Technology deep dive: Robots/cobots/robotic process automation

Description of technology

Robots and collaborative robots (cobots) serve three types of applications: domestic service, professional service, and industrial.

Three technology segments exist: stand-alone/autonomous robots, cobots, and mobile robots.[1]

Across applications and segments, robots/cobots can be configured through programs or a source of intelligence (for example, AI) to fulfill tasks.

Through robotic process automation (RPA), robotic programs can execute virtual tasks without requiring physical robots/cobots.

Technology maturity

Technical maturity — Fundamental research — Mass adoption

Since 2015, annual installations of industrial robots increased by **2× to ~450,000, estimated to grow to ~600,000** by 2022

By 2025, shipments of domestic robots will have increased by **3× to ~30 million** compared with 2019

Industry applicability

Industry applicability — Niche — Industry cross-cutting

What it enables companies to do

Deploy autonomous operations
Orchestrate robots/cobots through decision-enabled software such that full processes are stand-alone and automated

Scale up operations evenly and quickly
Deploy identical robots/cobots configurations and processes across locations with limited need to train humans (eg, only to interact with cobots)

Operate without dependence on human workforce
Greater independence on technical skills and reduced need to negotiate with unions

Flexibly adapt operations to new requirements
Robots are reprogrammable to adapt to new situations and learn new tasks

Segregate product/service creation from delivery
Flexible robots/cobots can deliver a range of items regardless of the product, while production can be stand-alone and disconnected from delivery

☐ Main opportunities

Example use cases

I ***Increase in capacity/productivity***
Enable quicker, longer, and more-continued working periods than humans (especially given adverse working environments, including pandemics) for tasks with limited complexity

II ***Improving conditions for human workers***
Human work can be supported or replaced by robots/cobots, often improving working conditions for workers (eg, in hot environments)

III ***Higher-quality output entailing repetitive tasks***
Precision execution over myriads of repetitions is higher for robots than for humans

Reduced need to fill skill gaps
Instead of time-intensive workforce reskilling, robots/cobots can be reprogrammed quickly[2]

Lower capital expenditures over long term
Adjustable operations allow leveraging of existing infrastructure for new purposes

New opportunities for product and service delivery
Domestic robots enable product or service provision directly at home, closing the last mile for customers

1. Includes automatic guided vehicles (AGV) and humanoid robots/exoskeletons.
2. For robots, you need intermediate programmable interface.

Source: Expert interviews; *World Robotics 2019 Industrial Robots*, IFR ; McKinsey analysis

Use case deep dive: Robots/cobots/robotic process automation

Proof points

Use case	Situation and approach	Impact
I Increase in capacity/ productivity 	Large manufacturing player implemented collaborative robots (cobots) mounted on AGVs[1] to directly feed pallets, removing the tasks from the human worker	Client was able to reduce FTEs[2] significantly in two shifts Payback time in 1.5–2.0 years, given only investments for AGVs and cobots, but limited running costs involved
II Higher productivity while improving conditions for human workers 	Player specialized in material handling used drones equipped with sensors to automatically detect amount of material in each box and automatically update information in inventory-management system	Operation is running 24/7, thus improving accuracy and productivity 10% reduction in workforce, freeing up manpower to do more value-adding tasks
III Higher-quality output entailing repetitive tasks 	Auto OEM focusing on efforts to reduce vehicle weights through more effective welding Current solutions make precise and accurate welds difficult to produce repeatedly at consistent quality levels Goal is to develop autonomous robotic laser-welding solution	New robotic laser welding allows for continuous welds of large body parts, eg, car door or rear center panel of chassis Reduced cycle times by 33–66% (increase jobs per hour) Increased quality and decreased consumables costs

1. Automatic guided vehicles.
2. Full-time employees.

Source: Expert interviews; McKinsey analysis

Expected technology-development horizons: Robots/cobots/robotic process automation

Expected technology-development horizons in next 5 years

Integration of programming platforms

Increasing interoperability across technology types, including integration in IoT[1] ecosystems

Diffusion of robots/ cobots across industries (outside of automotive/ manufacturing)

Rise of cobots and human-hybrid robots

Technology advancements lead to improved human–robot interaction, enabling robots to work with humans on precise tasks in addition to exoskeleton (wearable devices) use case

Decreasing unit economics given broad range of applicability

Flexible automation

Proliferation of completely autonomous, mobile robots

Ability to self-learn to adapt in real time to variation and change in components

Robots handle different models or assemblies enabling more flexible usage overall

1. Internet of Things. 2. Electric vehicles. 3. Human–robot collaboration.

Source: Expert interviews; McKinsey analysis

Enablers

Rising labor costs, labor shortages, declining robot prices, and technological advancements drive adoption of robots at double digits across verticals

Increased variety in production (eg, EVs[2] and combustion engines in automotive) call for new types of robots that enable flexible automation

Requirements for precision (eg, in healthcare) and trend toward mass customization (especially for cobots with need for HRC[3]) require robots at scale

Advances in AI, computer vision, and motion technology enable broader automation scope for more complex operations

Barriers

Growing complexity for systems integration due to stark surge in number of devices in ecosystems while lack of labor and experts remains significant

Robots (especially autonomous) require substantial infrastructure investments prolonging payback periods; often no compatibility with existing equipment

Lack of homogenous programming platform to skill a variety of robots

High safety requirements for cobots collaborating actively with humans

Lack of computing power (at the edge), hindering ability to process large amounts of data