



HOKUYO USA

INDUSTRIAL ROBOTICS TRENDS FOR 2024


INTRODUCTION

Robots are gradually becoming an essential part of our everyday lives alongside their growing acceptance and impact in the industrial sector. There are about **3 million industrial robots** in use across the globe. This data represents a paradigm shift in the application of robotics, affecting many facets of our daily lives and having a major impact on industrial processes.

Developments in sensor technology, material science, and data transmissions have equipped these robots to work in various industrial settings and perform. The involvement of robots in the industrial sector is escalating at an exponential pace, chiefly because of their role in enhancing efficiency and productivity. The 2023 data suggests that about **88% of companies** look forward to investing in robotic integration for their organizations.

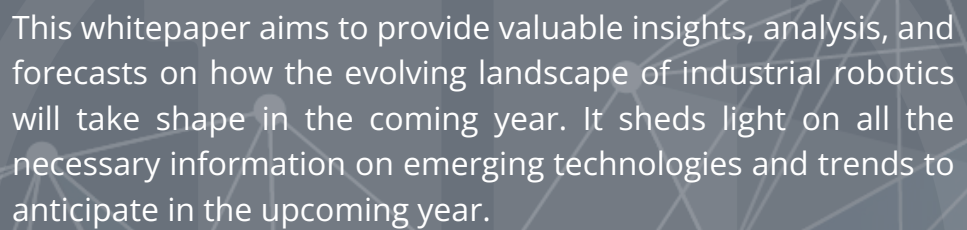
In 2024, myriad robotics trends are expected to emerge, showcasing the constant progress of this dynamic field. These trends reflect a drive to harness technology for the collective progress of various industrial sectors. Robotics promises a future where smart machines continue to influence and enhance our world in innovative ways.





There are various instances where industries have gone beyond the expected to push the boundaries of what was once seen as impossible. Aerial robots have improved geospatial informatics and the agriculture sector alike.

These robots help the [agriculture sector](#) conduct better mapping and forecasting by leveraging technologies like advanced LiDAR sensors and AI/ML capabilities. Heavy manufacturing units have employed collaborative robots to enhance human capabilities. Cobots are increasingly working alongside humans and acting as an extension of their bodies to deliver enhanced efficiency, versatility, and safety.



This whitepaper aims to provide valuable insights, analysis, and forecasts on how the evolving landscape of industrial robotics will take shape in the coming year. It sheds light on all the necessary information on emerging technologies and trends to anticipate in the upcoming year.

The paper is relevant to various stakeholders, including industry professionals, decision-makers, researchers, and technology enthusiasts, by providing insights on current and upcoming industrial robotics trends.

THE CURRENT STATE OF INDUSTRIAL ROBOTICS

The growing field of industrial robotics is going through significant change and innovation across a number of fields, making it a rapidly developing landscape. Some of the key markets with significant economic impact include AI-driven industrial robotics, agricultural robots, humanoid robots, and the Internet of Robotic Things.

Some of the notable trends include:

01

Globally, businesses are investing more in robotics technologies to automate and streamline their operations to improve overall efficiency, cut down on operating costs, and enhance productivity.

02

The market for AI industrial robotics is expected to grow at a compound annual growth rate (CAGR) of 13.53%, reaching US\$8.49 billion in 2023. The market is projected to reach a value of **USD 20.64 billion by 2030**. This indicates that artificial intelligence is being heavily incorporated into industrial robotics, improving functions like autonomous decision-making, computer vision, and machine learning throughout the manufacturing process.

03

By 2032, the agricultural robots market is projected to be valued at **USD 30.5 billion**, compared to \$6 billion in 2022. This indicates an exponential market rise and highlights how important automation is to transforming traditional agricultural practices and promoting sustainability and efficiency in the sector.

04

The Internet of Robotic Things (IoRT) market is expected to grow at an impressive rate, with a projected **value of USD 2,461.9 billion by 2031**, up from \$208 billion in 2021. The projected compound annual growth rate (CAGR) of 28.6% between 2022 and 2031 shows how robotic systems are becoming more interconnected, stimulating improvements in automated production, transportation, and other industries.

05

The market for humanoid robots, estimated to be worth USD 1.48 billion in 2021, is expected to grow remarkably, reaching an astounding **USD 35 billion by 2030** from USD 2.10 billion in 2022. Human-like robots are starting to gain traction in a number of sectors. At an impressive 42% growth rate, these machines are bound to transform human-robot interaction.





EMERGING TECHNOLOGIES IN ROBOTICS

Artificial Intelligence and Machine Learning

Artificial Intelligence is improving industrial robots by introducing adaptive learning, predictive maintenance, and more advanced visual capabilities.

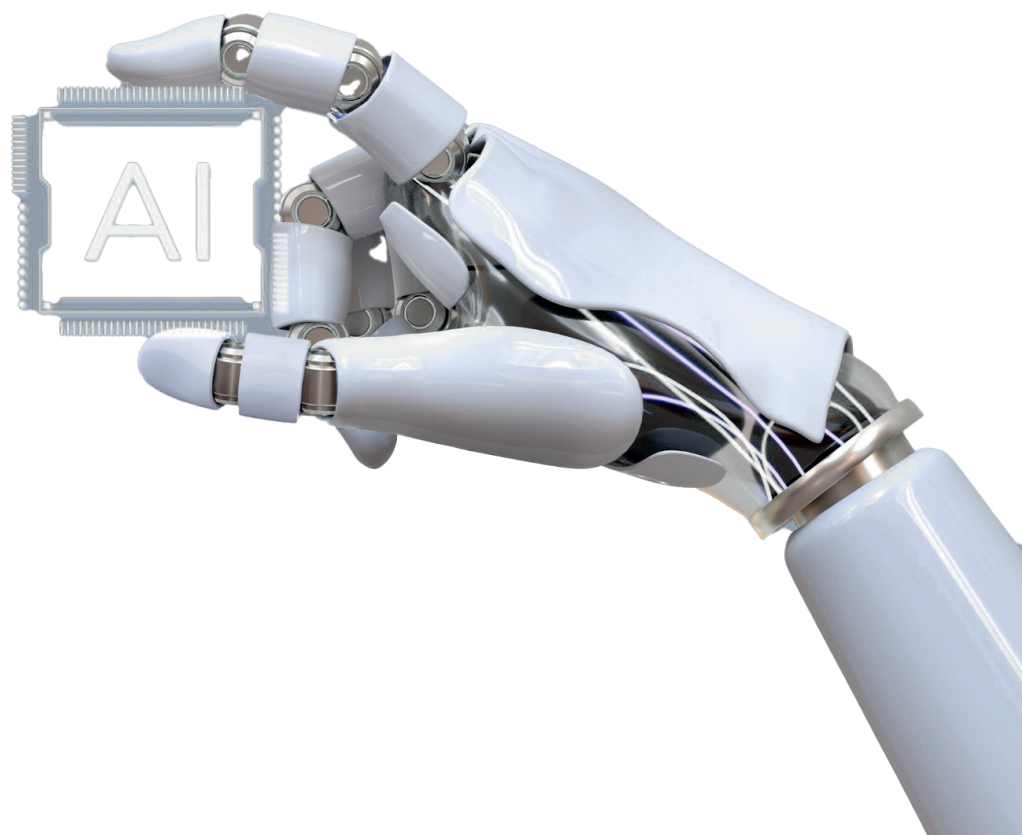
Robots now have the ability to learn from experience and continually optimize their own performance by leveraging machine learning capabilities. AI-driven predictive maintenance predicts parts failure to save downtime and increase, making industries more resilient to technical glitches and meltdowns.

Thanks to AI-driven computer vision, robots can better understand visual data, drastically improving object recognition and navigation. This is especially useful in environments where robots have to function with minimal human intervention. Robots can move more efficiently by constantly optimizing their routes based on real-time data through AI-facilitated intelligent path planning.

Robots are also becoming more intuitive to program. This means they can perform a wide range of activities without requiring extensive human programming. With the help of Natural Language Processing (NLP) capabilities, these intelligent machines can now understand human commands, which leads to intuitive human-robot communication. With this capability, one can brief a robot verbally like they may brief a human operator and specify detailed tasks or requirements.

Optimal energy consumption, real-time judgments, and enhanced human-robot interaction are other benefits of AI integration in robotics. AI simplifies task automation and trains them to function in several specific scenarios by allowing them to learn and adapt to new situations.

Collaborative robots or cobots can leverage advanced sensors to foster a secure, risk-free work environment, making it easier for them to work alongside humans in an industrial setting. AI also has a significant role to play in quality control and inspection since it allows robots using image recognition software to spot defects with greater accuracy.



Internet of Things (IoT) Integration


The [Internet of Things](#), or IoT, is a broad concept that is all about the interconnectedness of physical objects with the help of embedded sensors and actuators. This encompasses several everyday appliances, devices, and objects communicating via wireless networks with computing systems. In essence, IoT emphasizes communicating with the physical world digitally.

IoT integration in industrial robotic systems can help streamline operations by enabling seamless communication on the cloud. The Internet of Robotic Things (IoRT) allows industries to synchronize every tangible asset with their robotic systems.

IoT facilitates continuous monitoring and comprehensive performance assessments of robotic manufacturing systems so that production units can make data-driven decisions.

This interconnectedness makes it possible to have on-demand access to real-time statistical visualization of workflow, stocks, potential risks, and quantitative data on daily productivity on a dedicated dashboard.





By combining robotics and IoT, businesses can give rise to highly coordinated industrial automation workflows, improving overall efficiency and operational harmony. IoT integration in industrial settings means leaders have complete access to all their tangible and intangible assets at the tip of their fingers.

This connectivity involves manufacturing machinery, robots, equipment, storage systems, communication devices, all digitized data, and even entire physical infrastructures. With access to real-time data from both IoT and loRT, businesses can monitor, manage, calibrate performance, and enhance resource utilization from one centralized system.

Cutting-Edge Sensor Technologies

New-age sensor technologies are driving the evolving landscape of industrial robotics even further. In today's time, crucial advancements in sensor technology like LIDAR, proximity sensors, motor control sensors, and gyroscopic sensors serve as the major sensory apparatus that allow robots to perceive their surroundings and adapt accordingly. These sensors collectively enable the robot to gain a comprehensive awareness of its surroundings.

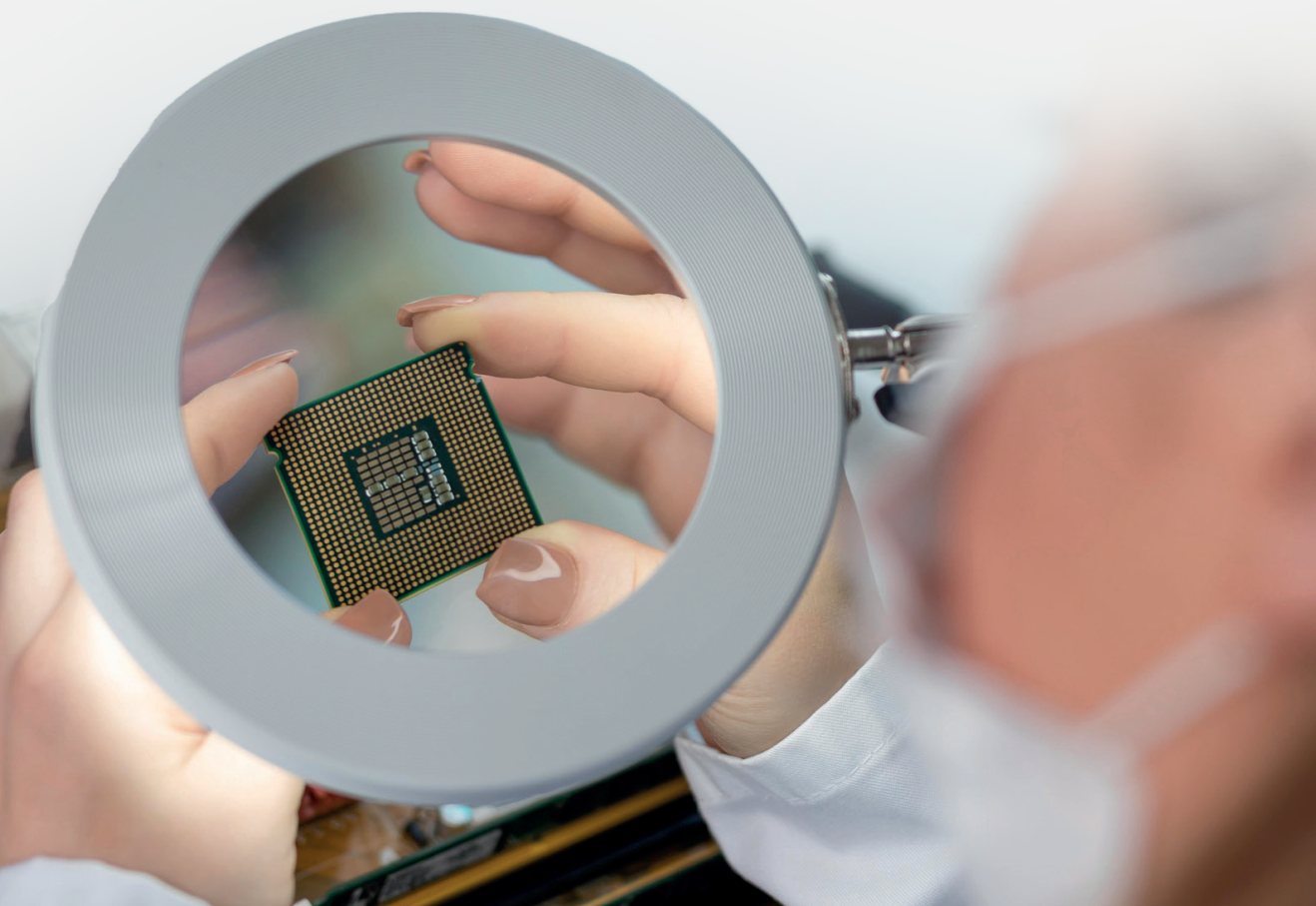
Robust sensor technology is not just advantageous but imperative when it comes to robotics, especially when executing intricate tasks within industrial environments. Without sensors, these robots simply reduce to conventional manufacturing machinery. They become empty shells without the ability to work out real-time data, make intelligent decisions, and navigate complex environments.

As for cobots, their ability to interact adaptively with their environment and collaborate with human workers while ensuring their safety is vital. Force and tactile sensors play a crucial role in this case. These sensors allow robots to quantify and react to varying levels of pressure and touch. With this ability, robots can perform delicate manufacturing, medical, and chemical processes with relative ease and heightened safety.

New-age sensor technologies are driving the evolving landscape of industrial In the coming years, we will see increasing involvement of advanced visual systems that involve machine vision algorithms and high-resolution camera or sensor imagery. With enhanced visual perception, robots can recognize objects, inspect, classify, and perform even the most intricate assembly tasks.

With heightened perception and adaptability, robots will be able to keep up with the technologies evolving around them and stay in sync. For instance, edge computing is increasingly gaining attention in the field of robotics. With cloud and edge capabilities in robotic applications, these super-intelligent machines will process data closer to the source with minimal latency.

Consequently, with the ability to anticipate and quickly respond to change, industrial robots will not only act reactively but also proactively. The convergence of cutting-edge sensory technology with edge computing and the cloud will place robots at the forefront of industrial innovation.



TOP INDUSTRIAL ROBOTICS TRENDS IN 2024

Autonomous Mobile Robots (AMRs)

As we move into 2024 and beyond, [Autonomous Mobile Robots \(AMRs\)](#) are set to play an increasingly pivotal role in industrial automation. These sophisticated machines, equipped with advanced LiDAR sensors, AI, and machine learning capabilities, are transforming the way businesses operate across various sectors.



AMRs are highly adaptable and capable of performing various tasks in different settings. They can be easily reprogrammed and repurposed, making them a flexible solution for businesses that need to quickly adapt to changing market demands.

They are built to safely navigate around human workers, reducing the risk of workplace accidents. Furthermore, the collaborative nature of some AMRs enables them to work alongside humans, combining the strengths of human intelligence and robotic efficiency.

The global autonomous mobile robot market, valued at \$2.2 billion in 2021, is projected to reach \$18.9 billion by 2032. This represents a Compound Annual Growth Rate (CAGR) of 21.8% from 2022 to 2032, highlighting the rapid expansion and increasing adoption of AMRs.

One of the primary drivers of AMR adoption is the need to address labor shortages, particularly in industries like manufacturing, logistics, and healthcare. The decreasing cost of robotics technology is another factor contributing to the growing importance of AMRs. As these robots become more affordable, they are no longer exclusive to large corporations but are increasingly accessible to small and medium-sized enterprises.

Cobots



Collaborative robots or cobots have revolutionized industrial robotics by furthering robot-human collaboration. Cobots are programmed to work close to humans in factory environments. [Working in a shared environment](#) allows them to collaborate with humans and enhance productivity by automating everyday tasks. [As a result, human workers can focus more on complex aspects of their work.](#)

Industries have warmly embraced cobots for their ability to improve efficiency, safety, and adaptability within the industrial ecosystem. With the help of advanced sensors, cobots foster a secure work environment and adjust their actions when in close human proximity.



For example, a cobot with force-torque sensors can work with intricate assembly components and also react to abnormal readings. If a human comes in contact with the bot, the sensor can immediately detect the force, prompting the cobot to slow down or stop its movement.

Cobots are also an extremely cost-effective and scalable alternative for industries seeking rapid automation. Whether it be simple picking and packing or more complex assembly tasks, with a relatively low upfront investment, cobots can be programmed to handle multiple tasks skillfully.

In 2024, cobots will continue to have a significant impact on the modern industrial workspace dynamics. Estimates suggest that by 2030, cobot shipments worldwide are expected to reach 42,000 from 4,500 in 2022. These robots will introduce new, transformative methods to efficiently carry out industrial processes.

Automated Guided Vehicles (AGVs)

2024 will also see a significant growth in the use of AGVs. These self-guided vehicles are revolutionizing operations in various sectors by offering efficient, reliable, and cost-effective solutions for material handling and transportation. Although these vehicles move along a defined path, modern AGVs have sophisticated sensors, AI, and machine learning capabilities, enabling them to navigate complex environments autonomously. This technological evolution not only enhances the functionality of AGVs but also broadens their application scope.

Key industries rapidly adopting AGVs include:

Materials Handling and Manufacturing:

These sectors leverage AGVs to automate transport and handling tasks, improving efficiency and reducing labor costs.

01

Automobile Industry:

AGVs are used for transporting parts and materials within manufacturing plants, enhancing the speed and precision of production processes.

02

Healthcare Sector:

AGVs are increasingly used for tasks like transporting supplies and medications, contributing to improved operational efficiency.

03

With a projected CAGR of 12.2%, the AGV market will reach USD 14.8 billion in 2031 from USD 5.9 billion in 2023.

The primary drivers behind the accelerated adoption of AGVs include the global shift towards automation, spurred by factors such as the COVID-19 pandemic and the rise of Industry 4.0.

RaaS

Robots are often a hefty capital expenditure for companies looking for quick and effective automation tools. Robotics as a Service, or RaaS, is a service model that essentially makes robotic integration much more accessible for everyone by eliminating the high-cost barrier, particularly for small and medium-sized enterprises (SMEs).

The RaaS model involves robotics companies renting out their robotic systems for short-term or long-term use. This method allows businesses to adjust their budgets and robotic deployments according to their evolving operational needs.

Additional advantages of the subscription-based RaaS model are that providers may include on-demand support, maintenance, and upgrades as a part of the whole service pack. This relieves industries from the high costs of servicing and upgrading these complex machines.

RaaS enables access to cutting-edge automation technology at a fraction of the cost, with minimal liability. This greatly impacts the industrial landscape by empowering small and medium industries to integrate robotic automation without taking the burden of ownership.

With a RaaS provider, large enterprises, too, can meet their productivity requirement by simply upscaling the robotic labor. Valued at USD 1.8 million in 2023, the Robotics as a Service market is expected to reach [USD 4.0 million by 2028](#).



Humanoid Robots

Humanoid robots are human-like bipedal machines that mimic the appearance, actions, and functions of human beings. In the past, these robots were merely an engineer's dream or a science fiction movie character. Today, these robots are increasingly finding applications in various industrial settings.

Humanoid robots are more suitable for tasks that require dexterity, but they can also be deployed to enhance automation efficiency in industrial settings. Their human-like agility makes it possible to manipulate objects and navigate spaces better than traditional robots.

These robots can do any physical task that a human worker is capable of, but with added strength, durability, and endurance. They can effectively replace human workers in highly sensitive environments like hospitals, chemical facilities, or construction sites, contributing to increased safety and efficiency.

With the integration of Artificial Intelligence, these robots can perform more human-like so that they are capable of communicating, empathizing, and experiential learning.



One prime example of the rise of humanoid robots for industrial use in our times is RoboFab, the world's first factory for humanoid robots. This 70,000-square-foot robot factory can produce 10,000 humanoid robots every year.

The company built 'Digit' a human-like bipedal bot to fix today's workforce problems, including turnover, injuries, fatigue, and labor gaps. The key purpose for the company Agility Robotics' for building this robot is "enabling humans to be more human."

Self-Repairing Robots

Self-healing or self-repairing robots are smart machines capable of autonomously fixing themselves physically or rectifying issues within their systems. While there is still a lot of experimentation and speculation around this subject, it is gaining traction in the robotics community as a subject of intense discussion and investigation.

These AI-powered machines are capable of determining points of improvement and respiration, whether physical or within the system. They are highly adaptable and responsive robots that require minimal maintenance and care. Their ability to promptly resolve small issues prevents problems from turning into major failures.

The self-healing robots under experiment are made of soft materials or polymers, allowing them to mimic human self-healing capabilities. Self-healing can also include a robot mending itself with the help of external parts or equipment.

The success of this concept is highly reliant on integrating AI-driven capacity for self-learning and adaptability in a robot operating system. In the realm of autonomous industrial systems, self-healing robots can reduce the need for manual maintenance and make industrial environments much more resilient and self-sufficient.



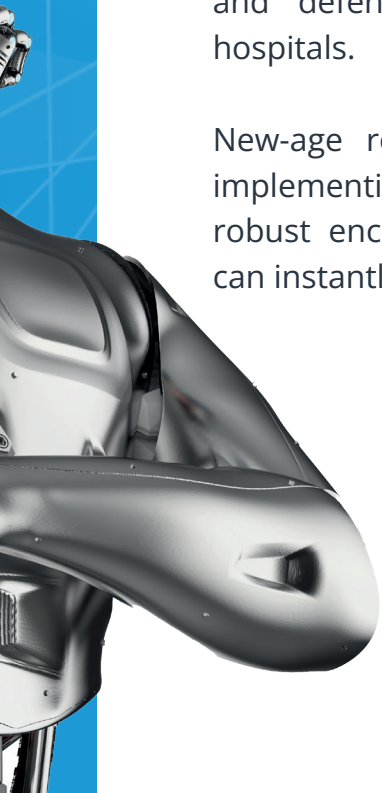
Robotics Cybersecurity

Robots are more vulnerable to cyberattacks than ever. This is due to the increasing need for connectivity and other technological integrations that expose them to open networks. For instance, the integration of IoT is going to make robots more interconnected to their surroundings. This inadvertently opens doors for a number of cybersecurity threats, and AI can potentially compromise operational continuity or even physical safety.

Recent data suggests that the manufacturing sector remains the prime target for threat actors. ReliaQuest's tracking data shows a 53% increase in attacks on automotive and parts organizations in 2023. The attacks on industrial goods and services organizations accounted for 24%.

Evidently, there is an immediate need for proactive cyber security measures to address these vulnerabilities proactively. Safeguarding robots from unwanted access is critical as they directly interact with virtual or physical environments at aerospace and defense facilities, manufacturing units, or hospitals.

New-age robotic cybersecurity strategies include implementing diligent authentication methods, robust encryptions, monitoring, and systems that can instantly detect and respond to threats.



Integrating virtual cyber security solutions that safeguard endpoints and connectivity stacks is crucial to stopping data leaks and asset outages. It is the collective duty of all manufacturers, developers, and end users to talk about best cyber security practices and follow them to stay safe from external threats.

Sustainable Robotics

Industries are seeking energy-efficient and eco-friendly automation solutions to meet sustainability goals. The purpose of sustainable robots is to use resources as efficiently as possible while reducing their negative effects on the environment. With the help of AI and robotics, manufacturers can ensure optimal resource utilization and reduce the overall carbon footprint of industrial operations.

Industrial robots can help conserve energy spent in operating heavy fuel-based machinery and cut emissions. They can also be programmed to conserve resources, for instance, to use a minimal amount of volatile material in manufacturing a certain product or to actively quantify the possibility of a sustainable alternative for the existing materials. Robots can work with advanced sensors and computer vision in quality check procedures to ensure the product meets the required sustainability standards.

According to the International Federation of Robotics (IFR), **“74 robot units per 10,000 employees is the new average of global robot density in the manufacturing industries.”**

This statement highlights how the increased robot density in manufacturing promotes resource efficiency, economic viability, and decreased environmental impact, aligning with sustainability goals.



Customizable and Modular Robotics

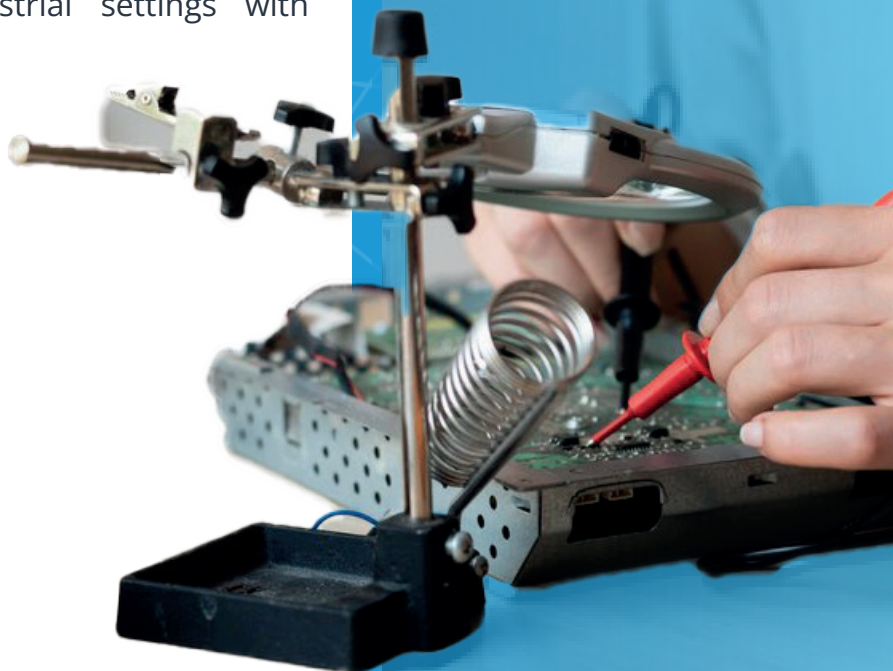
Modular and customizable robots offer incredibly flexible automation solutions. These robotic systems are the perfect automation system addition in industries with various production needs because they are simple to reconfigure and customize to carry out specific tasks.

The primary advantage is the ability to adjust to changing requirements quickly. This flexibility enables smooth transitions between different assignments by reducing downtime associated with reprogramming.

Some of these robots are also [self-reconfigurable](#) and quickly adapt to new situations and tasks or to recover from damage.

For now, modular robots need skilled personnel to operate as it is a product of complex robotic engineering. Efforts are underway to make these robots more accessible by simplifying and automating their operation.

With further development, they can provide unparalleled flexibility and perform multitudes of tasks by simply changing form, empowering industrial settings with versatility.



APPROACHING INDUSTRIAL ROBOTICS IN 2024 AND BEYOND

The industrial robotics landscape is witnessing transformative changes as 2024 draws closer. One of the most important highlights is that robots are becoming increasingly integrated with different technologies to function in disparate industrial settings to increase productivity, efficiency, and innovation.

Aerial robots in agriculture and geospatial informatics and the growing use of collaborative robots in manufacturing are examples of how robotics is advancing into new industries and standing up to its potential.

A number of market segments, such as AI-integrated industrial robots, cobots, humanoid robots, and the Internet of Robotic Things (IoRT), are anticipated to see robust growth. In 2024, a few significant trends are expected to dominate the industrial robotics scene. Robotics as a Service (RaaS) will become an attractive business model for greater accessibility to robotics technology, particularly for small and medium-sized businesses.

The development of self-repairing and humanoid robots demonstrates the progress in robotic autonomy and agility. Additionally, cybersecurity in robotics will become a top priority due to the growing interconnectedness of robotic systems. Moreover, an ever-increasing emphasis is on developing eco-friendly and energy-efficient or sustainable robotics solutions.

For businesses and industries hoping to fully utilize robotics, comprehending and adjusting to these advancements is essential. In addition to changing industrial operations, the trends covered in this paper will pave the way for an automated, more reliable, efficient, and sustainable industrial future.

