

MIRAE ASSET LENS ISSUE 7 PART I

Automation in China

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Part I. Automation in China

Contributors

Mirae Asset Global Investments
(Hong Kong) Limited
Asia Pacific Investment/Research Team

Joao Cesar
Investment Analyst

The Automation Industry in China

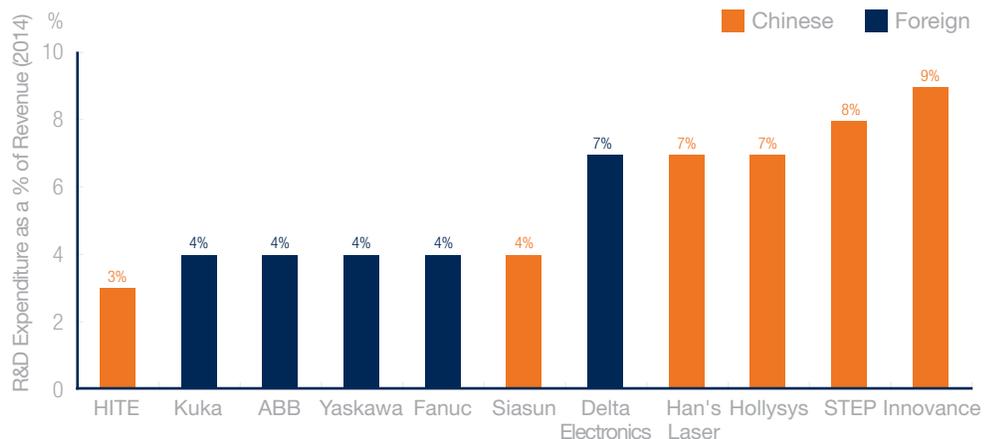
China's industrial automation is bringing structural change that we believe will continue to play out for many years to come. In this edition of Mirae Asset Lens we explore a few key trends in China that will underpin industrial automation growth, such as low penetration, demographic changes, rising labor costs, and government support.

Bridging the Divide

We are predicting that automation will experience up to 15% compound annual growth rate (CAGR) in China by 2020, with a 35% CAGR in the robots category alone. According to our

R&D as a Share of Sales in China (As of 2014)

Source: Company Disclosures, Sanford Bernstein Analysis (2014)



channel checks, there still is a significant technology gap that exists between Chinese players and developed market counterparts in Japan, Korea, the US, and Europe, especially on the software side. However, the gap is closing with increased investment in Chinese research and development (R&D), a trend that is set to accelerate.

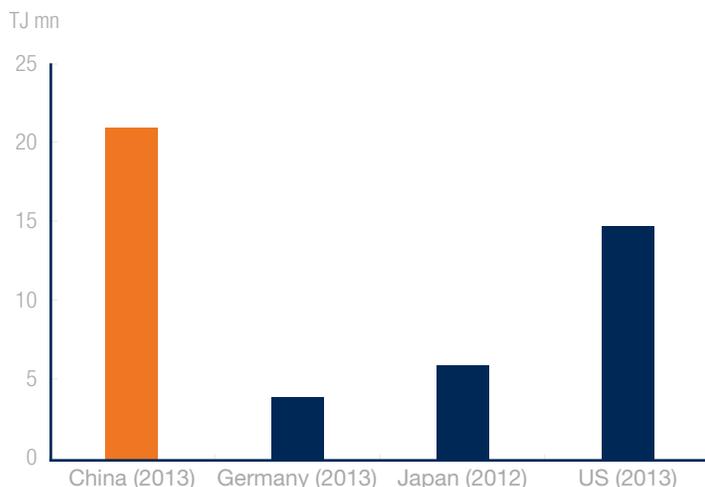
The Chinese are at the forefront of cost competitiveness on robot hardware. They are able to produce a range of components, except for a few precision items such as reducers, which are still largely imported from Japan. The global manufacturing share of Chinese industrial companies on a value-added basis totals around 33%.¹ However, according to Chinese specialists, the

country's industrial automation market is only RMB 106 billion (USD 17 billion²) in size, accounting for roughly 11% of the worldwide total, indicating that penetration is quite low. Apart from rising labor costs weighing on bottom lines, other factors that will influence the pace of adoption of robots in China include high energy consumption, a rising awareness of environmental protection, product customization, and improving living standards.

Chinese manufacturing efficiency also lags behind that of developed industrial nations, which is evidenced by China's poor energy utilization rates. These lower energy conversions translate into deteriorating margins for companies.

Chinese Manufacturing Energy Intensity (TJ mn per USD Manufacturing, Value Added)

Source: World Bank, Chinese NBS, Statistisches Bundesamt, US Energy Information Administration, Japanese Ministry of Economy, Trade and Industry (2013; Accessed 2016)



* TJ= Terajoule, one trillion joules. unit of energy

Made in China 2025: In the Footsteps of Japan

Beijing's automation policy framework, "Made in China 2025", sets targets, strategy and focus areas around intelligent manufacturing for factory upgrades. Based on the Japanese experience, we believe that the Chinese market has already entered the fast-

growth phase. If we perform a historical comparison analysis, we may observe that China's absolute robot ownership and density of units per 1,000 human workers in 2013 trends at similar levels to Japan 25 years and 30 years ago, respectively.

GSK Robots Testing Facility

Source: Mirae Asset Global Investments (2015)



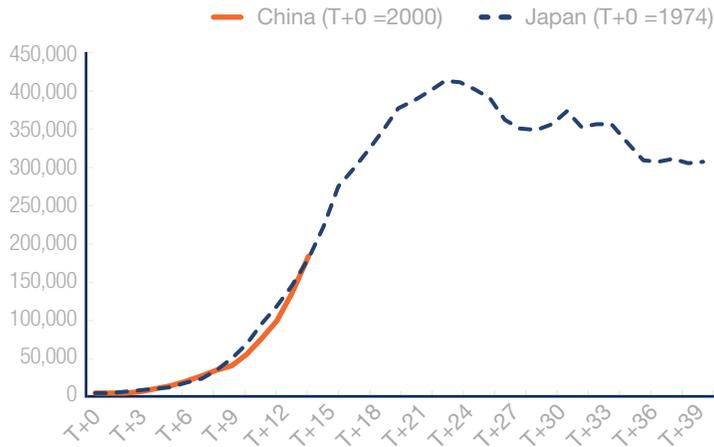
Joao Cesar, Investment Analyst, visits GSK Robots testing facility in China

¹ The World Bank (2015)

² All RMB figures are approximate and based on February 2016 foreign exchange rates.

China's Robot Ownership in 2013 was what Japan was 25 Years Ago (units)

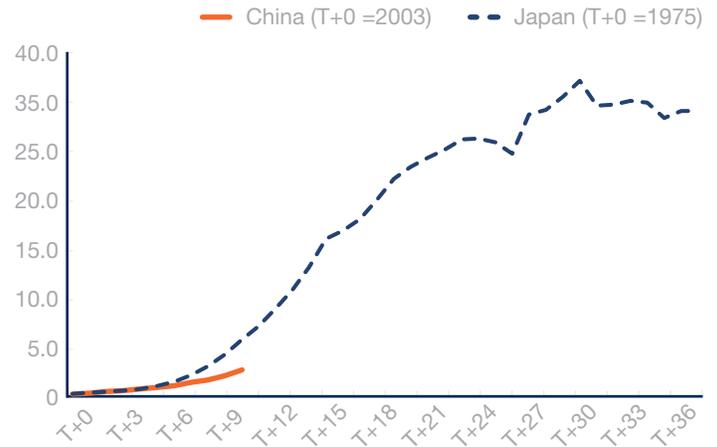
Source: International Federation of Robotics (Accessed 2016)



When viewed against developed markets, China's penetration is indeed low. Robot ownership in 2013 was just ~30% of that in the US, ~11% of Germany, ~9% of Japan and ~7% of Korea. In the same fashion, if we look at China's robot density at the

China's Robot density was what Japan was 30 Years Ago (units per 1,000 employees)

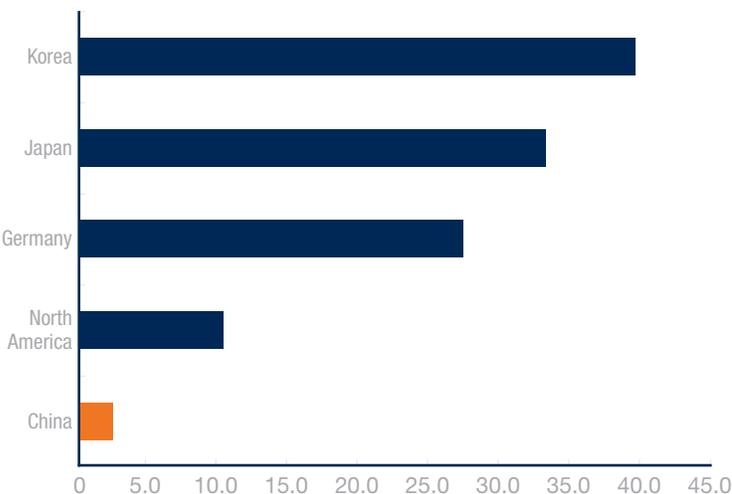
Source: International Federation of Robotics (Accessed 2016)



time, it stands at an equivalent stage of maturity to Japan in 1983, Germany in 1990, Korea in 1994 and the US in 1999. In the subsequent 5 years within each of these countries, robot installation grew at a swift clip of between 13-30% CAGR.

China Robot Density Compared to Other Industrialized Countries (units per 1,000 employees, 2013)

Source: IFR, Bureau of Labour Statistics (Accessed 2016)



Developed Markets' Experience on Robot Ownership Growth

Source: IFR, Bureau of Labour Statistics (Accessed 2016)

		Robot Density				
		T+0	T+5	T+10	T+15	T+20
China	2013	3.00	-	-	-	-
North America	1999	3.03	5.65	8.70	-	-
Germany	1990	3.09	5.70	10.55	21.62	26.30
Japan	1983	3.34	12.27	22.82	29.88	33.35
Korea	1994	2.66	8.36	14.04	24.10	-

		Robot Density Growth (CAGR)			
		5 year	10 year	15 year	20 year
China	2013	-	-	-	-
North America	1999	13.3%	11.1%	-	-
Germany	1990	13.0%	13.1%	13.8%	11.3%
Japan	1983	29.7%	21.2%	15.7%	12.2%
Korea	1994	25.7%	18.1%	15.8%	-

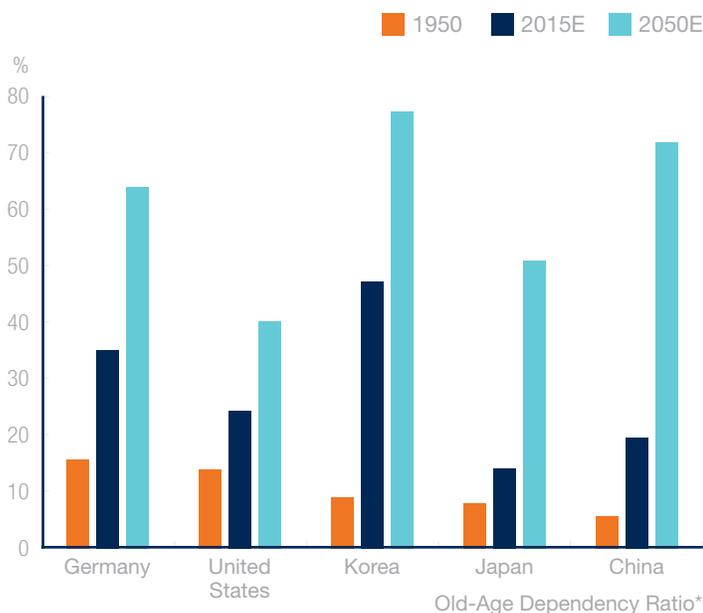
Rise of the Robots

Looking back to 2010, the demand for industrial robots in China was roughly in line with the U.S. at approximately 15,000 units. Since then, sales have markedly diverged between the two countries as China nearly quadrupled in the intervening period to 57,000 units by 2014, eclipsing the US that posted just shy of a doubling to 26,200 units over the same timeframe.³ Although economic growth was sluggish in 2015, China still imported ~27,000 sets of robots in the first four months of last year with an average selling price (ASP) of RMB102,000 (USD 15,600) per set.⁴ This brisk pace of adoption in China is forecasted by IFR to continue its dramatic rise, reaching 150,000 total industrial robots by 2018.

Labor is contributing less and less to economic expansion worldwide, putting the onus on improved productivity to sustain growth prospects. This is particularly true in China, where the rapidly ageing society has raised the dependency ratio, signifying a growing burden on the working population to support the elderly with the passing of time. Sensing the urgency and gravity of the issue, President Xi Jinping in 2014 called for “an industrial robot revolution”.

Ageing Economy Should Lead to Higher Labor Costs in China

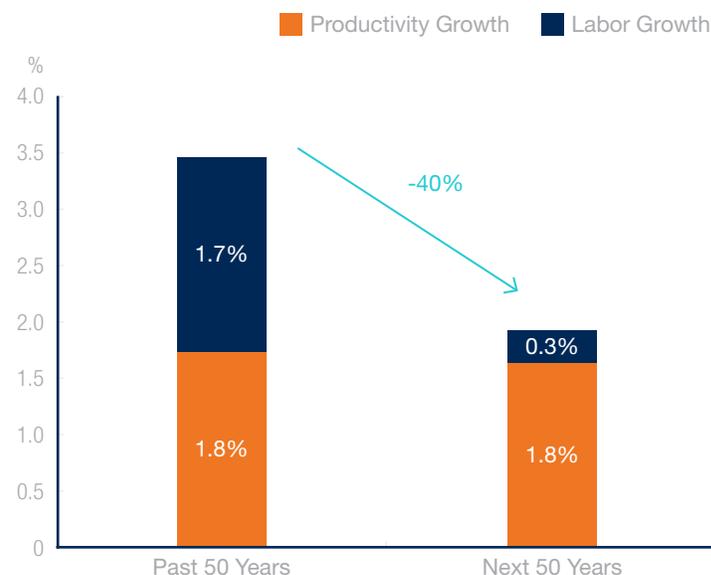
Source: NBS, United Nations Population Division (July 2015)



*Note: Ratio of population aged 65 years and older as a % of labor force (aged 15-64)

Global GDP Growth from Productivity and Labor

Source: McKinsey, “Global Growth: Can Productivity Save The Day In An Aging World?” (January 2015)



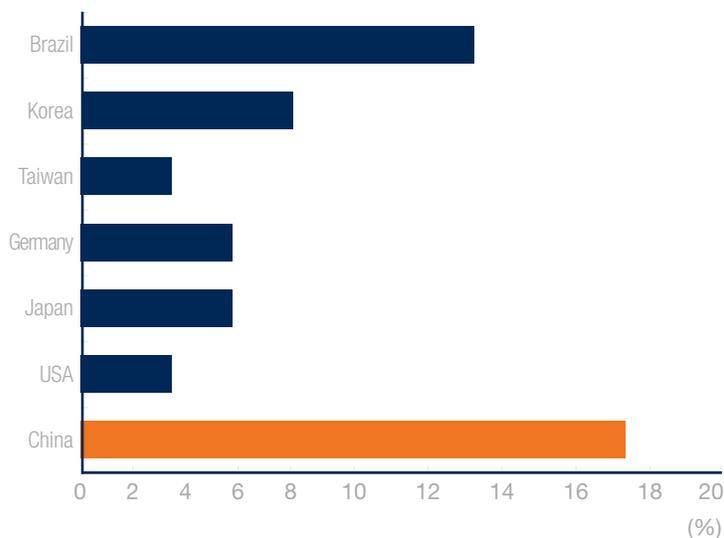
³ International Federation of Robotics

⁴ International Federation of Robotics

A number of industrial jobs are not only tedious and repetitive, but can also be unsafe. Indeed, occupational preferences are playing a role in the robotics segment, as greater education raises awareness of the safety and health hazards related to blue-collar work, prompting people to seek safer, more comfortable office-based professions. Consequently, industrial jobs that are exposed to extreme conditions are progressively being replaced by robots and automated systems. Urbanization is also raising labor costs, with city-dwellers seeking healthier working conditions and better benefits than rural workers. China is seeing a declining supply of rural migrants flowing into its cities, with more than half of the country's population already living in urban areas since 2011.⁵

Rapid Increase in Hourly Wages in China (2002-2012 CAGR)

Source: Bureau of Labour Statistics, Credit Suisse (2015)



“Those Chinese robotics companies offering products and services on par with that of global players, while at the same time differentiating themselves with local access, stand to reap the greatest rewards.”

In-House vs. Imported Machines

We believe that the market share of Chinese players will grow once costs drop, performance improves, and mass adoption takes off. We expect these forces to converge within the next few years, allowing new opportunities for local robotics players to emerge as end-users – factories and manufacturers – continue to face a squeeze on their margins from higher labor costs while the track record of robot deployment improves. Those Chinese robotics companies offering products and services on par with that of global players, while at the same time differentiating themselves with local access, stand to reap the greatest rewards.

Low-end applications will emerge first, then volumes will grow and prices will fall. Several cases of price reduction have already appeared in the industry:

- The price for DCS (dual check safety) dropped to RMB300 (USD 45)/input-output point in 2014 from RMB600 (USD 90)/point in 2006, driven by falling hardware costs, economies of scale for domestic players and product standardization.⁶
- Color HMI (Human Machine Interface) costed less than RMB1,000 (USD 150)/unit in 2012, down from RMB1,800-2,000 (USD 275-300)/unit in 2010 and RMB3,000 (USD 450)/unit prior to 2009, driven by volume ramp-up and low-end product upgrades.⁷
- Implementation of an integrated elevator driver (substituting a combination of programmable logic controller and inverter) resulted in around 50% cost reduction.⁸

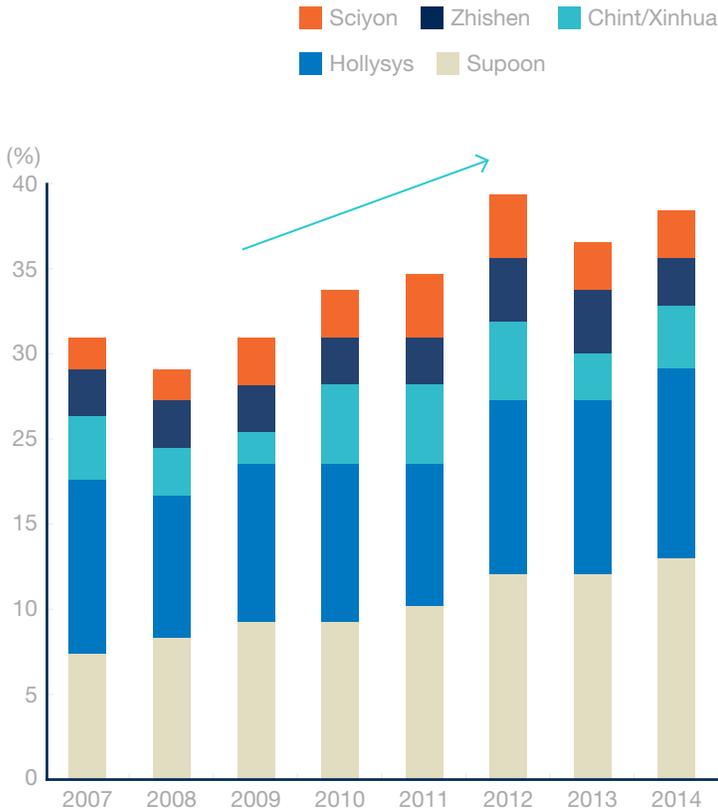
⁵ China Statistical Yearbook 2015

⁶ Company disclosures, Credit Suisse, Mirae Asset Global Investments Analysis

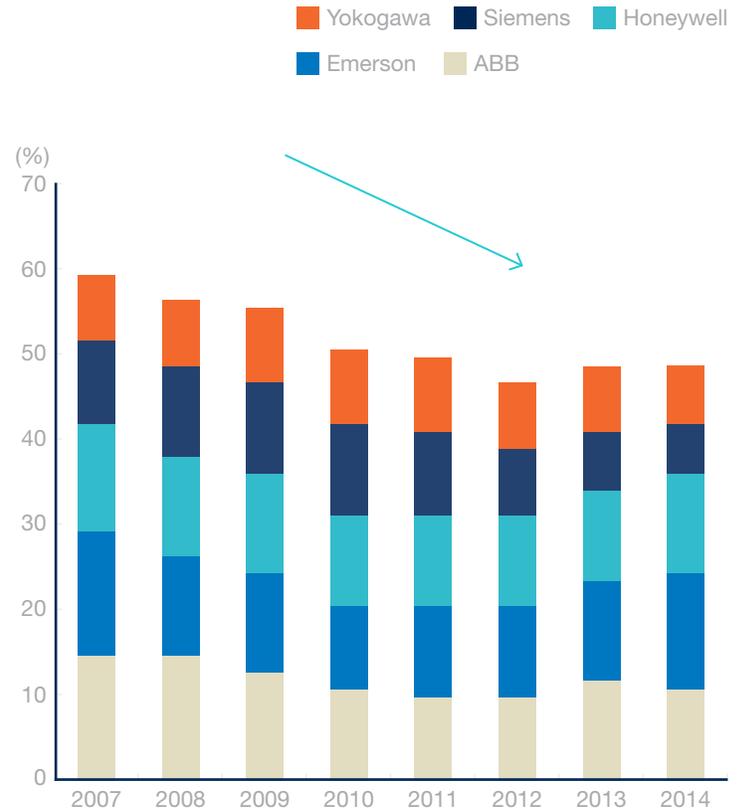
^{7,8} Ibid

Domestic Dual Check Safety Brands are Gaining Market Share

Source: Gongkong, Credit Suisse, Mirae Asset Global Investments (2015)



Global Dual Check Safety Brands are Losing Market Share



In China's first round of capital expenditures (CAPEX) on automation circa 2009 to 2012, local consumer firms imported equipment and carried out system integration internally. Most of the automation lines they installed were designed to last for around three years, after which they will be replaced by new lines designed to make new products. We believe that when these initial automated manufacturing lines are replaced, end-users will have gained enough understanding of the systems to source equipment, service, and maintenance locally for better reliability and cost-efficiency. However, we do not envisage Chinese

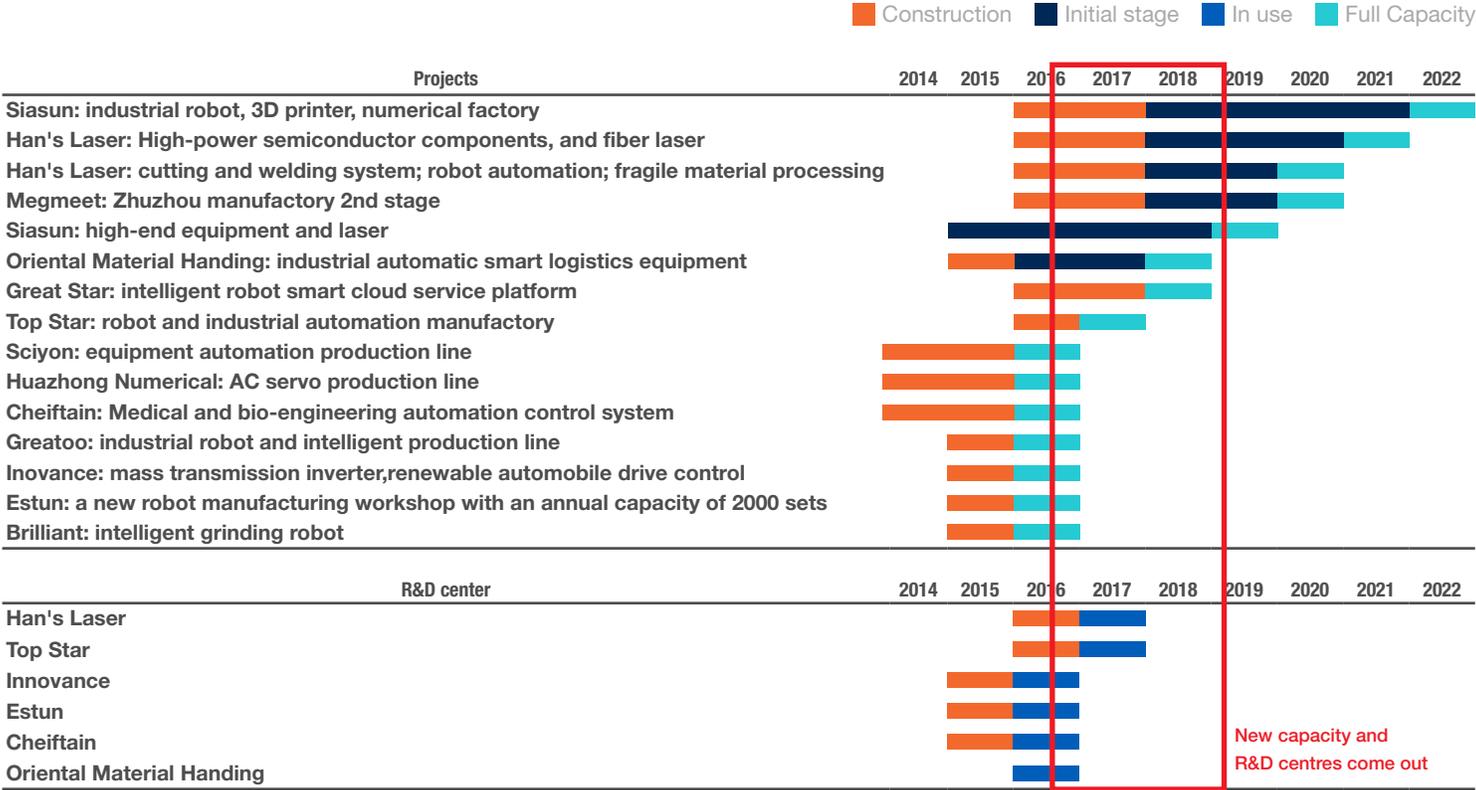
companies being competitive on high-end applications, such as automobiles, anytime soon.

Chinese companies are taking advantage of government support policies such as direct subsidies, labor incentives, value added tax refunds, and tax breaks,⁹ fueling a boom of investment in R&D projects, capacity expansion and human capital building and training. We believe that these new capabilities should come online for large-scale commercial application by 2017-18.

⁹ Financial Times, "China seeks productivity salvation in robots" (June 2015)

Estimated Capacity Expansion and New R&D Center Construction Timelines of Major Automation Players

Source: Company Disclosures, Credit Suisse (2016)



A Double-Edged Sword?

Many of the predictions on automation are especially pessimistic with regards to the unemployment caused by the substitution of humans by robots. There were an estimated 250,000 robots in China as of 2015.¹⁰ Using the rule of thumb that one industrial robot replaces four to five workers suggests that robots have rendered more than 1 million people jobless.

However, past correlation between meaningful productivity gains and structural unemployment has been more nuanced than that. Automated Teller Machines (ATMs), introduced in the 1980s, offer an interesting example of the counterintuitive nature of disruptive technology. Initially, analysts thought that ATMs would completely wipe out bank tellers and obviate the need for branches altogether.

However, ATMs decreased the cost of opening new bank branches and banks responded by opening more branches and hiring more people. The number of ATMs in the US went from almost nil in 1980 to 400,000 in 2010 and, although the number of tellers per branch decreased, the absolute number of tellers employed increased from 500,000 in 1980 to 550,000 in 2010.¹¹

Often, employment numbers remained quite stable, as creative destruction often helps create new industries which are hard to predict. While it is inevitable that jobs will be lost to robots, we contend that it is too early to fully comprehend the set of implications of automation on the labor force.

¹⁰ International Federation of Robotics, World Robotics: Industrial Robots 2015 (<http://www.ifr.org/industrial-robots/statistics/>)

¹¹ International Monetary Fund, "Toil and Technology" (March 2015)



Global Offices

Mirae Asset Global Investments

East Tower 26F, Mirae Asset CENTER1 Bldg,
67, Suha-dong, Jung-gu,
Seoul, Korea (100-210)
Tel.+82-2-3774-8200

Mirae Asset Global Investments (HK)

Level 15, Three Pacific Place, 1 Queen's
Road East, Hong Kong, HK
Tel.+852-2295-1500

Mirae Asset Global Investments (UK)

4-6 Royal Exchange Buildings,
London, EC3V 3NL, United Kingdom
Tel. +44-20-7715-9900

Mirae Asset Global Investments (USA)

1350 Avenue of the Americas,
33rd Floor, New York, NY, 10019, USA
Tel. +1-212-205-8300

Mirae Asset Global Investments (Taiwan)

6F, NO. 42, Sec.2 Zhongshan N. Rd.,
Taipei City 10445, Taiwan (R.O.C)
Tel. +886-2-7725-7555

Mirae Asset Global Investments (India)

Unit No. 606, 6th Floor, Windsor Building
Off. C.S.T Road, Vidyanageri Marg.
Kalina, Sanatacruz (East), Mumbai
400 098, India
Tel. +91-22-6780-0300

Mirae Asset Global Investments (Brazil)

Rua Olimpíadas, 194/200,
12 Andar, CJ 121, Vila Olímpia
São Paulo, CEP 04551-000, Brazil
Tel: +55-11-2608-8500

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