

Robotics and automation

Overview, applications, and impact on the workforce

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Introduction

Robotics is a rapidly growing field that involves the design, development, and use of robots to perform various tasks. Robots have become increasingly advanced in recent years, and they are now capable of performing complex tasks with speed and precision.

The robotics industry has seen tremendous growth in recent years. From manufacturing to healthcare, the use of robotics has transformed various industries and revolutionized the way work is done.

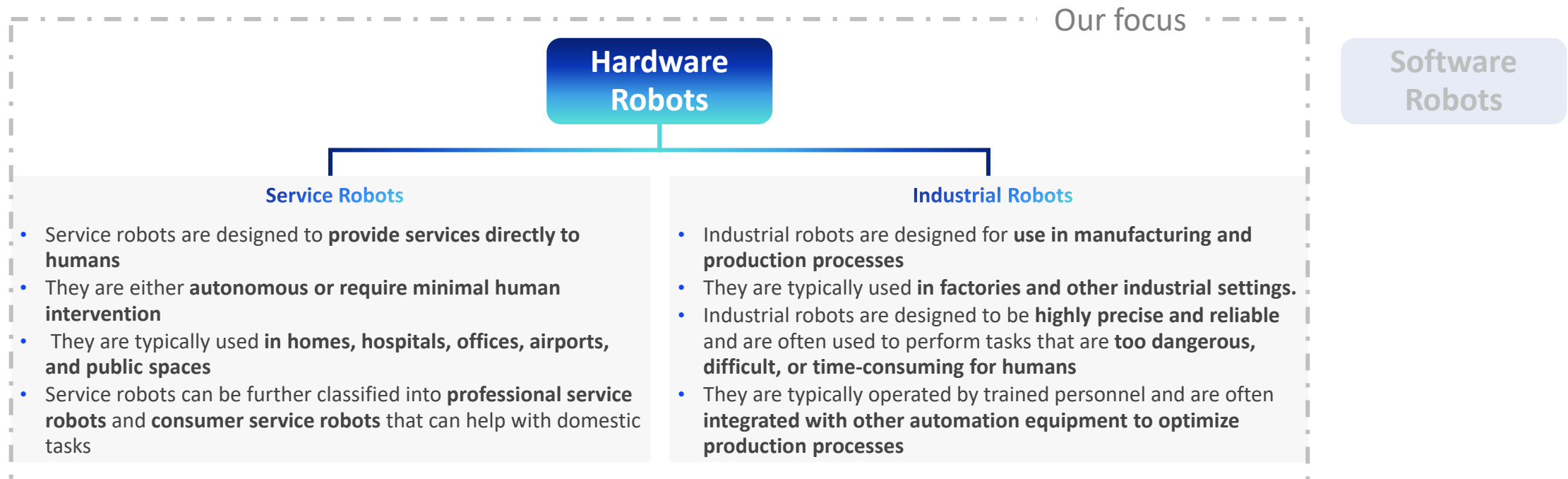
The potential benefits of robotics are vast, including increased efficiency, productivity, and safety. However, there are also several obstacles that are hindering its adoption in various industries, such as the high cost of robotics technology and the lack of skilled workers who can operate and maintain robotic systems.

With ongoing advancements in technology, robotics is poised to revolutionize many industries and transform the way we live and work. However, as with any emerging technology, there are also concerns about the impact of robotics on the workforce, particularly the potential for job displacement.

Scope of our report

Robotics is a field of technology that involves **designing, building, and programming** machines (robots) that can perform tasks **automatically and/or autonomously**, with or without human supervision, in a variety of industries.

The robotics industry is composed of hardware robots and software robots. Hardware robots are divided into service and industrial robots. While our primary focus in this report is on hardware robots, exploring current market trends, their applications, and success stories in different industries, we will also look at how robotics and automation will have an impact on the workforce.



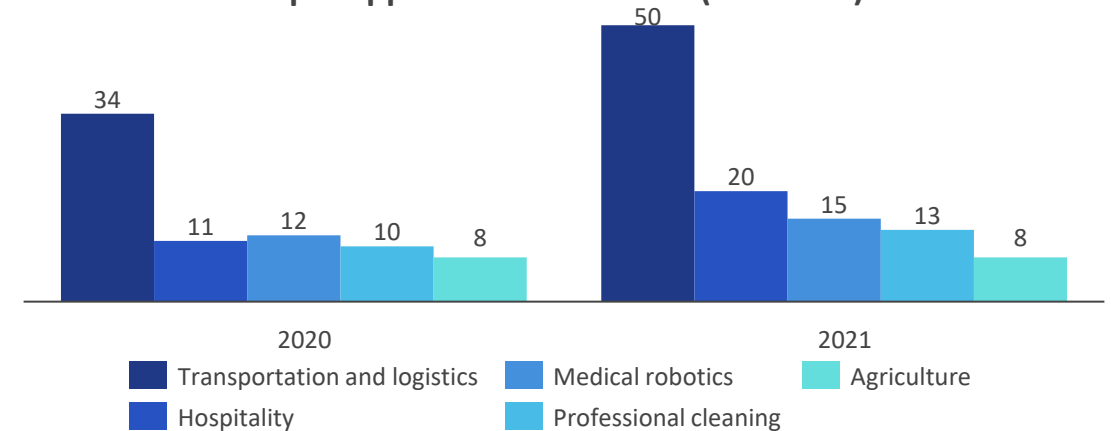


Hardware robotics market overview

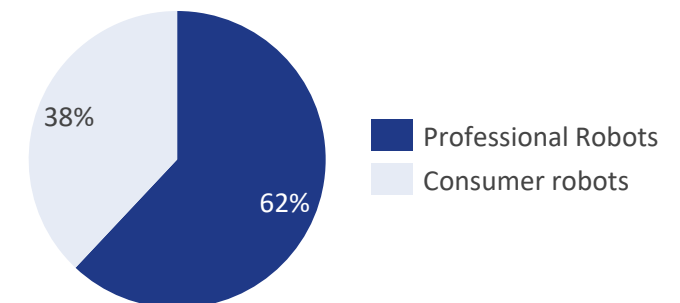
Service robots for professional use are prominently applied in transportation and logistics

- The market for service robots is divided into consumer and professional service robotics. ~60% of service robotics globally are professional robots
- **Consumer service robots:** Robots for domestic tasks constituted the largest group of consumer robots. **Almost 19 million units (+12%) were sold in 2021.** Vacuuming robots and other robots for indoor domestic floor cleaning are currently the most common applications
- **Professional service robots:** In 2021, **121,000 professional service robots were sold, an increase of 37% from 2020.** Despite an **85% increase in sales, hospitality robots** still have relatively low sales figures compared to their market potential. Professional cleaning robots also experienced a 31% increase in demand, with disinfection robots being especially popular due to the COVID-19 pandemic. In addition, robotics is playing an increasingly important role in agriculture, mainly for cow milking and feeding
- **The growth in service robots' adoption is due to several factors, including** the strong demand for remote control robots to support in the supply chain and distribution procedures, the expected increase in public and private spending to modernize healthcare systems using robotics, and the increased demand for personal service robots in emerging countries as they are enjoying higher standards of living

Service robots for professional use
Top 5-applications unit sales (000 units)¹



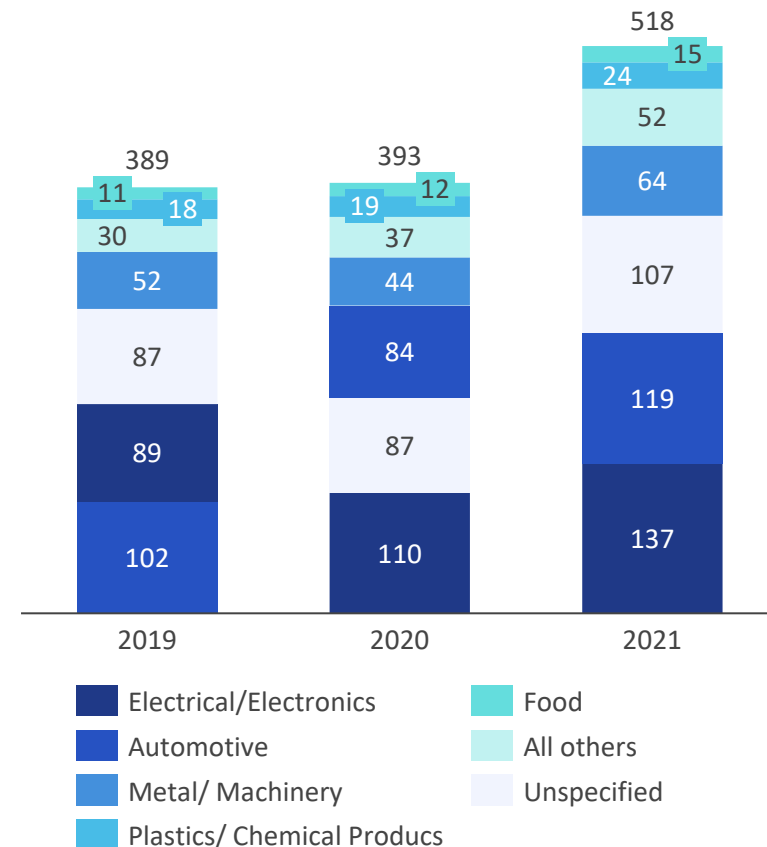
Professional vs Consumer robots' revenues share², 2023



Industrial robots reached a record high of annual installations in 2021, with the electrical/electronics industry having the largest share

- A record high of 517,385 new industrial robots were installed in factories worldwide in 2021, representing a 31% YOY growth rate, surpassing the pre-pandemic record of robot installations in 2018 by 22%
- The global stock of operational industrial robots has also reached a new high of approximately 3.5 million units
- Increased demand for semiconductor products, a greater focus on innovation to solve new challenges, rising labor costs, and avoiding the risk of hazardous effects on workers are all factors that have led to increased adoption of industrial robots by manufacturers
- Moreover, the electrical/electronics industry became the industry with the largest installations in both 2020 and 2021, overtaking the automotive industry. The worldwide decline in production in the automotive industry and the rise in production in the electronics industry due to COVID-19 might have been a principal cause of the shift in revenues and installations. Robotics were used in the electronics industry to overcome challenges such as increased costs and the need for more product customization, driving the development of the supply chain in this direction

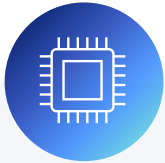
Annual Installations of industrial robots by 1000 units by sector¹





Industry applications

While the presence of robots in the electronics industry is not new, the rate of robot adoption has accelerated over the past two years



Applications

The electronics industry is increasingly deploying robots to reduce errors, waste, and inefficiencies throughout the production cycle due to the delicate nature of components and circuits.



Manufacturing

Robots can be used to pick and place components, build subassemblies, connectors, displays, and other delicate parts. Robots can also be used for handling and populating PCBs.



Packaging

Robotic systems can pack electronic products into boxes, label them, and load them onto pallets or trucks for shipping.



Testing

Robots with arm-mounted cameras can visually inspect electronics assemblies to ensure proper component alignment, soldering, and other physical features. Automated robotic arms with IR cameras can inspect powered boards for hot spots and thermal issues.



Repair and maintenance

Robotics can be used to perform routine maintenance on electronic equipment. Examples include cleaning, lubricating, and adjusting components.

Examples

Koyo

KOYO deployed a UR3 cobot for **quality inspection of touch panels**. The UR3 deployment increased KOYO's **productivity by 31%** and **halved the number of people required** for panel inspection tasks. This allowed workers to **focus on more ergonomic, higher-value tasks**. The ROI was achieved in just 12 months.



LG Electronics has a **fully automated appliance assembly plant** in South Korea, led by robots to improve productivity, reduce defects, and increase safety. The plant has increased output by 25% over five years (2017-2022) without increasing headcount. The plant uses **six-axis robots for welding and screwdriving**, and **automated guided vehicles (AGVs) to transport parts and finished devices throughout the plant**.

The automotive industry is one of the earliest adopters of industrial robots and is currently the second largest in terms of installations and revenue contribution



Applications

The automotive industry has been using traditional industrial robots for more than half a century. Since then, applications have continued to improve, offering lower-cost, more flexible, collaborative systems to complement or replace traditional robots.



Assembly

Light robotic arms assemble smaller parts such as motors and pumps at high speed. Robotic arms can do other tasks, such as screw driving, wheel mounting, and windshield installation.



Welding

Large industrial robots use giant arms for spot welding on heavier body panels and larger parts, while smaller cobots can help with welding smaller parts like mounts and brackets.



Painting, Sealing, and Coating

Robotic arms are used to apply paint to car bodies, providing a more uniform and controlled finish than manual painting. Machines are also useful for spraying adhesives, sealants, and primers.



Machine tending

Robots can be used for loading and unloading a production machine, including CNC machines or injection molding machines.

Examples



Ford Motor Company has deployed **UR10 cobots** on its engine assembly line in Craiova, Romania, where they **grease camshafts, fill engines with oil, and perform quality inspections**. The cobots help **improve production throughput and reduce repetitive tasks**.



Go Fast Campers (GFC) uses a **range of fully integrated UR5 machine-tending cobots** that can **produce any part needed on any specified machine**. This approach provides GFC with **22 hours of productivity per day, including 6 hours of unmanned, lights-out manufacturing**, allowing the company to **produce high-quality components at just the right time in the quantities needed for the day**.

The use of robotics in the chemical industry has increased in recent years to reduce liability, enhance consistency, and improve competitiveness



Applications

The chemical industry is increasingly leveraging robotic applications for product assembly, handling, packaging, and palletizing.



Assembly and packaging

Robotic arms can be used to assemble, pick, place, fasten, and package products, as well as ensure that they are properly sealed and labeled.



Material handling

Robotic arms can be used to handle hazardous and non-hazardous materials that can produce potentially explosive dust. Robots can also be used to move raw materials and finished products around a production facility.



Plastic injection molding

Robotics can be used to automate the injection molding process for plastic products. This involves using robotic arms to insert and remove molds, as well as to extract finished products from the mold.



Chemical mixing and processing

Robots can be used to mix and process chemicals, reducing the risk of exposure to hazardous materials and improving accuracy.

Examples



BASF uses **autonomous guided vehicles (AGVs)** and **robotic arms** in its manufacturing processes. AGVs equipped with sensors and cameras **transport raw materials and finished products** between different production stages. **Robotic arms** are used to mix chemicals and package finished products, improving consistency, accuracy, and efficiency. They can also handle **hazardous materials without risk of injury**.



Innovations in medical robots are revolutionizing healthcare by filling in the gaps from surgery to rehabilitation and transforming the healing process for patients



Applications

Medical robots are helping healthcare professionals provide smarter, more comprehensive care to their patients thanks to the innovations that have been made over the past few years.



Surgery

Robot-assisted systems utilize the hand movements of the operating surgeon to control tiny, precise instruments inside the patient's body.



Rehabilitation

Robotic devices such as exoskeletons and therapeutic robots can assist and guide patients during rehabilitation. AI and depth cameras can monitor a patient's form as they go through prescribed exercises.



Lifting Patients

Robotic lifting machines, such as nursing robots, can help nurses lift patients who are elderly or immobile.



Mental Comforting

Companion and therapeutic robots can comfort patients with mental health issues with a system of sensors, microphones, and cameras.



Examples



Hamilton Health Sciences (HHS) Hospital in Ontario has implemented a **robot-assisted surgical system** called the da Vinci Surgical System, which has enabled surgeons to perform more **complex procedures** with greater **precision and control**, resulting in **shorter hospital stays, less pain and scarring, and faster recovery times**.



Benefits and challenges of robotics and automation

Companies adopting robotics may face financial, regulatory, and technical challenges

High initial investment to integrate robots into existing production processes

Lack of internal expertise and the necessary skills to operate and maintain robots

Integration with existing systems can be difficult, especially if the systems were not designed to work with robotics. Companies may need to modify their existing processes to accommodate the robotics system.



Regulatory hurdles, which can add additional costs and complexity to the adoption process.

Resistance to change, either due to fear of losing their jobs or a lack of understanding about how the technology works.

Maintenance and repair can be time-consuming and expensive

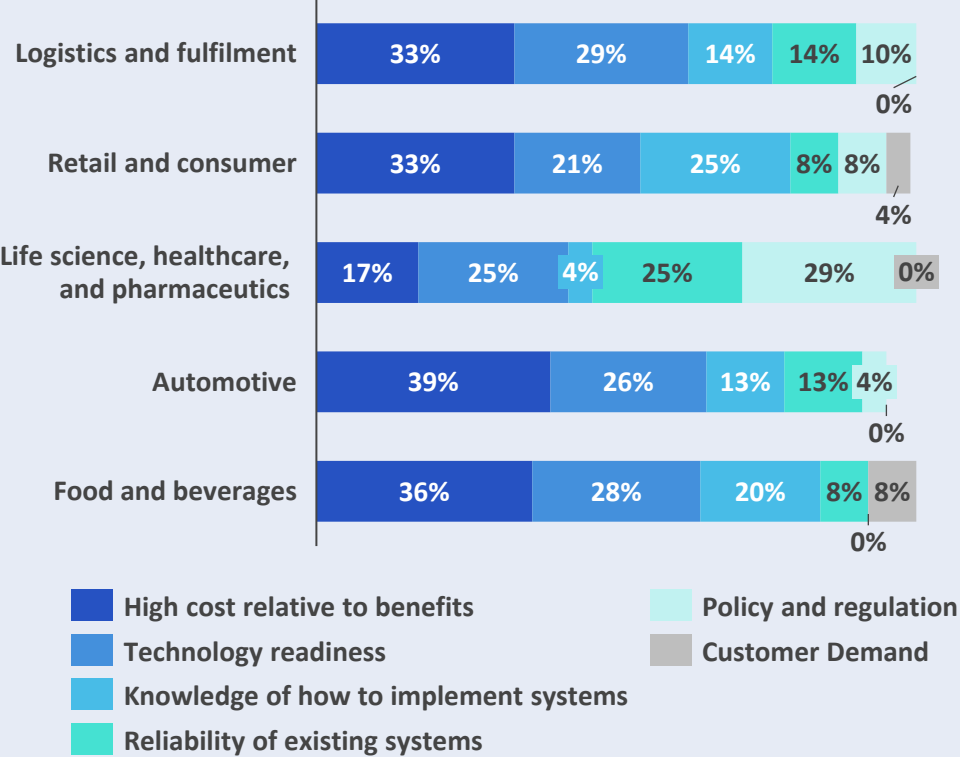
High costs and a lack of internal expertise are key challenges to automation adoption across industries

Bottlenecks to Robotics and Automation Adoption

According to the “2022 McKinsey Global Industrial Robotics Survey”, many companies are **struggling to convert their automation plans into actions**

In most industries, **the high cost of automation outweighs the benefits for at least one-third of respondents**. The exception is **life sciences, healthcare, and pharmaceuticals**, where **policy and regulation** is the main barrier to progress given that their products are more heavily regulated than others.

Other barriers to automation include the concern that automation will eliminate jobs and the integration of robotics with their existing technologies, as well as finding end-to-end solution providers to implement the required scope.



Source: McKinsey - Unlocking the industrial potential of robotics and automation - 2023

Robotic applications can help increase productivity, reduce costs, and improve workforce safety and product quality

Cost Savings

Robots can perform tasks that would otherwise require human labor, which can lead to cost savings for businesses over time.

Increased efficiency

Robots can work faster and more accurately than humans, increasing production efficiency and reducing the risk of errors.

Reducing downtime

Robots can work around the clock without getting tired or needing breaks, which can increase production output and reduce downtime.



Flexibility

Robots can be programmed to perform different tasks, making them versatile and adaptable to changing production needs.

Improved safety

Robots can handle dangerous tasks that would be unsafe for humans, reducing the risk of workplace accidents.

Consistency and quality

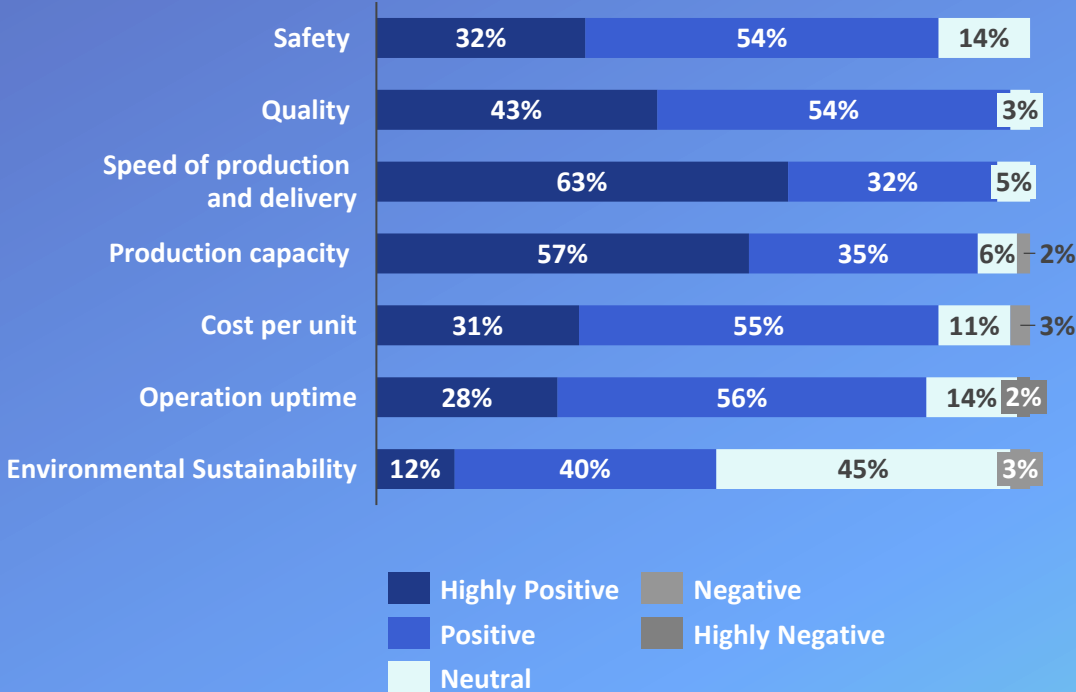
Robots can perform tasks with a high level of consistency and quality, which can improve the overall quality of the products being produced.

Robotics and automation positively impact speed, capacity, and quality

Impact of robotics and automation

Among the benefits expected from automation are the **ability to work faster and at a higher capacity**, and to **provide high quality**. Upsides to automation were also found to include cost, operational uptime, and safety.

On the other hand, **environmental sustainability is believed to be mostly neutral**, if slightly negatively impacted by automation and robotics.



Source: McKinsey - Unlocking the industrial potential of robotics and automation - 2023



Robotics and automation trends

Robots are becoming more affordable, accessible, user-friendly, and autonomous (1/2)



Increasing demand for robots

- E-commerce growth has driven investment in robotics and automation in the retail and logistics industries, with thousands of mobile robots increasingly being deployed in warehouses worldwide.
- Labor shortages and supply chain uncertainty, as well as the need for sustainable and resilient operations, are also driving businesses to adopt robotic automation.
- Demand for robots is expected to increase in response to global labor shortages. Robots will take on new tasks as more companies look to reshore their operations.



Focus on affordability and accessibility

- Robot implementation is becoming more accessible with the development of more affordable robot options as well as Robotics-as-a-Service (RaaS) offerings
- Companies are increasingly developing smaller and more affordable robots that are more accessible to small and medium-sized enterprises. For example, ABB's SWIFTI™ and Universal Robots' cobots
- Robotics-as-a-Service (RaaS) is an alternative business model that allows companies to access robots on a subscription basis and bypass the cost obstacle
- RaaS is attracting businesses due to its flexibility, scalability, and lower cost of entry. The software as a service model, which is already familiar to many companies, has also contributed to this trend
- These advancements are helping remove barriers that previously prevented companies from investing in robots

Robots are becoming more affordable, accessible, user-friendly, and autonomous (2/2)



Robots being more user-friendly and allowing for collaboration with humans

- There is a growing trend toward robots that are intuitive, user-friendly, and easier to deploy. This can be seen in the growing popularity of collaborative robots (cobots)
- Cobots, or collaborative robots, are becoming increasingly popular with applications in various industries
- Cobots are designed to work safely and collaboratively with humans in a shared workspace. Their light weight, flexibility, and mobility make cobots easier to deploy
- Cobots can automate assembly tasks such as welding parts and drilling screws, as well as lifting heavy materials and other hazardous materials that could pose a hazard to human workers
- Manufacturers are also developing new types of robots that require little to no programming, such as KUKA's Ready_2, which can be taught instead
- User interfaces are becoming simpler with icon-driven programming and manual guidance of robots



Advances in AI allowing for more autonomous robots

- Advancements in artificial intelligence are driving improvements and broadening the scope of tasks that robots can carry out
- One key area where AI has made an impact is Autonomous Mobile Robots (AMRs). AMRs are self-directed material handling machines that can be rapidly trained to accomplish a wide range of material movement assignments
- AI allowed AMR to create new paths autonomously, detect obstacles, and reroute their path around them, which is an addition to their predecessors, autonomous guided vehicles (AGVs), which rely on tracks or predefined paths and often require operator oversight.
- AMRs use sensors and computer vision to understand their immediate environment and operate autonomously. Warehouse AMRs, for instance, utilize scanners to identify stock levels, automate material handling processes, and prevent inventory shortages. AMRs can also be used in factories to transport parts, accelerating operations and reducing the need for workers to push heavy carts

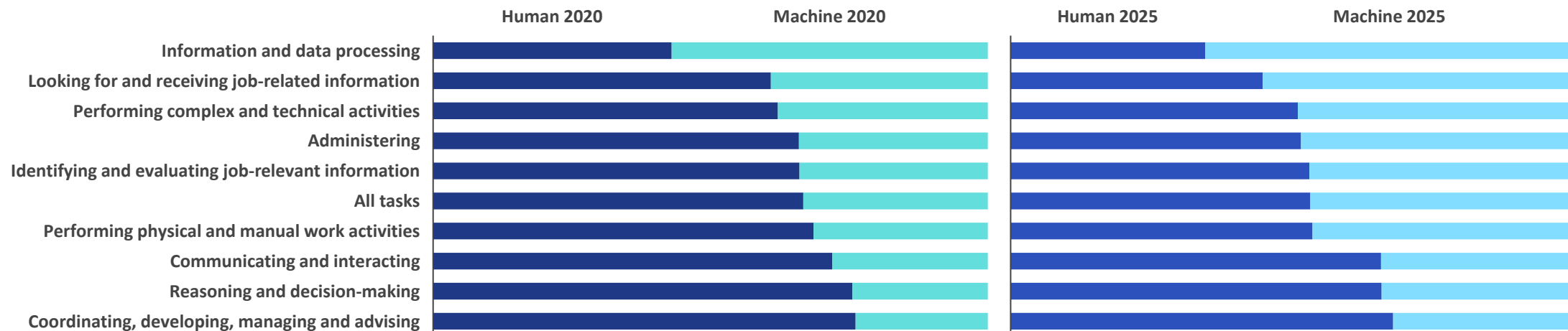


Robotics and the Workforce

While the tasks performed currently by humans might be at risk of change or elimination...

- While automation and robotics will revolutionize various industries and inevitably impact the workforce, there are many **conflicting views on the number of jobs that will be affected**. Given the wide range of variables that influence different job roles, even within a single job role, different individuals have different levels of risk of losing their jobs. In addition, **it is believed that some jobs may be at risk of significant change, but not necessarily elimination**
- Despite differences between studies, there is a consensus that the impact of automation and robotics on employment can be assessed based on the **nature of the tasks and the current capabilities of computers** to perform those tasks, i.e., tasks that involve repetition are more susceptible to being replaced by robots, which could result in the displacement of human workers by machines. Machines will also be taking over a significant amount of physical and manual work by 2025

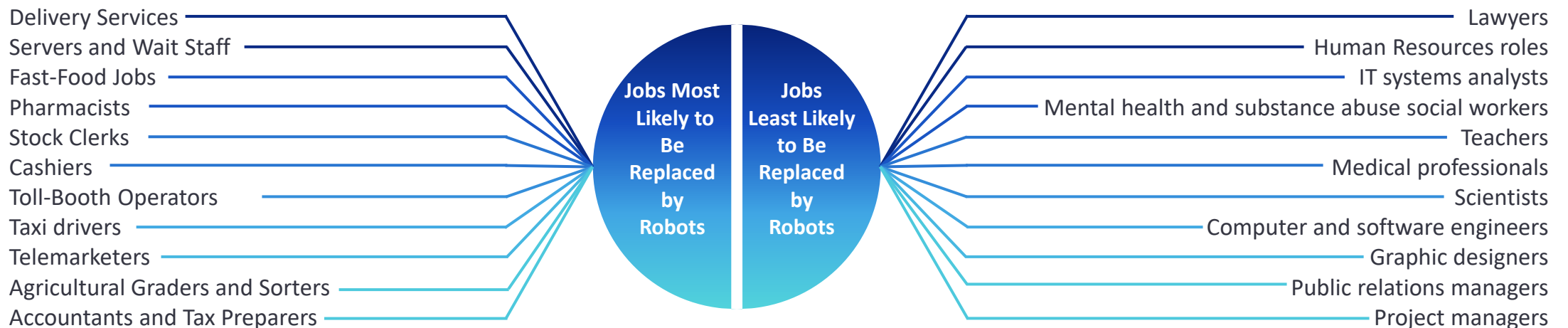
Share of tasks performed by humans vs machines, 2020 and 2025 (expected), by share of companies surveyed



... it is also believed that robotics and automation will create as many jobs as they will eliminate

- The "Future of Jobs Report 2020" by the World Economic Forum predicts that, **even if around 85 million jobs worldwide will be replaced by AI and robotics** by the year 2025, the same timeframe will also see **the creation of approximately 97 million new jobs**
- In the coming years, **repetitive and manual work** such as **cashiering, serving, delivering, agricultural sorting and stock clerking** will increasingly be performed by robots. Advancements in robotics technology will allow machines to perform these tasks more efficiently and accurately, thus reducing the need for human workers in such roles
- This shift towards robotics will likely create new job opportunities for those with skills in **robotics engineering and developing, data analytics, AI and machine learning experts, automation programmers, and Internet of Things (IoT) specialists**, while some traditional job roles may become obsolete

Jobs most and least likely to be replaced by robots and automation



Conclusion

Despite the rapid advances in robotics technology over the past few years, it is still in the early stages of development, and there is much more to come. The potential applications of robotics are endless, and we have only begun to scratch the surface of what is possible.

As robotics technology continues to evolve and mature, we can expect to see more sophisticated robots capable of performing more complex tasks with greater levels of autonomy and adaptability. This will lead to increased efficiency, productivity, and safety in various industries, as well as the creation of new job opportunities.

Furthermore, with ongoing developments in artificial intelligence, machine learning, and other related fields, robots will become even more intelligent and able to adapt to new environments and situations.

Concerns about machines replacing humans in the workplace are not necessarily valid. While robots may eliminate certain tasks, it is unlikely that they will completely replace an entire profession. Moreover, as with other technology introductions in the past, robotics will create new opportunities and jobs.

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