

DOMINATORS VS DISRUPTERS

THE FUTURE OF INDUSTRIAL ROBOTICS

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DOMINATORS VS DISRUPTERS – THE FUTURE OF INDUSTRIAL ROBOTICS

BY ANDREW BROWN

Expect to be mesmerised if you visit the factory of any of the world's leading car makers these days. Giant robotic arms pick up, paint and weld together entire vehicle carcasses, while parts and equipment propel themselves gracefully around the factory floor. Workers are scarce, required only for the few tasks machines have yet to master. Robots are already ubiquitous in the auto industry and will become increasingly important in manufacturing more widely.

For many years the robotics industry has been dominated by Japanese and European companies. Now, through a combination of new technology, government policy and disruptive new entrants from China and elsewhere, the industry is undergoing profound change.





From left to right: A Fanuc robotic arm is demonstrated during the World Robot Expo in Tokyo, Japan. Industry robots at the booth of Yaskawa at the Hannover Industry Fair (Hannover Messe) in Hanover, Germany. Visitors watch a KUKA robot perform precise movements as part of the Robochop interactive robot installation at the CeBIT technology trade fair. An ABB industrial at the Schunk booth at Hannover Messe.

THE BIG FOUR

The four largest manufacturers of industrial robots are Fanuc and Yaskawa of Japan, KUKA of Germany and ABB of Switzerland. Between them they command around three quarters of the global market. The long-term stability of their respective market shares suggests an industry with high barriers to entry. The main hurdle is gaining the trust of customers. A good name for quality and reliability in production is essential, given what's at stake. BMW, for example, claimed at a trade fair that five minutes of factory downtime can cost it up to €250,000.

Success in industrial robotics also takes expertise in material science and mechatronics (the fusing of mechanical and electrical processes) to deliver high levels of torque without compromising weight. This quest demands substantial investment and knowhow hard for newcomers to replicate. Superior scale also helps the four dominant incumbents balance their technological superiority with affordability, while maintaining a wider range of products and higher safety standards.

Each of the leading manufacturers has its own edge. KUKA boasts a 'seven-axis' robot, an arm whose multiple joints allow a wide range of precise actions, offering customers more tailored solutions. ABB is strong in process automation and claims that broad industry engagement enables it to leverage its best-practice advantage. In Japan, Fanuc and Yaskawa increase specification and focus by making most higher-value components in-house.

Perhaps these four companies' most important edge is in customer relationships. This sound understanding of clients' businesses helps them to develop future products and applications. At the same time, such is the complexity of robotic products, customers' familiarity with a user interface discourages purchasing managers from shopping around. This is most evident within the auto industry where KUKA has a longstanding close relationship with the large German car-makers, notably BMW, Daimler and Volkswagen, while Fanuc has close links with their Japanese and US competitors.

THE ROBOTIC SUPPLY CHAIN – QUALITY IS PARAMOUNT

A similar concentration of provider power exists in the higher-value robotic component market. Arguably technological barriers to entry are even stronger here, given the degree of specialism required and the benefits of higher, more focused, research and development (R&D) spend. Customers are even more willing to pay top dollar for quality components critical to their supply chain.

Japanese companies feature predominantly in robotic components. SMC Corp enjoys a third of the global market in the pneumatic equipment and control valves used in production lines. With an R&D budget almost ten times larger than its nearest direct competitor, Airtac of Taiwan, SMC offers a broader product range, higher levels of energy efficiency and more collaborative functions. Having a sales force of almost 20,000 staff (compared to Airtac's 3,500) is also an advantage, supporting faster delivery times and superior customer service.

Fanuc commands over half the market in computer numerical controls (CNCs), the specialist computers that synchronise the movements and actions of machine tools. Fanuc's strength in this area comes from working closely with customers, gleaning valuable data as well as a sound understanding of their needs.

Leading-edge software allows Fanuc to integrate other parts into the overall system. Appealing user interfaces also help. I was struck, when visiting Fanuc's head office beneath Mount Fuji, that most employees are not engineers but software specialists, and that the making of robots and robotic components is itself largely done by robots.





In speed reduction gears, which allow robotic arms more precise movements, Japanese firms Harmonic Drive Systems and Nabtesco have long dominated the market. For applications that require exceptionally high levels of accuracy such as electronic assembly and surgery, Harmonic Drive has until recently enjoyed a monopoly. Where it is losing share it is largely losing it to another Japanese business, Nidec, a global leader in electric motors with a strong track record in automation and manufacturing excellence. For larger rotor vector (RV) gears, used on the robots that put cars together, Nabtesco commands almost 60 per cent of the market.

Financial strength is common to all these component companies. Many Japanese machinery firms attract criticism for their conservatively-run balance sheets; but in an industry requiring constant investment, this can be an advantage. Of course, it is important to assess where this investment is being directed. Is there a risk of complacency and ‘innovators dilemma’ (missing out on future developments by protecting an existing franchise)? Or can we expect to see these industry bellwethers adapting to stay ahead of the competition?

Illustration of a surgical robot. Surgical robots use Harmonic Drive speed reducers to afford required levels of precision.

KEEPING UP WITH TECHNOLOGY

Four major technological innovations could disrupt the robotics industry and transform the competitive landscape. They are: the improved connectivity of 5G cellular networks and accompanying proliferation of Internet-of-Things (IoT)-enabled devices; advances in artificial intelligence (AI) and machine learning; improved access to information on the cloud; and a new category of robots allowing greater dexterity and safer interaction with humans.



The big players have varying levels of commitment to investing in these new areas. However, they all share a willingness to collaborate with other companies globally and to skill up where necessary. This is encouraging, particularly for the Japanese companies long accused of remaining insulated from foreign innovation.

Among the big four, Fanuc and ABB stand out for their commitment to exploring these new opportunities. Fanuc works closely with US firm Rockwell Automation, renowned for computers that control machine tools remotely. Unlike CNCs, they are open source and not tied to specific hardware.

Fanuc has developed the 'FIELD' open source connected platform in conjunction with Rockwell Automation. Targeted first at their existing customers, FIELD allows machines across the factory floor to talk to each other, reducing downtime by allowing remote and predictive maintenance.

To accelerate this capability in collaborative robotics, Fanuc embarked on a rare acquisition, buying fellow-Japanese company Life Robotics. It also invested in its fellow-Japanese machine learning specialist Preferred Networks. It has leveraged that firm's expertise to design a new range of picking robots that use deep reinforced learning to improve accuracy. Fanuc accepts lower short-term profitability as the price of investment in future growth.

Swiss conglomerate ABB has developed a cloud-based open source platform called Ability, in partnership with Microsoft and IBM, as well as German pneumatic equipment specialist Festo. It can connect with multiple devices, support remote diagnostics, and conduct maintenance and training using augmented reality. Through its corporate venture capital arm ABB also purchased Vicarious, a Silicon Valley AI research firm, and has announced a new robot factory in Shanghai, due to open in 2021.

The other big four companies, Germany's KUKA and Japan's Yaskawa, seem to have made only tentative investment in new areas. KUKA was consumed by a takeover by Chinese appliance producer Midea Group in 2016. Since then integration challenges have reduced profitability, with little evidence of genuine innovation. In its annual report the company refers to the 'KUKA SmartProduction Center' developed with Munich Re, which has a stated aim of digitising the production process, as well as improving efficiency, quality and flexibility. Remaining in a development phase it is difficult to judge the likely impact of this new platform. The German firm was conspicuously absent from the 2019 Hannover Messe, one of the world's largest industrial technology fairs, happening on its own doorstep.

Interestingly, Yaskawa established a joint venture with Midea Group in 2015 to research and develop 'cobots', collaborative robots that work safely with humans. It has since released one model used in auto assembly. Management is keen to highlight a new data management tool named Yaskawa Cockpit and a smart factory concept that uses the IoT and AI, but there is little sign of progress so far.

In robotic components, most investment has been directed at enhancing existing product ranges. Two exceptions are Nidec and SMC. Nidec has been making acquisitions in robotics to expand its offering from niche components (notably gears) to complete solutions. SMC has committed some of its investment budget to electric machinery which now commands a small proportion of sales. Electric equipment is lighter, more efficient and needs less maintenance than its pneumatic equivalent, but it remains too expensive for most. Although it may be several years away from gaining traction with the mass market, it seems unwise to discount SMC's ability to leverage its scale, reduce costs and engender demand.

Four major technological innovations could disrupt the robotics industry and transform the competitive landscape.

THE CHALLENGE FROM CHINA

Before looking at the new entrants from China it is worth considering Chinese Government policy. Robotics and automation feature prominently in ‘Made in China 2025’, Premier Li Keqiang’s strategy to move from low cost goods to higher value products and services. The plan aims to raise the share of domestically made robots and key robotic components to 70 per cent within six years. As things stand only 30 per cent of industrial robots and 20 per cent of critical robotic components are made in China.

Beijing has been heavily subsidising the domestic industry to achieve this ambitious goal. It is estimated that government handouts accounted for 44 per cent of net profit for 53 listed Chinese robotic companies in 2018, a sharp rise from the 10 per cent recorded between 2012 and 2017 and there are around 100 subsidised robotics firms in total.

AI is also attracting large amounts of government funding. The Shanghai Municipal Government plans to invest over \$14 billion setting up a dedicated fund, supporting emerging AI technologies and hosting six demonstration zones. One of these will be a 66,000 square-metre zone which will serve as a prototype, with programmes ranging from smart

parking to unmanned convenience stores. Beijing’s city administration also implemented an AI plan in 2017, investing \$2.1 billion on a development park in the west of the capital, housing 400 companies.

In Japan meanwhile, automation was part of Prime Minister Shinzo Abe’s much talked-about ‘third arrow’ of growth through structural reform. There is, however, little evidence of any policy to encourage investment. Similarly, in March 2019 a Japan AI plan was laid out with an aim of producing 250,000 AI experts a year, from just a few thousand today, by mandating that all university students take a beginner’s AI course. This is an admirable aim, but seems more likely to improve general awareness than to

develop a leading-edge capability.

There is no doubt that China is aggressively seeking to close the gap in automation and to develop a clear lead in AI. Taking this, and the country’s unparalleled access to data into account, the rest of the world should take notice.

Despite government policy and an increasingly exciting start-up scene, there are still only a small number of genuine robotics contenders from China, and there has been no discernible growth in its global market share. Chinese businesses offer technologies or solutions good enough for local customers at lower cost, but it seems unlikely that leading global auto and electronics manufacturers

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will trade down. Nevertheless, with a third of all robotics demand already coming from China, a figure likely to grow, these companies will enjoy a supportive backdrop.

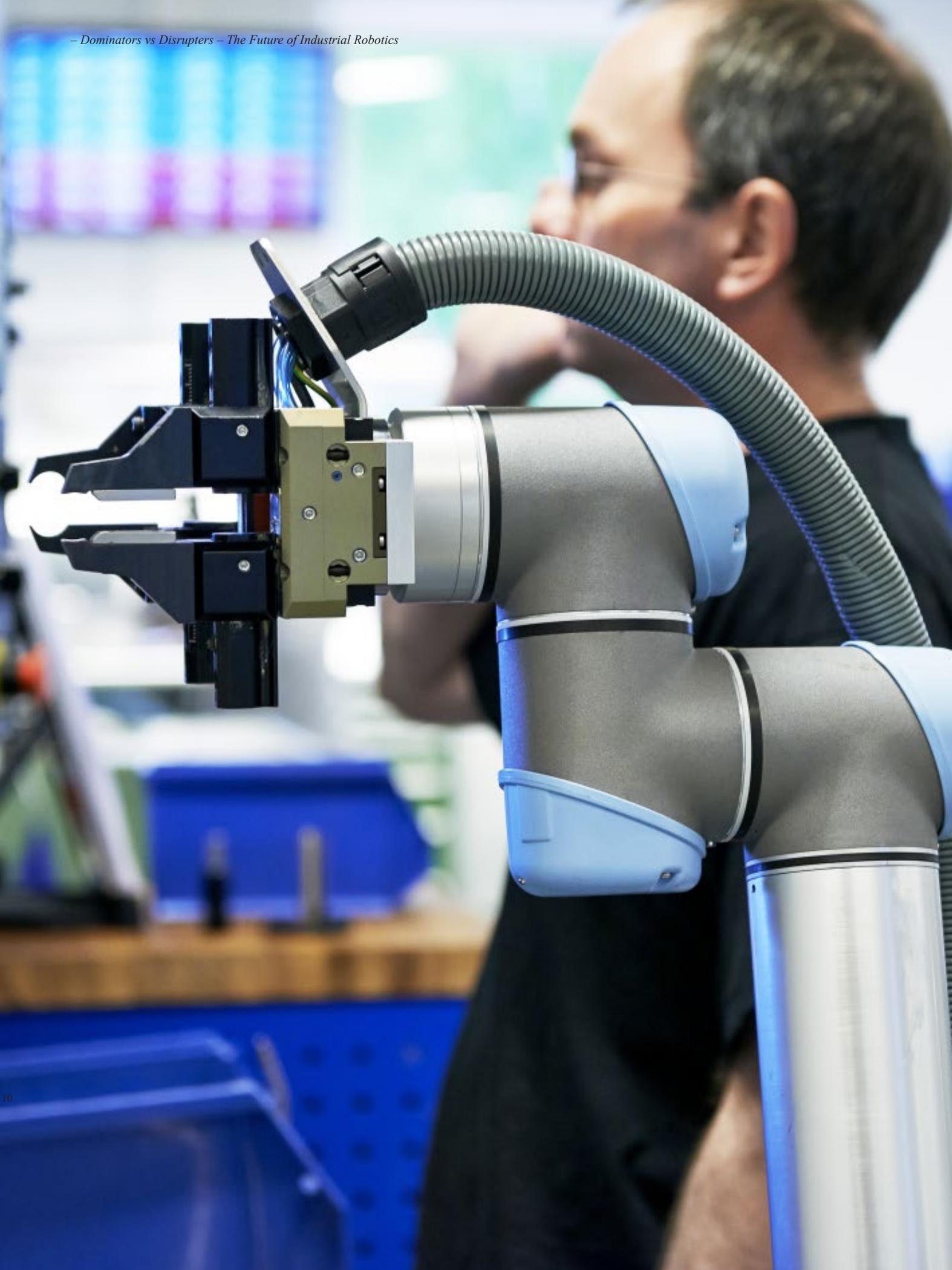
Specialising in motion control, Inovance and Estun Electronics stand out as the most viable Chinese challengers. Founded in 2003 by a team of engineers from telecoms giant Huawei, Inovance is a leading industrial conglomerate that generates half its sales from automation. It serves nine per cent of the local market for motion-controlling servomotors while leveraging its expertise to broaden its offering into related areas. Its technology may not be cutting-edge, but with 20 per cent of staff focused on R&D and

a reputation for customer service, incumbents should pay attention.

Founded in 1993, Estun Electronics became a viable challenger after acquiring UK-based Trio Motion in February 2017. It also enjoys strong growth in industrial robotics with annual volumes quadrupling from 600 to 2,500 over the past three years, though this is still small in a global context.

LeaderDrive Harmonic, Siasun and Aubo are other Chinese companies worth highlighting. LeaderDrive Harmonic (not to be confused with Japanese rival Harmonic Drive Systems) has been developing speed reducers in-house since 2003 and has a significant proportion of the local

market, as well as a small share of overseas demand. Although it now supplies gears to all domestic Chinese robot manufacturers, the big four have yet to risk switching. Siasun is a state-backed manufacturer of industrial robots that sells significantly less units than its larger competitors, like KUKA. Aubo makes cobots and is backed by the financial conglomerate Fosun Group. Each of these businesses would prevail even if government subsidies were cut and all can be described as successful fast followers. But that is a far cry from showing industry leadership.



THE OTHER DISRUPTORS

There are different requirements for manufacturing cobots. In this market there is a highly credible and disruptive new entrant from Denmark named Universal Robots. Founded in 2005, and now fully owned by semiconductor testing business, Teradyne, Universal boasts a 50 per cent market share with three standardised models. It has developed a technological lead with its seven-axis robot; while at the same time its open ecosystem has a proven appeal, enabling multiple manufacturers to develop hardware and software on top of its cobot system. Burgeoning demand for their products despite annual price rises speaks volumes. However, there is a concern that the limited capabilities of Universal's robots restricts their uses on sophisticated modern production lines. We would not discount the likelihood of the big four catching up.

At the lower end of the quality spectrum, a UK-based startup named Automata makes small, simple cobots that can be programmed in under 30 minutes and cost only \$6,000, compared to \$35,000 for one of Universal's models. Falling between these two offerings is Japanese electric motor specialist Nidec, another business

interested in cobots. It has been on the acquisition trail to improve its offering and has an unrivalled reputation for successfully integrating new technologies and leveraging scale, to get costs down. Nidec has already made excellent progress disrupting Nabtesco, the Japanese leader in RV gears, from a standing start a few years ago. Leading Japanese tier-one auto parts supplier Denso is also a contender. Its capabilities frequently attract industry commentary and its exhibit at the 2019 Hanover Messe was impressive.

Finally, it's worth acknowledging developments among the leading industrial conglomerates. German behemoth Siemens, which has an established position in several automation segments, has been investing heavily in a cloud-based machinery platform akin to Fanuc's FIELD system, partnering with Amazon Web Services and Festo among others. Honeywell and Parker Hannifin are also credible players in industrial automation and are actively investing for future growth. There is, of course, a tradeoff between the overall scale and resilience afforded by conglomerates and the impact of targeted R&D from a specialist operator.

HOW BIG IS THE GROWTH OPPORTUNITY AND WHO WILL CAPTURE IT?

Annual Installations of Industrial Robots



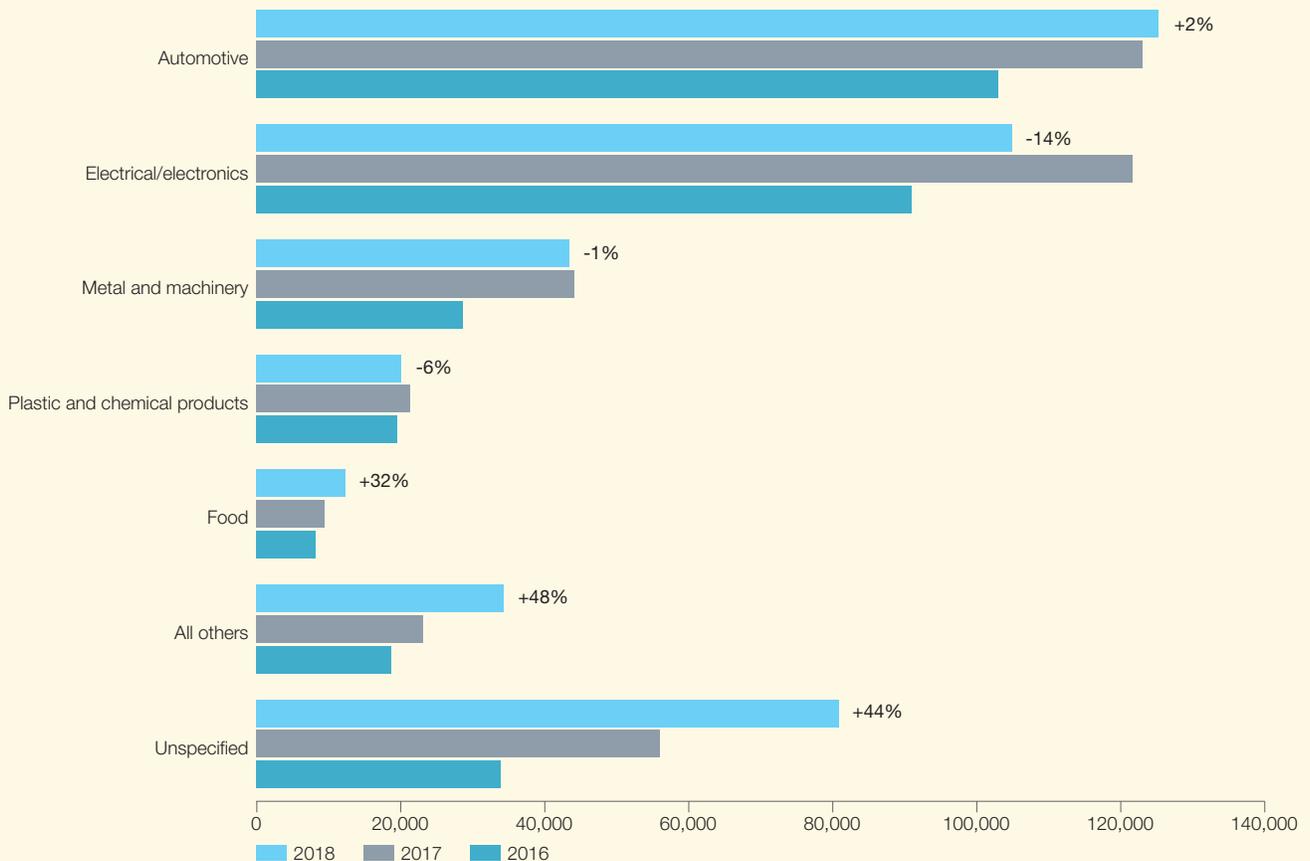
Source: World Robotics 2019.
*Forecast.

According to the International Federation of Robotics the industry has grown strongly over the past decade, a trend projected to continue for years. Growth will come from a combination of the following: replacement demand from existing customers in a few highly automated industries and countries; rising penetration in an industrialising developing world; and finally, technological innovation.

It is striking that almost three quarters of demand for industrial robots comes from just five countries, with robot penetration within this group ranging from 710 robots per 10,000 employees in South Korea to 97 in China. The global average is only 85. Similarly, almost two

thirds of demand comes from two industries: automotive and electronics. Other fields, ranging from logistics to medical to pharmaceuticals to food, are all growing rapidly from a tiny base. As functionality improves and costs fall we would expect the applications of robotics to increase. Cobots are likely to play a major part in this. In 2018 only 14,000 cobots were sold, accounting for \$500 million in revenues. This compares to an estimated 409,000 units of industrial robots representing industry sales of over \$16 billion. This number of cobots is expected to grow rapidly with improvements in dexterity and function, with some research bodies predicting sales of \$10 billion by 2025.

Annual Installations of Industrials Robots at Year-End Worldwide by Industries 2016–2018



Source: World Robotics 2019.

The companies we've spoken to endorse this view. ABB believes that global robotics sales, including all aspects of the supply chain, will grow from today's \$80 billion dollars to \$130 billion in 2025. Yoshiharu Inaba, the chairman of Fanuc postulated that robot applications and functions could double over the next decade. Thinking with an admirably long-term view, management at Nidec recently mused in their results presentation that by 2050 the ratio of robots to people will reach three-to-one.

Although the robotics growth story remains intact, the industry is rapidly evolving and becoming increasingly complex. It seems likely

that future profits will be shared amongst more players. Much incremental demand will be absorbed by Chinese manufacturers who offer adequate and improving technology and who benefit from government support. At the same time the incumbents will be forced to cede some of their profits to a growing list of partners who help them stay relevant to customers. With collaboration only a recent development and with new AI and cloud-based systems still in their infancy, it is far from clear how profitability will be apportioned in future.



A robotic hand is on display at the 2019 China International Industry Fair in Shanghai.
© Visual China Group/Getty Images.

Although many uncertainties and challenges exist, today's industry leaders start with enviable reputations for quality and financial nous. Incumbency matters. As one expert from industrial robot-maker Siasun was heard to remark at the China International Industry Fair in Shanghai recently: "Fanuc is just way too strong."

That kind of market muscle may prevail for now, but there are signs aplenty that the status quo won't hold forever. Slowly but surely the global industry is being reshaped by new technologies in the hands of determined would-be disruptors. The dominant companies will have to respond if they want to stay that way.

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