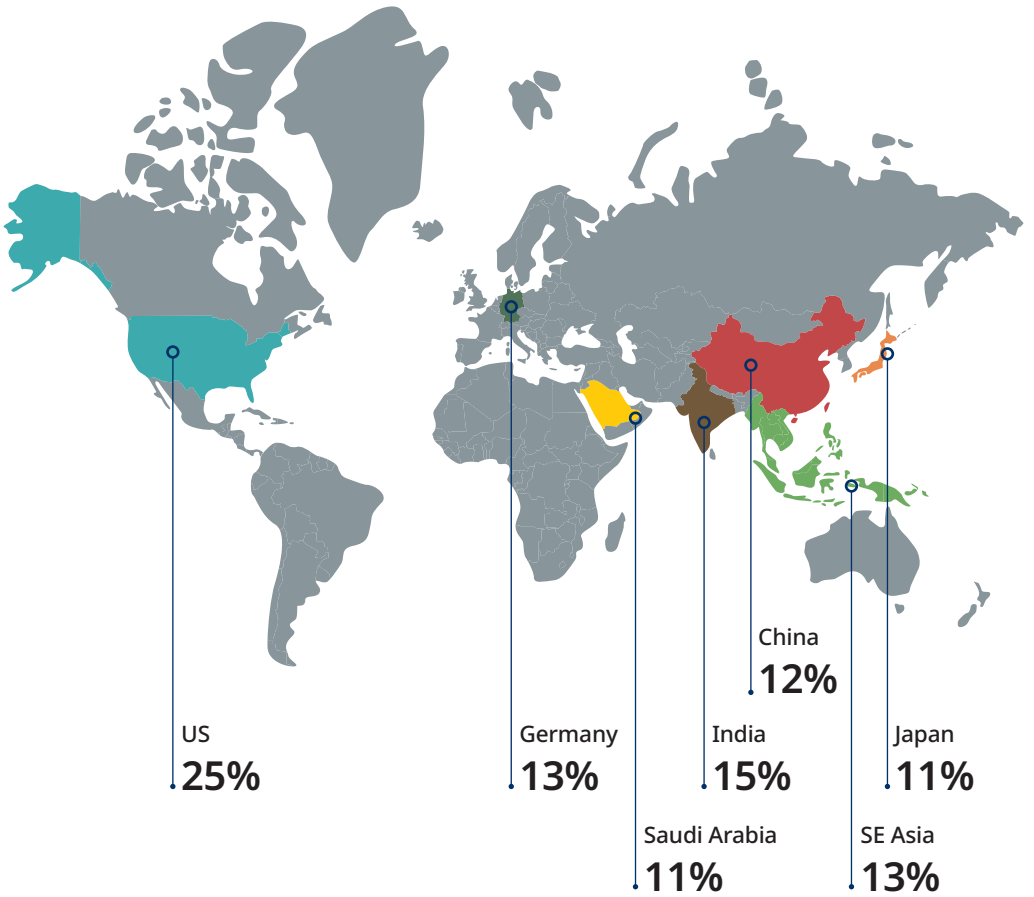
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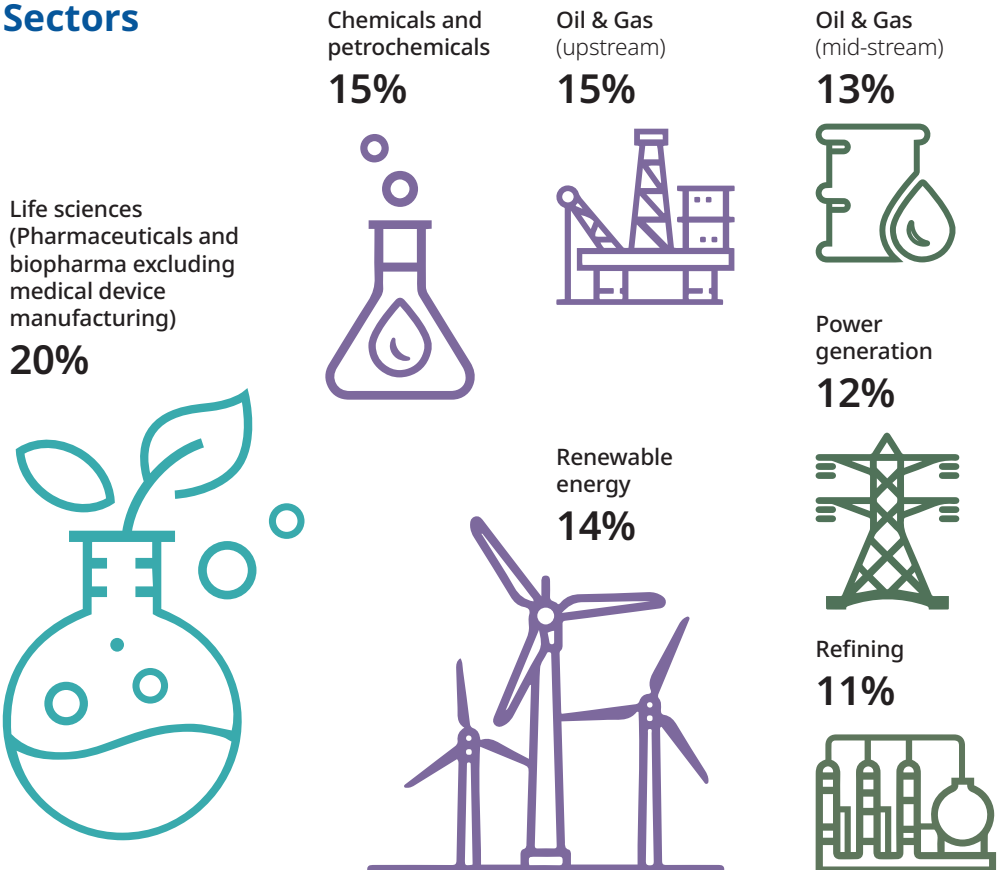
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Industry Sectors



Environmental sustainability emerges as an area in which industrial autonomy is expected to make a significant positive impact

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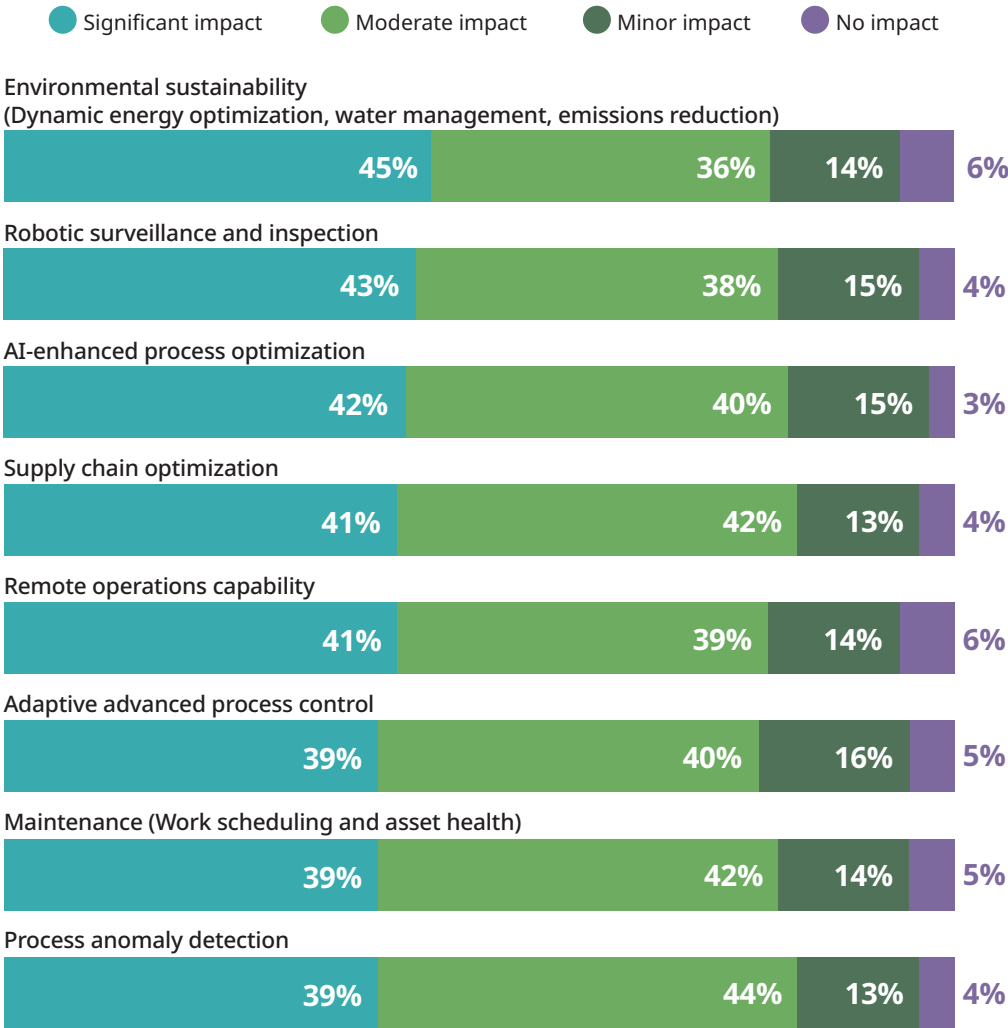
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Aligned with a global focus on the greening of industry and a drive towards more sustainable manufacturing processes and operations, the survey reveals that 45% of respondents expect industrial autonomy to have a significant impact on environmental sustainability improvements in the plant. Only 6% expect industrial autonomy to have no impact at all on environmental sustainability.

When asked specifically about sustainability, respondents indicated that high levels of positive impact are expected across energy management, worker safety, greenhouse gas reduction and waste reduction.

These findings reveal the developing industry recognition of industrial autonomy as a way to achieve environmental impact reductions and sustainability goals.

What level of impact are you expecting industrial autonomy will have on the following applications in your plant in the next 3 years?



Percentages in charts may not total 100% due to rounding.

What level of positive impact do you believe industrial autonomy will have on the following sustainability categories?

High impact Moderate impact Low impact No impact

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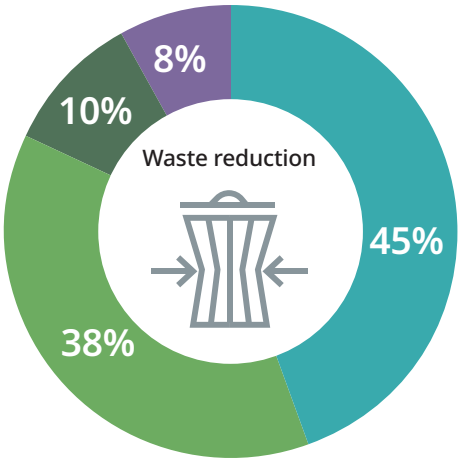
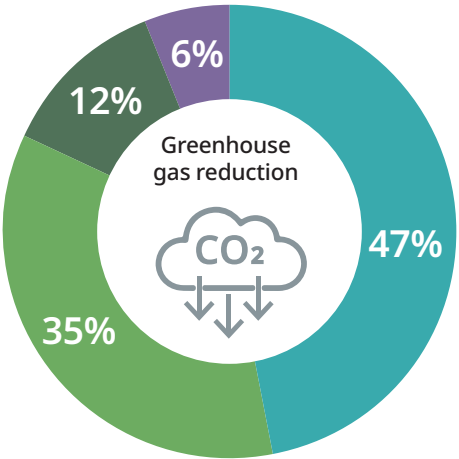
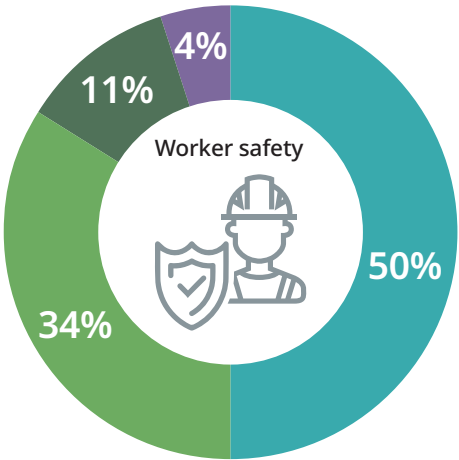
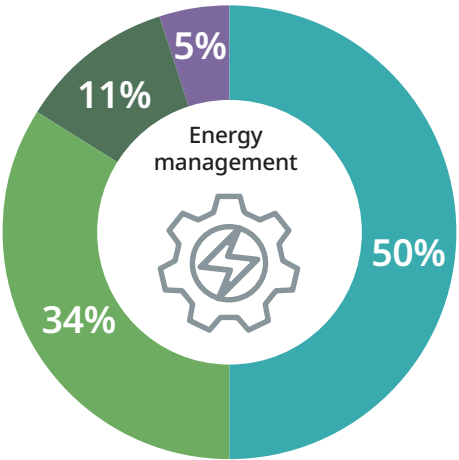
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Acceleration of industrial autonomy deployment

Due to the expected positive impacts of industrial autonomy, more than a third (37%) of respondents have already implemented multi-site industrial autonomy projects, and 31% have implemented single-site projects, specifically for environmental sustainability, encompassing dynamic energy optimization, water management, and emissions reduction.

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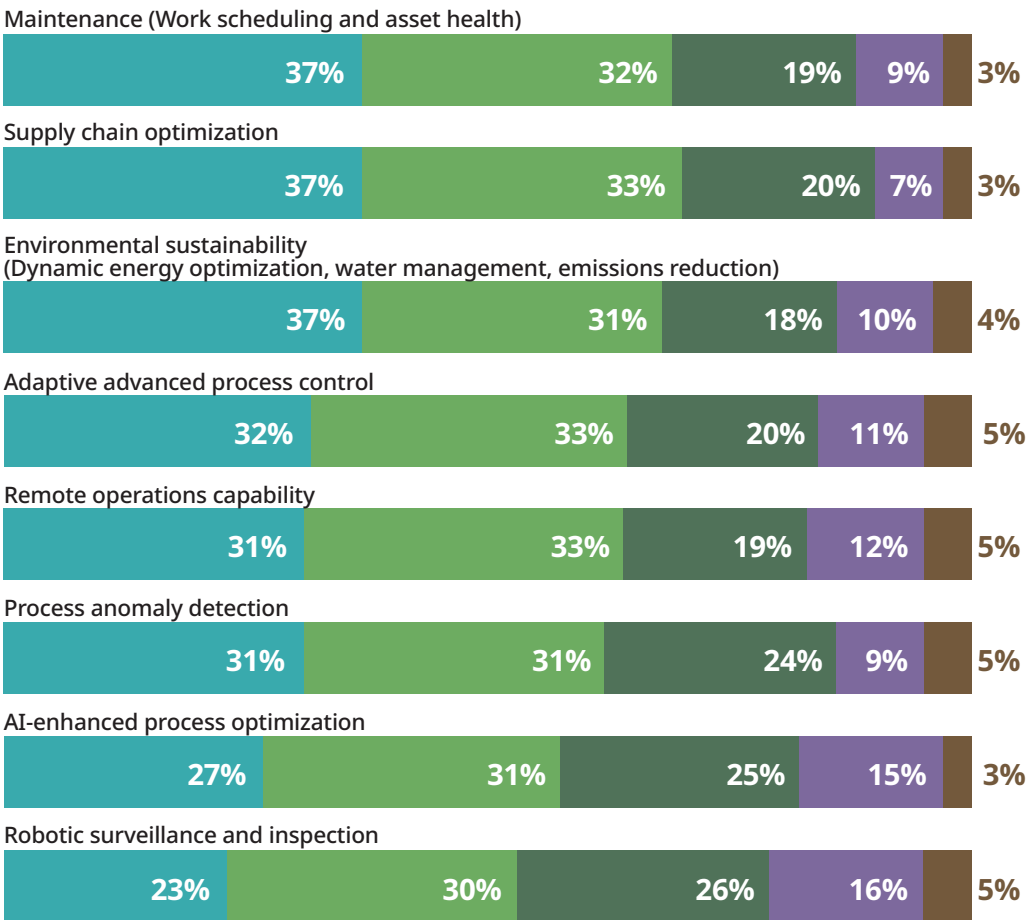
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Which best describes your company's current phase in introducing the following applications to its plant as it relates to industrial autonomy?

Implemented (multi-site) Implemented (single site) Currently piloting Plan to begin within three years No plans



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More than half of manufacturers are starting to deploy some level of industrial autonomy

The 2020 Yokogawa survey revealed that 30% of process industry companies had implemented autonomous operations and 30% planned to begin them in the next three years. This trend seems to be accelerating, with 51% of the manufacturers surveyed in this year's study now scaling deployment of industrial autonomy across multiple facilities and business functions, and another 19% having deployed this in at least one facility or business function.

Further confirmation of this acceleration can be seen in the companies that are not engaging in industrial autonomy. In the 2020 Yokogawa survey, 7% reported that they had no plans to implement autonomous or semi-autonomous operations, whereas all the manufacturing companies surveyed in 2021 are now actively considering industrial autonomy of some kind.

Clearly companies are starting to deliver on their intention to deploy industrial autonomy, driving an increase in adoption and implementation, although there remains considerable scope for broader deployment.

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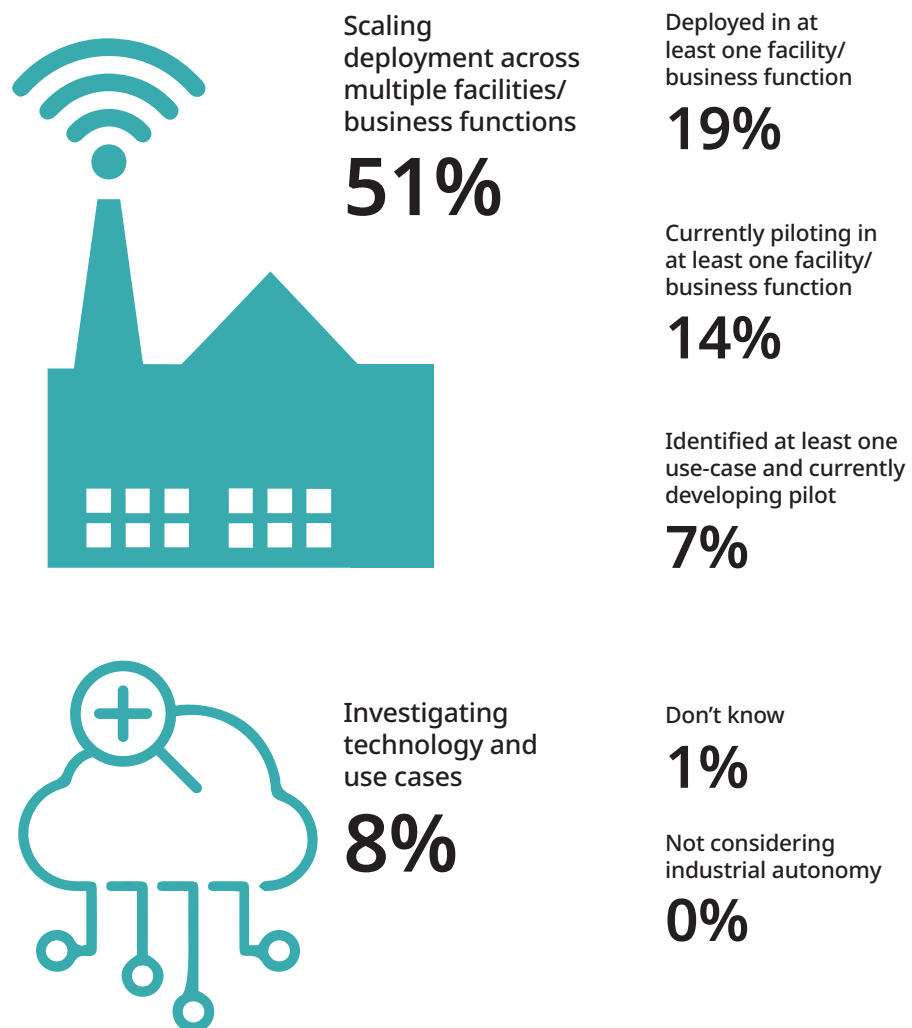
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What is the state of industrial autonomy in your company today?



ROI from digital transformation to come mainly from manufacturing and production improvements, but ROI from health, safety and environment emerging

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Productivity improvements in production/manufacturing processes are expected to deliver the highest ROI resulting from investments in digital transformation over the next three years, with 31% ranking this first and a further 20% ranking it second.

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However, health, safety and environment is emerging as another area of significant ROI, with 26% ranking it first (13%) or second (13%) as the area for greatest ROI resulting from investment in digital transformation in the next three years.

Deployment acceleration

Improvements in manufacturing and production process represent the primary area for ROI from investments in digital transformation, but there is a rising significance of ROI related to health, safety and environment benefits.

Digital transformation ROI

In which areas will Digital Transformation (DX) investment have the largest ROI over the next 3 years in your company?

Technology readiness

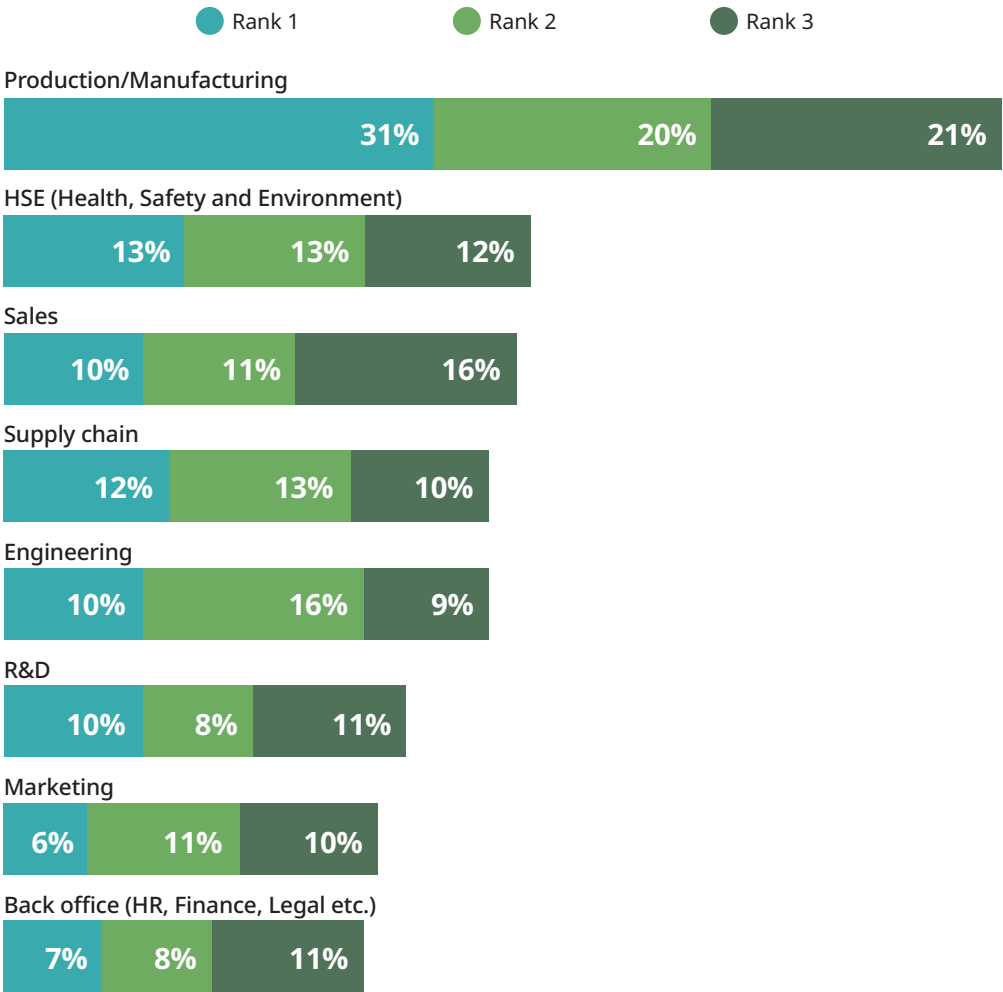
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Technology is ready to support large-scale industrial autonomy deployment

Technology readiness is a critical factor in successful industrial autonomy deployments. The survey revealed that the cloud is ranked as the technology area most ready to support industrial autonomy, with 36% of respondents citing that the cloud is mature enough to support large scale deployment and 34% quoting it as a mature technology ready for certain use cases of industrial autonomy.

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Other technologies such as distributed ledger/block chain, edge devices, AI, robots, and digital twins are most commonly cited as being mature enough for certain use cases.

Environmental sustainability

Technologies are generally ready for industrial autonomy with cloud leading the way.

Deployment acceleration

How do you perceive the readiness of the following technologies to support industrial autonomy?

Digital transformation ROI

Technology readiness

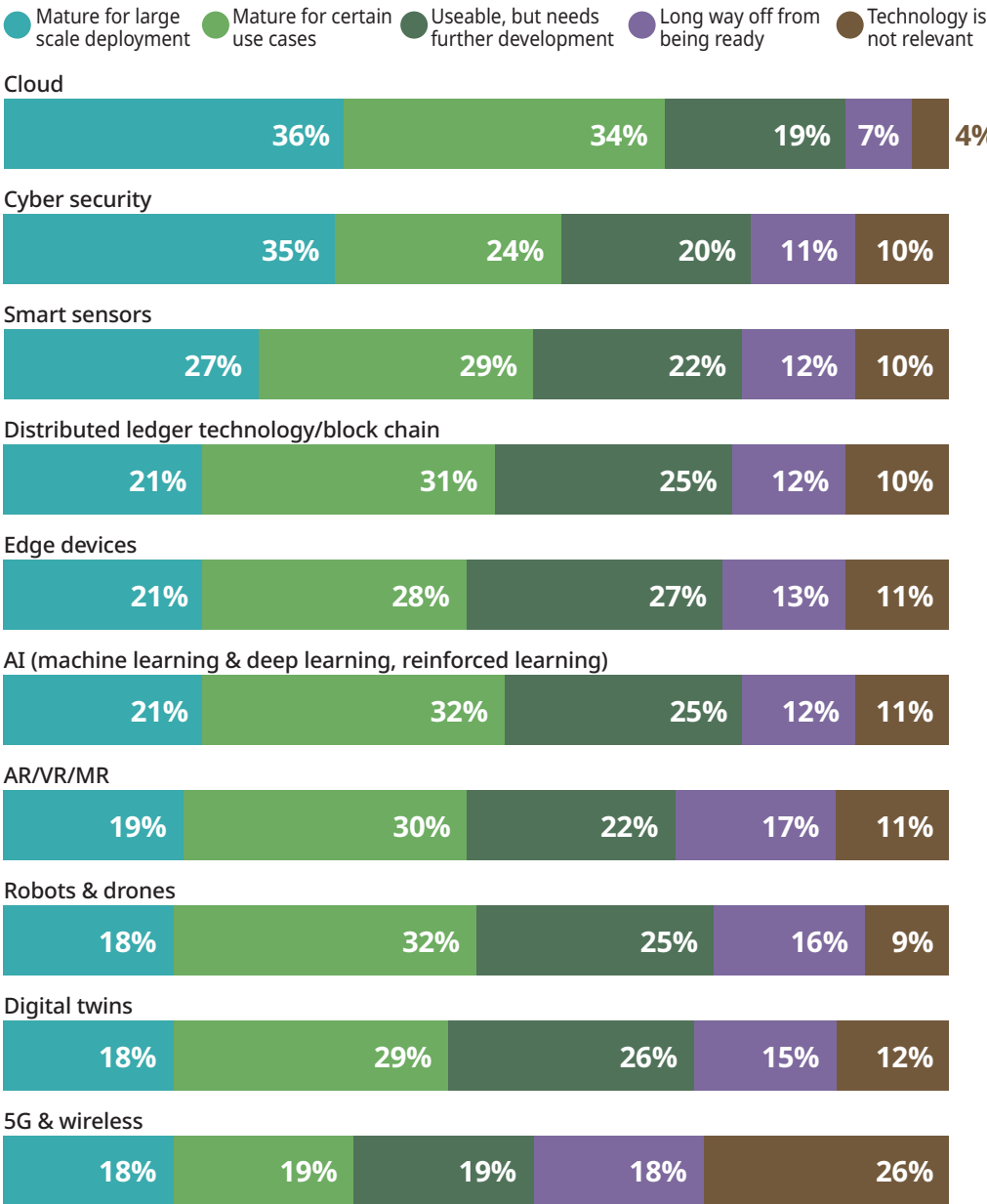
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Need for remote operations a catalyst for industrial autonomy, but is COVID-19 a factor?

Increasing the level of remote operations in manufacturing processes represents an important factor in industrial autonomy. The 2020 survey showed that as a direct result of COVID-19, more companies are looking to invest in remote operations. The ongoing impact of the COVID-19 pandemic is likely to continue to drive the adoption of remote working and autonomous operations.

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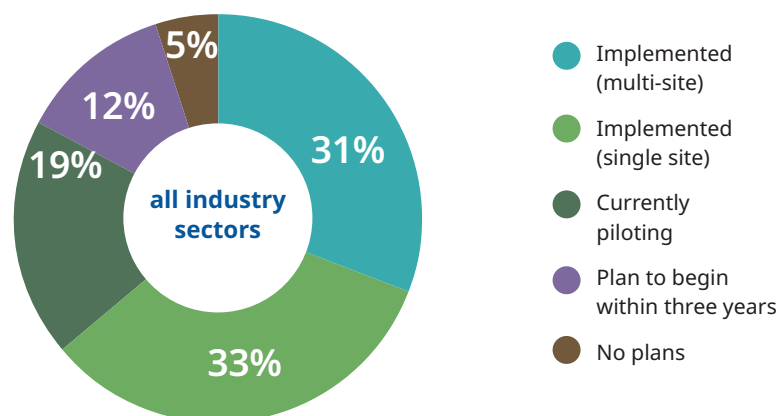
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One third (33%) of manufacturers are deploying remote operations in single sites and 31% are implementing it across multi-sites in connection to industrial autonomy. Furthermore, 41% of manufacturers expect industrial autonomy to have a significant impact on their remote operations capability.

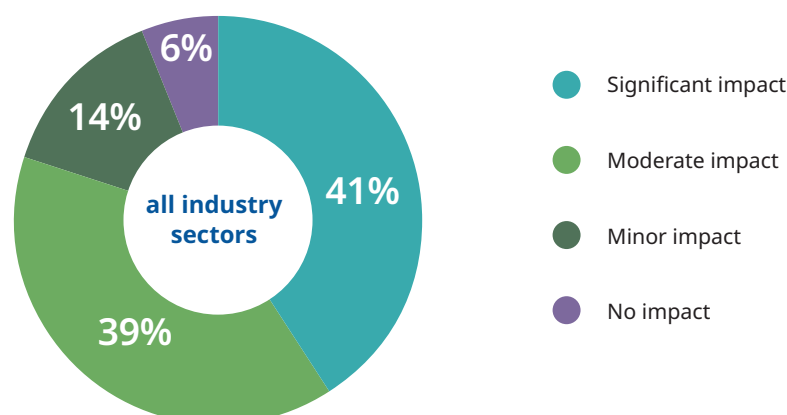
A greater necessity for remote operations in a post-COVID manufacturing environment is integral to the introduction of industrial autonomy.

Remote Operations Capability

Which best describes your company's current phase in introducing remote operations to support industrial autonomy?



What level of impact are you expecting industrial autonomy will have on the remote operations capability in your plant in the next three years?



Percentages in charts may not total 100% due to rounding.

The importance of the C-suite in industrial autonomy decision-making

The survey shows that the Chief Executive Officer plays a key role when it comes to implementing plant level autonomy, with 38% of respondents ranking the CEO as most influential in decision-making. The Chief Technical Officer (34%) and Chief Information Officer (31%) are also seen as key decision-makers, showing the prevalence of C-suite involvement.

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Senior-level technical professionals provide important support to these decisions, with 43% saying the Chief Digital Officer has a significant influence on plant level autonomy decisions.

Industrial autonomy deployments are typically significant capital investments that fundamentally change working processes, and it is clear that decisions on them are made in the boardroom, and are influenced by senior-level technology professionals.

Deployment acceleration

What level of decision-making influence do each of the following roles in your company have on plant level autonomy?

Digital transformation ROI

- Primary/final decision maker
- Significant influence
- Some or moderate influence
- Limited influence
- No influence
- Unknown N/A

Technology readiness

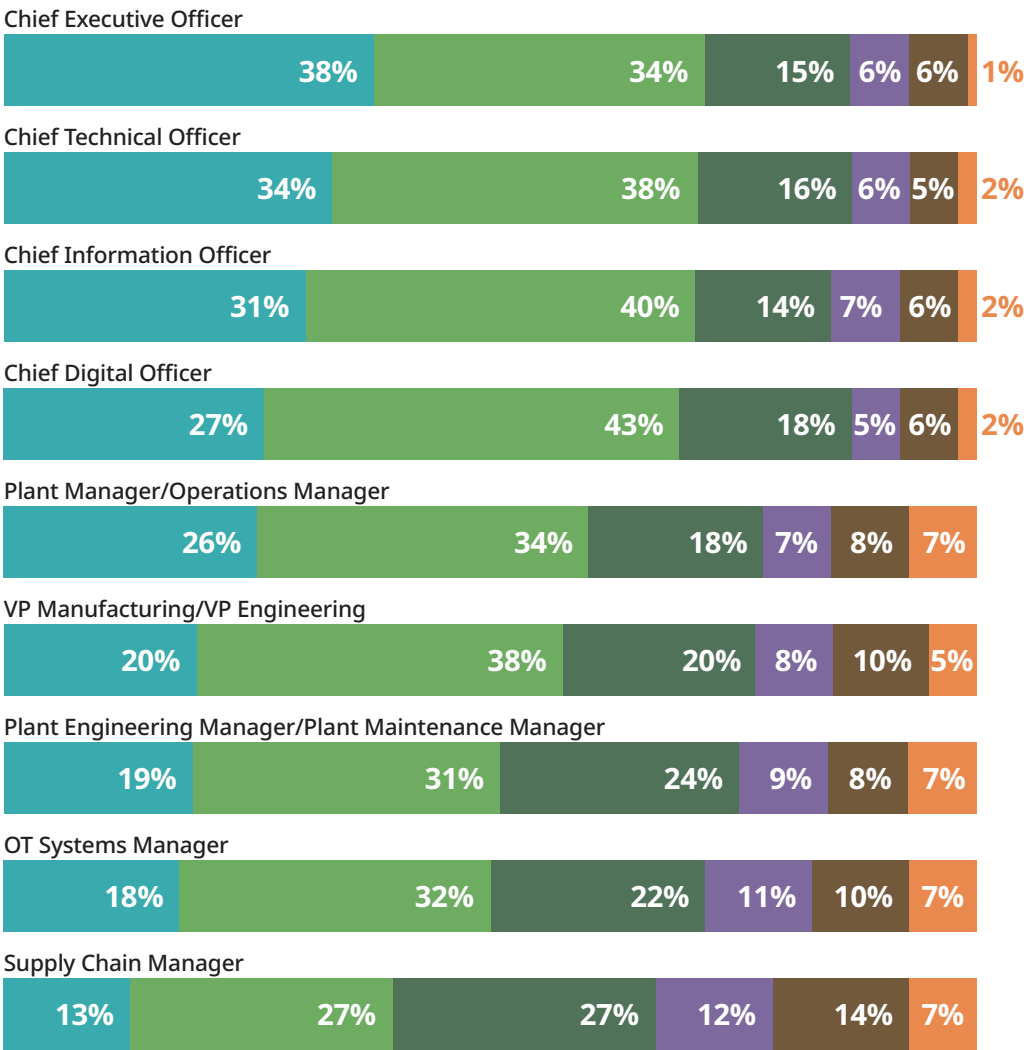
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Industrial autonomy augments and extends workers' roles

The general assumption that increased industrial autonomy, with self-governing systems and higher levels of autonomous operations, will lead to loss of jobs is challenged by the findings of the survey. In fact, according to the respondents, there will be greater emphasis on industrial autonomy creating new opportunities for the evolution of roles.

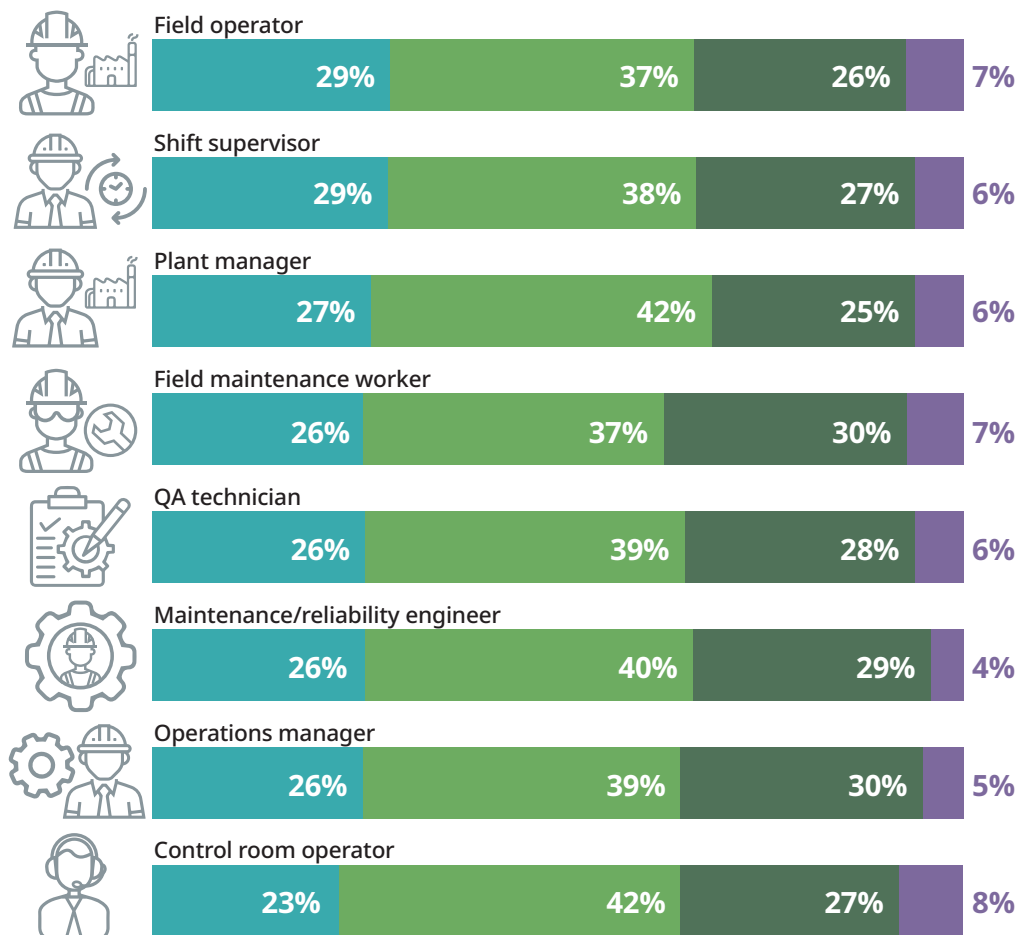
Across eight key roles in a manufacturing plant, an average of 40% will require some retraining and an average of 28% will require extensive retraining as a result of industrial autonomy implementations. Over 26% will see minimal impact from industrial autonomy or remain unchanged, whereas only 6% of these roles will be eliminated.

The survey also shows that 58% of respondents see industrial autonomy/autonomous operations as systems that augment human tasks, provide decision-making assistance, and adapt to changing conditions.

The survey indicates that fears around industrial autonomy causing workforce reduction are unfounded, with greater emphasis on opportunities for skills enhancement.

How will industrial autonomy impact the following job roles in your company?

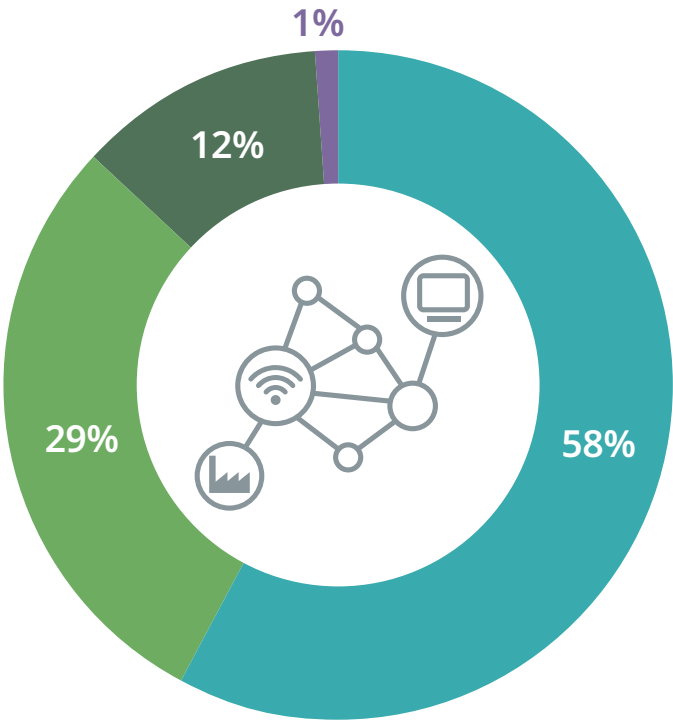
- Minimal impact: role largely unchanged
- Extension of existing role: some retraining required
- Significant change of existing role: extensive retraining required
- Reduces or eliminates need for role



Percentages in charts may not total 100% due to rounding.

Which of the following best aligns with your understanding of how industrial autonomy/autonomous operations can be applied to your business?

- A system with extensive automation which also augments human tasks, provides decision-making assistance, and adapts to changing conditions
- A self-governing system that requires no or limited human intervention
- A natural extension to our digital transformation efforts
- No practical applications at this time



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Next steps for industrial autonomy deployment, challenges to overcome, and what to look for in a partner

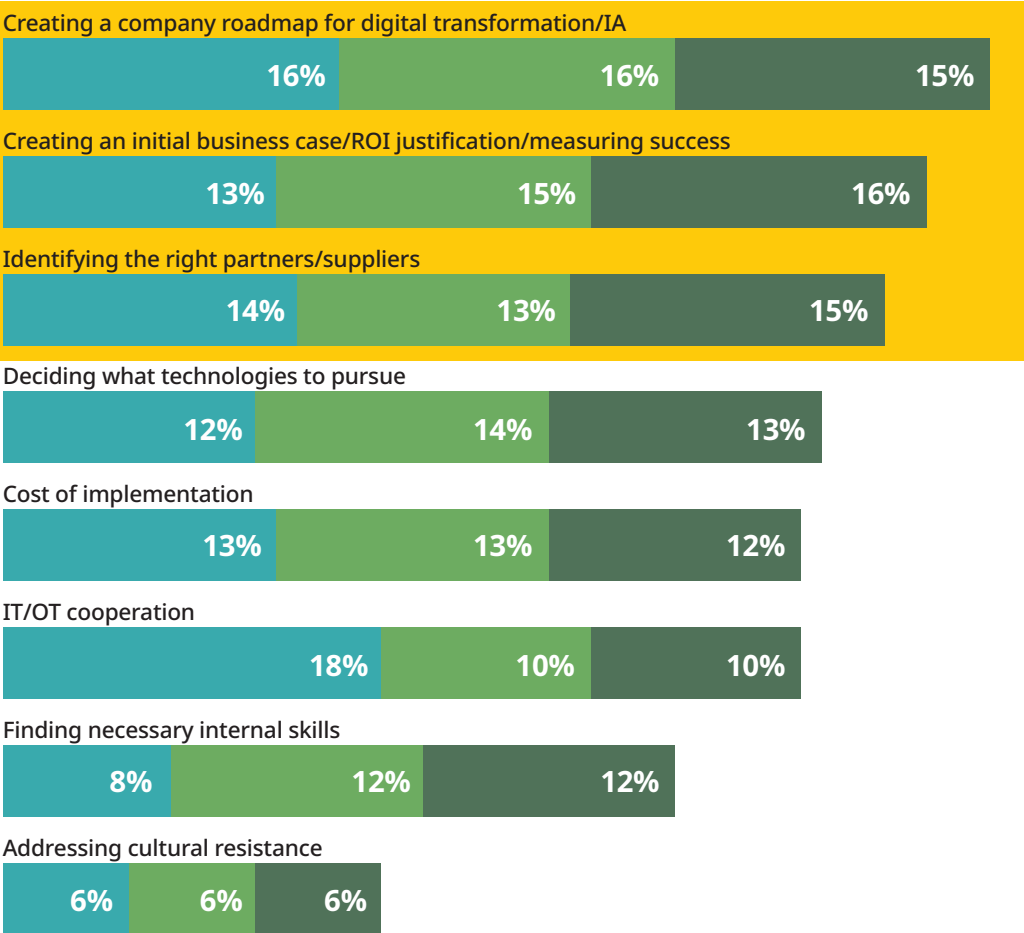
In ranking the top three challenges in implementing industrial autonomy and digital transformation, 47% of respondents quote the ability of their company to set a clear roadmap, 44% state building a strong business case, ROI justification and measuring success, while 42% rank finding the right partner or suppliers as a top three challenge.

When looking for the right partner, the most important criteria is a clear technology vision and strategy, with almost two-thirds ranking this in their top four as the most important competencies/capabilities expected. Technology integration capability and support for both OT and IT departments are also top criteria.

The survey identifies that knowledge of how to deploy industrial autonomy, making a financial case for it, and having a partner to resolve these challenges are seen as more important than cost, which is ranked only fifth as a significant challenge.

Rank the three most significant challenges in implementing industrial autonomy in your company

● Rank 1 ● Rank 2 ● Rank 3



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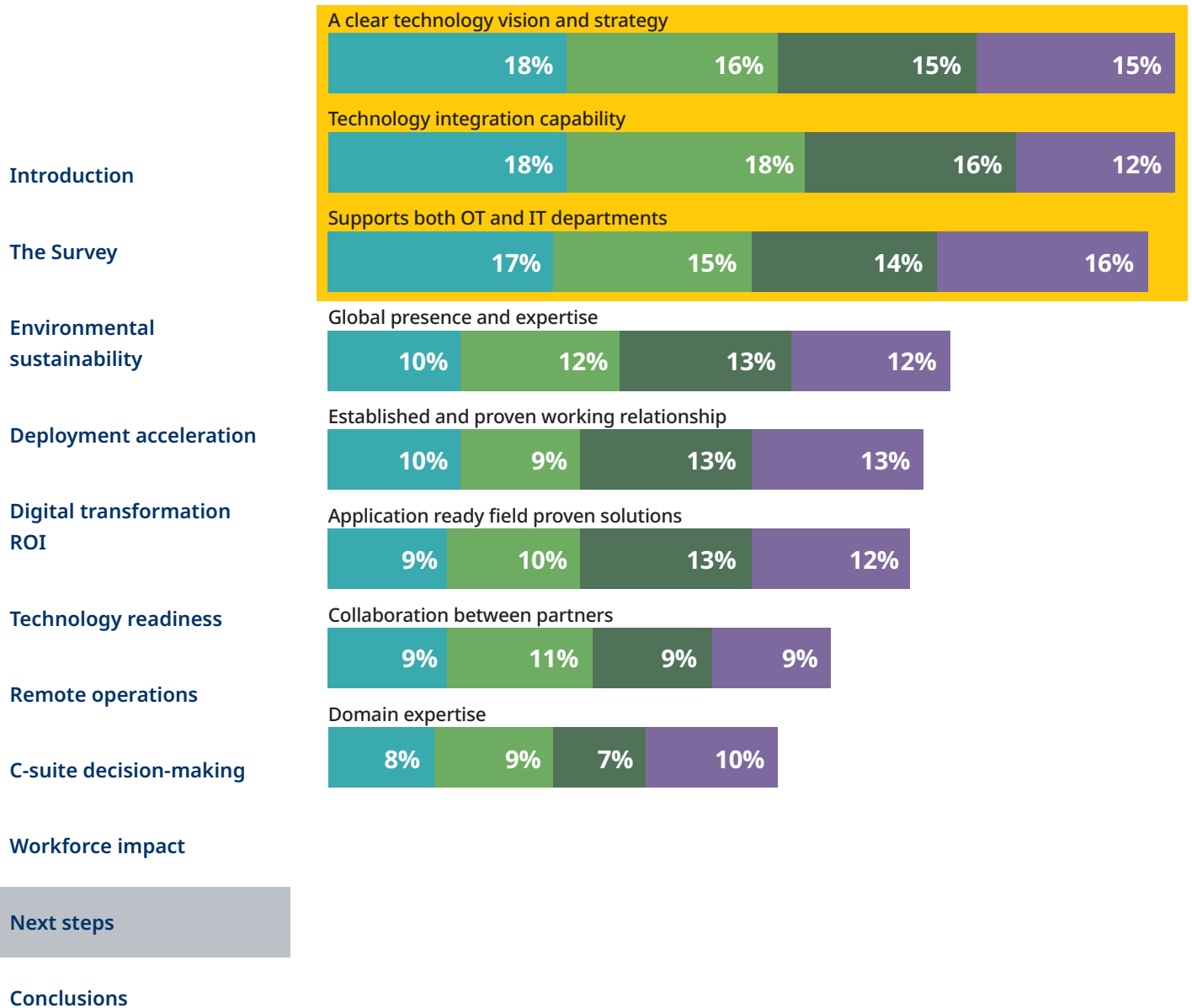
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What are the most important competencies/capabilities you expect from a partner for industrial autonomy?

● Rank 1 ● Rank 2 ● Rank 3 ● Rank 4



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The survey provides valuable insights into how major manufacturing companies are implementing industrial autonomy across the globe and across industries.

The survey findings deliver important data that inform us of the reasons why manufacturers are implementing industrial autonomy, how advanced they are in their deployment, the key challenges they face and what they are looking for in a partner on industrial autonomy development.

Our key conclusions from the study are:

- The deployment of industrial autonomy is starting to accelerate, with environmental sustainability now seen as an area of important and significant impact.
- Significant ROI benefits in production and manufacturing process operations are expected due to the application of industrial autonomy and digital transformation solutions, with Health, Safety and Environmental emerging as an ROI impact area.
- There are healthy levels of technology readiness to support large scale industrial autonomy deployment, with the cloud leading the way.
- The need to implement remote operations, likely driven by the pandemic, is a catalyst for industrial autonomy deployment.
- Industrial autonomy decision-making at the plant level lies with the C-suite.
- Companies believe that industrial autonomy will lead to an expansion in job roles, with some skills enhancement required. Few companies feel industrial autonomy will eliminate jobs.
- The right partner with a strong vision is key in order to develop a roadmap and make a strong business case.



Yokogawa Electric Corporation

Market Intelligence Center, Integrated Communications Center

Marketing Headquarters

2-9-32 Nakacho, Musashino-shi, Tokyo 180-8750, Japan

www.yokogawa.com

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