Global UST survey
Industry 5.0: Convergence at the Edge of Innovation

Overview

This year's Thinking Ahead survey reveals a transformative shift toward Industry 5.0—a phase defined by the convergence of intelligent systems, custom silicon, and a renewed emphasis on ethical, human-centric innovation. As organizations seek to personalize experiences, enhance efficiency, and unlock sustainable value, integrating technologies such as AI, IoT, robotics, sensors, digital twins, and advanced silicon engineering is accelerating globally.

Based on responses from 502 senior technology and business decision-makers across North America, Europe, and Asia-Pacific, the study explores technological maturity, investment outlook, ethical readiness, and barriers to adoption.

Industry 5.0 at a Glance

01 Human + machine collaboration

80% say ethical and responsible tech use defines Industry 5.0

78% see human-machine collaboration as a defining trait

02 Global familiarity (not uniform)

Asia-Pacific: **84%** awareness

Europe: **72%** awareness

North America: **68%** awareness

03 Industry 5.0 readiness

79% of organizations feel ready to adapt their business models

Expected improvements in 5 years

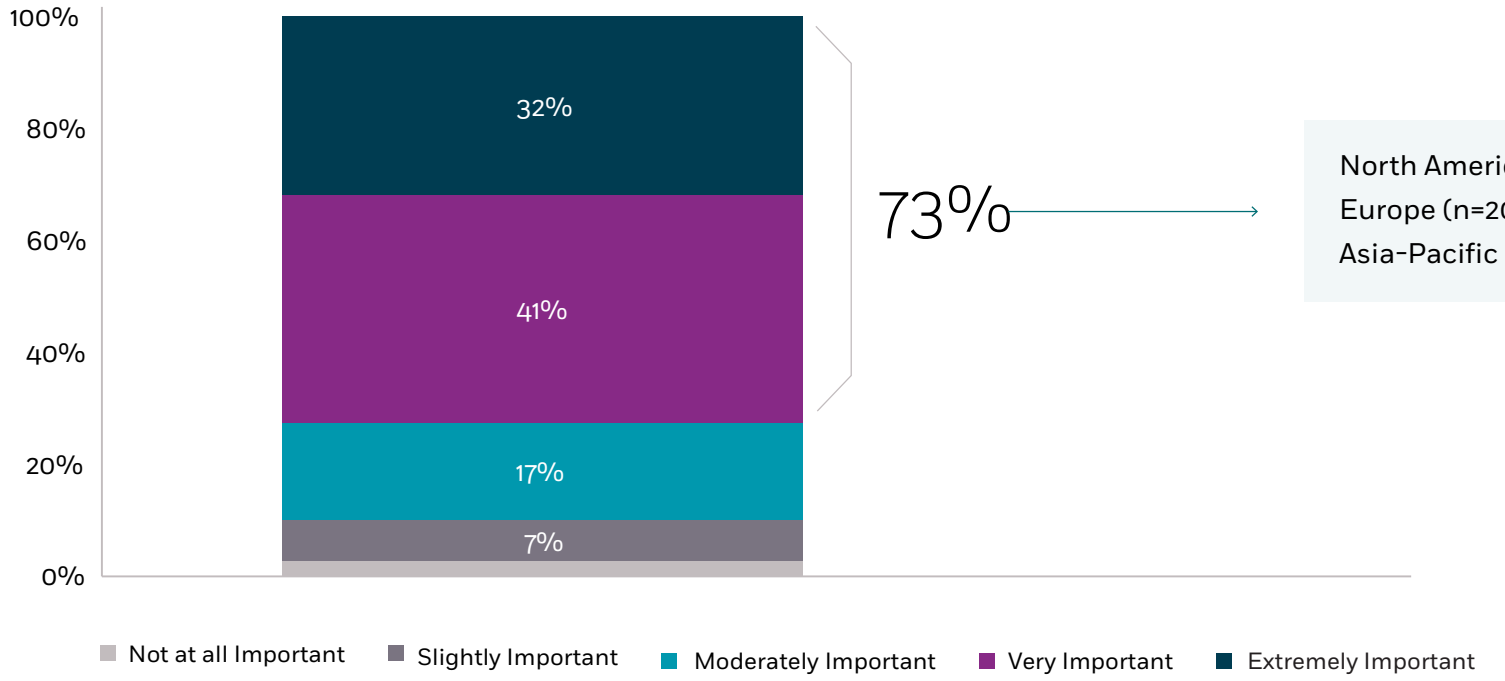
- Operational efficiency: **76%**
- Customer experience: **66%**

Deep dive: Technology-specific trends

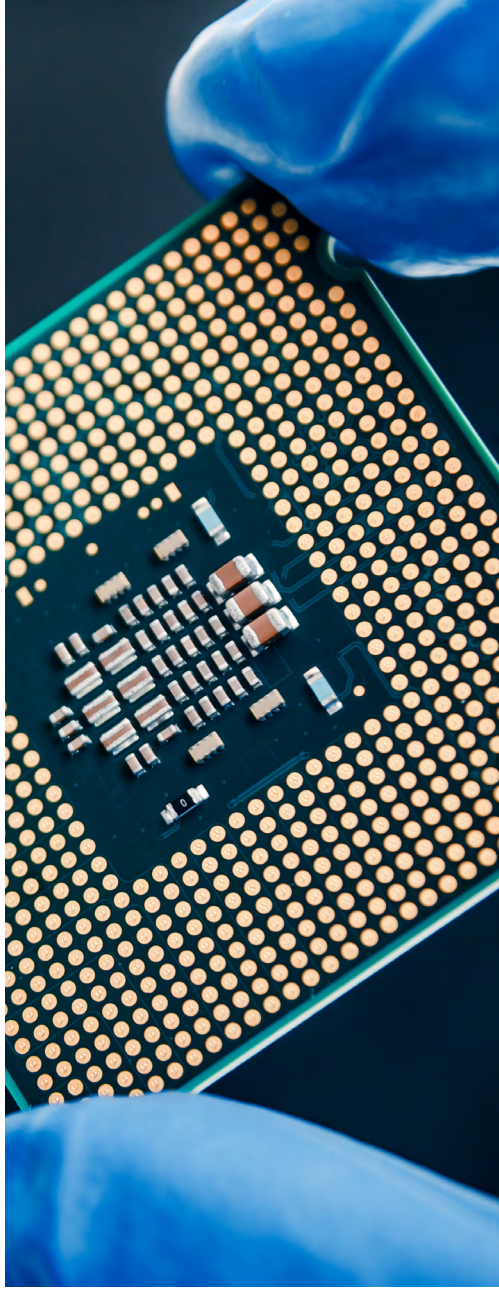
1 Silicon engineering and chip development

Three-quarters of organizations find custom chip development important for competitive advantage

Custom chip development is less important for competitive advantage in Europe (67%) than in Asia-Pacific (81%).



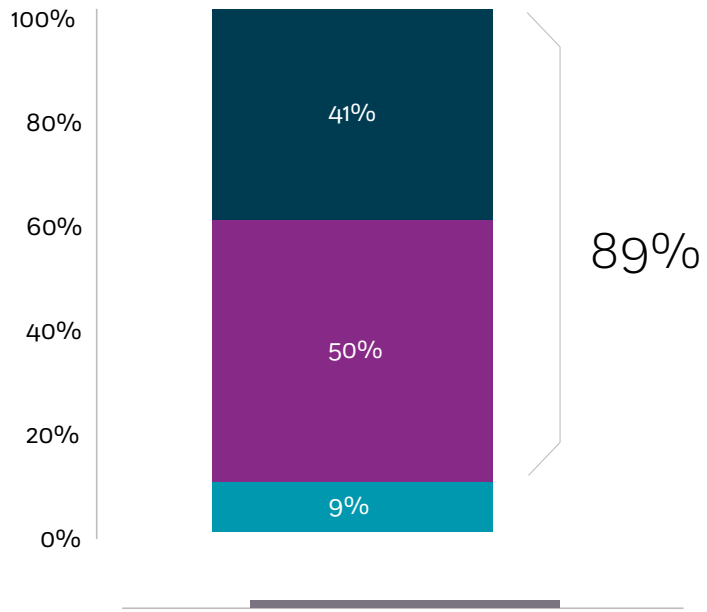
North America (n=201) [A]: 74%
Europe (n=201) [B]: 67%[C]
Asia-Pacific (n=100) [C]: 81%[B]



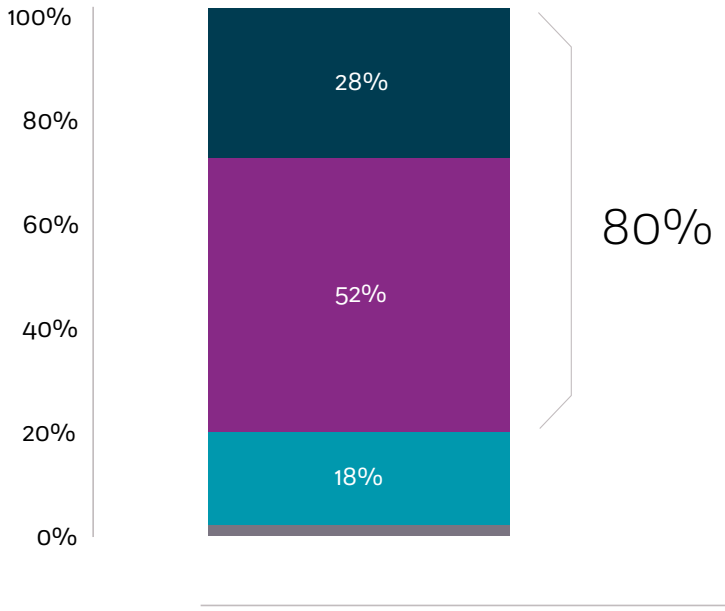
Organizations find collaboration between hardware and software development highly important in driving innovation

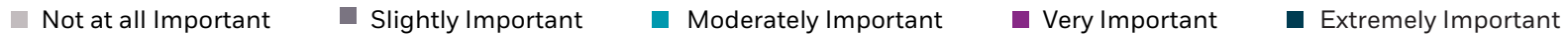
80% of organizations are confident that current hardware-software collaboration can drive innovation.

IMPACT OF HARDWARE/SOFTWARE COLLABORATION ON INNOVATION



CONFIDENCE IN CURRENT HARDWARE/SOFTWARE COLLABORATION DRIVING INNOVATION





81% in Asia-Pacific view custom chips as a strategic differentiator.

Technological optimism:

90% expect heterogeneous integration to have a positive impact.

64% say Moore's Law remains relevant.

Policy impact:

73% of North American companies see the CHIPS Act as a positive force for supply chain resilience.

Hardware-software collaboration:

90% view hardware-software collaboration as essential for innovation, with 80% confident in their current collaboration levels.

2 Artificial intelligence and machine learning

Automation adoption

74% Boost efficiency	69% Improve decision-making	64% Increase productivity

Positive impacts

91% Efficiency gains	85% Better real-time decisions

Future potential of AI

78% Revolutionize operations	72% Enhance customer centricity

Ethical focus

76% High ethical concern in banking	75% High ethical concern in healthcare
73% Organizations have ethical guidelines	67% Provide bias awareness training

Machine learning use case

Deployed for optimization (82%)	Predictive analytics	Predictive maintenance
	Improving accuracy and decision-making	

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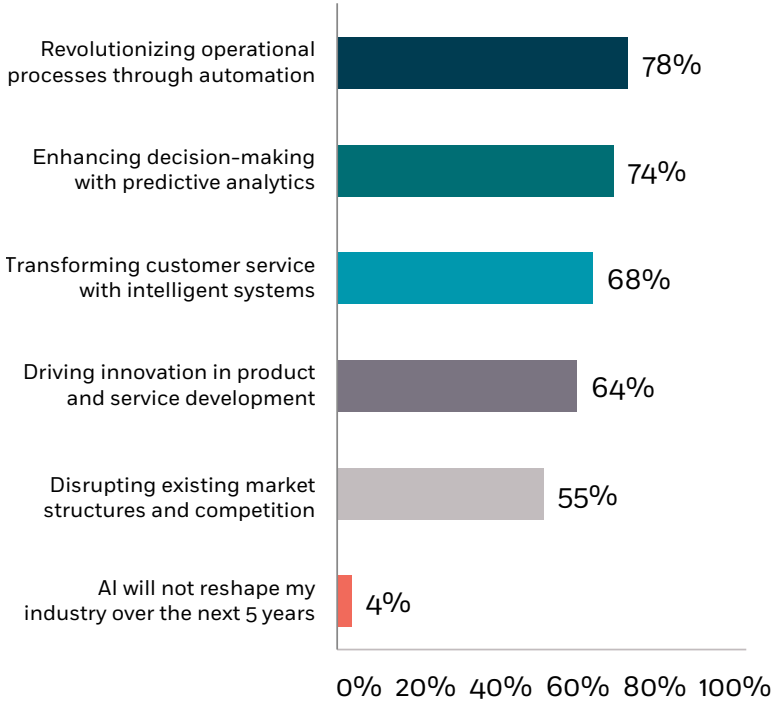
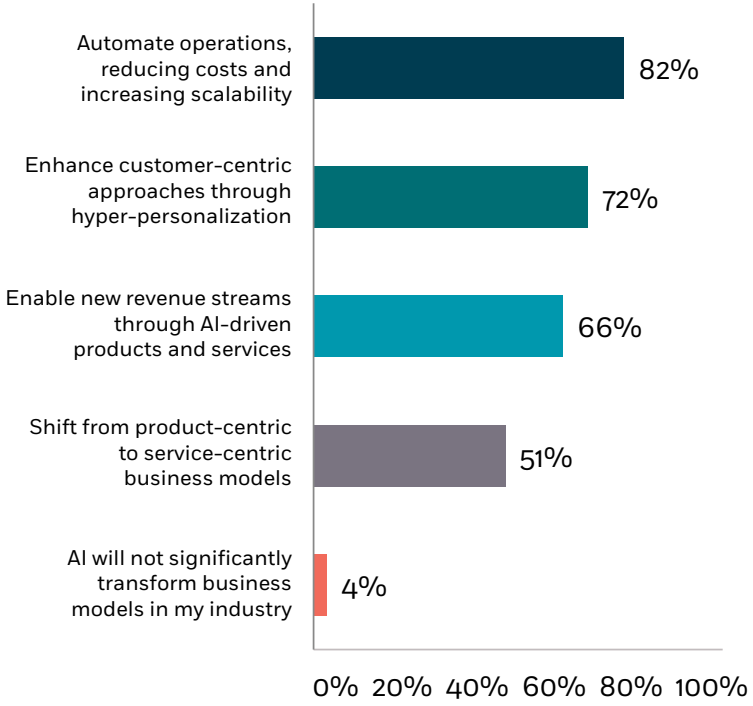
Ai is reshaping industries by revolutionizing operational processes and enhancing decision-making

Three-quarters of organizations believe AI will transform business models in the next 5 years.
AI will automate operations, reduce costs, and increase scalability (82%).
AI will enhance customer-centric approaches (72%).

AI'S ROLE IN RESHAPING INDUSTRY OVER THE NEXT 5 YEARS



AI'S ROLE IN TRANSFORMING BUSINESS MODELS OVER THE NEXT 5 YEARS



3 Sensors and IoT

Primary uses:
Safety/security (68%)
Quality control (60%)
Predictive maintenance (57%)

Challenges: Concerns around data privacy (53%), network vulnerabilities (52%), and device authentication (48%).

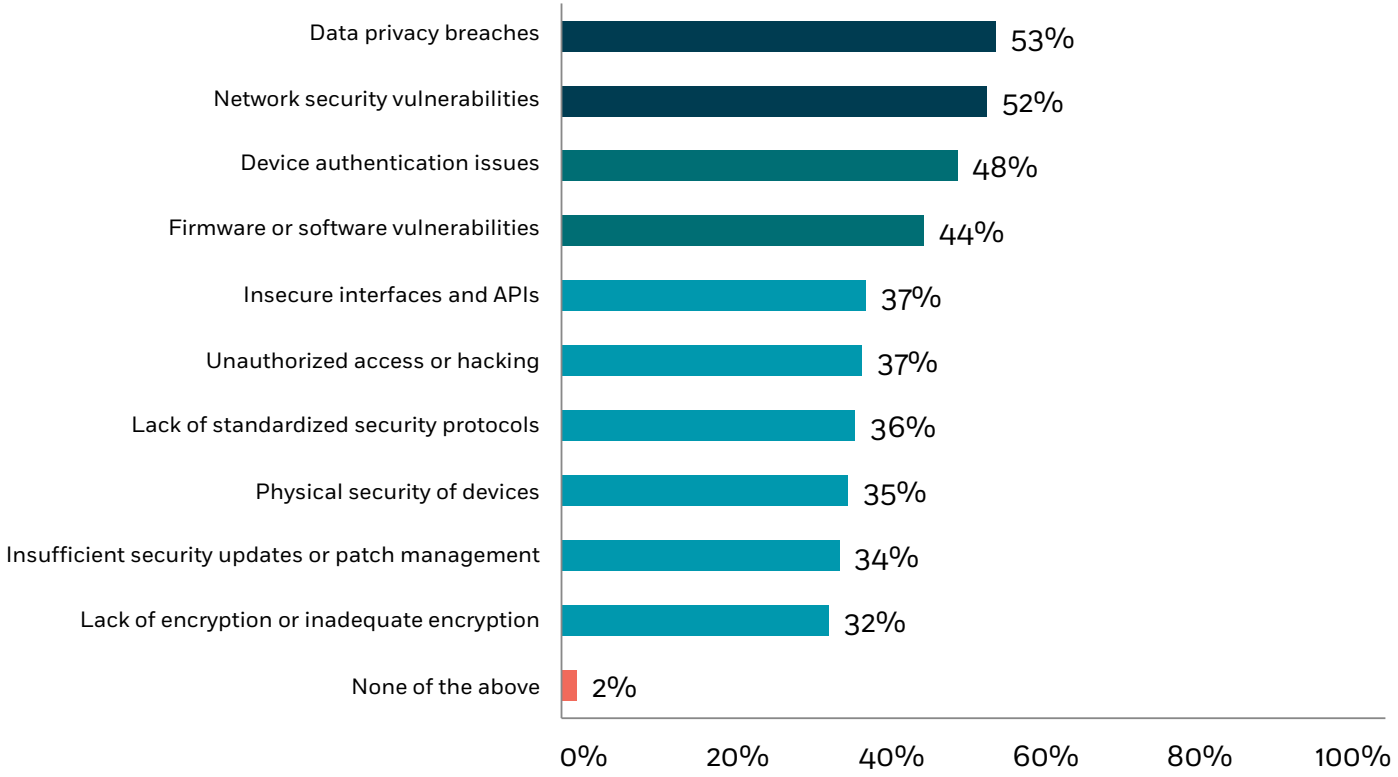
Advancements: Miniaturization has enhanced device integration (72%) and safety (68%).

Edge computing: Key to enabling real-time insights (61%) and system customization (64%).

Data privacy breaches and network vulnerabilities are potential challenges with IoT devices and networks

Organizations also cite potential challenges with device authentication issues (48%) and firmware/ software vulnerabilities (44%).

SECURITY CHALLENGES – IOT DEVICES AND NETWORKS

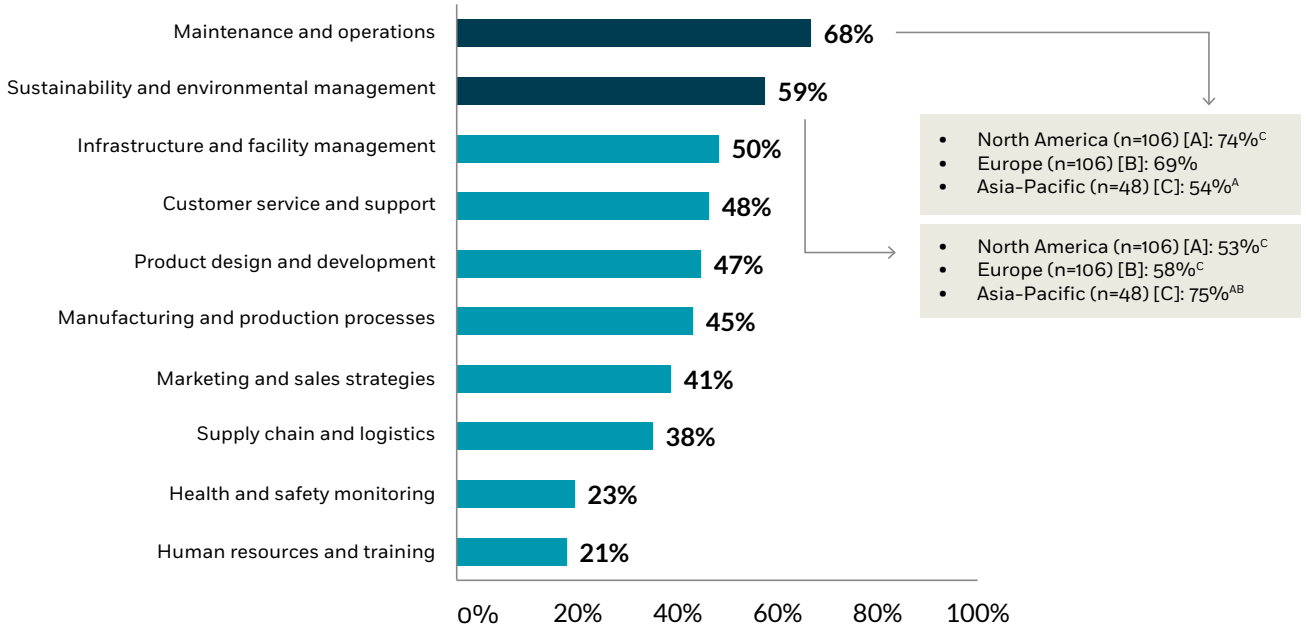


4 Digital Twins

Organizations are most likely to expand their digital twin usage into their maintenance and operations areas

Digital Twin usage by region: 59% expect increased use in sustainability and environmental management. 74% of North American organizations use digital twins for maintenance vs. 54% in Asia-Pacific. 75% of Asia-Pacific find digital twins valuable for sustainability, compared to 53% in North America and 58% in Europe.

DIGITAL TWIN POTENTIAL USE CASES



Adoption: One-third of organizations report mature or advanced use.

Benefits:

Operational efficiency (78%)
Customization (61%)
Improved decision-making (60%)

Integration:

With AI: Enables real-time monitoring (68%) and better decisions (60%)

With IoT: Leads to increased automation (65%)

With Robotics: Drives performance innovation (62%)

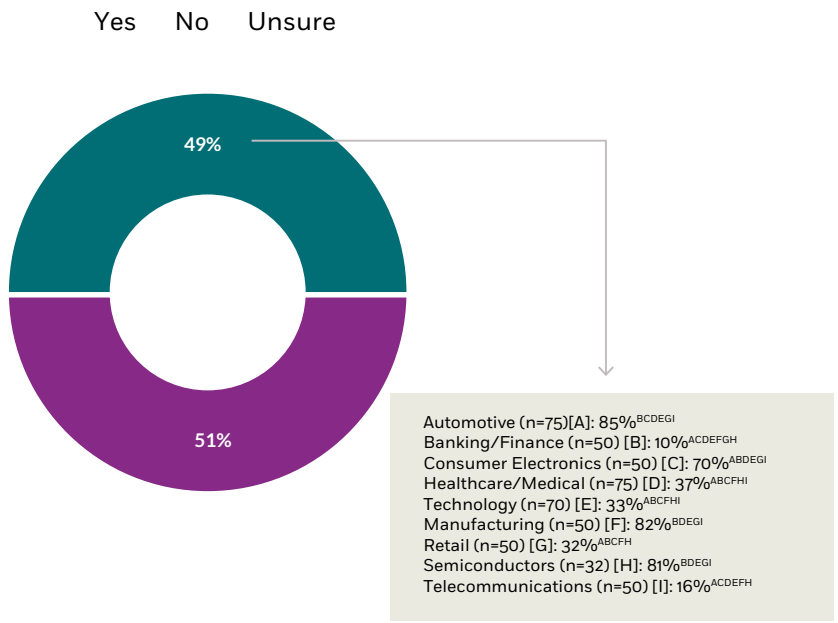
5 Robotics

Half of organizations do not currently use collaborative robots

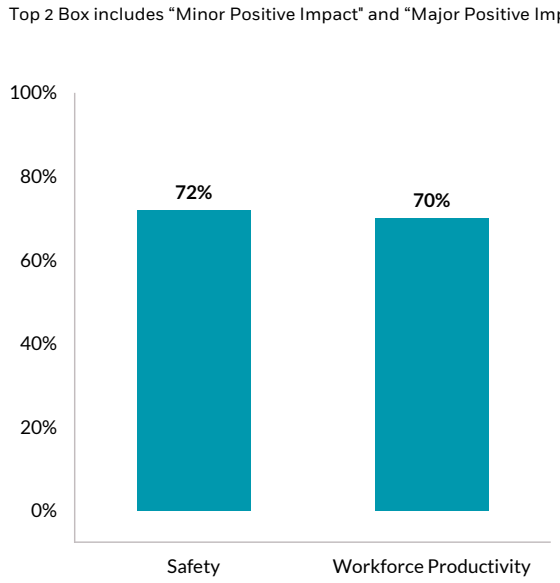
Three-quarters of organizations expect future collaborative robots to positively impact safety (72%) and workforce productivity (70%).

Compared to organizations in other sectors (10%-70%), automotive (85%), manufacturing (82%), and semiconductor (81%) organizations are the most likely to be currently using collaborative robots.

CURRENT USE OF COLLABORATIVE ROBOTS



COLLABORATIVE ROBOTS IMPACT



Collaborative robots (Cobots): Used by about half of organizations, especially in automotive (85%), manufacturing (82%), and semiconductors (81%).

Training gaps: Almost half (46%) lack dedicated training programs for cobots.

Autonomous robots: Expected to assist in inspection (39%), logistics (37%), and assembly (36%).

Ethical concerns: Focused on safety in human-robot interaction (43%) and decision-making bias (43%).

6 Security

Cybersecurity challenges: Half of organizations struggle with data management and security

49% face challenges protecting against emerging cyber threats.
45% struggle with ensuring regulatory compliance.

CYBERSECURITY CHALLENGES

51%

- 2,500 to 4,999 employees (n=350) [A]: 48%[B]
- 5,000+ employees (n=152) [B]: 59%[A]

45%

- 2,500 to 4,999 employees (n=350) [A]: 40%[B]
- 5,000+ employees (n=152) [B]: 55%[A]

Preparedness:

Most organizations are confident in securing chip software and connected systems.

Practices:

Access controls (56%)
Cybersecurity training (54%)
Multi-factor authentication (63%)

Challenges:

Data overload (51%)
Emerging threats (49%)
Regulatory compliance (45%)

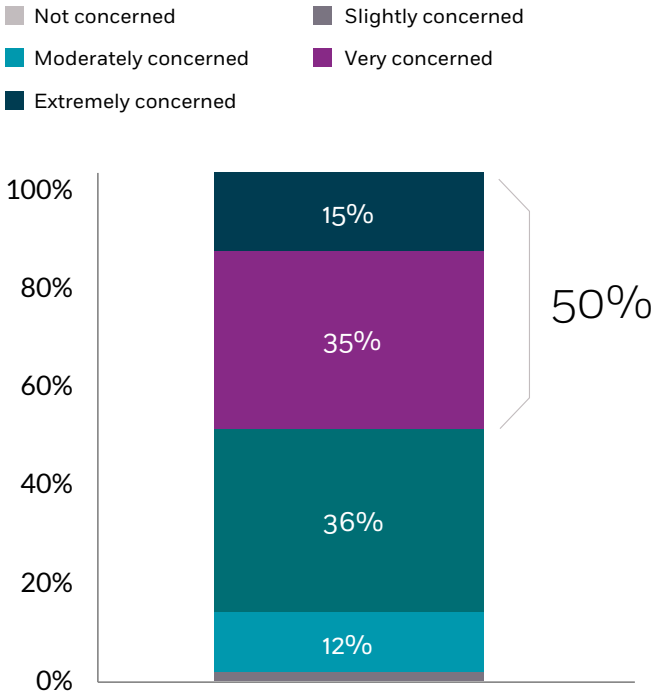
Larger organizations are notably more likely to view cybersecurity as mission-critical.

Ethics and governance

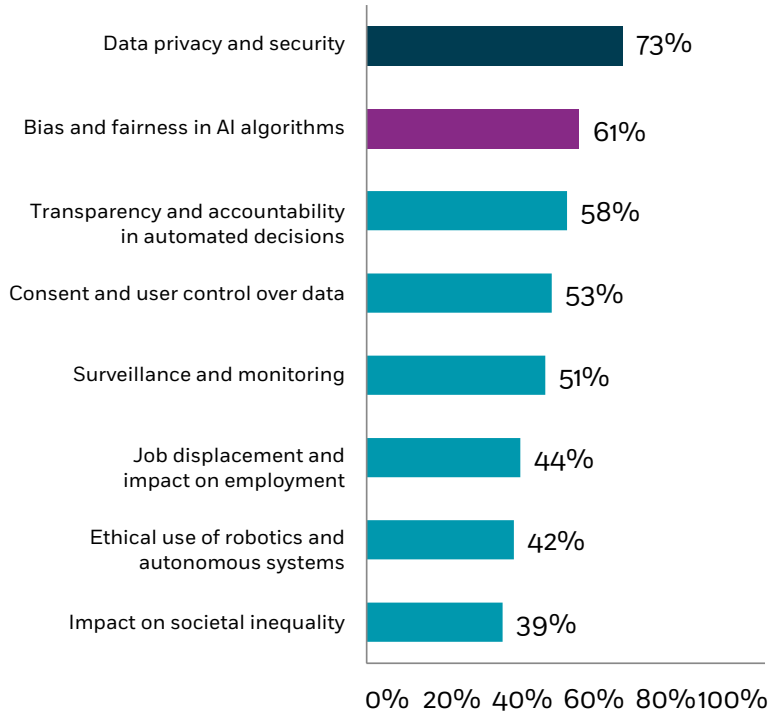
Half of organizations are concerned about the ethical implications of Industry 5.0 technologies

Data privacy and security (73%) and bias/fairness in AI algorithms (61%) are top ethical concerns among organizations regarding industry 5.0 technologies.

CONCERN ON ETHICAL IMPLICATIONS OF INDUSTRY 5.0 TECHNOLOGIES



INDUSTRY 5.0 ETHICAL CONCERNS



Ethical readiness:

Most organizations (90%) have ethical AI frameworks, and 85% provide ethics training.

Key principles:

Privacy and data protection (79%
Transparency (74%)
Safety/security (73%)

Proactive measures:

Risk assessments (69%)
Transparency in AI decisions (48%)

What's not obvious: Hidden insights and emerging patterns

While many findings reinforce expectations, the data also reveals a set of underappreciated insights that challenge assumptions and illuminate new opportunities:

- Ethical AI is operational, not theoretical: 73% of organizations already have ethical AI guidelines, and 67% conduct bias training—indicating that responsible AI is being codified, not just discussed.
- Hardware-software collaboration is a strategic innovation lever: 90% of respondents view this interplay as essential to innovation, with 80% confident in their execution, challenging the software-centric view of digital transformation.
- Digital twins are moving into ESG territory: 59% of organizations plan to expand digital twin use into sustainability and environmental management—signaling alignment between tech investment and environmental goals.
- Agentic AI is quickly becoming enterprise-relevant: 75% believe agentic AI will soon manage workflows and resources autonomously, with 66% expecting it to handle complex decision-making without human oversight.
- Robotics training is critically overlooked: Despite adoption, 46% of organizations using collaborative robots offer no dedicated training, revealing a significant safety and workforce-readiness gap.
- Mid-sized enterprises lag culturally: Ethical preparedness, AI governance, and security prioritization vary dramatically by company size. Organizations with 2,500–4,999 employees are consistently less confident and less proactive.
- Security fatigue is real—even among the well-prepared: 51% of organizations cite the challenge of managing vast volumes of security data, and 49% struggle with emerging threats despite having dedicated teams and controls in place.

Conclusion

Industry 5.0 is not a distant vision—it is already reshaping how enterprises operate, innovate, and interact with customers. Organizations are embracing a new paradigm where intelligent systems, ethical frameworks, and human ingenuity converge to unlock unprecedented value.

Critically, the survey underscores that readiness goes beyond investment—it requires cultural alignment, operational maturity, and ethical foresight. As digital and physical systems converge at the edge, leaders who can connect these deeper insights to action will shape the future.

Methodology

Respondent characteristics

Age (n=502)

25 to 34	4%
35 to 44	37%
45 to 54	51%
55 and older	8%

Regions (n=502)

North America	40%
Europe	40%
Latin/South America	20%

Industry (n=502)

Automotive	15%
Banking/Finance	10%
Consumer Electronics	10%
Healthcare/Medical	15%
Technology	14%
Manufacturing	10%
Retail	10%
Semiconductors	6%
Telecommunications	10%

Company Size (n=502)

2,500 to 4,999 employees	70%
5,000+ employees	30%

Organization Revenue (n=502)

$500 million to less than $1 billion	32%
$1 billion to less than $5 billion	43%
$5 billion or more	24%

Job Role (n=502)

Manager	25%
Director	29%
Vice President/Sr. Vice President	30%
C-Suite Executive	15%
President/CEO	2%

Years of Experience (n=502)

2 to 10 years	18%
11 years or more	82%

Decision-Making Status (n=502)

Primary decision maker	24%
Share the decision-making authority	46%
I participate by giving input/feedback	30%

Functional Roles (n=502)

IT/Tech	23%
Operations	17%
Engineering	17%
Supply Chain	12%
Cybersecurity	9%
Research and Development	7%
Compliance/Regulatory	7%
Corporate Leadership/Strategy	6%
Data Science/Artificial Intelligence/Machine Learning	4%

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