Asset Management Equity Business

Thematic Insights: Robotics, Security & Safety

Robotics & Automation: cheaper with greater performance

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> *"Automation is not our enemy. Our enemies are ignorance, indifference, and inertia. Automation can be the ally of our prosperity if we will just look ahead, if we will understand what is to come"*
>
> **Lyndon B. Johnson, 36th President of the United States[1]**

In the November edition of Thematic Insights we explored some of the advances in technology, in particular semiconductors and sensors, which are enabling robots to perform a much broader range of tasks than have been feasible in the past. Tasks both physical and cognitive. In this edition we look beyond the technical feasibility of robotics and take a closer look at the economic benefits of robotics. In other words, the cost argument.

An age of cheap computers

In the 1970s computers were expensive and typically only found in the offices of blue chip companies and in the homes of the very rich. In 1972, the HP "3000" sold for USD 95,000,[2] or USD 541,000 in today's inflation adjusted terms. The average selling price of a desktop computer today is USD540 and a notebook PC USD690.[3] As a result of this dramatic decline in the price and the great expansion in the scope of its use-cases and in people's familiarity with technology, the computer is no longer the exclusive purview of the elite, but is now one of the most ubiquitous technologies worldwide. In 2015, approximately 114 million desktop computers were sold worldwide, 163 million laptops, 208 million tablets and an incredible 1.4 billion smart phones.[2]

The dawn of Robotics

Robotics are following the same path of cost compression and performance gain, driven by Moore's Law, the availability of open source software and the gradual standardization of parts and components.

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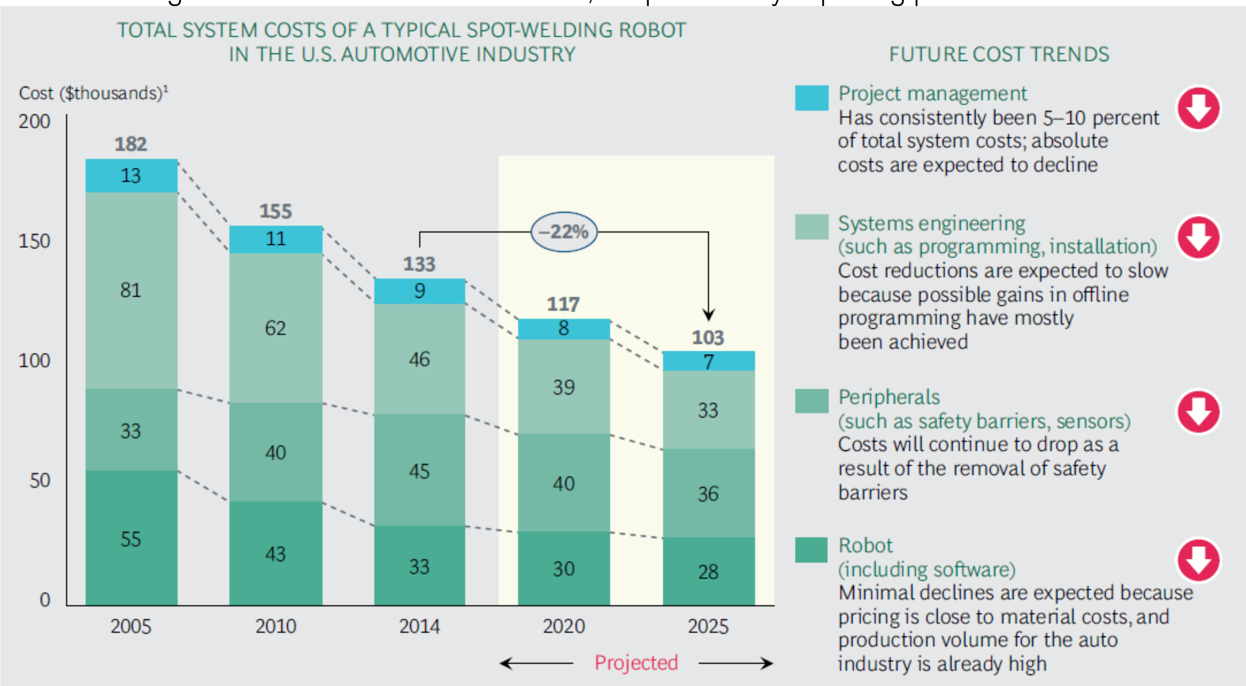
[1] Exert from Johnson's speech to Congress on the signing of the of Bill to create a "National Commission on Technology, Automation and Economic Progress," 19th August 1964

[2] Computerworld magazine, 26th January 1981

[3] Source: IDC quarterly PC data series (actual data: 2015 worldwide PC ASP: desktop USD 544; notebook USD 692)

The Boston Consulting Group estimate that the average cost of a "spot welding" robot had fallen from USD 182,000 in 2005 to just USD 132,000 by 2013.[4] They predict continued declines and expect that by 2025 the price would likely be closer to USD 103,000. As shown in the chart below, they estimate that the cost of the hardware and software, "Robot (including software)", fell approximately 40%, while the cost of the programming, installation and integration, "Systems engineering", fell even further, thanks to the improved "intelligence" of the system.

Chart 1. Falling cost of advanced industrial robots, despite steadily improving performance



Source: BCG Perspectives, "The Robotics Revolution," page 8. September 2015

A Robot's hourly wage

Typically the heavier the robot, the larger the price tag. Larger machines, designed to lift and manipulate larger objects, or payloads, require more power, larger motors and stronger gears and mechanics to cope with the strain. More accurately, the robot's application is the largest determining factor behind its price, since the application determines the size of the robot, the weight of the payload, the level of safety equipment, the complexity of the task and the speed and quality at which it can be performed.

A new industrial robot complete with controllers and "teach pendants" typically costs between USD50,000 and USD80,000.[5] The "spot welding" robot mentioned above is more expensive, but spot and arc welding are two of the most expensive applications in industrial robotics. Once the work cell and peripherals, and "effectors" for the specific use-case in the factory are added, as well as the cost of integration into the production line, total costs might rise to USD100,000 - USD150,000.[4]

The Robotics Industry Association (RIA) estimates that on average industrial robots have a useful life of 10-15 years. Therefore, a factory robot costing USD 150,000, used for two 8 hour shifts every day, 5 days a week, 50 weeks a year, for 10 years, would imply a useful operational life of 40,000 hours. Ron Potter, the Director of Robotics Technology at Factory Automation Systems in Atlanta, estimates that medium size industrial robots handling 100kg payloads, might use USD 0.75 in electricity per hour (based on an assumption of 7.35kW at 10c. per kW hour).[6] Adding the energy cost to the investment cost of the robot implies an hourly cost of USD 4.50 for the robot, assuming zero residual value.

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[4] The Boston Consulting Group paper: "The Robotics Revolution", pages 7-8. September 2015.

[5] RobotWorx Corp homepage: "How much do industrial robots cost."

[6] Factory Automation Systems, Inc. homepage: "ROI Calculator"

Major car companies typically run their production lines much more aggressively. Building a more extreme scenario: 24 hours a day, 7 days a week, for 48 weeks a year over 15 years, would imply 120,960 hours of operation, an energy bill of USD 90,720 and an effective total cost per hour of just USD 1.99. To put this into perspective, the average hourly wage for a factory worker in USD 2.70, before including benefits.[7]

It's not what you do; it's the way that you do it

Thanks to increased speed and reliability, and easier reprogramming, the productivity of industrial robotics and automation has increased by approximately 5% per year.[3] Taken together with the lower price, an investment into a USD 100,000 robot today would yield approximately twice the productivity of a USD 100,000 robot 10 years ago. RobotWorx, a major refurbisher and reseller of industrial robots based in Ohio, suggest that gains in productivity are often more important to the economic equation than per hour cost savings. They estimate that a single robot produces the same "rate of parts" as 4 workers and that waste or "scrap rate" is typically lower. [4]

With continued advances in sensors, semiconductors and open source software and algorithms, improvements in both price and performance are likely to continue for the foreseeable future. McKinsey estimate that as a result robotics and automation could raise productivity growth globally by 0.8% to 1.4% annually. [8]

Real world pressures

While robotics and automation is becoming more affordable and more capable in matching or outperforming human workers in a range of activities, labour costs and regulations around quality and safety are rising. Over the last 4 years wages for low skilled workers have risen in real terms in both developed and emerging markets.

China's rise to become the world's largest manufacturer in 2010 (a title the US had held since 1895), provides a good illustration of wage inflation amongst lower skilled factory workers. Gordon Orr of McKinsey Asia notes that:
"The vast majority of the economy has seen double-digit wage growth for the past decade, with the minimum wage in many cities doubling in less than 5 years."[9]

And rising labour costs are not the only concern. As the economy has grown, production-line fatigue and worker's expectations and aspirations are starting to create a shortage of labour willing to take factory work. Terry Gou, the founder of the largest electronics manufacturer in the world, Foxconn, told the Financial Times:
"The young generation don't want to work in factories, they want to work in services or the internet or another more easy and relaxed job."[10]

Some businesses have already started shifting production to lower cost markets, such as Vietnam, India and Mexico. However, with a third of China's GDP and 15% of the entire workforce in manufacturing, the Chinese government are highly motivated to keep production in China and are subsidizing the domestic robotics industry to encourage businesses to invest in automation to remain competitive and to push up the value-chain into the manufacture of precision electronics which require sophisticated robotics to produce.

Foxconn already have production facilities in Vietnam, Brazil and Mexico, but in their Chinese factories they are following the government's directive and are engaged in a 3 stage plan. In March 2016 they announced the first step of stage 1 of this plan: replacing 60,000 factory workers with 40,000 Foxconn built robots, known as "Foxbots", to perform dangerous or repetitive tasks. Stage 2 will be fully automated production lines and stage 3 fully automated factories.

Despite these efforts to increase automation, China remains a long way behind Japan, South Korea, Germany and the US, with just 36 robots operating on average for every 10,000 workers in the manufacturing industry. In contrast the global average is 66 robots per 10,000 workers, and the most highly penetrated countries are South

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[7] The Economist, "The future factory of Asia: a tightening grip," 14th March 2015 (assumes one 10-hour shift per day).
[8] McKinsey Global Institute, "A future that works: automation, employment and productivity," page 15, January 2017.
[9] McKinsey & Company, "What could happen in 2015," December 2014, Gordon Orr, Director of McKinsey & Company Shanghai.
[10] The Financial Times, "Young Chinese shunning factory jobs," 8th October 2013 (FT.com).

Korea and Japan, due largely to the high level of automation in the car and semiconductor industries, with 478 and 315 robots per 10,000 workers respectively.[11]

Small, flexible and highly personable

As the processing power of semiconductors grows and hardware components become more standardized, it is becoming easier to design and build small and medium sized robots almost entirely from 3rd party components. In the last few years, a large number of companies have started producing collaborative robots, or "Co-bots", such as Foxconn's "Foxbot", designed to safely operate alongside people, typically in small-lot production facilities, or in areas where there is limited space.

Companies such as Rethink Robotics, Precise Automation, F&P Robotics and Universal Robots, all have robots on the market for as little as USD 10-30,000. To make them safe to work alongside people, these robots are typically "force- or power-limiting", meaning that they stop immediately if they sense resistance from touching something, such as a person or another robot. However, this force-resistance limits their payload capacity and reduces their speed of operation. Furthermore, in order to keep costs low, they are designed to have only half the life expectancy of traditional industrial robotics. For these reasons they do not compete directly with their more expensive and more productive brethren from Fanuc, ABB, Yaskawa and KUKA. However, these young co-bots are bringing some interesting innovations to the industry, such as program by example (PbE) and are expanding the market for robotics beyond large scale production plants, to smaller scale producers, perhaps producers without automated production lines, and potentially to consumer and commercial applications outside the factory altogether. The "P-Rob" robot from F&P Robotics for example, is adept at food preparation for catering and at operating a Nespresso coffee machine and serving cups of coffee to guests.

Labour upheaval

As automation in the workplace becomes more prevalent, what will that mean for employment, jobs and the future of "work" itself? McKinsey note in their latest paper that the fear of technology destroying jobs and displacing workers dates back several hundred years, beyond the Luddite movement in Britain during the Industrial Revolution. Yet the lesson from history is clear. Although new technologies have repeatedly created periods of upheaval in the labor market as tools and equipment allow for more efficient production processes and inevitably result in the loss of jobs in the short term, over the long term, new technology has forced people to adapt and to learn new and more highly valued skills. Technology also creates new forms of work and new types of employment in designing, building, maintaining and servicing the robots themselves as well as the digital ecosystem of which they become part.

"In the US the share of farm employment fell from 40% in 1900 to 2% in 2000. Similarly the share of manufacturing fell from 25% in 1950 to less than 10% in 2010."[12]

As a final point, robotics and automation may not only threaten low skilled factory jobs, but with advances in artificial intelligence and machine learning, cognitive work and the world of professional services may also be impacted. McKinsey estimates that although fewer than 5% of all jobs globally may be fully automatable, more than 60% of all jobs have approximately 30% of content which could in theory be automated.[13]

Conclusion

Advances in technology are creating a new age of automation in which ever smarter and more versatile robotics will be deployed in ever wider use cases in the factory and more broadly across society. As more companies, consumers and governments begin to see the benefits of robotics, automation and A.I., it is likely that the industry will continue to expand and growth rates for companies with well differentiated and critical technologies will continue to accelerate. As robotics and automation become omnipresent, connected and critical to our daily life, the implications from a security and safety point of view also become more critical. The relationship between robotics and security is symbiotic, with more automated systems requiring more security and controls to be put in

[11] International Federation of Robotics, "World Robotics 2016 Industrial Robots", excerpt from executive summary on www.IFR.org.

[12] McKinsey Global Institute, original data based on Stanley Lebergott's, "Output, employment and productivity in the US after 1800," 1966, and data from the World Bank (worldbank.org).

[13] McKinsey Global Institute, "A future that works: automation, employment and productivity," page 32, January 2017.

place, and in turn, more security and controls necessitating more automated management and coordination tools to operate the security systems efficiently. We have designed two strategies to provide clients with "pure-play" exposure to these compelling and complementary long-term secular growth themes: robotics & automation and security & safety.

For further information (such as current fund factsheet, performance or quarterly comments) please click here (security & safety) or here (robotics).

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Overview of Fund Characteristics

Key Facts	Credit Suisse (Lux) Global Security Equity Fund	Credit Suisse (Lux) Global Robotics Equity Fund
Portfolio manager	Dr. Patrick Kolb since March 1, 2007	Dr. Patrick Kolb since June 30, 2016 Angus W. H. Muirhead since September 01, 2016
Location	Zurich	Zurich
Fund domicile	Luxembourg	Luxembourg
Fund currency	USD, CHF, EUR	USD
Inception date	Oct 19th, 2006	June 30th, 2016
Management fee p.a.	For unit class B and BH: 1.92% For unit class IB, IBH and EB: 0.90% For unit class UB and UBH: 1.15%	For unit class B: 1.60% For unit class EB: 0.90% For unit class UB: 1.15% For unit class IB: 0.90%
TER (as of 31.05.2016)	Unit class B 2.20%, unit class IB 1.18%, CHF unit class BH 2.20%, EUR unit class BH 2.20%, USD unit class EB 1.14%, USD unit class UB 1.44%, CHF share class UBH 1.42%, EUR unit class UBH 1.43%	n. a.
Maximum Sales Charge	5% for all unit classes except unit classes IB, IBH and EB (max. 3%)	5% for unit class B and UB, 3% for unit class EB and IB
Single Swinging Pricing (SSP)[1]	Yes	Yes
Benchmark	MSCI World (NR)	MSCI World (NR)
Unit classes	Unit class B, IB, UB, EB in USD, unit class BH, IBH and UBH in CHF, unit class BH and UBH in EUR	Unit class B, EB, UB, SB, IB in USD
ISIN	USD unit class B: LU0909471251 USD unit class UB: LU1144416432 USD unit class IB: LU0971623524 CHF unit class UBH: LU1144416515 CHF unit class BH: LU0909471681 EUR unit class UBH: LU1144416606 EUR unit class BH: LU0909472069 USD unit class EB: LU1042675485 (QI only*) CHF unit class IBH: LU1457602594 (newly launched in Aug)	USD unit class B: LU1330433571 USD unit class EB: LU1202667561 (QI only*) USD unit class UB: LU1330433738 USD unit class SB: LU1422761277 (seeding share class, closed for investments) USD unit class IB: LU1202666753 (newly launched on 15.09.2016)

Source: Credit Suisse, January 31, 2017

[1] SSP is a method used to calculate the net asset value (NAV) of a fund, which aims to protect existing investors from bearing indirect transaction costs triggered by in- and outgoing investors. The NAV is adjusted up in case of net inflows and down in case of net outflows on the respective valuation date. The adjustment in NAV might be subject to a net flow threshold. For further information, please consult the Sales Prospectus.

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