GLOBAL MEGATRENDS: AUTOMATION IN EMERGING MARKETS
Executive Summary

Automation is not new. Robots have existed for several decades. However, new technologies do not always have an immediate impact. The impact of computers, for instance, was not fully obvious until Microsoft’s Windows operating system and the Internet introduced new ways for people to work and interact. It is becoming more and more likely that we are now at a tipping point where a number of compelling drivers will accelerate the greater use of automation.

We therefore believe that automation is a multi-year trend and there are a number of Emerging Market companies that qualify as attractive investment opportunities within this theme. These companies are mainly in the Information Technology (IT) and Industrial sectors, where it can otherwise be difficult to find companies that have long-term sustainable advantages. The industry dynamics are also attractive, as is illustrated in the industry analysis in the appendix to the report.

The diagram below summarizes the key reasons supporting the positive view on the automation theme.

<table>
<thead>
<tr>
<th></th>
<th>Costs Associated With Automation Are Declining</th>
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<tbody>
<tr>
<td>1</td>
<td>• Costs of both robots and computer numerical controllers (CNC) machines have declined and this has led to a shorter payback time for this type of manufacturing equipment</td>
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<td>• Both automation hardware components such as sensors and processors and automation software have become cheaper</td>
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<td>• At the same time, labor costs in Asia have been increasing by 10-15% in the past decade, leading to a convergence of labor and automation costs</td>
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<td>• The labor cost increase has been especially severe in China where a shortage of labor is causing further difficulties for manufacturers</td>
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<td>• Range of returns of small cap has been much wider than the range of returns of large cap, providing more opportunities</td>
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<th>What Can Be Achieved With Automation Is Increasing</th>
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<tr>
<td>2</td>
<td>• Automation equipment is becoming more sophisticated and can perform more complex actions than in the past</td>
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<td>• The actions of equipment can increasingly be changed by reprogramming software instead of the actual machines</td>
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<td>• Because of the increased complexity of automation machines, the demand for them is diversifying into industries other than the automotive sector</td>
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<td>• Health care and food &amp; beverage are examples of industries that are increasing automation adoption rapidly</td>
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<th>Automation Penetration Is Low</th>
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<td>3</td>
<td>• Automation penetration in non-automotive industries globally is much lower than the penetration in automotive industries</td>
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<td>• Even in automotive industries there is a lot of potential for growth in Emerging Markets</td>
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<td>• China stands out as having very low penetration and has the highest automotive/non-automotive multiplier</td>
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<td>• Small and medium private enterprises are expected to have the strongest growth potential in China given the rise of these types of companies in the economy</td>
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<th>New Technologies Make Automation A Necessity</th>
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<tr>
<td>4</td>
<td>• The replacement cycles of electronics products are getting shorter and shorter which necessitates automation equipment that can ensure accuracy, consistency and faster time-to-market</td>
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<td></td>
<td>• Mass customization is an important trend where products increasingly must cater to individual needs of customers, which will lead to an increasing need for versatile and programmable automated machines</td>
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<td>• Automation has been named as an important development area in China to enable the next-generation of IT and high-end equipment manufacturing</td>
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<th>A Self-Propelling Transformation</th>
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<td>5</td>
<td>• New technologies often take time to have an impact, but the inflection point has now been reached for automation</td>
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<td></td>
<td>• This will lead to growth in automation technology as seen with other technologies, others will need to follow to stay competitive leading to a self-propelling transformation</td>
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<td></td>
<td>• The outlook on automation is so promising that we could be entering an automation revolution</td>
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Introduction

Automation is defined as the use of various control systems for operating equipment with minimal or reduced human intervention.

We are seeing signs of automation becoming more prevalent around us every day. Many metropolitan cities now have driverless metros and trains, ticket booths and cashiers are replaced with self-checkout machines, and bank branches are being closed down as customers increase their use of ATMs and online banking.

However, it is in factories and production processes that the impact of automation will be most significant over the next decade, as part of a revolution in manufacturing. Automation aids in business flexibility and product quality, which can lead to competitive advantages. Companies that incorporate automation in their manufacturing process should see the labor intensity of their operations fall at the expense of capital intensity: lower asset turns versus higher profit margins. Automation should also reduce working capital as production lead times fall, thanks to scheduling flexibility. If inventories have been built, or demand is weakening, it would be easier to run the machines for fewer hours or even shut them temporarily, at the expense of lower capacity utilization, rather than reducing the actual number of employees.

This report is divided into five sections, each of which identifies a reason for why automation is likely to show strong growth going forward. In addition to these sections, there is an appendix at the back of the report which shows an overview of the automation industry, describes the characteristics of the different types of automation markets, and provides an industry analysis.

REASONS FOR AUTOMATION

Costs Associated With Automation Are Declining

The costs of automation are declining. At the same time, labor costs in Asia have been and are continuing to increase. Data supports that there is a convergence of unit costs of robots compared to labor. The same is the case for unit costs of CNC controllers (Computer Numerical Controllers) compared to costs of manual machining.

Convergence of robot costs and labor costs: Until recently, high costs of industrial robots restricted their use to few high-wage industries like the auto industry. However, in recent years, the average costs of robots have fallen, and in a number of key industries in Asia, the cost of robots and the unit costs of low-wage labor are converging. The average cost of industrial robots shipped in 2010 was 29% lower than in 1999. Combining this with rising wage pressures around Asia, robots are now becoming a viable alternative to labor.

As an example, for the world’s largest private sector employer, Foxconn, the average salary for an employee over two years was almost equal to the average cost of an industrial robot in 2010, as shown in Exhibit 1. This chart is based on the most recently available data from 2010, and given that the average wage increase in China has been 15% over the past decade, it is likely that robot costs have now fallen below labor costs on this measure.

Another way of looking at the convergence between robot costs and wages is that robots are having shorter payback periods. The payback period is an important consideration when smaller- and medium-sized enterprises make investment decisions in Asia.

EXHIBIT 1

Convergence of Robot Costs and Wages

Source: GaveKal, as of 8.26.13
Payback period of automated machine tools are decreasing: Computer Numerical Controllers (CNC) is another example of factory automation equipment. Just as robots have become an attractive alternative to manual labor, automated machine controllers are also increasingly showing shorter payback periods. When comparing the total cost of ownership of a CNC machine tool to the total cost of ownership of manually operated machines, the automated CNC solution does require higher initial costs and will be more expensive in the short run, but it also has much lower marginal costs. As labor becomes more expensive, the payback period thus decreases.

As shown in Exhibit 2, data from China shows that CNC machine tools will be cheaper than manual machines after three years. This is interesting considering that the same payback time would have been five to six years in 2009.

Sensors and software are becoming cheaper: Other important drivers for the decreasing prices of robots have been the increasing amount of computing power and sensor technology that can be bought for a given price. New, better and cheaper sensors that are able to sense movements of persons are increasingly being adopted with robot-makers. These sensors are easy to use and they are able to provide a fairly reliable sense of depth that helps robots map and navigate their surroundings.

As well as having access to better sensors and processors, software is also becoming more accessible for automation companies. The new Robot Operating System (ROS) is a uniform way of passing messages between the various software routines to run a robot. This ROS is open-source, free to use and easily customized. Using the new sensors combined with the ROS has now made it relatively easy to build a capable robot.

Robotics used to be hard to do because to make even a mediocre robot, one had to be good at an array of different things like artificial intelligence, engineering joints and wheels, electronics, etc. Now, a small team with a fresh insight in a single area of the automation chain can use the ROS and reasonably cheap hardware to put together a robotic system on which to try out ideas without being experts in the other fields involved.

High wage inflation in Asia: It is not only the decrease in automation equipment that has shortened the payback period, but also rising labor costs which are becoming a major issue and driver for Asian manufacturers to increase automation. Wage inflation stimulates demand for automation since automation reduces the weight of labor costs as a percentage of total costs and thus reduces the negative impact of rising wages. Automation also allows manufacturers to increase productivity without increasing the number of employees, which therefore effectively increases profits per employee.

Exhibit 3 shows the growth in monthly wages across Asia. It is especially the coastal areas in China that have experienced rapid wage growth. While Chinese wages were on par with or lower than Southeast Asian wages in 2000, they have risen by 2.3-3.2x in major cities over the past 10 years. For instance, in major cities like Shanghai and Beijing, wages have grown from about 200 USD per month in 2000 to around 450 USD per month in 2013.
As wages increase, China can no longer rely on its position as a low-cost producer, so improving product quality through automation provides a solution. Chinese companies are focusing more and more on closing the product-quality gap with companies in Japan, North America and Europe as they are seeking to avoid price competition, leaving manufacturers with thin margins. Chinese firms are also hoping to establish themselves better in overseas markets where restrictions on product security, from cars to toys, are tightening.

Aside from automating plants, choices for manufacturers operating in high cost areas, like coastal areas in China, who wish to lower labor costs are to relocate plants to mainland areas where manpower is more readily available, or to relocate to lower cost territories like Southeast Asia. However, by moving into the mainland, companies lose the convenience of easy access to material imports and product exports as the infrastructure is worse. With relocation to lower-cost countries, manufacturers risk having to operate in less stable political environments with possible labor strikes, as seen previously in Cambodia and Vietnam for example. Therefore, with automation costs coming down and wages continuing to rise, the most attractive option for manufacturers is to invest in automation equipment.

**Labor shortage a major issue in China**: Increasing labor costs continue to be a major driver for increasing automation, and these increases are expected to continue due to a regular labor shortage in China, which is becoming a big issue for manufacturers. The pool of new entrants to the labor market in China peaked 4-5 years ago and will decline rapidly due to the negative impacts of the one-child policy.

As shown in Exhibit 4, new entrants into the labor market started declining in 2008 for women and 2009 for men. Furthermore, this decline is estimated to continue for the next decade. As the entry-level labor force in China, as measured principally by 15-19 year olds and secondarily by 20-24 year olds, falls sharply, it raises the bargaining power of workers and will likely spur further wage rises.

Another factor that makes it difficult for manufacturing companies to attract sufficient labor is that the fast-growing service sector is reducing the pool of labor for the manufacturing industry. While average wages in the manufacturing sector at RMB 3,000-3,500 per month is higher than the 2,000-2,500 in the service sector, the working conditions in the service industry tend to be much better than in manufacturing, which makes people increasingly seek these alternative opportunities.

With population growth decelerating and China’s labor force becoming increasingly educated, we expect to see a tighter labor market for manufacturers and continued upward pressure on wages across the board, making automation more attractive.
What Can Be Achieved With Automation Is Increasing

Most industrial automation in the last century was fixed automation focused on robots that could only perform a single movement, like a stamping press machine stamping only one type of metal parts together. Nowadays, robots are able to perform more complex actions and the process can be changed by reprogramming software instead of the actual machine. The robots that are now being produced are able to offer more intelligent solutions for a wider range of industries and applications.

Given that robots are also becoming more affordable, they should also be able to move into new fields which have previously only shown a passing interest in this technology.

As a consequence of this, the demand for robots is diversifying into different industries. Historically, the automotive industry has been leading other industries in terms of automation and it still accounts for the majority of demand for industrial robots. For example, car companies accounted for the lion’s share of industrial robots; in 2012 they accounted for 52% of robot installations in the U.S.

Nevertheless, robots are becoming increasingly common in non-automotive industries globally as well.

While automotives have grown at a compounded annual growth rate (CAGR) of 13.8%, there has been even higher growth for food & beverage, electronics, and other industries demanding robots, with 17%, 17.9% and 35.6% respectively. This shows that the demand for automation equipment and solutions is diversifying.

Going forward, it is also expected that the non-automotive applications of robots will represent the best growth opportunities. Specifically, the food & beverage and medical industries are untapped markets and expected to be the most promising areas in terms of growth potential, according to industry experts.

Data from the International Federation of Robotics (IFR) supports this view as it shows that robot sales in the food & beverage industry, as an example, are growing exponentially.

The food & beverage industry has a lot of opportunity for increasing robot penetration. Robots are currently mainly being used here in downstream packaging, palletizing and logistics and not as much in processes upstream of packaging. There is great potential to use robots in the future for handling and processing tasks, such as cutting, positioning, and inspection. It is already being done but much less than it could be.

The health care industry is another example of an industry with potential. Companies in the sector are continuously working to improve the quality and increase the quantity of products. The worldwide R&D expenditures are very high: about 10% of the total turnover. The demographic shift will result in an ageing society and the global demand for pharmaceutical products is on the rise. Similar trends can also be observed in the medical devices industry. In both industries, robot installations will gain momentum in the coming years.
The growing adoption is driven by the increasing functionality of automation equipment. And as the functionality continues to grow, it will continue to drive further adoption of robots and related equipment as more and more tasks can be completed by automation.

**Automation Penetration Is Low**

As explained in the previous section, the automotive industry is one of the biggest end-markets for automation equipment. In contrast, the non-automotive industries are very underpenetrated by comparison. Since the functionality of equipment is increasing, it is expected that the non-automotive industries will start to catch up with automotive industries in terms of automation penetration going forward.

It is not just among industries but also among countries that we see differences in penetration. Looking globally, it is clear that developed markets, and especially Japan, have much higher penetration than China. However, even in mature markets there is still room for penetration to grow further.

The potential for more robot installations is tremendous in many of these countries, especially in non-automotive industries, but also within automotive industries in Emerging Markets. This is mostly due to the necessary modernization and retooling that is needed in these markets. These statistics are encouraging for automation companies as they suggest that there is a lot of room for further growth in adoption. It is likely that the low penetration will drive sustainable growth in the coming several years, providing good fundamental support to automation makers.

China stands out as the biggest opportunity. Analyzing the number of industrial robots per employee shows that China has only 11 robots in non-automotive industries per 10,000 employees. And for automotive industries this number is 213. This compares to Japan with 219 and 1,562 respectively.

The automotive/non-automotive industrial multiplier in China is much higher than in other countries, which suggests that there should be a lot of growth potential in other industries, such as food and beverages as previously discussed. Although China could still see high growth rates driven by rising automotive penetration, other industries could take an even larger share of the growth pie.

**Demand from SMEs:** It is expected that the majority of the future growth in China automation will be coming from the private sector and small-to-medium enterprises (SMEs). Private companies in China are showing the strongest growth and growth prospects according to the automation system integrators that operate in the country. These system integrators derive on average 60% of their current business from foreign joint ventures (JVs), 35% from private Chinese enterprises, and 5% from state owned enterprises (SOEs). However, they are most optimistic about the potential from the SMEs.

These observations are consistent with the growth of small companies in China. This rise of SMEs is an important development for the country as the private sector now employs 80% of the urban workforce, creates 90% of new jobs and represents a rising share of industrial profits.
After the reforms following the Third Plenum in China in November 2013, the most significant outcome was that the government is willing to support the private sector, which will occupy a more important role in the economy going forward.

As such, the private sector will incrementally become a more important driver both in the growth of the economy and in the demand for automation equipment.

For SME’s, automation can be a way to obtain orders or preserve production. Automation can help to increase efficiency with better quality production and less waste. This can support the smaller private companies in avoiding relocation to low cost countries or mainland areas in China. As an example, a typical SME application is medical devices. Usually, the same product is manufactured for years, so investing in automation makes sense for consistent quality and cost savings.

**New Technologies Make Automation A Necessity**

**Replacement cycles getting shorter:** A product’s replacement cycle describes how often each product in the installed base gets replaced on average. The new generation of electronic products like smartphones and tablets are displaying shorter and shorter replacement cycles. This requires quick adaptability and better accuracy and consistency on the production line – increasingly in a way that is beyond the skills of human workers.

Exhibit 9 shows the development in replacement cycles over time. It is clear from this chart that new technological products have shorter life-cycles. Whereas it had been the norm to only replace desktop computers every 6 years on average, this fell to every 4-5 years for notebook computers.

Feature phones have typically had a replacement cycle over 3 years, but this has been converging towards the shorter replacement cycle displayed by smartphones. For smartphones, the replacement has been quite stable at about 2.5 years since 2002. Based on these four types of products, the new growth products have all had shorter life-cycles.

Over time, it is expected that the technology innovation will lead to the introduction of new products and form factors that will continue to shorten product life-cycles.

This development is important in an automation context. Looking ahead, there will be a growing need for shorter lead time-to-market. Robots are geared to the technological advances as they can be retooled quickly to move from one product specification to another with a greater degree of flexibility and lower capital investment than before.

**Need for improved accuracy, consistency and customization:** While life-cycles for electronics products have become shorter, the foundation for building these end-products, namely semiconductor components, has seen an industry evolution as well. Semiconductors are used in virtually every technology product such as PCs, smartphones, tablets, televisions as well as telecom equipment and infrastructure and automobiles. The semiconductor industry is being driven by the need to build smaller, faster, and lower cost devices to drive higher volumes and revenues of new electronics products.
In 1965, Gordon Moore observed that the number of transistors in an integrated circuit had doubled and cut costs in half approximately every 18 months. The primary enabler of this observation has been the miniaturization of the semiconductor manufacturing process. Forty years ago, the leading edge manufacturing plants built transistors on 10μ (μ = micro) technology while current leading edge transistors are built on 20nm (nm = nanometer) and soon 14nm technology. On average, transistor dimensions have been shrinking by 30% with every process node every two years.

The device physics and manufacturing challenges at each successive process node have been getting increasingly difficult – and we are now getting to a point where several companies have highlighted that the cost per transistor on current nodes is higher than on previous nodes. Current trends indicate that the cost challenges could be even greater on the next generation nodes. As a result, several vendors are working on process and packaging technologies to drive higher integration while lowering costs. And as the nodes increasingly get smaller, the need for assembly and inspection has increased given the need to ensure product functionality and quality.

These are important developments for automation because robots can potentially be increasingly utilized in many of these steps in the production chain. Robots have clear advantages over humans in applications like this since they can ensure accuracy and consistency for complex processes as output quality is more consistent than it is with manual labor. Product uniformity is one of the most important criteria for maintaining high quality levels and is best achieved with automation. With automation equipment becoming more affordable and the functionality increasing, it is likely that it will progressively be used more extensively in advanced manufacturing. Miniaturization and new sensing capabilities will mean that robotics will be used in an increasing number of industries, including those with small and varying lot sizes, materials and product geometries.

**Mass customization**: A key technological trend these years is the evolution of mass customization. Mass customization describes business models that can cater to individual needs of end users at high volumes, at prices closely comparable to mass produced items and on demand. A number of remarkable technologies in the automation industry are converging and enabling the growth of these business models. These business models will be characterized by automated machines that are versatile and programmable and can make different things according to different sets of software instructions. In particular, clever software has the potential to become the dominant driver within the automation industry over the next decade enabling the shift to more flexible automation, the kind needed to support a mass customization environment.

Everything in the factories of the future will be run by smarter software. Digitization in manufacturing will have a disruptive effect every bit as big as in other industries that have gone digital, such as with office equipment, telecoms, photography, music, publishing and films. Digitization will allow things to be made economically in much smaller numbers, more flexibly and with a much lower input of labor, thanks to new materials, completely new processes such as 3D printing, easy-to-use robots and new collaborative manufacturing services available online.
A number of remarkable technologies are converging: clever software, programmable robots, new processes and a whole range of web-based services. The factory of the past was based on cranking out a high number of identical products but the cost of producing much smaller batches of a wider variety, with each product tailored precisely to each customer’s whims, is falling, and the factory of the future will focus on mass customisation.

**Political commitment to support automation in China:** The economic development in China is driven by the five-year plans which are approved by the Communist Party. The five-year plans are a series of social and economic development initiatives mapping strategies for economic development, setting growth targets and launching reforms. The current five-year plan, the twelfth five-year plan, was approved by the Communist Party in March 2011. In this plan, the Chinese government stated that it would promote the usage of industrial automation. Industrial automation fulfils two categories of the “Seven Strategic Industries” supported by the State Council: next-generation information technology, and high-end equipment manufacturing.

More specifically, robots and CNC machine tools were identified as important areas for development. To boost this development, the Chinese government has stepped up its investment in training and developing professionals for the robotics industry. The five-year plan highlights the importance of the automation industry and recognises that robots can help the manufacturing sector improve quality and efficiency. Furthermore, CNC machine tools are described as aiding in environmental improvement by reducing waste and increasing production efficiency.

China has set up five geographical areas for Chinese companies to develop and improve the quality of their robot products and capabilities. The five areas are Shanghai, Beijing, Guangzhou, Chengdu and Liaoning. As an example of the investments, a robot industrial complex is being constructed in the Liaoning province that is expected to generate revenues of $8 billion for robots and other automation equipment by 2017. Several other places such as Tianjin and the north-eastern province of Heilongjiang are also actively cooperating with research institutions to build their own local robotics industry demonstration bases.

The five-year plan includes a goal of 30% to be produced with home grown technologies, which is an advantage for competitive domestic automation companies. The plan mentions an expectation of a compound growth rate of 25% over the five years in automation equipment. While this sounds like an ambitious target, it is not unrealistic when looking at the development in robot shipments in China over recent years.

Globally, robot shipments have seen a 7% compounded annual growth rate (CAGR) from 2008-2012. This compares to a global GDP growth CAGR of 2%. However, in China there has been a CAGR of 49% over the decade from 2002-2012. The growth target of 25% therefore seems achievable and shows why the automation market in China has very strong potential going forward.
Conclusion

A Self-Propelling Transformation

Robots have become more advanced and the functionality has increased as described previously in this report. The exponential growth in the power of silicon chips, digital sensors and high-bandwidth communications improves robots, and R&D is becoming cheaper as sensors and software become more readily available. Robots are now capable of offering much more intelligent solutions for a wider range of industries and applications and can be easily re-programmed to respond to new input and situations.

We are also seeing big companies like Amazon investing heavily in automating warehouses, to the point of eventually making deliveries by drone. Conversely, Google, who has also made sizeable automation investments, has a robot program which promises the possibility of something spectacular, but no one outside the company knows what this is as of yet. However, perhaps the clearest sign of having reached this inflection point is how we are seeing an increasing presence of automation around us.

It is likely that we will see companies increasing their degree of automation and that it will in take off in a similar way as other new technologies have done in the past, making it a self-propelling spiral. As an increasing number of companies start to adapt new technologies, other companies will be forced to follow suit in order to be competitive with low prices and high quality products.

Today, given the exponential growth in technological innovations in cameras, speech recognition, vision sensors and wireless networking, combined with the dramatic drop in the price of robots, we are possibly reaching the point where the outlook on automation is so promising that we may now be entering into an automation revolution. Global manufacturing and industrial production lines have started a transformation and as price tags on robots drop, we will likely see the know-how gathered from specialized robots in automotive and robot industries transfer down to personal robotic devices. As such, we will start to see a more widespread use of robots for even the most mundane tasks, such as vacuum cleaning, ironing, lawn-mowing, and then perhaps even further down the road, more personal interactions like educational help or services to the elderly.

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Appendix

In order to understand automation markets better it is helpful to illustrate the major product categories with the simplified pyramid chart to the right.

At the top is the Enterprise Resource Planning (ERP) system, which functions as a decision-making support system by integrating all necessary internal and external enterprise information. The second layer is Manufacturing Execution System (MES), which aims to optimize the workflow by linking ERP information and plant-floor machines (third layer to sixth layer). Among information and plant-floor machines are the top layer machines, such as Programmable Logic Controllers (PLC) or Distributed Control Systems (DCS), which control the machines that perform the actual tasks. The next layer consists of process control equipment, such as CNC machines or Motion Control devices (motor drives, etc.) Following this is the set of sensors, detectors and switches, which sense various parameters in the manufacturing system (pressure, temperature, time, weight etc.) and relay it back to the PLC and MES layers for further action. The lowest or the sixth layer is the actual machinery – such as robots and linear guides, which perform the physical action such as sorting of material handling on the factory floor.

Broadly, investable automation companies in Emerging Markets fall into two categories: factory (discrete) automation and process automation. Factory automation refers to automating steps in a manufacturing process, such as assembly, packing, monitoring, inspecting, etc. The manufacturing processes involve the production or processing of a countable number of individual pieces or products. Automation of discrete production requires fast moving, repetitive control functions. In the pyramid, this would represent the 6th layer.

In contrast, process automation is related to automating continuous, uninterrupted, slow moving production control systems, typically the flow, control and mixing of liquids, gases and electricity. Products here are focused on limiting downtime and dangerous interruptions in cooking/flow type processes. Normally, these continuous processes are used to produce very large quantities of product per year. Examples of applications include boilers, digesters, blast furnaces, and waste water treatment plants. This type of automation corresponds to the 3rd and 4th layers in Exhibit 13.

In spite of the differences between these two types of automation, many industrial processes require functionality that involves a combination of these two. Both streams of technology have evolved to accommodate some functionality of the other, resulting in a slight blurring of the distinction between process and discrete automation.

As mentioned, we find Emerging Market companies that fall into both these types of automation markets, but a few companies are increasingly trying to expand their reach and become total solution providers as the industrial usage of both functionalities increase and the distinction diminishes.
EXHIBIT 15
Segmentation of Factory and Process Automation

Factory Automation
- CNC (8%)
- PLC (8%)
- Sensors (11%)
- Pneumatics (15%)
- Motion (19%)

Process Automation
- Service (3%)
- Marine (3%)
- Oil & Gas (28%)
- Metals & Mining (6%)
- Power & Utilities (4%)
- Other PA (17%)

Source: CLSA, as of 7.8.13

EXHIBIT 16
Cyclicality of Automation Markets

<table>
<thead>
<tr>
<th>Year</th>
<th>Factory Automation</th>
<th>Process Automation</th>
<th>Global GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>-5%</td>
<td>-15%</td>
<td>0%</td>
</tr>
<tr>
<td>2009</td>
<td>-5%</td>
<td>-10%</td>
<td>0%</td>
</tr>
<tr>
<td>2010</td>
<td>0%</td>
<td>-5%</td>
<td>0%</td>
</tr>
<tr>
<td>2011</td>
<td>10%</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>2012</td>
<td>15%</td>
<td>10%</td>
<td>15%</td>
</tr>
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</table>

Source: CLSA, as of 7.8.13

EXHIBIT 17
Porter’s Five Forces Applied to Automation

<table>
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<tr>
<th>Force</th>
<th>Description</th>
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<tbody>
<tr>
<td>Threat from New Entrants</td>
<td>LOW</td>
</tr>
<tr>
<td>Rivalry Among Existing Players</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>Threat from Substitutes</td>
<td>LOW</td>
</tr>
<tr>
<td>Bargaining Power of Buyers</td>
<td>LOW</td>
</tr>
<tr>
<td>Bargaining Power of Suppliers</td>
<td>LOW</td>
</tr>
</tbody>
</table>

Market size: The total value of the factory automation market is estimated to be USD 100bn while the process automation market is estimated at USD 80bn. The markets can be broken down into the following segmentations as shown in Exhibit 15.

The breakdown of the markets shows how it is the end markets that characterize the two types of automation. The demand for process automation is dominated by companies in the energy sector while the segments in factory automation are more balanced due to the several different stages in a manufacturing process which require different solutions. Currently, factory automation is mostly used in the automotive, machinery, packaging and semiconductor industries.

Of the different segments shown in the first graph, the one that would most likely associate with automation is industrial robots. Robots are the most visual part of an automation system in a factory as they are output devices. Most of the data that is available on automation is also related to robots. Thus, a lot of the data and charts in this report are focused on the robot segment. However, robots are also put together using a number of different devices and are dependent on sensors, vision systems, controllers, linear motion guides, etc.

Growth of automation markets: Like other subsectors within IT and industrials, automation is more cyclical than GDP-growth overall as shown in Exhibit 16. Within the two types of automation, factory automation tends to grow faster than process automation due to increasing penetration and expanding applications. Factory automation is also more cyclical than process automation with shorter cycles. On the other hand, the key end markets for process automation, such as the energy sector, tend to expand at a slower pace and typically have longer cycles as a consequence of their end markets, with large project sizes and long lead times.

Industry analysis: To examine the attractiveness of the automation industry, it can be analysed through a Porter’s Five Forces industry analysis framework as shown in Exhibit 17.

The analysis reveals that the industry dynamics are attractive. The entry barriers are high and the bargaining power of a quality automation company is generally strong since automation only represents about 2-6% of the costs of a typical plant, so plant managers do not need to be very cost conscious. However, the type of solution chosen impacts up to 30% of the output performance and return on asset over time. Furthermore, plant managers are generally risk-averse and therefore unlikely to support a solution that is cheaper but which they do not know and trust given the limited upside and material downside from such a decision.

The biggest risk for the listed Emerging Market companies in the sector is potential competition from low-cost domestic producers or price competition from the established global players. However, most of the high-quality companies are in the sweet spot of selling higher quality products than the low-end domestic producers who compete in a very fragmented market, while still not posing a threat to the very high-end products that the established international companies produce. There is therefore still a lot of potential for future growth and market share gains for these companies.