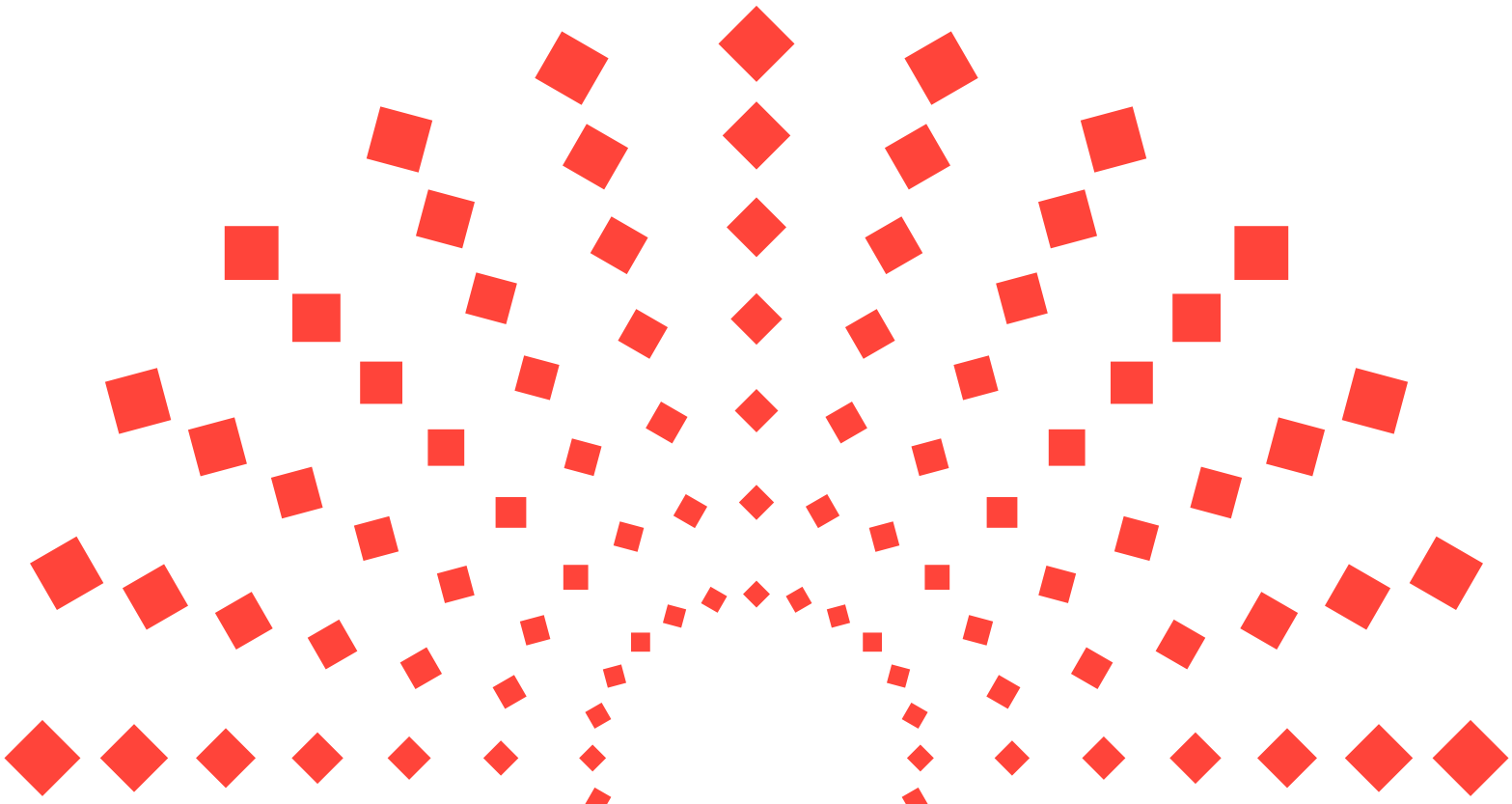
QNX

Report

Inside the Robot: Architecture Benchmark Report

2026



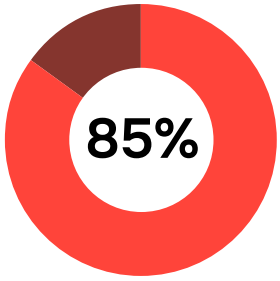
Foreword

The Evolving Role of Software in Robotics

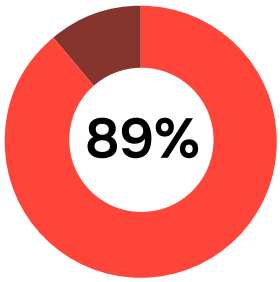
This is a period of extraordinary change and innovation in robotics, as technologies that have advanced at a remarkable pace during the past 20 years are augmented by the rise of effective AI innovations, including highly capable and consistent physical AI systems.

Yet, software developers and engineers working with robotics face greater pressures than ever before, as they try to harness the potential of deterministic real-time execution within systems safely, for use alongside people in a wide range of use cases. They must do so while ensuring unprecedented levels of precision and safety, complying with an ever-evolving range of exacting industry standards and regulations, and mitigating against a long list of risks including cybersecurity threats that never sleep.

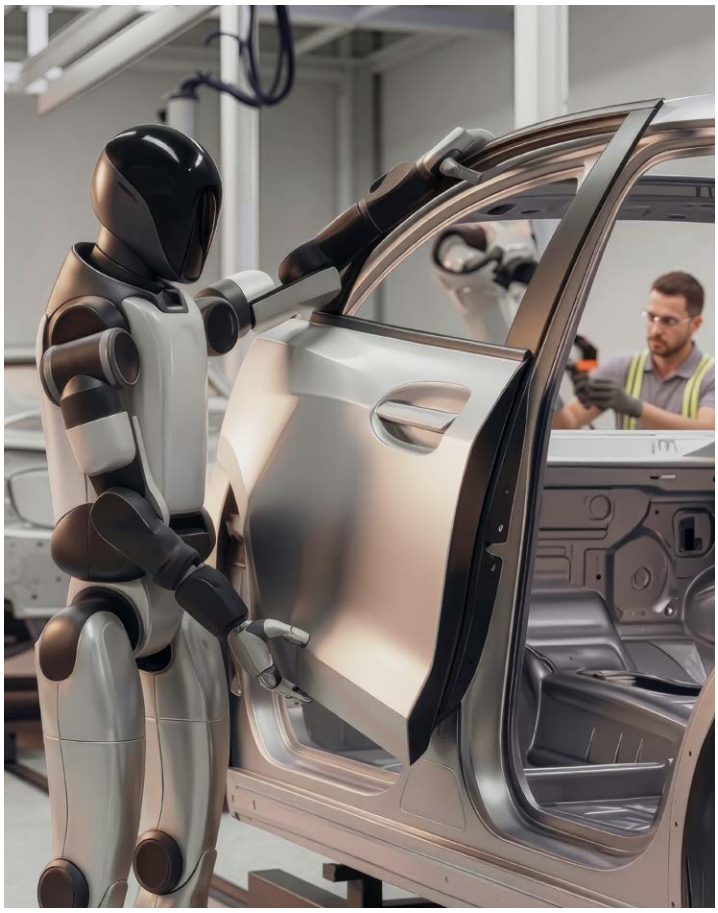
Against this backdrop, we surveyed 1,000 software developers and engineers working on commercial robotics programs across North America, Europe, and Asia, to better understand their challenges as software architectures and development processes evolve.



of developers and engineers expect the role of software within robotics to increase during the next three to five years



believe physical AI-based robotics will be critical to their robotics strategy during this time



Their responses confirm the growing dominance of software architectures within robotics systems and underline the need to invest in architectures capable of meeting future demands for robotics systems. More than eight out of ten developers and engineers (85%) across all seven countries surveyed expect the role of software within robotics to increase during the next three to five years, and almost nine out of ten (89%) believe physical AI-based robotics will be critical to their robotics strategy during this time.

Overall, our research results reveal a picture of an industry filled with innovators trying to recalibrate strategies and processes on the cusp of a new age in robotics. These are uncertain, but very exciting times.

Jim Hirsch
Global VP of Sales, General Embedded Markets at QNX

Executive Summary

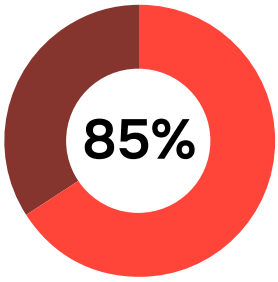
Hybrid architectures comprising safety controllers, vision and main computers, and microcontrollers, dominate robotics software architectures:

64%

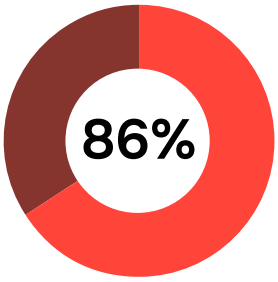
of respondents surveyed use hybrid architectures

9 out of 10

businesses use a general-purpose OS to run at least some real-time or safety-critical tasks, an approach that is unlikely to be sustainable as scale-up demands increase in future.



of all respondents...

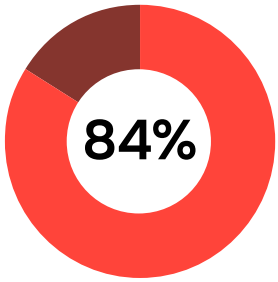


of those using a general-purpose OS...

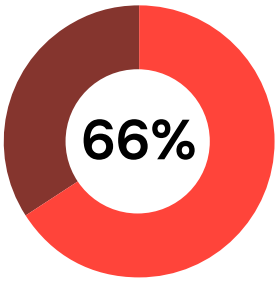
... would consider changing their current OS, for reasons including concerns about performance, security, scalability, integration or costs.

Most challenging regulatory/industry standards to comply with:

Cybersecurity regulatory requirements	51%
Functional safety standards for robotics and autonomous systems	49%
AI/machine learning regulations relevant to robotics	44%



think that pressures on robotics developers to deliver on time and on budget can lead to compromise on critical aspects such as safety



of respondents have experienced project delays because of a need to obtain industry-specific certifications

Future outlook:

89%

believe physical AI-based robotics will be critical to their business's robotics strategy during the next three to five years.

85%

expect the role of software within robotics to increase during the next three to five years.

95%

globally say deterministic real-time execution is important to their business, including...

99% in the US	**98%** in China	**97%** in the UK

With these concerns certain to persist for the foreseeable future, there is a strong case to invest in a scalable foundational software architecture able to support virtualization and RTOS requirements, and to ensure compliance with all relevant regulations.

Fit for purpose?

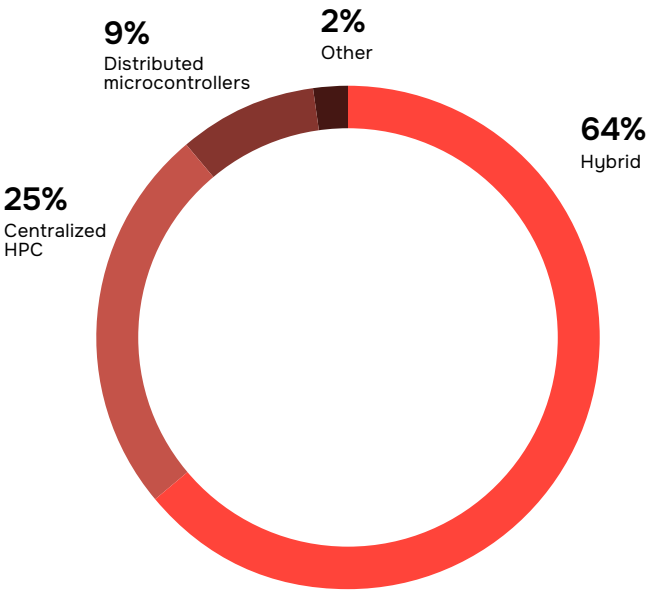
The gap between ambitions for robotics systems and current capabilities

This is a transformative period in robotics, as developers and engineers try to create systems to meet unprecedented requirements for precision, efficiency and safety. Our research reveals the nature and capabilities of robotics currently used in North America, Europe and APAC. But it also highlights the difficulties faced by software developers and engineers working on a new generation of robotics systems, based on real-time determinism, and able to exploit the capabilities of physical AI and other emerging technologies.

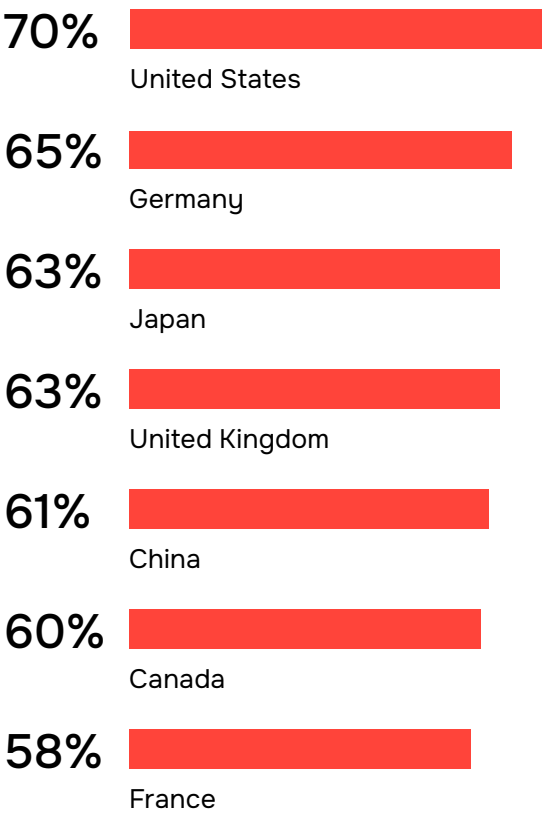
Almost two-thirds of robotics systems are based on hybrid architectures

Hybrid architectures, comprising safety controllers, vision and main computers, and microcontrollers, are by far the most common architecture underpinning robotics systems, used by 64% of respondents' businesses. That percentage is highest in the US, where 70% of architectures are hybrid, and lowest in France – but even here hybrid architectures are used by 58% of businesses. Centralised HPC architectures are used by only 25% of businesses across all seven countries, although this includes 35% of those in China.

Current system architectures used



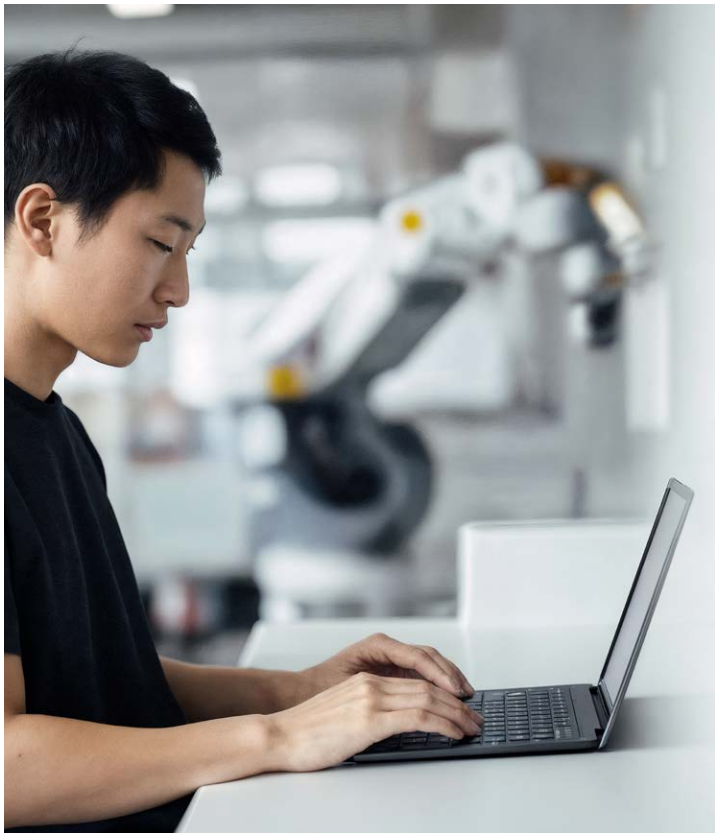
Use of hybrid architecture by country:



Software development tends to consume more resources than hardware development

A hybrid architecture may enhance system capability but can also introduce additional complexity and risks. This is one reason businesses are more likely to spend a larger share of engineering time and resources on the development of robotics software than on robotics hardware. Almost four out of ten respondents (39%) say this is the case, compared to 20% who say hardware accounts for more time and resources. 29% say development resources are shared more or less equally between software and hardware.

Answers vary by country: software development is most likely to dominate among US businesses, but in both Canada and Germany businesses are as likely to split development resources equally between hardware and software as they are to prioritize software. Those in China are more likely than those elsewhere to invest more time and resources in hardware development, but even here software is still more likely to be prioritized.



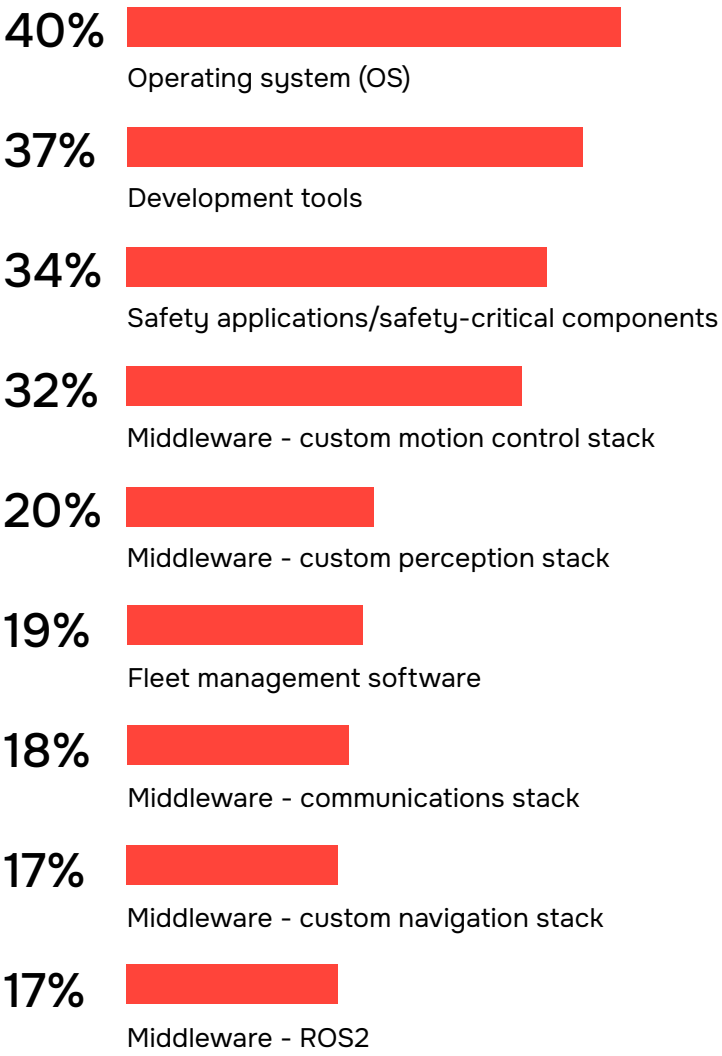
Where have you historically spent more engineering time and resources?

	Average	US	UK	Germany	France	Japan	China	Canada
Software development	39%	43%	33%	42%	41%	42%	38%	29%
Hardware development	20%	15%	22%	12%	25%	23%	32%	22%
About the same	29%	26%	32%	42%	27%	29%	20%	29%
Varies depending on application	11%	16%	13%	4%	7%	6%	10%	20%

Multiple elements of robotics software architectures present development challenges

Asked which software components are most critical to their business's robotics system, respondents are most likely to cite the operating system (OS) – cited by 40%, development tools (37%), safety applications (34%), or custom middleware for controlling motion functions (32%). Responses vary significantly by country, suggesting that working on many different elements within the robotics software stack, and managing risks associated with them, may present challenges to developers.

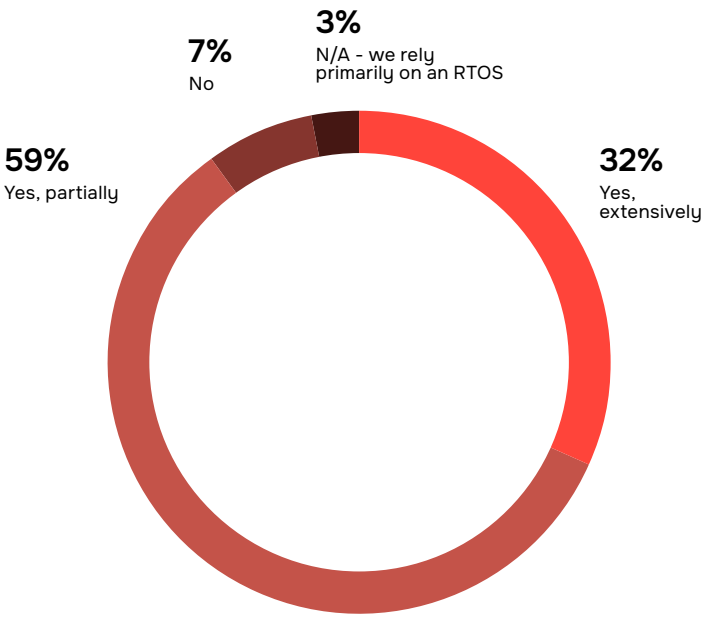
Most critical software components to businesses' robotic systems



A growing gap between ambitions for robotics and current systems' capabilities

More than nine out of ten respondents (91%) say their business uses a general-purpose OS such as Linux to run at least some real time or safety-critical tasks. Almost one in three (32%) say their business does this "extensively".

Are you currently using a general-purpose operating system (e.g., Linux) to run real-time or safety-critical tasks?



This widespread reliance on general-purpose operating systems, at a time when requirements for safe and secure real-time, deterministic performance in robotics are increasing rapidly, highlights a widening gap between the ambitions businesses have for their robotics systems and the capabilities of the software architectures upon which those systems rely. This gap is also linked to other factors that limit a business's ability to exploit the capabilities of emerging robotics technologies, including physical AI, as we shall see in the next section.

Architecture, regulation, capability gaps and budgetary stress:

Barriers and risks hampering robotics performance and development

Consequences of a flawed software architecture

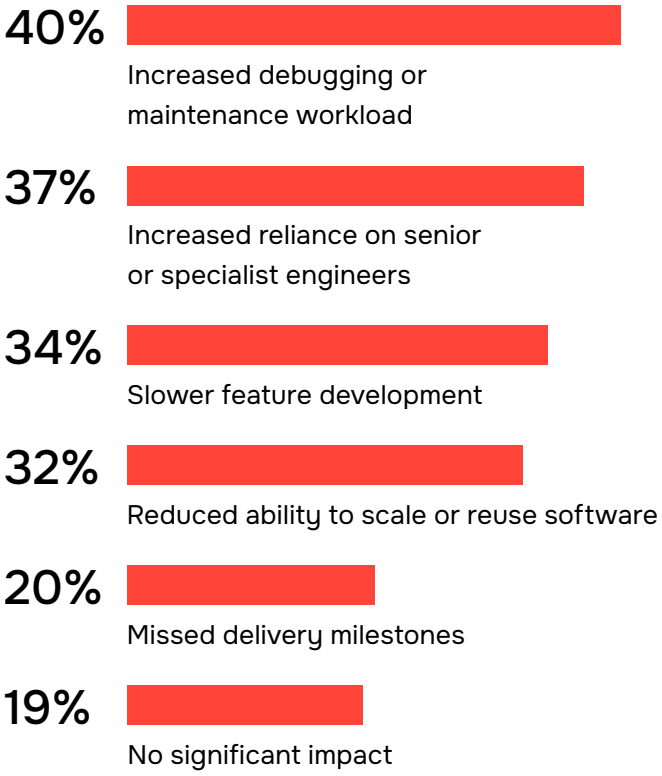
Asked which factor most limits the real-world performance of robotics systems today, respondents are most likely to point to software architecture and integration. More than one in four (27%) say this is a key factor, including at least one in three in each of the US (35%), China (34%) and the UK (33%).

Factors that most limit the real-world performance of robotics systems today

27%	Software architecture & integration
21%	Regulatory or deployment constraints
20%	Data availability or quality
16%	Hardware capability
14%	Sensor quality

Large numbers of respondents say that architecture-related challenges often affect their development teams. These include increased debugging/maintenance (cited by 51%, including 70% of those in China and 60% in the US), increased reliance on senior or specialist engineers (43%), and slower feature development (43%).

How architecture-related challenges most commonly affect development teams



Respondents are most likely to say that integration complexity is the biggest challenge faced during software development processes: 42% say this, including 49% in both Japan and the US. Debugging and testing is the second most common challenge, cited by 41%, including 60% of respondents in China.

All these findings underline the fact that the state and capability of software architecture is a crucial strategic factor in the quality, speed of deployment and performance of robotics systems: architecture is not just a back office, downstream issue.

Regulatory constraints hamper development and system performance

The second major barrier to robotics systems' performance and development is regulation. As we have seen, regulatory or deployment constraints are the second most cited limiting factor on the real-world performance of robotics systems – and the most cited factor in France, Germany and Canada. Regulatory compliance is also the third most cited challenge to the robotics software development process.

Large numbers of respondents in each of the countries surveyed say their robotics teams find it challenging to comply with a range of cybersecurity, safety, AI and machine learning, or data regulations. This includes two-thirds (67%) of respondents in China who cite functional safety standards for robotics and autonomous systems, and almost six out of ten of those in the UK who cite cybersecurity (59%) and AI and machine learning (58%) regulations.

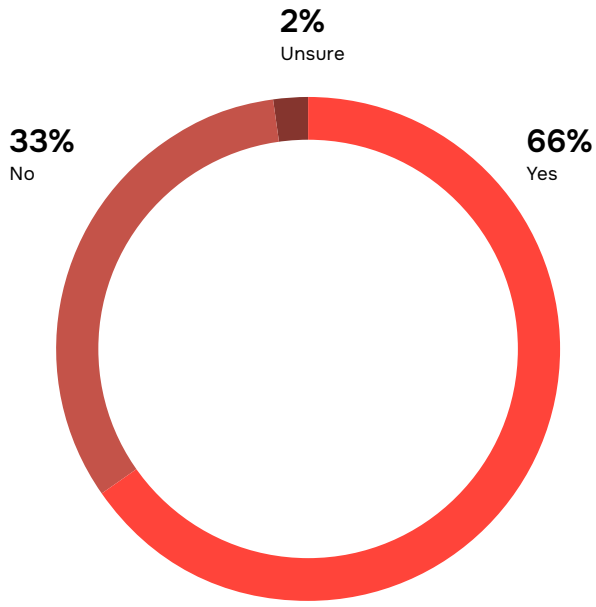
Most challenging regulatory/industry standards to comply with:

Cybersecurity regulatory requirements	51%
Functional safety standards for robotics and autonomous systems	49%
AI/machine learning regulations relevant to robotics	44%
Human–robot interaction and collaborative robot safety	38%
Data privacy and data-handling regulations	37%

Certification requirements can be a significant source of delays

Two-thirds (66%) of respondents report having experienced project delays as a direct result of industry-specific certification requirements – and this rises to about seven out of ten in both Germany (70%) and the UK (69%). This indicates that certification is not just a peripheral issue, but a structural constraint on robotics development timelines.

Have you ever experienced project delays because you needed to obtain industry-specific certifications?

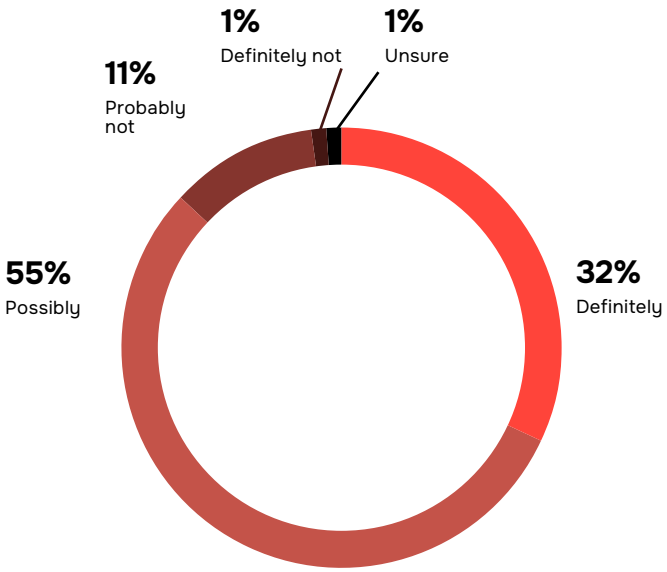


For many organizations, the most effective countermeasure is architectural: re-using pre-certified software components that are designed to be deployed in safety-critical systems. This approach can reduce certification timelines while also lowering integration risk and ongoing maintenance overhead.

Almost all respondents expect regulation to keep up with swiftly evolving technology

Most respondents expect regulatory frameworks to evolve quickly enough to keep pace with innovation and ever-increasing complexity in robotics. Almost nine out of ten (87%) think these frameworks are ‘definitely’ or ‘possibly’ capable of this, including 95% of those in the US and an average of 32% across all seven countries who think regulation can “definitely” keep up with these changes.

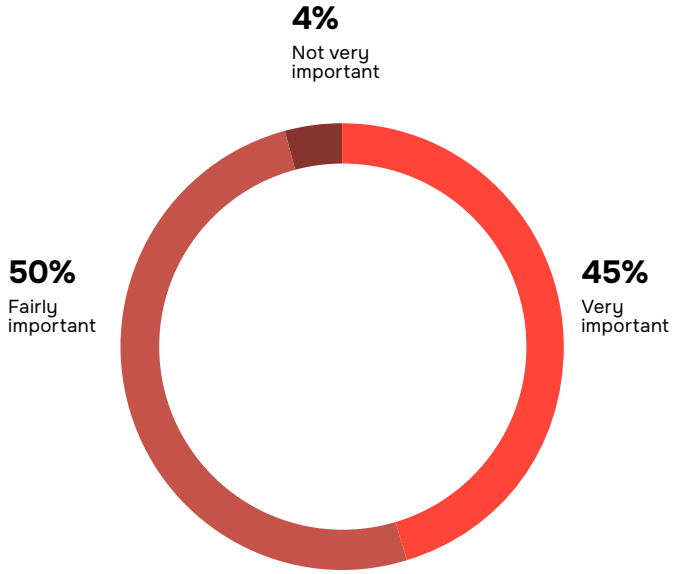
Do you think regulatory frameworks can realistically evolve fast enough to keep up with innovation and growing complexity in robotics systems?



Demand for deterministic real-time performance

Regulatory compliance is made even more difficult by the need to build and deploy robotics systems that meet ever-increasing use case requirements, including deterministic real-time execution, under real-world conditions. 95% of respondents say deterministic real-time execution is either “very” (45%) or “fairly” (50%) important to their business. This includes 99% in the US, 98% in China and 97% in the UK.

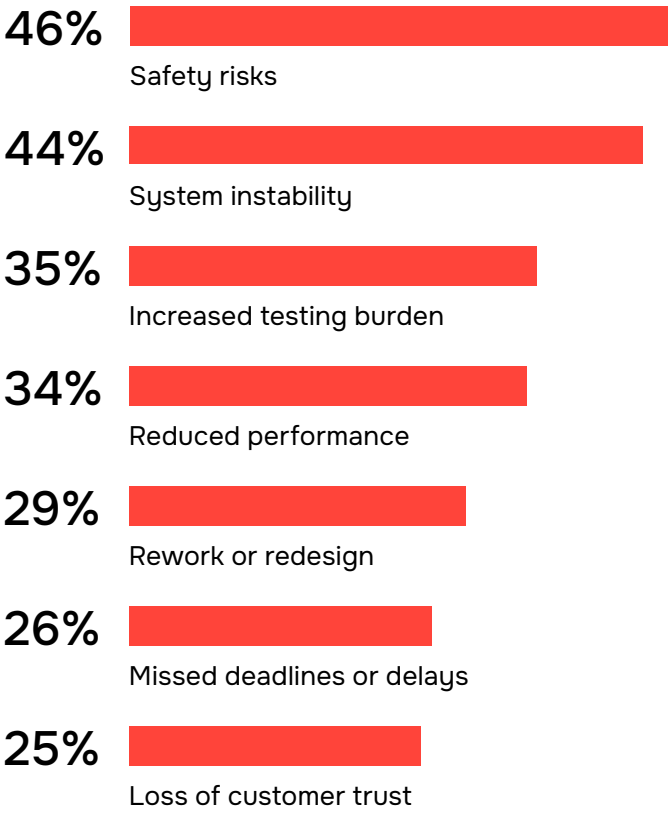
How important is deterministic real-time execution in the robotics systems your organisation develops?



Risks linked to non-deterministic system behaviour

We asked respondents about possible impacts of non-deterministic system behaviour in their robotics projects. The most common concerns were increased safety risks and system instability, each of which were cited by almost half of respondents. An increased testing burden and reduced performance were also cited by more than one in three.

What would be the biggest impacts of non-deterministic system behaviour in your robotics projects?

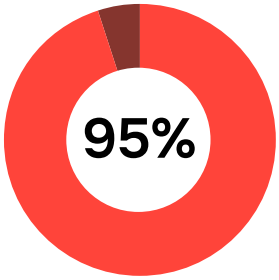


Among those who say real-time determinism is important, almost all (95%) are confident their system architecture consistently delivers deterministic behaviour under real world workloads. However, that confidence falters when respondents are asked about the ability of their current software architecture to scale, in order to handle more demanding real-time workloads in the next three to five years.

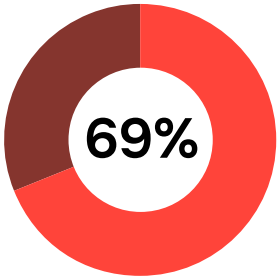
Only 25% of respondents are confident their current architecture could scale "significantly", while 58% think it could scale "moderately". Confidence about the ability to scale is higher among respondents in China, the UK and the US, and lowest in Japan.

This divergence suggests that determinism in current robotics systems is achieved through careful constraint and optimization, rather than through architecture inherently designed to scale over time.

These concerns about system capability, scalability and compliance explain why almost seven out of ten respondents are either "fairly" or "very" concerned about potential legal liabilities linked to robotics failures or malfunctions. Respondents are the most be concerned about this in the UK (80%), Japan (78%) and the US (77%). Additionally, when asked who should bear the most responsibility for failures or malfunctions involving robotics systems, 32% of respondents most commonly indicate manufacturers as the liable party (32%), followed by software providers (22%) and system integrators (20%).



are confident their system architecture consistently delivers deterministic behavior under real world workloads at present

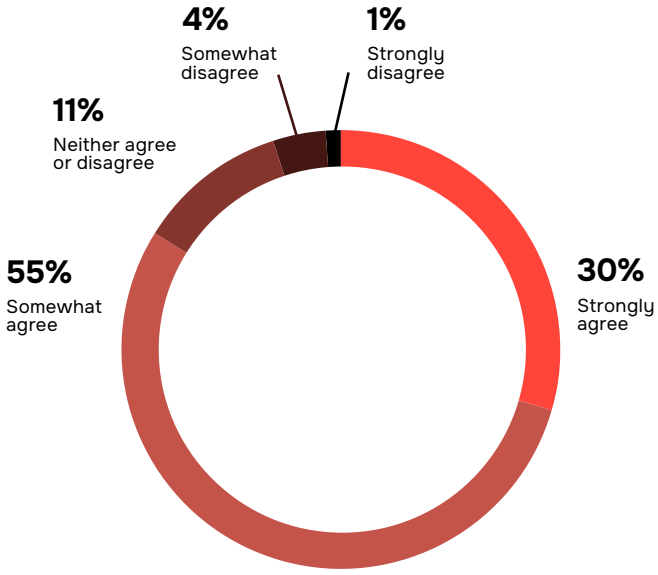


of respondents are "fairly" or "very" concerned about potential legal liabilities linked to robotics failures or malfunctions

Budgetary constraints apply extra pressure

In the current environment amid such rapid technological innovation, it is unsurprising that a majority of respondents agree (84%) that deadline or budget pressures can lead robotics developers to make compromises on critical aspects - including safety. 30% of respondents were found to “strongly agree” with this sentiment. And around nine out of ten respondents in the US (92%), Canada (90%) and the UK (89%) agreed.

Pressures on robotics developers to deliver on time and on budget can lead to compromise on critical aspects such as safety?



Percentage of respondents that “agree” by country

92% United States

90% Canada

89% United Kingdom

82% France

79% Germany

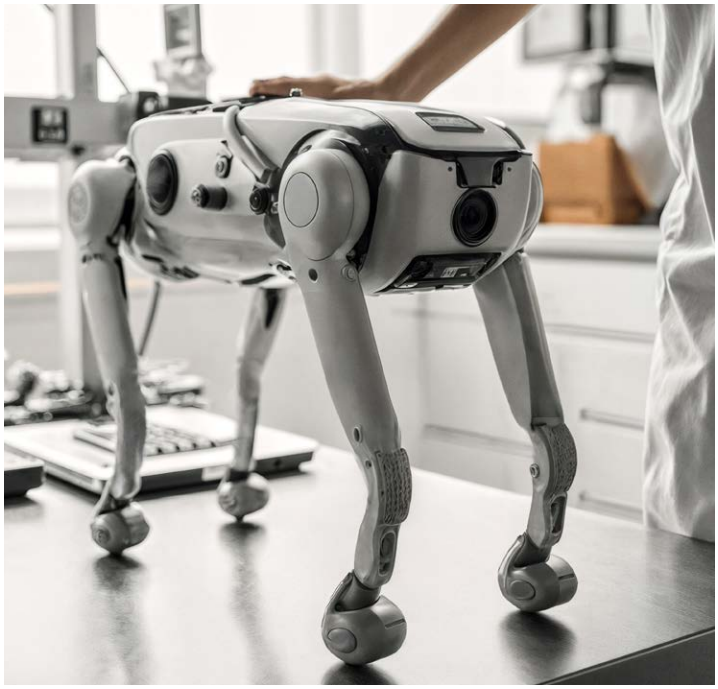
77% China

73% Japan

When asked what the largest software-related costs linked to robotics system development are, respondents cite engineering time most often by a notable margin (28%). Testing and validation is the second most commonly cited cost (22%).

What is the largest software-related cost in your robotic system?

Engineering time	28%
Testing and validation	22%
Ongoing maintenance	17%
Commercial software licensing	17%
Certification and compliance costs	16%

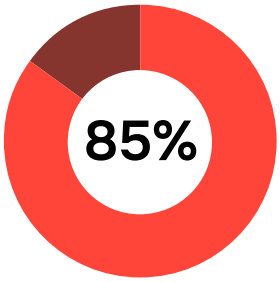


It is clear that budgetary and commercial pressures alongside technical challenges and regulatory demands, add to the difficulties and risks faced by developers and engineers deploying robotics. In the next section we consider what steps could be taken to address these challenges and risks, while retaining appropriate control over costs.

Planning for future success in robotics

Robotics sector leaders can take action to reduce the time and resources needed to develop and deploy fully fit for purpose, compliant systems.

First, they must address issues linked to software architecture, which now has such a significant influence over both system development and performance. Indeed, 85% of respondents say they expect the role of software within robotics to increase during the next three to five years.



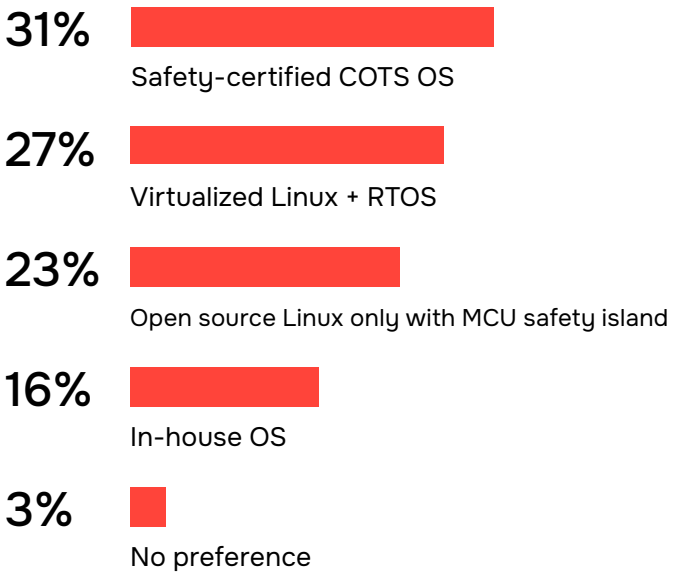
of respondents expect the role of software within robotics to increase during the next three to five years

Choosing the best OS strategy

As robotics systems become more software-defined, OS strategy has emerged as a foundational architectural decision, determining whether systems can scale safely, meet regulatory requirements, and support mixed-criticality workloads over time. Our findings show a mix of strategies meet developer needs at present. A safety-certified commercial off-the-shelf (COTS) OS is the most common choice, meeting the needs of 31% of businesses. This is the most common strategy choice in France, Germany, Japan and the US, despite 91% of global respondents currently using a general-purpose operating system to run safety-critical tasks.

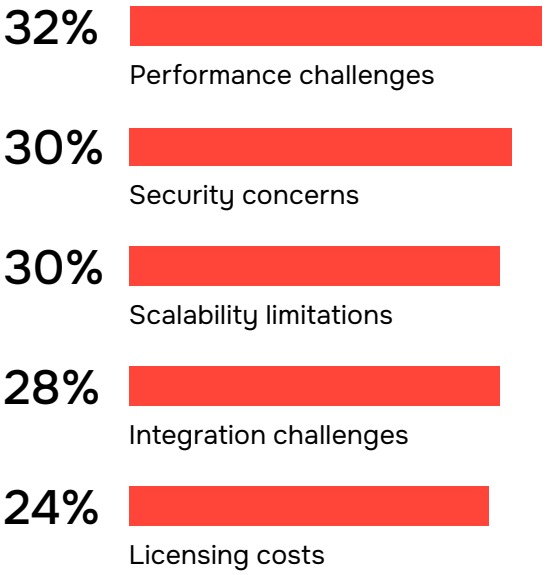
A strategy based on use of virtualized Linux alongside a Real-Time OS (RTOS) is being followed by 27% of all respondents and is the most frequently used strategy in Canada, China and the UK. In addition, 23% of businesses use an open source Linux OS alongside a safety island for the microcontroller.

Which operating system strategy best meets your current needs?



More than eight out of ten respondents (85%) would consider changing their current OS, with 86% of those using a general-purpose OS open to switching. Possible reasons to do so include concerns linked to performance challenges, security, scalability, integration and costs.

Top 5 reasons respondents* might consider changing their existing operating system:



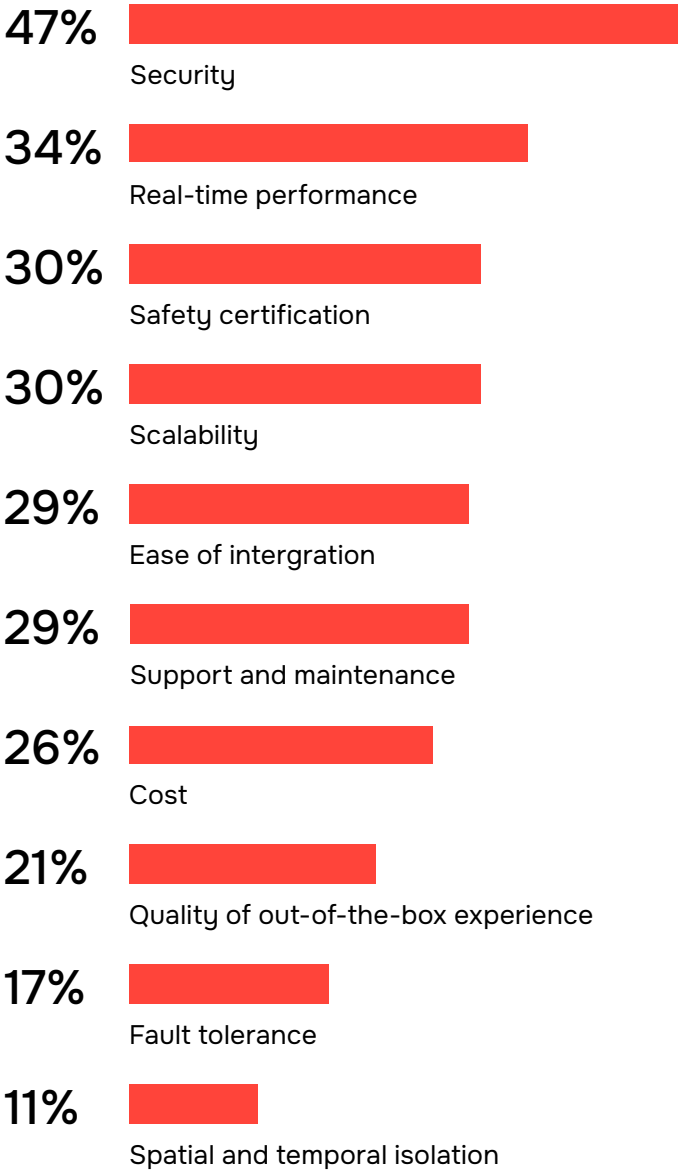
***respondents who will or would consider changing their existing operating system**

The process of switching to a different OS strategy would entail extra complexity and risk, but may be necessary for a business seeking to grasp the full potential of an enhanced architecture capable of supporting an evolving, scalable robotics system.

The fact that so many developers and engineers recognize the importance of real-time, deterministic execution suggests many businesses would benefit from the capabilities of a RTOS, if this does not already form part of their software architecture.

Asked which would be the most important factors to consider when selecting a new OS, respondents are most likely to pick out security, but substantial numbers also cite the need to support real-time deterministic performance, as well as safety certification, scalability and ease of integration.

Most important factors to consider when selecting a new operating system

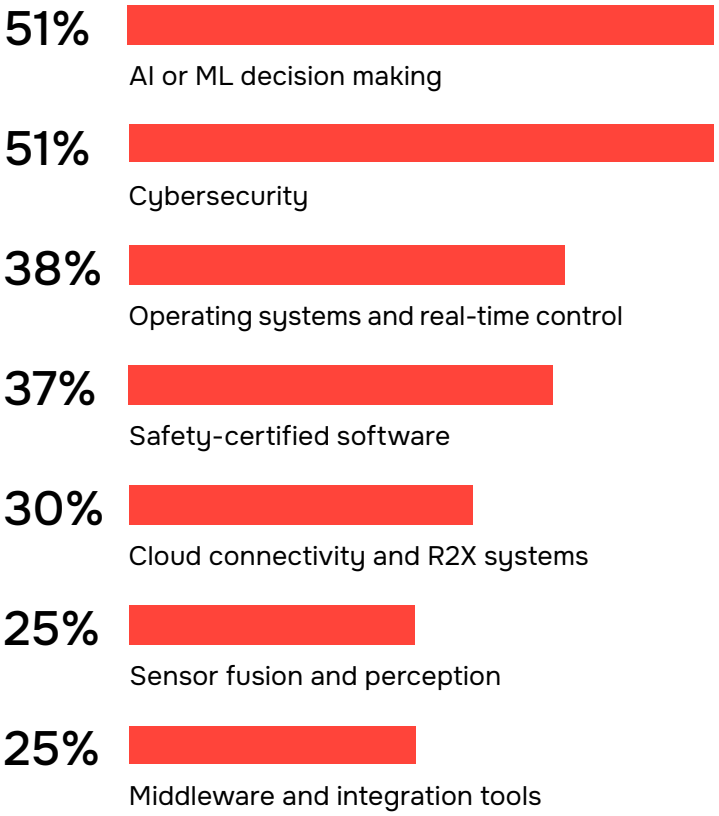


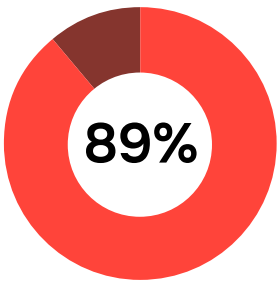
With all of these concerns certain to persist for the foreseeable future, there is a strong case to invest in a scalable foundational software architecture able to support virtualization and RTOS requirements, and ensure compliance with relevant regulations.

Future budgetary priorities

Among the 85% of respondents who expect software to play a bigger role within robotics during the next five years, almost four in ten (38%) think operating systems and real-time control will be a high priority in budgetary decision making. But AI/machine learning decision making and cybersecurity functions are the two areas seen as most likely to be prioritized in budgeting decisions by more than half of respondents in both cases.

Where do you expect robotics software budgets to shift over the next 3-5 years?



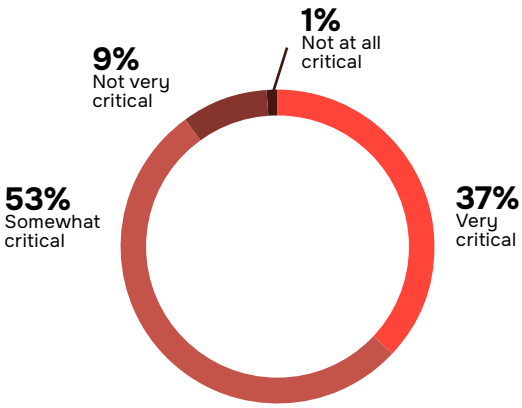


see Physical AI as critical to their robotics strategy over the next 3–5 years

The ever-growing importance of Physical AI

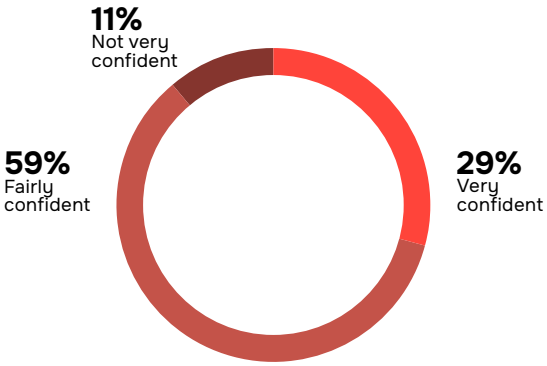
Physical AI-based robotics, which enables robots to perceive, reason and act autonomously in physical environments, is seen as critical to their business's robotics strategy during the next three to five years by nine out of ten respondents (90%). This rises to 95% for respondents working in China, with almost six out of ten Chinese respondents (58%) saying Physical AI will be "very" critical to their robotics strategy.

How critical is Physical AI to your robotics strategy over the next 3–5 years?



Respondents' thinking here is aligned with that of other researchers: PwC estimates that the global Physical AI market may be worth €430bn (US$500bn) by 2030[1]. Our respondents have confidence in the long-term potential of Physical AI, but readiness remains uneven. Only 29% of respondents feel "very confident" in their ability to make safe, predictable decisions in real-world environments.

How confident are you that Physical AI robotics systems can make consistent and predictable decisions in safety-critical scenarios?



Priorities for robotics development during the next three to five years

Respondents are also most likely to pick out AI capability growth as one of the highest priorities for robotics development during the next three to five years, with almost half (48%) saying this, well ahead of the next most commonly cited options: safety certification and regulatory compliance (36%), operational efficiency (32%) and cost reduction (29%).

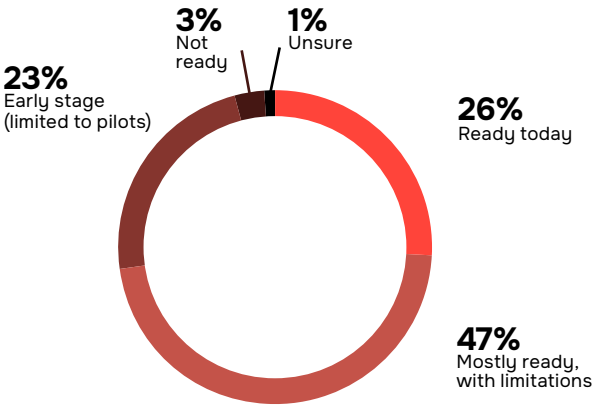
Highest priority areas for robotics development in the next 3 to 5 years

48%	AI capability growth
36%	Safety certification and regulatory compliance
32%	Operational efficiency
29%	Cost reduction
28%	Software reusability

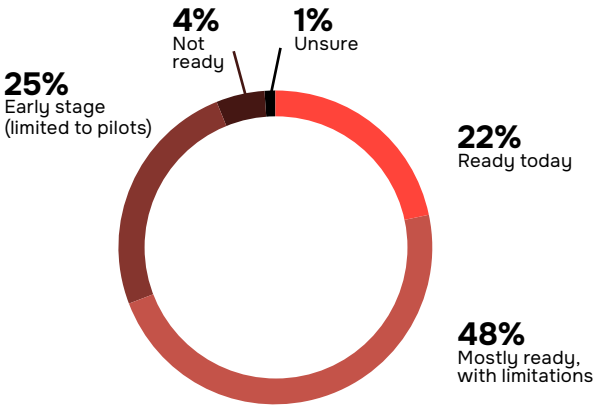
We also asked respondents how ready they think the robotics industry is to support Robotics as a Service (RaaS) business models, Robot to Everything (R2X) connectivity, and the use of humanoid robots in commercial or industrial settings. In each case, a majority say they are either ready to be deployed today or are mostly ready, with some limitations.

How ready do you believe the robotics industry is today to support the following technologies at scale?

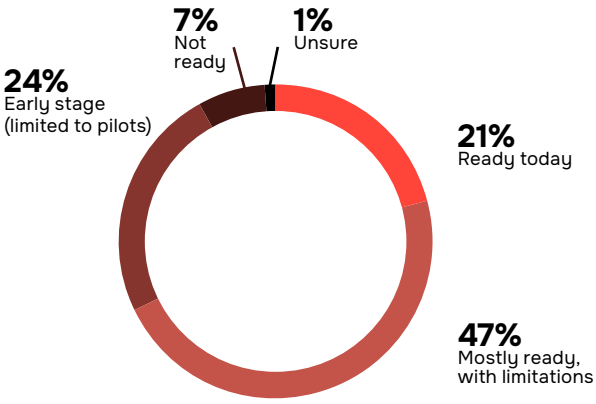
Robotics as a Service (RaaS) business models



Robot to Everything (R2X) connectivity



Humanoid robots (commercial/industrial)

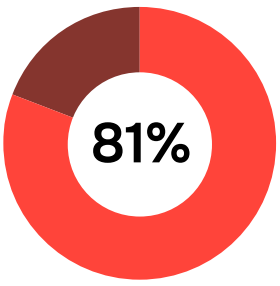


Fears and hopes

Respondents express some concerns about the future of robotics.

Top concerns cited by respondents are:

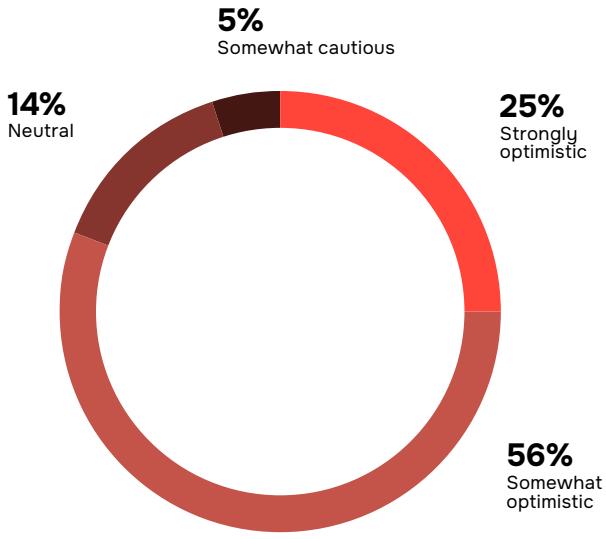
45%	Security threats or vulnerabilities
39%	Regulatory or compliance burden
39%	Skills shortages
32%	Consumer trust or acceptance
30%	Slowing pace of innovation



of respondents say they are optimistic about the pace of progress in the robotics industry

However, more than eight out of ten respondents (81%) say they are optimistic about the pace of progress in the robotics industry, including 93% in the UK, and 88% in the US. More than one in three are “strongly” optimistic in the UK (38%) and the US (34%), along with 33% in China.

How respondents feel about the pace of progress in the robotics industry:



Regional-specific insights

North America

Robotics software developers and engineers working in the US are most likely to be using a hybrid software architecture, with seven out of ten doing so, compared to 64% across the full sample. They are most likely to cite software architecture and integration as the factor that most limits the real-world performance of robotics systems today: more than one in three (35%) say this, compared to 27% across all seven countries surveyed. US respondents are also most likely to say the OS is among the most critical components of their robotics system: 58% say this, compared with an average of 40% across all seven countries.

In Canada, regulatory and deployment constraints are the most fequently cited barriers to real-world performance of robotics, ahead of software architecture, integration or data availability/quality. Canadian respondents are also more likely to pick functional safety standards for robotics or autonomous systems, or AI and machine learning regulations as the regulations or standards that pose the greatest compliance challenge.

In the US, cybersecurity requirements are cited most often as the main compliance challenge. With functional safety standards close behind – cited by a larger share of respondents in the US than in any other country except China.

Almost all US respondents (99%) say deterministic real-time execution is important in robotics systems developed by their businesses, including 61% who say it is "very" important. Both percentages are the highest in any country surveyed: average figures for the full sample are 95% and 45%. Canadian respondents are more likely than those in any other country except China to believe that robotics software budgets will shift towards AI/machine learning decision making during the next three to five years.

Respondents in the US and Canada are most likely to agree that "Pressure on robotics developers to deliver on time and on budget can lead to compromise on critical aspects such as safety." 92% of those in the US and 90% in Canada agree, compared to a sample average of 84%.

Over 9 in 10

respondents in North America agree that time and budget pressure could lead robotics developers to compromise on critical aspects of systems such as safety

Most challenging regulatory or industry standards to comply with

US

Cybersecurity requirements	57%
Functional safety standards for robotics and autonomous systems	55%
AI and machine-learning regulations relevant to robotics	48%

Canada

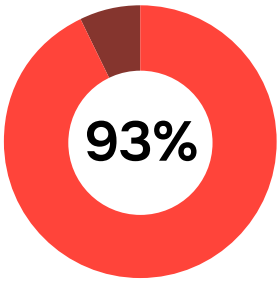
Functional safety standards for robotics and autonomous systems	48%
AI and machine-learning regulations relevant to robotics	47%
Cybersecurity requirements	41%

The UK

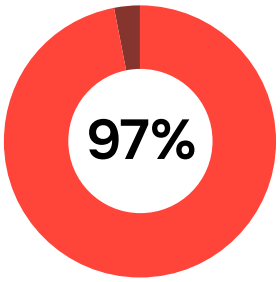
Until now, one in three UK businesses (33%) have spent more engineering time and resources on software development than on hardware development – the second lowest share among all seven countries surveyed, while 32% say resources have been shared between both.

But almost nine out of ten (89%) now expect the role of software within robotics to increase during the next three to five years, and 33% say that software architecture and integration is the factor that most limits the real-world performance of robotics systems today – a figure exceeded (just) in only the US and China. It's clear that UK respondents understand that software is becoming ever more important to the success of robotics systems.

UK respondents are among the most confident that their business's current architecture consistently delivers deterministic behaviour under real world workloads: 97% are confident about this. But they are also more likely than those elsewhere to say that complying with both cybersecurity and AI/machine learning regulations poses major challenges: almost six out of ten (59% and 58%) say this about both sets of regulations, compared to 51% and 44% across all the countries surveyed.



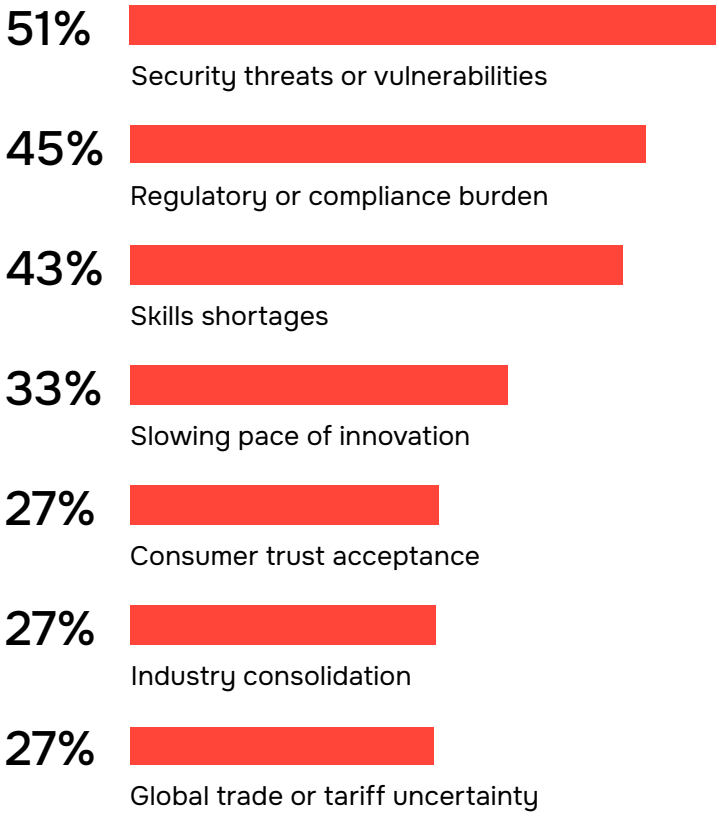
of UK respondents are optimistic about the pace of progress in the robotics industry



of UK respondents are confident that their business's current architecture consistently delivers deterministic behaviour under real world workloads

The focus on these two regulatory issues is reflected in broader concerns. UK respondents more frequently cite regulatory compliance as a challenge for the future of robotics development. They are also among the most likely, second only to China, to identify security threats and vulnerabilities as a major concern.

Which factors most concern you about the future of robotics development as an industry?



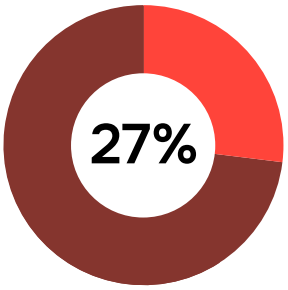
Despite these challenges, UK respondents are the most optimistic about the pace of progress in the robotics industry. Overall, 93% express optimism, compared with 81% across the full sample, including 38% who are "strongly optimistic".

France

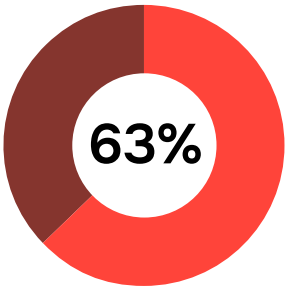
Respondents in France are more likely to cite the need to attain regulatory compliance as a major challenge in the software development process, with 43% doing this, than other challenges including long development cycles (highlighted by 38%), or integration complexity (31%).

They are also more likely than other respondents to see regulatory or deployment constraints as the factor imposing the greatest limitation on the real-world performance of robotics systems today: 27% think this, compared to 21% across all the countries surveyed.

French developers and engineers are more likely than those in other countries to see regulatory or deployment constraints as the factor imposing the greatest limitation on the real-world performance of robotics systems.



of French respondents see regulatory or deployment constraints as the factor imposing the greatest limitation on the real-world performance of robotics systems today

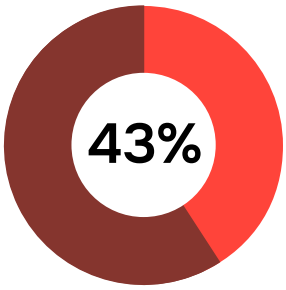


of French respondents expect robotics software budgets to shift towards cybersecurity

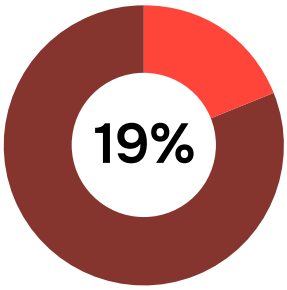
French respondents see regulations related to cybersecurity as the most challenging, and are most likely to cite security threats and vulnerabilities as a concern for the future of robotics development. Larger numbers of French respondents than those in every country except Japan also expect robotics software budgets to shift towards cybersecurity: 63% think this, compared to 51% across the full sample.

Our findings suggest a more widespread confidence in the technical strengths of robotics systems among French respondents than is visible in some other countries. French respondents are less likely than those elsewhere to cite increased debugging or the maintenance workload as an architecture-related challenge affecting their development teams, and the least likely (joint with peers in Germany) to cite debugging and testing as among the biggest challenges faced during the software development process. They are also the second least likely to cite software architecture and integration as a factor limiting the real-world performance of robotics systems today.

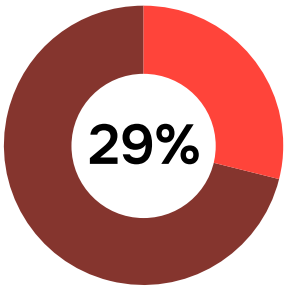
This may be part of the reason why French respondents also seem less concerned than those in every country except Germany about potential legal liabilities that may be associated with failures or malfunctions in robotics systems. A majority (55%) are concerned, but this is well below levels of concern in the UK, Japan or the US.



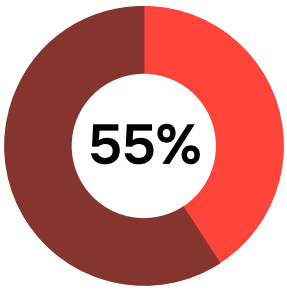
of French respondents cite increased debugging or the maintenance workload as an architecture-related challenge affecting their development teams, compared to 51% across all countries



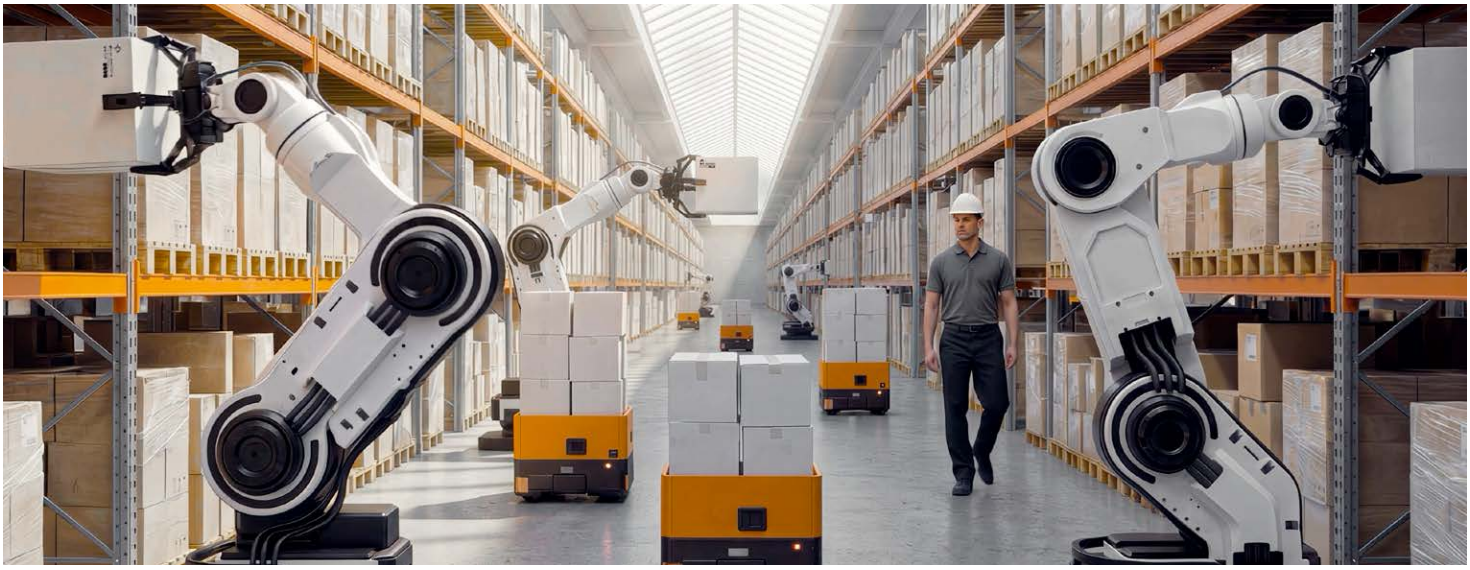
of French respondents cite software architecture and integration as a factor limiting the real-world performance of robotics systems today, compared to 27% across all countries



of French respondents cite debugging and testing as among the biggest challenges faced during the software development process, compared to 41% across all countries



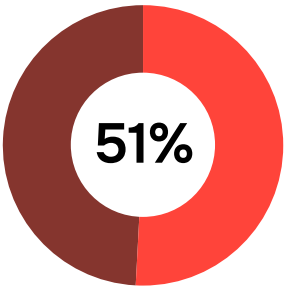
of French respondents are concerned about potential legal liabilities that may be associated with failures or malfunctions in robotics systems, compared to 69% across all countries



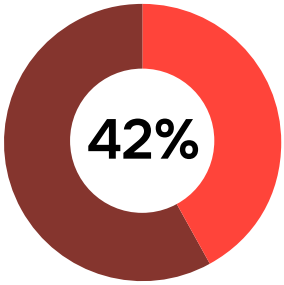
Germany

Survey responses provided by robotics software developers and engineers in Germany reveal the prevalence of a pragmatic, risk-focused approach to meeting the challenges and requirements involved in robotics development.

German businesses are the second most likely to be using a hybrid architecture, with 65% doing so, compared to 64% across all seven countries. While they are among the most likely to have dedicated more engineering time and resources to software development rather than hardware development, they are also most likely to have allocated equal resources to both.



of German respondents say safety applications and safety-critical components are most critical in robotics systems

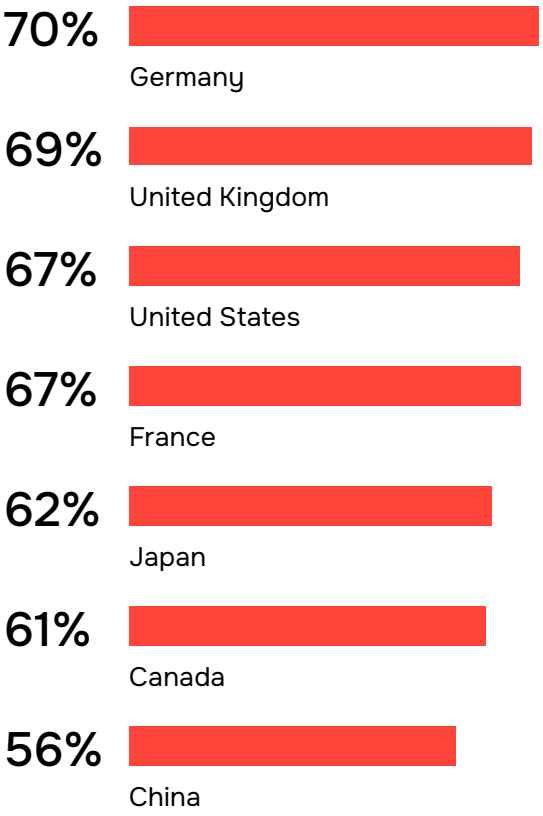


of German respondents have allocated equal resources to software and hardware development

German respondents are also the least likely to say the OS is the most critical software component in robotics systems, with only 10% doing so, compared to 40% across the full sample. Instead, 51% say safety applications and safety-critical components are most critical – many more than among most of the other countries surveyed.

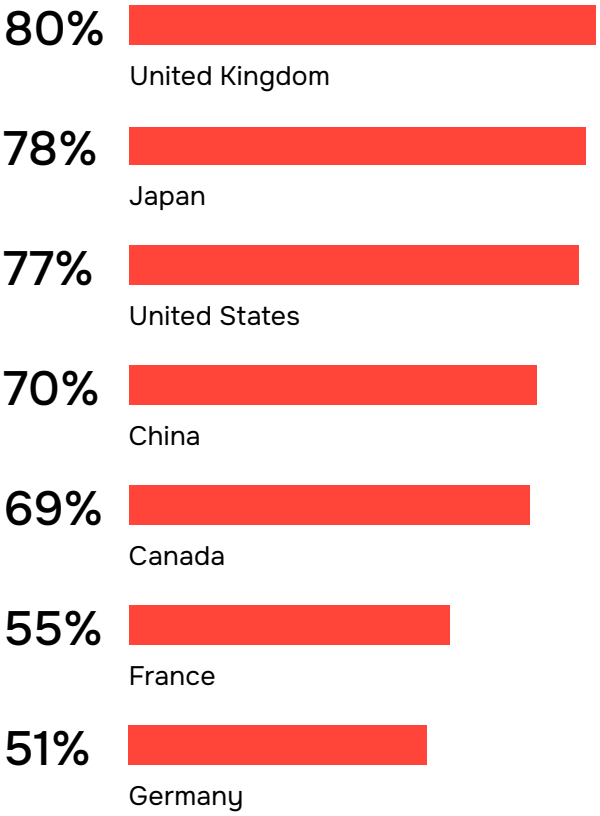
Cybersecurity and functional safety regulations are cited as the most challenging for businesses to comply with, while German respondents are more likely than those in any other country to have experienced project delays because of a need to obtain industry-specific certifications.

Respondents who have experienced project delays because they needed to obtain industry-specific certifications:



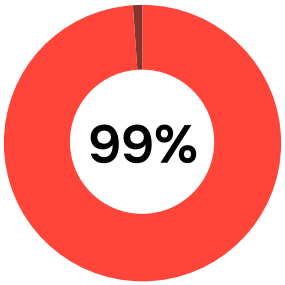
This focus on mitigating regulatory and development risks may have instilled a sense of confidence in German robotics professionals: they are the least likely to agree that pressure to deliver projects on time and on budget can result in compromising aspects of development such as safety – only 19% "strongly" agree, compared to 30% across the full sample – and are less likely to be concerned about potential legal liabilities associated with failures or malfunctions in robotics systems.

Respondents who are very or fairly concerned about potential legal liabilities associated with failures or malfunctions in robotics systems:



China

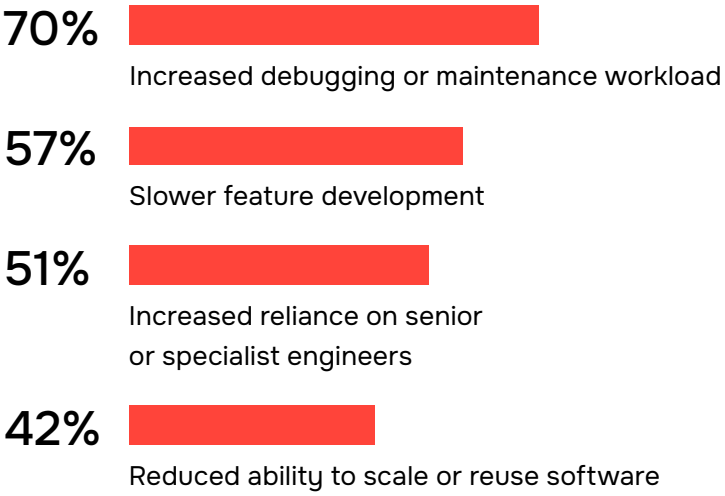
Responses from robotics software developers and engineers working in China suggest a robust confidence in at least some aspects of the development and deployment of robotics systems is widespread across the country. Almost all (99%) are confident in their team's ability to keep pace and comply with evolving regulations.



of Chinese respondents are confident in their team's ability to keep pace and comply with evolving regulations

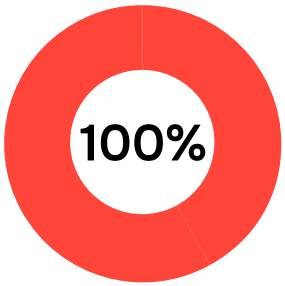
Some responses suggest more attention may need to be paid to specific aspects of development. Chinese respondents are most likely to cite debugging and testing as major challenges in software development: 60% do so, compared to 41% across all the countries surveyed. When asked about architecture-related challenges that affect development teams, they are most likely to cite increased debugging or maintenance workloads, slower feature development and risks linked to increased reliance on senior or specialist engineers.

Architecture-related challenges that most commonly affect Chinese development teams:



Chinese respondents are the least likely to view safety applications or safety-critical components as critical to robotics systems (only 10% do so, compared to 34% across the full sample), yet are also most likely to pick out functional safety standards as a major compliance challenge: 67% do so, compared to 49% of all respondents. Those in China are most likely to say security threats or vulnerabilities cause them the greatest concern about the future of robotics development: 61% do so, compared to a sample average of 45%.

But the confidence of Chinese robotics specialists is also visible in the fact that every single Chinese respondent is confident that their current architecture consistently delivers deterministic behaviour under real-world workloads, while almost one in three respondents (32%) believe their architecture can scale "significantly" to handle more demanding real-time workloads during the next three to five years – more than in any other country.

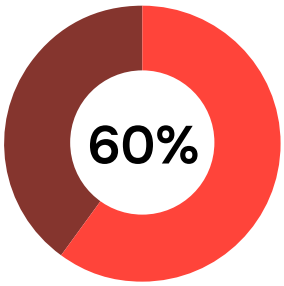


of Chinese respondents are confident that their current architecture consistently delivers deterministic behaviour under real-world workloads

They are also the most certain of any respondents that AI capability growth will be among the highest priorities for robotics developments during the next three to five years, with 57% saying this (sample average 48%). They are fully committed to further investment in physical AI: 58% say this is "very critical" to robotics strategies, compared to 37% across the full sample. They are also the most confident that their physical AI robotics systems can make consistent and predictable decisions in safety-critical scenarios: 96% say so.

Japan

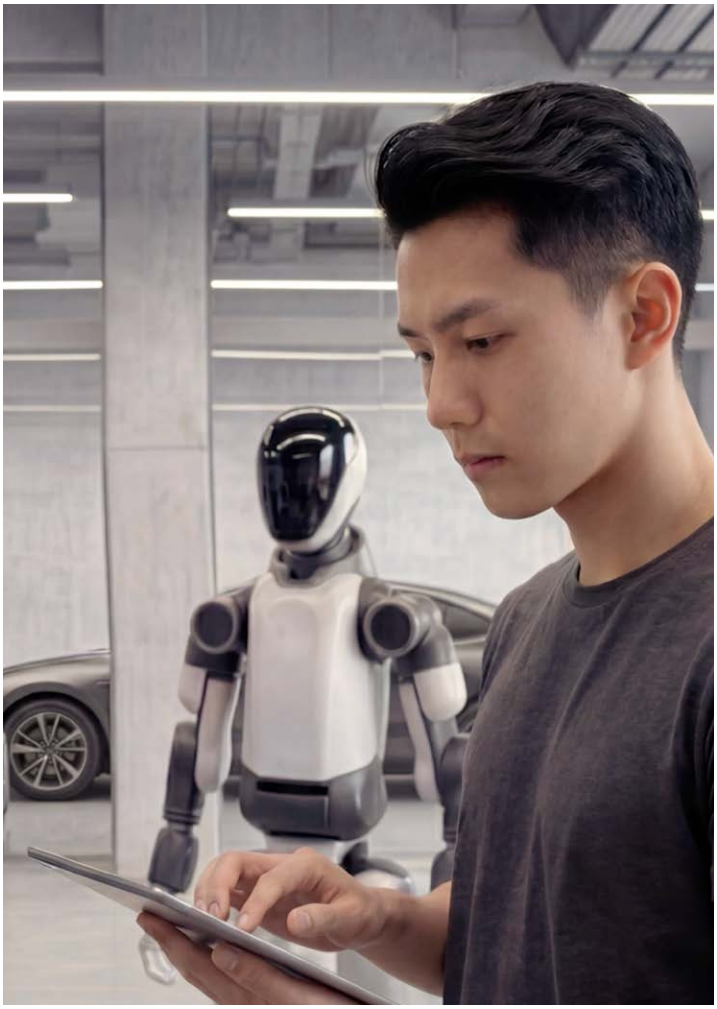
Robotics software developers and engineers in Japan are among the least likely to say the OS is a critical software component within robotics systems, with only 14% saying this compared to a sample average of 40%. But they are most likely to cite development tools such as build systems and debuggers: 60% do so compared to an average of 37% across all seven countries. They are also the joint most likely (alongside those in the US) to cite integration complexity as one of the biggest challenges faced during software development processes: 49% say this.



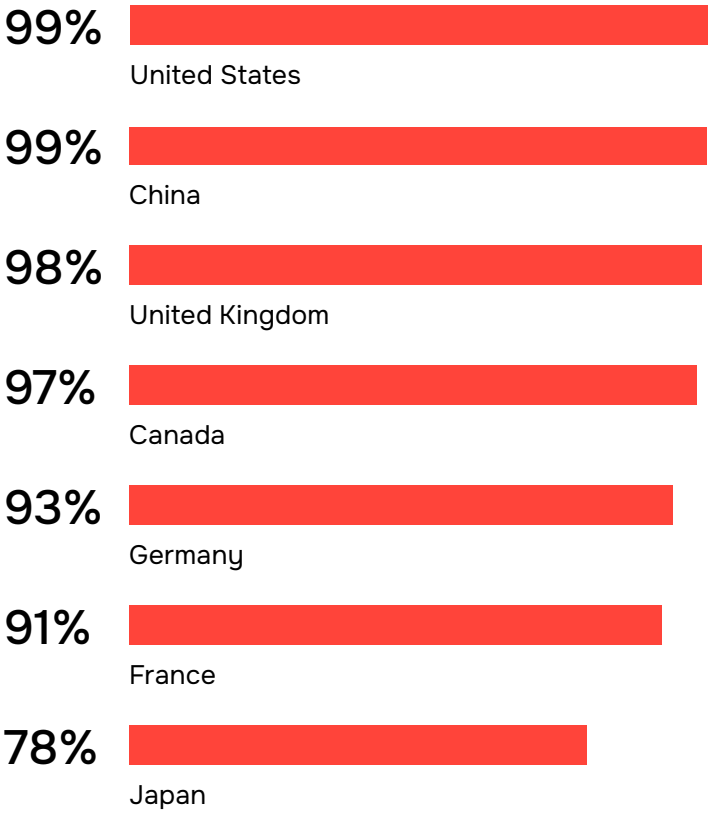
of Japanese respondents cite development tools such as build systems and debuggers as most critical software component within robotics systems

Alongside this acknowledgement of the difficulties involved in robotics development, some survey results suggest a relative lack of confidence among many Japanese respondents in the current and future capabilities of their teams, processes and systems.

Japanese respondents are the least confident about their teams' abilities to keep pace and retain compliance with evolving regulations, although almost eight out of ten (78%) say they are confident that they can. The average across all the countries surveyed is 95%.



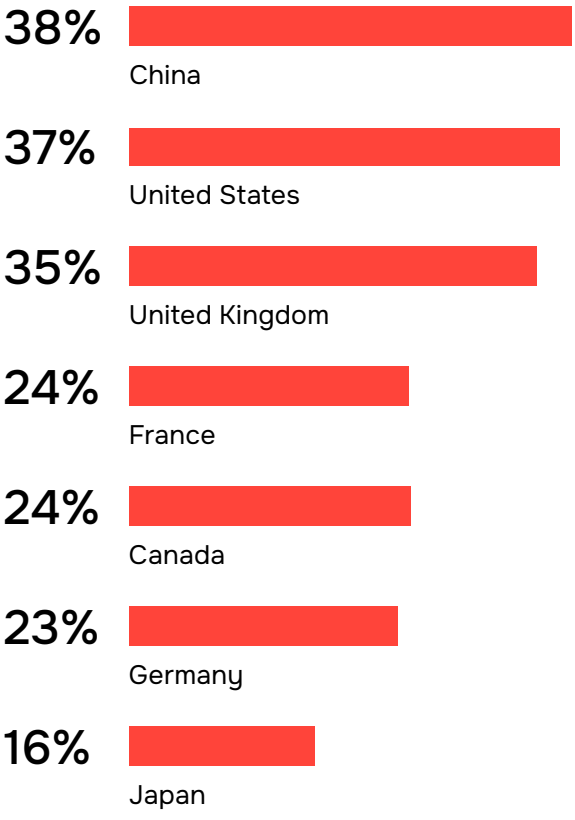
Respondents who are confident in their team's ability to keep up with, and remain compliant with, evolving regulations:

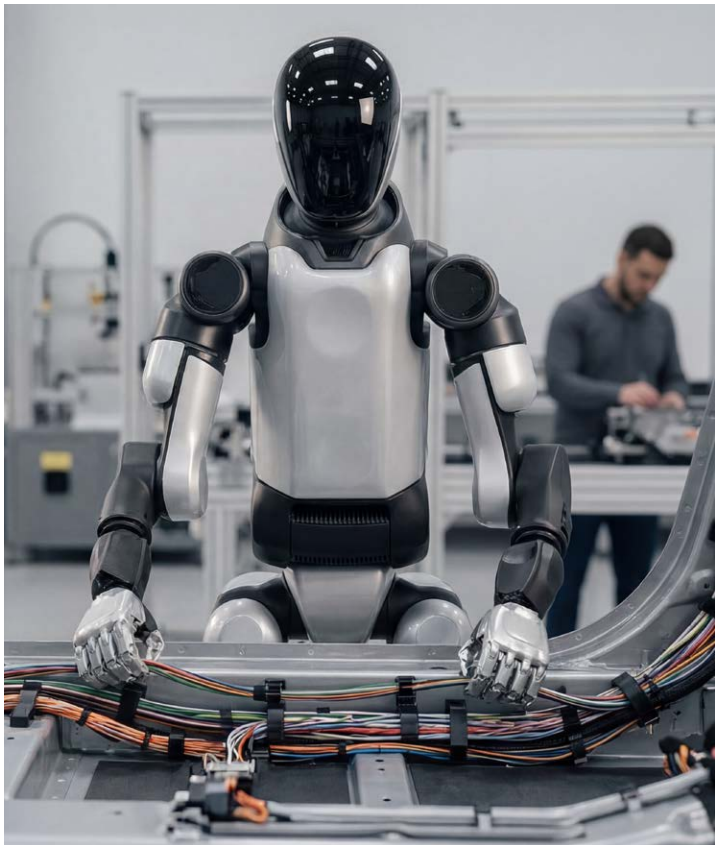


Japanese respondents are also less confident than those elsewhere in the ability of their current system architectures to consistently deliver deterministic behaviour under real-world workloads, although 82% are confident about this. They are the least likely to believe their architectures can scale “significantly” to handle more demanding real-time workloads, with only 12% saying this, fewer than half the average across all seven countries (25%).

They are also the least confident that physical AI robotics systems can make consistent, predictable decisions in safety-critical scenarios, with just 16%, the lowest of any country, saying they are “very confident”.

Respondents who are very confident that physical AI robotics systems can make consistent and predictable decisions in safety-critical scenarios:



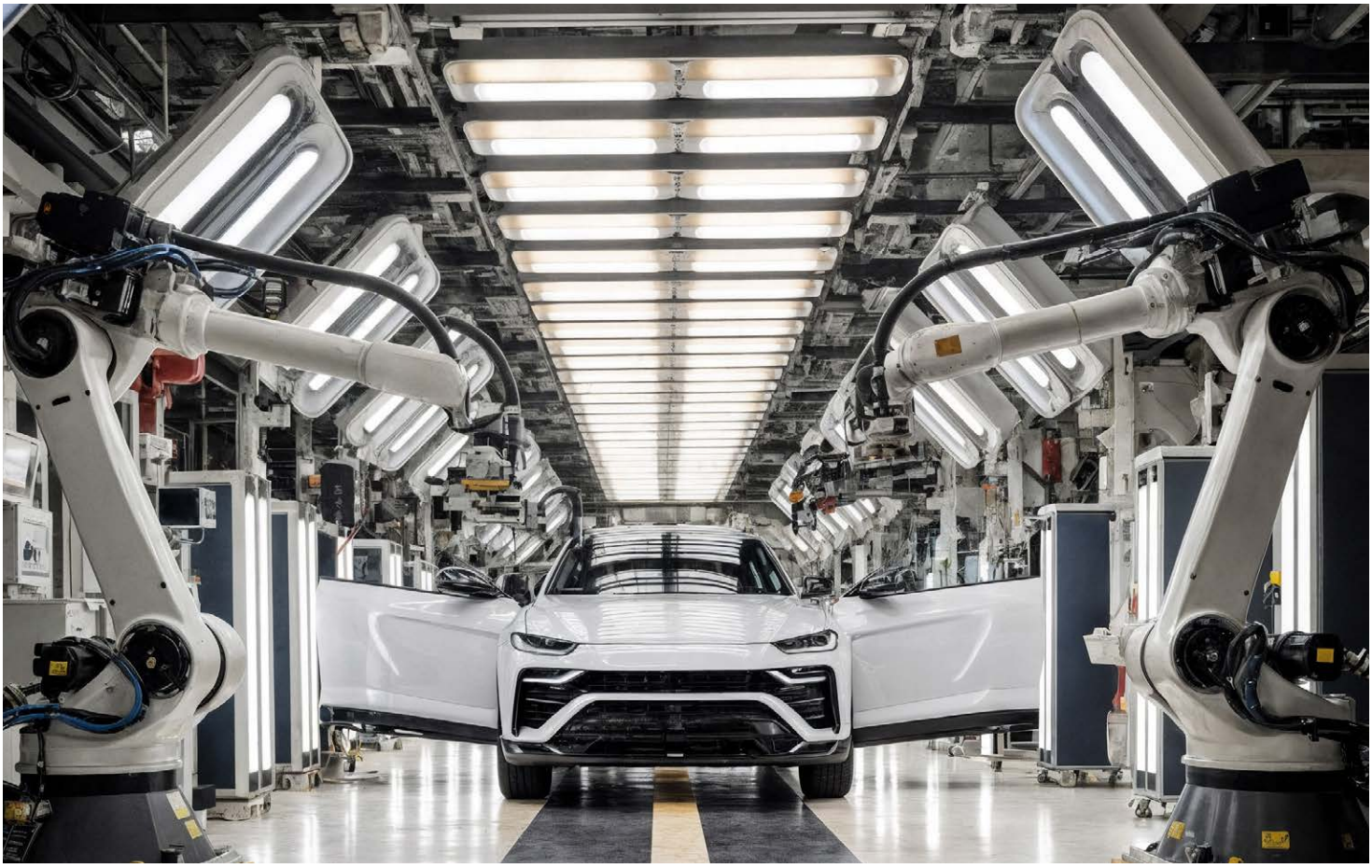


Finally, respondents in Japan are less optimistic about the pace of progress in the robotics industry than their peers elsewhere. A majority (56%) are optimistic, but the equivalent figure is more than 75% in every other country. Just 8% are “strongly” optimistic, compared to more than one in three in China, the UK and the US.

Only 8%

of Japanese respondents are “strongly” optimistic about the pace of progress in the robotics industry

But it may be reasonable to question whether higher levels of optimism displayed by respondents from other countries, or confidence in the capabilities of their technologies actually reflect an element of over-confidence, or under-estimation of risk, rather than the inferiority of robotics systems in use in Japan.



Methodology

This report is based on research conducted on behalf of QNX by OnePoll in February and March 2026. Surveys were conducted of 1,000 robotics developers and software engineers working with robotics based in China, France, Germany, Japan, North America (Canada and the US), and the UK.

References:
1. PwC Physical AI study.
See https://www.strategyand.pwc.com/de/en/industries/telecommunication-media-and-technology/physical-ai.html

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