

Automation/Robotics

ACTIVE FUNDAMENTAL EQUITY | COUNTERPOINT GLOBAL | INVESTMENT INSIGHT | 2018

WELCOME TO THE EDGE.

Morgan Stanley Investment Management's Counterpoint Global shares its proprietary views on a big idea that has the potential to trigger far-reaching consequences—ideas such as blockchain, autonomous vehicles, machine learning and gene editing.

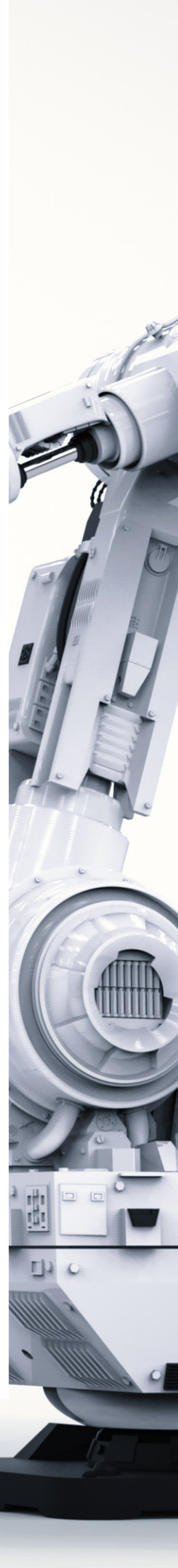
Counterpoint Global's long-term ownership mindset emphasizes perspective, insight and thinking across categories, while our investment process focuses on identifying unique companies with sustainable competitive advantages. Through The EDGE, we share our framework for thinking about change and our process for recognizing patterns that may drastically alter the investment landscape over the longer term.

This work complements our team's more traditional, fundamental research to create a framework for long-term investing that is grounded in intellectual curiosity and flexibility, perspective, self-awareness and partnership.

Factory automation has been around since the advent of the mechanized spinning wheel in the late 18th century Britain, which began the Industrial Revolution. The first robots were introduced by the auto industry in the 1960s, and since then, auto manufacturers and their suppliers have been the largest commercial users of robots. In the last decade, however, advances in technology have enabled robots to address more needs across a greater number of industries.

What Has Changed

Historically, the biggest issues with robots have been their high cost and lack of flexibility to perform new tasks or accommodate variations in their current task. Over the last 10 years, there have been three technological changes in robotics that have increased their flexibility, lowered their cost and expanded their addressable market. ►





► First, suites of sensors originally developed for both smartphones and video gaming have been adapted to robotics. The scale of these industries enabled them to invest in rapid advances and achieve lowered costs through mass production that the smaller robotics industry could never have achieved on its own. In general, sensor prices have fallen across the board, with some types—like imaging sensors—experiencing 100x price declines.¹ These lower-cost sensors have given robots the ability to perceive their environment, fundamentally changing the way robots interact with their surroundings. Heretofore robots had only been able to perform simple yet repetitive tasks that required a precise choreography of steps to be repeated each and every time. Perception enabled by sensors now allows robots to dynamically adjust themselves in real time to accommodate deviations from their routine (e.g., if a part is misaligned or out of place).

Over the last 10 years, technological changes in robotics have increased their flexibility, lowered their cost and expanded their addressable market—enabling a new generation of robots.

Second, integration, which entails programming and outfitting the robot so it can perform the desired task, historically cost two to three times the price of the actual robot and could take several months to complete.² These high setup costs had limited robots to the production of products with large runs and long product cycles where the setup costs could be amortized over many units. Improved software is now changing this equation. The

latest software for robots significantly simplifies the programming required to enable a robot to perform a given task. Whereas before it may have taken an engineer or computer scientist a month to program a robot, with the newest software a company can use less-skilled labor to program the robot in one to two days. In addition, the software, working in conjunction with sensors, can detect the presence of humans in the vicinity of the robot and can adjust

¹ Lesser, A. (January 25, 2015). Declining Sensor Costs Open up New Consumer Applications. Retrieved from <https://gigaom.com/2015/01/25/declining-sensor-costs-open-up-new-consumer-applications/>.

² Bélanger-Barrette, M. (February 3, 2016). What is an Average Price for a Collaborative Robot? Retrieved from <https://blog.robotiq.com/what-is-the-price-of-collaborative-robots>.

the robot's behavior to ensure human safety—this effectively reduces the amount of safety equipment (e.g., cages) required during the integration process.

Third, improved and lower-cost grippers are increasing the number of applications that can be addressed with robots. 3D printing and standardization of parts for grippers enable lower costs at small volumes. Combined with sensors that provide feedback on the force required to manipulate an object properly, a new generation of grippers has a higher level of dexterity than its predecessors and can perform a larger range of tasks.

Why It's Disruptive

Taken together, these three developments lower costs of deployment and expand the addressable market for robots away from just the manufacture of high-volume products with little product variability. They are enabling new categories of robots that serve a wider set of end markets. For instance, collaborative robots ("cobots"), which didn't exist 10 years ago, are the fastest-growing segment of the robotics market, growing over 70 percent in 2017.³

Cobots are designed to work alongside people, rather than be separated behind cages. Their lower cost and ease of implementation are spurring adoption despite limitations such as their inability to lift heavy weight. Most of their customers are mid-sized companies that have not previously deployed robotics.

In addition to cobots, we are seeing the production of autonomous mobile robots that can be used for deliveries everywhere from factory floors to hospitals. This new generation of robots uses sensor technology and maps to guide themselves instead of relying on external guides that were expensive to build and made them difficult to retrofit into existing processes.

In the medical field, we have witnessed the rise of robot-assisted surgery powered by robotic systems that enable surgeons to perform operations through a few small incisions. Over the last decade, the number of robot-assisted surgeries performed using such systems has increased more than six-fold.⁴ Driving this trend are improved surgical outcomes due to greater precision and control afforded by the robots. These two benefits are made possible by improvements in software, sensors and grippers. These robotic systems provide the surgeon with a 3D view of the surgical field and translate the surgeon's movements of the controllers into appropriately scaled movements of the robotic arms. The grippers at the end of the arms, called Endo-wrists, are notable for their wider range of motion compared to the human wrist, which allows them to perform tasks that are impossible with traditional methods.

As robotics expands further beyond its traditional base in manufacturing, logistics has become one of the fastest new adopters. As of 2017, only 5 percent of warehouses and distribution centers (DCs) qualified as "highly automated."⁵ In a traditional DC, pickers walk 12 to 15 miles per day retrieving items from shelves across the facility to complete orders that they then pack and ship to end customers. Not only is this inefficient from a labor utilization perspective, but typically companies experience high turnover in their pickers, who dislike the strain on their body and the solitary nature of the work.

In 2012, the largest U.S. online retailer purchased a leading mobile robotic logistics fulfillment systems company for \$775M. With their system, items in a DC are now stored on shelves that are mobile robots. Instead of the pickers going to the item to retrieve it, with

these mobile robots, the needed items come to the pickers. This arrangement provides several benefits: It speeds up the fulfillment time, increases picker job satisfaction and reduces the square footage required for the DC. The online retailer estimates that these benefits have lowered its operating costs in automated DCs by about 20 percent.⁵

Over time, these technologies (improved grippers, sensors and software) have the potential to unlock new applications like picking and sorting, which could expand the addressable market further. Currently, robots have trouble differentiating between size, shape and color. Improved vision capabilities could solve this challenge. Combined with improved gripping, robots could begin to attack bin picking and expand their increasing role in areas like logistics.

By boosting labor productivity, robotics has the ability to lower the cost of labor across a host of industries, but particularly manufacturing. As labor costs become less of a concern, the dynamics of where to locate a factory change. At the turn of this century, many factories were located in Asia in order to take advantage of lower-cost labor. Today, with improved robotics, companies can determine the locations of factories based on other factors. For instance, factories can be located close to end customers to enable shorter lead times, allow for faster design changes in response to market trends, lower transportation costs and reduce working capital tied up in inventory. Moving manufacturing closer to the engineers can improve innovation capability and allow better control over intellectual property. Companies can also site factories to take advantage of a more favorable regulatory environment or lower tax regime.

³ Berglund, S. (March 7, 2017). Cobot Market Boom Lifts Universal Robots' Fortunes in 2016. Retrieved from <https://www.roboticsbusinessreview.com/manufacturing/cobot-market-boom-lifts-universal-robots-fortunes-2016/>.

⁴ Schwitzer, G. (August 28, 2018). New Questions About the \$3B/Year Robotic Surgery Business. Retrieved from <https://www.healthnewsreview.org/2018/08/new-questions-about-the-3b-year-robotic-surgery-business/>.

⁵ McCrea, B. (March 31, 2017). Automation Study: The State of Automation. Retrieved from https://www.mmh.com/article/automation_study_the_state_of_automation.

Challenges

One of the biggest threats to increased adoption of robotics is increased regulation. Of particular concern is the potential for robots to eliminate jobs. In recent years, there has been talk of implementing a “robot tax.” Proponents argue the tax would offset the negative social consequences of increased automation, including job loss and loss of tax revenue. That said, increasing levels of automation has occurred almost continuously since the Industrial Revolution, and people have been able to adapt to these changes. In 1900, 38 percent of the U.S. population worked in agriculture.⁶ Today the

percentage that works in agriculture is below 2 percent and yet the overall unemployment rate is still less than 4 percent.⁷

Conclusion

Despite being around since the 1960s, robots today are going through a period of rapid advancement. These improvements are allowing robots to expand beyond their historic market in the auto industry into industries like consumer electronics, logistics and even services. In the coming years, the number of tasks that will be automatable with robotics will likely only increase. We will stay abreast

of these changes to determine the longer-term impact of robotics on the investment opportunity set.



OTHER DISRUPTORS

Other themes the team is currently researching include

- Blockchain
- Autonomous vehicles
- Machine learning
- Gene editing

Risk Considerations

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⁶ Historical Timeline – Farmers & the Land. (2014). Retrieved from https://www.agclassroom.org/gan/timeline/farmers_land.htm

⁷ U.S. Bureau of Labor Statistics, Percent of Employment in Agriculture in the United States. Retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/USAPEMANA>, October 18, 2018.

Counterpoint Global

Counterpoint Global Team

DENNIS LYNCH, Head of Counterpoint Global

New York

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EARL PRYCE	Portfolio Administrator	19	19	12
ROBERT ROSS	Portfolio Administrator	27	22	2

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- 2 Portfolio Specialists

"Investor" refers to an analyst or portfolio manager on Counterpoint Global

Team members may change without notice from time to time. Years of Experience listed above refers to Industry Experience.

Years of Experience, Years with Firm and Years with Team are as of November 2019

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