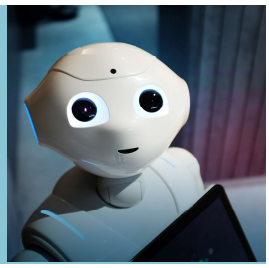
future tech

Fourth Industrial Revolution
Robotics



Robotics encompasses the design, construction and use of machines (robots) to carry out tasks that may be simple repetitive processes. This is known as RPA (**Robotic Process Automation**) as it corresponds to the automation of various tasks.

Technological advances have been transforming this initial idea by introducing **intelligent automation**, a natural evolution of *RPA*, based on cognitive technology that increases flexibility, **improves the quality and accuracy of processes and provides "intelligent" responses in specific contexts.**

Finally, there is **artificial intelligence, where there is already an analytical capability that allows the robot to generate a coherent and independent response**.

Originally robots were used only in industrial processes. Today they are part of everyday life across the spectrum, from small domestic robots to advanced robots that are capable of precision surgery.

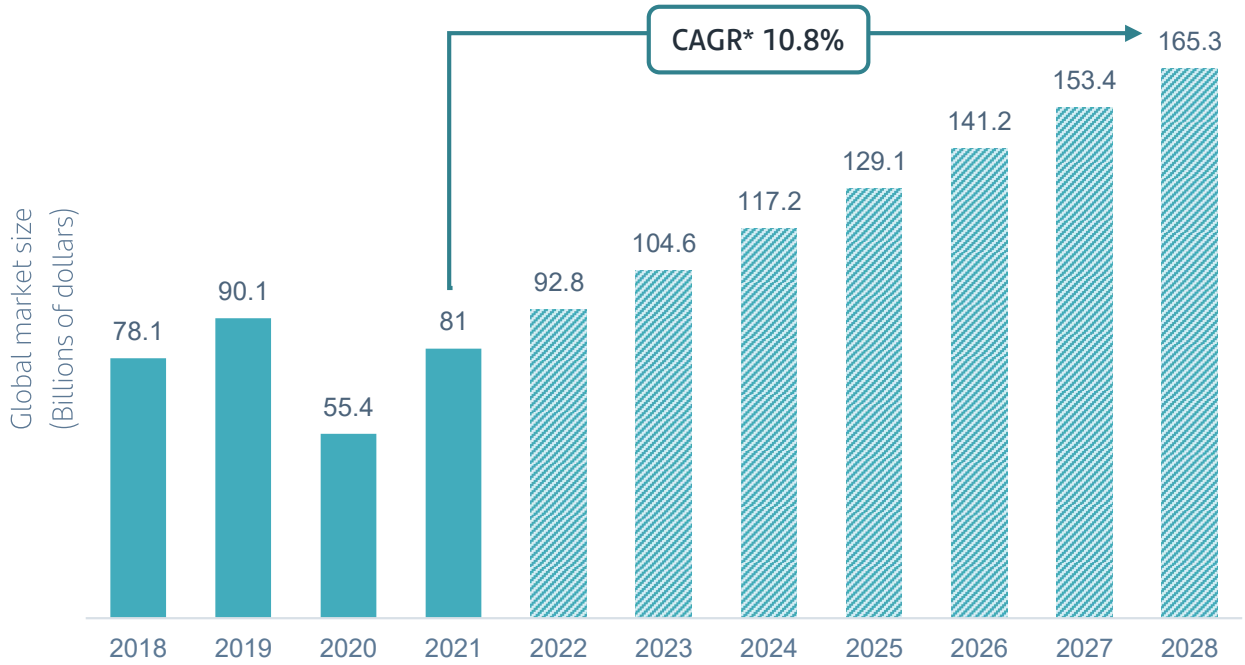
Automation is an integral part of human progress. The invention of devices, processes and technology has **increased productivity, or output per man-hour.** Much support for innovation in this field comes from general-purpose technology platforms, teamwork structures that combine industry, science and technology where, by working together, we identify and prioritize projects and needs

Demand for robots has and will grow significantly, improving margins for businesses and potentially reducing costs for consumers. According to Statista data, **globally the robotics industry growth would have a compound annual growth rate (CAGR) of 10.8% between 2021 and 2028.** Automation improves accuracy in many processes that may have some degree of hazards and can avoid unnecessary human exposure.

With China's entry into the World Trade Organization (WTO) in 2001, many companies in advanced economies took advantage of low trade barriers and globally integrated supply chains to outsource manual tasks to workers in countries with lower labor costs. Recently, exogenous risks such as trade conflicts, the COVID-19 crisis and the invasion of Ukraine have caused companies to rethink their supply chain strategies**. Reorientation toward self-sourcing, domestic manufacturing rather than manufacturing in distant countries, and diversification of supply chains have become very important as companies seek to maintain greater control and avoid costly disruptions. Companies will rely heavily on the latest robotics and automation technologies to help control costs in this process.**

Robotics industry size 2018-2028.

Source: Statista



CAGR: Compound annual growth rate

Key innovations driving the growth of robotics

Drones and mobile robots

Like the Internet and GPS before them, **drones, a type of aerial mobile robot, are evolving beyond their military origins to become powerful business tools.** They have already made the leap into the consumer market, and are now being put to work in commercial and civilian government applications, from firefighting to agriculture. This is creating a market opportunity too big to ignore. A **Goldman Sachs** study **estimated a $100 billion opportunity for drones between 2016 and 2020, with 70% coming from the military industry, 17% consumer-related and 13% for different industries. By 2021, it is estimated that the commercial drone industry will sell 1,000,000 units per year**. On the other hand, **autonomous mobile robots have become essential in logistics operations.** Equipped with sensors and assisted by artificial intelligence software, they can carry out tasks ranging from order preparation, product classification and even dispatching and the "last mile", or the last journey from the logistics center to the end consumer.

Autonomous vehicles

The future of the autonomous vehicle industry is driven by decreasing the cost of operation and increasing the **safety and reliability that autonomous vehicles provide**. The Society of Automotive Engineers (SAE) defines **a taxonomy according to the level of vehicle autonomy**[1] described below. Levels 0 to 2 include driver assistance features, and the other three levels (3 to 5) include actual automation features. It is these that we will refer to. In **level 3, which requires a driver**, the vehicle is able to analyze its environment and make decisions through sensors with computer vision, cameras, radar and location. They automatically activate safety settings. **Level 4, high automation, can, without the need for driver intervention, control critical driving functions, modify its response based on external conditions, stop in an appropriate place in case of adverse conditions**, and only carry passengers, not a driver. Finally, **level 5 of full automation, we are talking about a robotic vehicle, even conceptual** that does not have a driver (no steering wheel or pedals) and the instructions are given by voice command or through applications. Both levels 4 and 5 exchange information with their environment, use 360º recognition and provide greater safety. They are still prototypes, mostly electric. The European Parliament[2], aware of this reality, is preparing for this future by establishing parameters and adjusting legislation and estimated in 2019 that this type of vehicle could become available between 2020 and 2030.

3D Printing

Before the advent of 3D printing, a prototype could be cast, injection molded or milled using traditional subtractive manufacturing techniques, or even carved by hand. Each of these processes would take weeks, leaving designers largely on the sidelines after their initial contribution. In contrast, a 3D printed prototype is much less expensive, takes days or hours, and saves on material waste. Importantly, design changes can be incorporated and sent to the printer for each iteration seamlessly. In recent years, **3D printing has become a crucial component in the robotics industry. 3D printing can produce much more precise parts for robotics projects with less wasted material**. Using direct metal laser sintering (DMLS) or directed energy deposition (DED), metal products can be produced much more cheaply than with traditional manufacturing methods.

According to Beroe, an Indian market intelligence and analysis consultancy**, the global 3D printing market size was over $11.5 billion in 2019. It further estimates that it will have an annual growth of 14% until 2027.** In addition to the prototyping market, 3D printing is also penetrating injection molding and casting applications and has already made the leap into the finished product market.

(1) https://www.sae.org/standards/content/j3016_202104/
(2) https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019IP0005&rid=9

Innovators in the Internet of Things

FANUC Corporation, of Japanese origin founded in 1958, **develops, produces and sells robots, including robots used in precision assembly and injection molding machines.** Its largest segment is the robot division, which accounts for about 40% of sales. Its factory automation (FA) business focuses on computer numerical control (CNC), servo motors (drives with error-detecting feedback for correction) and laser products used in FA systems, mainly in the automotive and machine tool industries.

KEYENCE CORPORATION is headquartered in Osaka, Japan. Founded in 1974, **it manufactures automation sensors, measuring instruments, image processing equipment, control and measurement equipment, research/development analysis equipment and business information equipment.** The vision measurement line offers optical micrometers, digital microscopes and other products. Factory automation sensors, are used in a wide range of industries such as automotive, semiconductor, electronics, electrical equipment, communications, machinery, chemicals and food.

Rockwell Automation, Inc engages in the **provision of industrial automation and information services.** It operates through the following segments: Intelligent Devices (DI), Software and Control (SC), and Lifecycle Services (LC). The DI segment combines a complete portfolio of intelligent products that create the basis for an agile, resilient and sustainable production system. The SC segment contains a complete portfolio of production automation and production operations platforms, including hardware and software. The LC segment contains a complete portfolio of professional services and value-added solutions.

Intuitive Surgical, Inc. designs, manufactures and markets surgical systems. Intuitive is one of the **pioneers in robotic-assisted surgery.** It is the manufacturer of the da Vinci surgical system that combines software, hardware and optics that allows surgeons to operate remotely from a console. **It focuses on five specialties: gynecology, urology, general surgery, cardiothoracic, and head and neck.** In addition, the Company **offers endoscopes, endoscopic retractors and dissectors, scissors, scalpels, forceps, needle holders, electrocautery, ultrasonic cutters** and accessories during surgical procedures.

Azenta Inc. provides **manufacturing automation solutions for the semiconductor industry, and sample-based services and solutions for the life sciences market worldwide.** The company operates through two segments: Life Science Products. It offers automated ultra-cold storage systems and consumables, such as racks, tubes, caps, plugs, plates and sheets, and instruments, such as labeling, barcoding, capping, uncapping, auditing, sealing, peeling, and punching of tubes and plates. The company was founded in 1978 and is based in Chelmsford, MA.

Microchip Technology Inc. **designs, manufactures and markets microcontrollers, related mixed-interface and memory products, and application development systems for high-volume embedded control applications.** It offers a wide variety of embedded devices, such as 8-bit, 16-bit and 32-bit microcontrollers (it is one of the world's leading producers). It also manufactures special memories, such as electrically erasable programmable read-only memories (EEPROMs) and field-programmable gate arrays (FPGAs). Its chips have customers in the automotive, consumer, aerospace, defense, computer, industrial and telecommunications markets.

Did you know?

+13% CAGR

It was, between 2015 and 2020 the compound annual growth rate (CAGR) of the industrial robot market, reaching 3 million units in 2020.

(1)Source: /ifr.org/downloads/press2018/2021_10_28 _WR_PK_Presentation_long_version.pdf.

4.34x

China increases its lead in annual robot installations in 2020 with more than 168,000 units, 4.34 times what Japan installed in the same year, or 5.46 times what the United States installed. Labor is no longer as cheap as it used to be.

(2)Source: /ifr.org/downloads/press2018/2021_10_28 _WR_PK_Presentation_long_version.pdf.

900 per 10,000

is the number of robots per 10,000 human employees in South Korea, the highest robot density in the world.

(3) Source: https://webtribunal.net/blog/robotics-industry-statistics/#gref

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