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Insights

Signals for Strategists

Robots uncaged

How a new generation of sophisticated robots is changing business

By David Schatsky and Amanpreet Arora

INDUSTRY has used robots for decades. They were once confined to safety cages in manufacturing facilities, programmed to perform one task perfectly, over and over again. Their purpose was to make high volumes of goods more quickly and cheaply.

But advances in a number of technologies are springing robots from their cages, liberating them to work in new roles, in new industries, and with new benefits. Robots are changing far more than manufacturing—in industries ranging from retail to financial services, they are clambering onto the agendas of strategy, marketing, customer experience, and product leaders.

Signals

- Next-generation robots, including collaborative and service robots, are projected to account for two-thirds of unit robot sales by 2025, up from 22 percent in 2015.¹
- Venture capital investment in robotics technologies has accelerated since 2013, exceeding \$3.5 billion since 2012.²
- Toyota is investing \$1 billion over the next five years to establish a new R&D arm focused on artificial intelligence and robotics.³

- Major companies are already using robots to prepare meals,⁴ support manufacturing workers,⁵ assist retail shoppers,⁶ deliver room service,⁷ and engage customers in banks.⁸
- Kuka, a maker of industrial robots, is planning to enter new markets, offering robot assistants able to help with tasks such as looking after the elderly.⁹
- Members of the European Parliament are seeking to create a European agency for robotics and artificial intelligence, to supply public authorities with technical, ethical, and regulatory expertise.¹⁰

Freed from their cages

Rapid technological advancements are giving rise to a new generation of smarter, more flexible, and more mobile robots. Some can perform diverse tasks in unstructured environments and work with and alongside people. Some can fly; others can navigate terrestrial routes. These next-generation robots are changing manufacturing operations and workforce plans, gaining greater adoption in health care, and beginning to penetrate nontraditional sectors such as food and beverage, hospitality, banking, and retail. They are increasingly showing up in homes as well.

Market analysts segment the robotics industry in various ways. A typical scheme categorizes robots according to their primary use: industrial, commercial, domestic, military, or social and entertainment. In contemplating the sweeping changes that a new generation of robots promises to bring to organizations, this article focuses on two emerging robot categories: a type of industrial robot known as a collaborative robot, or *cobot*, that can work alongside people, augmenting their abilities rather than replacing them; and commercial, or service, robots, able to perform a growing array of tasks outside of manufacturing environments. Service robots may include autonomous guided vehicles, drones, medical robots, field/agricultural robots, or others.¹¹

To be sure, traditional industrial robots are the biggest segment of the robotics market. Last year, robot manufacturers sold about 300,000 industrial robots, worth about \$12 billion; only around 9,000 of them were cobots. Service robots, the other new category, also comprise a relatively small share of the market. Manufacturers sold about 130,000 of them, worth about \$5 billion, in 2016. But sales of next-generation robots are growing rapidly. One venture capital firm projects a 61 percent compound annual growth rate (CAGR) for cobots and a 34 percent CAGR for service robots. The next

generation of robots may ultimately eclipse traditional industrial robots.¹²

Business has long seen robots as tools to improve efficiency and productivity. But now, they are being put to use in pursuit of other business benefits as well: Organizations are using them to enhance customer service, increase operational flexibility, and improve product quality. This means that robots are now of interest well beyond managing manufacturing operations; business strategists, marketing and customer service leaders, and IT heads should all take note.

Technological advances power the new generation of robots

Why are robots emerging from their cages and stepping into new roles? Because technological advances are endowing them with powerful capabilities and making them easier to use. Progress in both software, including cognitive technologies, and hardware, particularly sensors, actuators, and batteries, plays a role.

This next generation of robots is an embodiment of the powerful trend in which the physical and the digital worlds increasingly interact with and affect each other. Robots act upon data they receive from their environment and, in response, aim to alter their environment. In this way, robots exemplify the last stage of what Deloitte has characterized as a physical-to-digital-to-physical loop: the leap from the digital environment back to action in the physical world. In the context of manufacturing, this powerful dynamic is at the heart of what is known as Industry 4.0.¹³ But as we are arguing here, next-generation robots are making a growing impact outside of manufacturing as well.

Robots are becoming easier to configure and use than their traditional industrial forebears. Embedded vision systems, sophisticated behavior software, and robotic positioning systems enable workers to train them by example. For instance, some robots can be trained simply by moving them around to teach them where they are expected to go or to perform different tasks such as metal fabrication or molding.¹⁴ Fanuc's cloud-connected industrial robots use a form of machine learning called *reinforcement learning* to teach themselves tasks.¹⁵

Some new-generation robots possess remarkable dexterity. Computer vision and machine learning help them identify objects and learn how to grasp them; grippers featuring suction, electro-adhesion, or articulated fingers and force sensors help them grasp and manipulate objects with precision. Increased dexterity

is expanding applications in surgery, food preparation, and warehousing and distribution. Kindred is a robotics start-up whose first product combines computer vision, machine learning, and human supervision to help warehouse staff sort items for shipment more quickly and accurately.¹⁶

Improved learning and dexterity mean that robots are becoming more versatile. Unlike conventional industrial robots of yore built to perform a single task such as welding or painting a part, some newer robots can switch between different tasks with minimal reprogramming. For instance, a global logistics company is using the same collaborative robots to perform tasks such as assembly, fabrication, and packaging at its warehouses.¹⁷ A marine robot can patrol oceans to detect illegal vessel activity while simultaneously monitoring environmental variables such as ocean currents and temperatures.¹⁸

Many robots are now capable of autonomous motion; they are able to navigate and work in unstructured environments alongside people rather than remaining bolted to a fixed location within caged workspaces. These robots have multiple sensors, mapping and location software, and computer vision capabilities to help them recognize people, objects, and locations; they can navigate ordinary work or home environments, avoiding obstacles. For instance, OTTO's self-driving vehicles use laser-based perception and memory-based visual reference points to learn and self-adjust their paths.¹⁹ Savioke's robots can autonomously navigate indoor environments such as workshop floors, hotels, and apartment buildings. Other robots designed for collaborative use by workers are stationary but have sophisticated and versatile arms and grippers. A diverse array of collaborative robots—whether mobile or stationary—are entering the workforce to operate alongside humans, helping rather than replacing them.²⁰

Some robots are capable of sophisticated human interaction thanks to computer vision, speech recognition, and natural language processing. This opens up numerous applications for direct human-robot interaction with minimal human training. Jibo, a personal robot intended for home entertainment and automation, uses face recognition to personalize its interactions.²¹ Banks are trialing robots to interact and communicate with customers in branches to provide basic information and answer customer queries.²²

FACTORS DRIVING DEMAND FOR NEXT-GENERATION ROBOTS

Basic laws of economics are driving growing demand for robots: As price falls, demand rises. The average selling price of traditional industrial robots is declining by over 4 percent per year, and analysts expect prices of cobots to decline by about 3 percent annually.²³ The cost of most types of service robots is projected to decline by between 2 and 9 percent each year as well.²⁴

Not all of the new robots are being deployed to support humans, of course. Rising labor costs in some regions are making robots an attractive alternative to workers: One analysis found that the payback period for an investment in a welding robot in the Chinese automotive industry, for instance, was 5.3 years in 2010 but on track to fall to just 1.3 years in 2017.²⁵

Labor shortages are also driving adoption of robots. For a mix of demographic and policy reasons, factories in China,²⁶ restaurants and hospitals in Singapore,²⁷ and farms in the United States²⁸ are facing labor shortages. For these businesses, robots offer an increasingly viable substitute for human workers. Other businesses, particularly in the automotive industry, are employing collaborative robots to take over physically demanding tasks, allowing aging workers to focus on less taxing work.²⁹

Robots bringing new business benefits

As robots' capabilities improve, the benefits they offer go beyond better/faster/cheaper. Companies are increasingly looking to robots as a way of boosting innovation, improving customer service, and differentiating their brands.

Next-generation robots are leading some companies to consider moving manufacturing closer to research centers and large markets. "Reshoring" production could enhance companies' ability to innovate in response to market demand. Adidas' new robot-powered factory in Germany, for instance, is intended to turn out prototypes close to where they are designed. Ultimately, robotic facilities in Europe and the United States could reduce the time from product design to delivery.³⁰ Another sportswear brand is using robots and other technologies to slash the time it takes to manufacture and deliver customized shoes.³¹

Service robots can not only improve efficiency by taking on tasks that human workers used to do—they have

the potential to enhance customer service and satisfaction and boost sales. Silicon Valley-based Fellow Robots makes mobile robots that can provide multilingual customer service and automated inventory tracking in retail locations.³² Robot maker Savioke says it has more than 70 installations completed or in progress in hotels, offices, logistics facilities, and luxury high-rise apartments. The company cites several hotel customers that it says are reporting improved guest and worker satisfaction, increased occupancy, and a surge in sales of sundries, which can now be delivered to guest rooms automatically, meaning guests with the munchies needn't face a human in the middle of the night.³³

The Gongbei Port of Entry, the busy main border crossing between Macau and mainland China, has deployed 50 mobile robots capable of answering 3,000 common questions in 28 languages. The robots also perform facial recognition to help detect potential security threats, alerting human workers to questions and tasks beyond their capabilities. A press release quoted the director of Gongbei Customs as saying that travelers who interact with the robots “are left with a memorable experience that makes their time at Gongbei more enjoyable and more efficient.”³⁴

FOR A DIVERSE SET OF APPLICATIONS, USE OF ROBOTS IS ON THE RISE

In which industries will robots have the biggest impact in the coming years? With robots becoming smarter, more capable and more affordable, their impact will be felt widely. Our analysis of venture capital investment in robot-related companies, together with the forecasts of market analysts, suggests that in the coming years we will see significant adoption of robots in the following areas:

Manufacturing. As noted earlier, cobots represent a small part of the industrial robotics market today; they are used to perform tasks such as metal fabrication, packaging, testing and inspection, and parts assembly, loading, and unloading.³⁵ But analysts project cobot sales to grow nearly five times as fast as traditional robots in unit terms through 2025.

Health care. Robot-assisted surgery is not new. But its use is growing. And the use of robotics in health care is broadening. Health care providers, including physicians and hospitals, are employing robots for applications such as rehabilitation (prosthetics, exoskeletons), diagnostic systems, surgical assistance, hospital operations, sanitation, and disinfection.

Drones. Drones are a type of robot rather than a type of application. But they have attracted hundreds

of millions of dollars in venture investment to date, are benefiting from advances in navigation and data analysis technologies, and are already seeing adoption for a diverse set of applications. These include monitoring construction, inspecting agricultural crops and infrastructure, inventorying goods and materials, surveilling traffic and crowds, responding to catastrophes, and enhancing perimeter security.³⁶

Materials handling. A growing number of enterprises in consumer goods, e-commerce, food, and beverages are using robots for automating their warehouses to perform tasks such as movement of goods, loading and unloading, pallet handling, and picking and packing.³⁷

Business services. Advanced interactive and navigational capabilities are propelling adoption of robots in applications such as customer service in banks, stores and hotels; meal assembly in restaurants; and security in public facilities.

Others. Additionally, robots will increasingly be used for applications such as professional cleaning, farming, infrastructure inspection, and education.

Implications for enterprises

Many manufacturing engineers and plant managers have long experience with robots. The rise of a new generation of robots now presents a broader group of business and technology leaders with opportunities and choices.

The evolution of industrial robots presents senior executives with the opportunity to reconsider where they locate manufacturing operations, since automation reduces the significance of wages in such decisions. Reshoring could enable greater responsiveness to market demand and greater innovation. But it would naturally require companies to reconfigure supply chains.

Product managers and marketers may want to consider how smarter, more flexible robots can make it possible to offer customized products more economically and efficiently.

Customer service leaders can evaluate opportunities to use service robots to enhance customer experience, boost customer retention, and increase sales.

Operations leads may want to assess how robotics can improve worker productivity and satisfaction, increase production flexibility, and reduce lead times.

HR leaders should be aware of the potential impact of robotics on strategic workforce planning. Robotics may help mitigate staff shortages and could be deployed

to support workers, especially ones with physically demanding roles.

IT leaders will be tapped to help evaluate robotics technology, to upgrade and integrate with back-end systems when necessary, and to address cybersecurity and privacy issues.

Risk management professionals may be called upon to manage a range of risks related to robots. These may include technological risks connected to cybersecurity and privacy, operational risks involving business continuity and workplace safety, legal and regulatory risks entailing compliance in the face of evolving regulations

and standards, and financial risks associated with any capital-intensive mass rollout of robots.

WELCOME THE ROBOT WORKFORCE

Robots are no longer about just about making goods better, cheaper, or faster. As robots themselves get better, cheaper, and faster, their importance is growing. Companies will feel their impact far beyond the factory floor. With robots emerging from their cages, now is the time for senior executives and leaders of all business functions to inform themselves and prepare to take advantage of increasingly able robot workers.

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