Industry 4.0 & Made in China 2025

How will industry jobs evolve and what effects will these strategies have on the workforce?

Ritgerð til BA-prófs í Viðskiptatengdri kínversku

Andrea Líf Ægisdóttir
Kt.: 160488-2049

Leiðbeinandi: Þóra Christiansen
Október 2016
Industry 4.0 & Made in China 2025: How will industry jobs evolve and what effects will these strategies have on the workforce?

Ritgerð þessi er 6 eininga lokaverkefni til BS-prófs við Deild erlendra tungumála, Hugvísindasviði, Háskóla Íslands.

© 2016, Andrea Lif Ægisdóttir
Ritgerðina má ekki afrita nema með leyfi höfundar.

Prentun: Nón ehf.
Reykjavík, 2016
This thesis is a 6 ECTS credit thesis towards a bachelor’s degree in Chinese Language and Business administration from the University of Iceland. The purpose of this thesis is to introduce a relatively new concept called Industry 4.0. The name refers to the fourth industrial revolution which is currently underway. As well as introducing Industry 4.0, this thesis will also look into the Chinese plans to implement Industry 4.0 and what can be expected in coming years.

While working on this thesis the writer utilized information and experience that she gained during an internship with the company Tajco Manufacturing in Ningbo, China. The idea of the topic was suggested by her superior, Ragnar Oddsson, Managing director of Manufacturing excellence at Tajco. During the internship the writer worked closely with Ragnar Oddsson and Cengiz Gencer, Project manager of Manufacturing excellence on two different projects that both involved Lean management.

The writer would first and foremost like to thank her parents from the bottom of his heart for their unwavering support and encouragement while working on this thesis. In addition, she would like to thank Ragnar Oddsson for the introduction to the topic and Cengiz Gencer for his support and for all the knowledge he shared during the internship. Last but not least, the writer would like to thank Þóra H. Christiansen for her guidance and swift replies when they were needed.
ABSTRACT

The objective of this thesis it to better understand the concept of Industry 4.0 and how it will change the way we work, live and communicate in the coming future. The German powerhouse of manufacturing is often used as an example.

To begin with, this thesis looks back to the first industrial revolution in the 18th century, how it started and the significant changes that followed. From there it takes a look into the Industrial revolutions that followed in similar context. Industry 4.0 is explained as well as some of its main components.

The thesis closes with a look at Chinas strategy to implement Industry 4.0 which they have named “Made in China 2025”, as well as with a close look at an international company with a factory in China and their future plans with the strategy.

Many questions have been asked in regards to Industry 4.0. What effects will this upcoming industrial revolution have on the world as we know it? Will it change the way we live? Will it create or destroy Jobs? Will it change demand for certain types of skills? These topics will be lightly discussed in this thesis but the main focus will be to answer the following question: “How will industry jobs evolve and what effect will Industry 4.0 have on the workforce?”

Many people will lose their jobs, the ones that stay in the workforce will have to be retrained to keep up with new technology and educated people with knowledge and experience in working with robots will be in high demand.
# Table of Contents

Prologue .................................................................................................................. 4

ABSTRACT .............................................................................................................. 5

1 Introduction ......................................................................................................... 8

2 The industrial revolutions .................................................................................. 9

3 Industry 4.0 – the future of manufacturing .................................................. 11

3.1 Explanation of main concepts of Industry 4.0 ........................................... 11

3.1.1 Cyber-physical systems (CPS) ................................................................. 11

3.1.2 Internet of Things (IoT) ......................................................................... 12

3.1.3 Cloud computing .................................................................................... 12

3.1.4 Real-time sense-and-response technology ............................................. 13

3.1.5 Big data analytics .................................................................................. 13

3.2 The Expectations of Industry 4.0 ................................................................. 13

3.3 Industry 4.0 in numbers ............................................................................... 14

3.4 Changes in Workforce .................................................................................. 15

3.5 Preparation .................................................................................................... 17

4 China and industry 4.0 ..................................................................................... 19

4.1 Made in China 2025 .................................................................................... 19

4.2 Key contents .................................................................................................. 20

4.3 China’s future plans with Made in China 2025 ........................................... 21

5 Tajco Manufacturing ......................................................................................... 23

6 Conclusion .......................................................................................................... 25

Sources ..................................................................................................................... 26

Appendix 1 ............................................................................................................. 29

Appendix 2 ............................................................................................................. 31
Table of Figures

Figure 1: China GDP growth rate 2012-2016 (Tradingeconomic, N.d)............................... 19
1 Introduction

Industry 4.0 was first discussed during the 2011 Hannover Fair in Germany. The following year the Industry 4.0 workgroup, a group of scientists and industry executives who worked on the strategy, made a presentation to the German government on how best to adopt Industry 4.0. Later, In the Hannover Fair of 2013 the final report was presented, two years after the original discussion had taken place (Anderl, I.R. o.fl., N.d.). The strategy has been called by many different names, such as Industrial Internet, Smart Factory and Cyber Physical Production Systems (CPPS), but most people choose to simply call it “Industry 4.0”. Although they sound different, the meaning is mostly the same. To connect everything using the Cyber Physical Systems (CPS) (Frison, 2015). The term Industry 4.0 was originally coined by the German government which promotes the computerization of manufacturing. The name refers to the fourth industrial revolution which is already underway (Donovan, 2013).

Through the years there have been three industrial revolutions. These revolutions in technology have forced us to make significant changes to the way things are made, how we work and how we live our lives. Technological breakthroughs are being made in a rate that has never been seen before and is touching every industry all over the world (Schwab, 2016).

In the following chapters the writer will try to answer the question of how the manufacturing industry’s jobs will evolve with in the coming years and what effect these changes might have on the workforce. To begin with this thesis will look into the three previous industrial revolutions. Industry 4.0 will be explained as well as some of its main components. Chinas strategy to implement Industry 4.0 which they have named “Made in China 2025” will be examined and finally, a close look will be taken at an international company with a factory in China, their plans and participation in “Made in China 2025”.
2 The industrial revolutions

As mentioned before, Industry 4.0 refers to the fourth and upcoming industrial revolution. The first industrial revolution began in the late 18th century in Great Britain thanks to James Watt’s improvements to the steam engine. These changes lead to a great upsurge in textile manufacturing and as a result labor went from being solely manual to being machine-based. This is when mechanized factories using steam power became a reality (Donovan, 2013). Until around 1775, Ironworks in the United Kingdom had relied heavily on charcoal, yet at that time the availability of charcoal was limited and its prices were on the rise. The need for higher smelting temperatures meant a need for change. They required larger volume blast furnaces which in turn, required more powerful air pumps than most existing waterpower sources could provide. This change came when, in 1776, John Wilkinson who at the time worked for Bersham Ironworks in the United Kingdom, first applied a steam engine to this purpose (Ayres, 1989).

After the steam machine had been implemented into factories, labor went from being solely manual to somewhat machine based. Textile factories implemented cotton spinning machines. The following picture shows how these machines, named the power loom, increased the output of a manual worker by a factor of around 40 (Ayres, 1989). This caused a decrease in demand for skilled hand weavers which caused lower wages and unemployment for many workers. Because weaving became so easy companies even started employing young children from the age of 5-6 to save even more money. Many riots broke out and many people died as a result. It wasn’t until 1819 when “the cotton mills and factories act” was introduced that things started to cool down. Many factory acts followed giving workers more rights (Historymesh, N.d.)

The second industrial revolution took place in late 19th century till the beginning of the 20th century and took advantage of electrical power. It was during this time period that Henry Ford, the founder of Ford Motors, introduces the world to the assembly line. As a result, there was a huge increase in production and soon almost every manufacturing industry had assembly lines. This lead to increased efficiency as well as saving companies a lot of money. The age of mass production had begun (Donovan, 2013). One of the biggest changes in manufacturing in the second industrial revolution was the invention of the assembly line by Henry Ford. This invention made the automobile cheap, reliable
and accessible for everyone. The automobile quickly became a household necessity and was no longer a luxury product for the wealthy. With the help of mass production and lean production, Ford was able to lower the price of the infamous Model T from an original 950 USD in the year 1909 to 290 USD in the early 1920’s making it affordable for the worker class. For the first time, cars were not just a luxury for upper class (Ayres, 1989).

The third industrial revolution took place in the late 20th century and was powered by technology. This is where computers were introduced into manufacturing. This is where the automated assembly line became a reality and machines started replacing people on the factory floor increasingly (Donovan, 2013). The third industrial revolution is where computers were first implemented onto the factory floor. With the implementation of the automated assembly line and other such technology, computers increasingly replaced humans in production. In factories today, every manufacturing function that can be automated, has been. However, even though manufacturing jobs have decreased with these technological developments, different types of jobs have been made. (Ayres, 1989).

Industry 4.0 is said to be merely the beginning of the fourth industrial revolution. This revolution will introduce “the internet of things” into manufacturing. This is where the digital world and the physical world will merge. According to the Lean Management Journal, Industry 4.0 will revolutionize the current business models of how we design, manufacture and deliver products and services. This is the first time in history that an industrial revolution is predicted ahead of time (The Lean Management Journal, 2015).
3 Industry 4.0 – the future of manufacturing

The European manufacturing powerhouse, Germany, has set its course to a future of a high-tech industry. The strategy they named industry 4.0. The prospect of Industry 4.0 is to create a so-called “Smart factory”. These smart factories will have Cyber-physical systems, in which sensor-laden “Smart products” monitor and communicate to machines how they should be processed (Donovan, 2013). Simply put, it means the implementation of computers and machines that communicate amongst themselves in real-time, to the factory floor. These machines, or smart devices, work together wirelessly either directly or through the Internet of things, to once again revolutionize production. They will be embedded within the global network of supply and demand through “the cloud”. The result will be an intelligent value-creating supply chain network that autonomously and automatically responds to change in end-demand. In addition, these factories produce their products faster, produce less waste and have the potential to reduce inventory throughout the whole supply chain. Decentralized intelligence will take over from old school centralized factories, as machine to machine communication is the Industry 4.0 vision of the Fourth Industrial Revolution (The Lean Management Journal. 2015). This is the future of manufacturing (Donovan, 2013).

Industry 4.0 uses many different concepts (components), such as the Cyber-Physical Systems (CPS), the Internet of Things (IoT), Cloud Computing, sense-and-response technology, big data analytics and many more (The Lean Management Journal, 2015).

3.1 Explanation of main concepts of Industry 4.0

3.1.1 Cyber-physical systems (CPS)

The idea of so-called cyber-physical systems was first brought up by Dr. James Truchard, President and CEO of National Instruments, in the year 2006. His idea was based in a virtual representation of a manufacturing process in software (Donovan, 2013). The Cyber-physical systems are said to be an evolution of “machine to machine” technologies (Ciprian-Radu, Hancu, Takacs, & Olteanu, 2015). They enable individual devices or “things” to communicate amongst themselves and are monitored and controlled by a computing and communication core (Lee, Rajkumar, Sha, Stankovic, 2010). Simply put, a device gets an input task, the sensors in the device pick up information to carry said task,
however, this information cannot be analyzed by these sensors. The information that has been gathered is therefore sent elsewhere. The information can be sent to a computer or a chip within the device that has the ability to process the information. The processed information is then sent back to other components in the device. Now the system can understand and carry out the task (Boucherville, Personal communication, August 16th 2016).

### 3.1.2 Internet of Things (IoT)

It was a British visionary named Kevin Ashton that first used the words “Internet of Things” in the year 1999. He used this term to describe how devices, connected through the internet, would change our lives. Fast forward to today and his idea has become so mainstream it can be seen in household objects all over the world (Wood, 2015). According to the Business Insider, the Internet of Things is “A network of internet-connected objects able to collect and exchange data”. The internet if things is changing the way people live, how they work and even how governments and businesses interact with the physical world. For example, smart applications can be downloaded into personal smart devices to control air conditioning and lights in homes, cars come preloaded with GPS systems and wristbands that track people’s movements during the day can connect to a computer or smart device and tells the owner how many steps or kilometers he or she walked today. All of these devices, and many, many more are connected by the internet of things (Greenough & Camhi, 2015).

### 3.1.3 Cloud computing

The origin of the term is unclear. Cloud computing can be described as a number of servers, storage, networking hardware and software that all are connected to the internet. In its definition, the National Institution of Standards and Technology states that a “cloud” must possess all five of the following characteristics. It must provide on-demand self-service, the service must be measurable, it must have elastic scalability, it must provide resource pooling and lastly, it must have broad network access (Newman, N.d.). To once again simplify, Cloud computing is a hosting application through the internet. Instead of saving a document on your computer hard drive and worrying that your computer might crash and you might lose a document you have been working. It can be
saved on the cloud and accessed from any device, at anytime, anywhere (Boucherville, Personal communication, August 16th 2016).

3.1.4 Real-time sense-and-response technology
Sense-and-response supply chains monitor activities in real time and allow for root causes of issues to be identified quickly. This helps companies respond to shifts in the market and proactively pursue potential opportunities. This type of technology offers a real-time look into transactional event information. They can sense a potential problem before it happens and respond with flexibility and speed to infrequent or sudden demand (Butner & Buckley, 2004).

3.1.5 Big data analytics
The concept of analytics has been around for many years. Even in the 1950’s companies were using basic analytics to uncover hidden patterns, correlations, trends and other insights that could be used in future decision making. “Big data” analytics however examines vast amounts of information, or data, to uncover these patterns in a fast and efficient way. Now companies can identify these insights and make decisions on the spot, which gives them the competitive edge they didn’t have before (SAS. N.d.).

3.2 The Expectations of Industry 4.0
Industry 4.0 is expected to transform the Industrial workforce through the year 2025 with advanced technologies. Previous technological advancements have shown that many jobs will be lost, but with changes in technology there will also be changes in the workforce. Demand for workers that perform repetitive tasks, such as production line work, will decrease as most basic activities will be performed by machines. Though the number of manufacturing jobs may decrease with the implementation of machines into factories, there will be a demand for new sets of skills as new types of jobs emerge. It is expected that these new technologies will increase companies’ competitiveness immensely. This will allow companies to expand their industrial workforce and increase their productivity (Bolle, Lorenz, Lueth, Russmann & Strack, 2015).

Thanks to technology, algorithms based on historical data will identify issues in quality and reduce product failure. Machines will perform basic operations such as assembly and packaging and fully automated transportation will be able to navigate itself within the
factory. These are just a few of the technological changes that are expected out of industry 4.0 (Bolle o.fl. 2015).

Industry 4.0 is expected to open the possibility of gathering and analyzing data across machines. This makes processes to produce high-quality product at a low cost faster, more flexible and more efficient. This will then increase manufacturing productivity, shift economics, foster industrial growth and change the profile of the workforce. Eventually, it will change the competitiveness of companies and even regions (Bolle o.fl. 2015).

3.3 Industry 4.0 in numbers
Industry 4.0 is, as of now, still more of a vision than an actual reality. There is still a certain level of uncertainty regarding what the implementation of Industry 4.0 actually requires, and many manufacturers struggle to figure out where to start. In a recent survey published by the management consultant firm McKinsey & Company researchers discovered that merely 30% of technology suppliers and 16% of manufacturers had already made an overall strategy for Industry 4.0. Furthermore, only 24% had already assigned responsibilities to employees to start implementing the strategy (Breunig, Kelly, Mathis & Wee, 2016).

The before mentioned survey, named “Industry 4.0 Global Expert Survey”, was first made in January 2015 and again in January 2016. In these surveys they engaged a panel of 300 industry experts from German, the United States and Japan. The purpose was to explore the changes in attitude towards Industry 4.0 between years and measure progress made in the strategies implementation (Breunig o.fl., 2016).

In the second survey made in 2016, 67% of German and 74% of Japanese participants said they were as optimistic about the potential of the Industry 4.0 as they had been the year before. At the same time a total of 44% of US based companies said they were more optimistic than before (Breunig o.fl. 2016).

During the survey, researchers found that the main barrier in implementation of Industry 4.0 could be cited to four main reasons. Firstly, the fact that the companies had difficulties in coordinating actions across different departments. Secondly, to concerns regarding cybersecurity and data ownership when working with a third-party provider. Thirdly, to lack of courage when it came to making drastic changes in the workplace. And
lastly, a lack in talent needed when implementing these types of changes (Breunig o.fl., 2016).

In an article McKinsey & Company published in July 2016 named “Where machines could replace humans – and where they can’t (yet)”, the writers wrote that about 45% of activities people are paid to perform today could easily be automated with current technology. Furthermore, they wrote that about 60% of all jobs could see 30% or more of their basic activities automated (Chui, Manyika & Miremadi, 2016).

With implementation of machines and robots into manufacturing it is obvious that many jobs will be lost. In their report from September 2015 “Man and Machine in Industry 4.0” the Boston Consulting Group estimated that Industry 4.0 would generate an additional annual growth of 1% in German companies alone, and that the technological advancements will be up to 50%. If this is true, that will mean a net increase of about 350,000 jobs. The increased use of machines will reduce the number of available jobs in assembly and production by about 610,000 jobs but with all these changes in manufacturing they estimate that about 960,000 new jobs will be created. Employees with good grasp of IT and software development will be in high demand (Bolle o.fl., 2015).

In the years 1997 to 2013 there was an 18% decrease in the manufacturing workforce in Germany due to automation and offshoring, meanwhile, production volume increased. As production becomes more capital intensive, the benefits of traditional low-cost manufacturing locations will shrink, making it appealing for manufacturers to bring previously offshore jobs back home (Bolle o.fl. 2015).

3.4 Changes in Workforce

The extent to which machines will take over human labor is still being debated among experts but they are all in agreement that robotics amongst other technical advancements will come to assist workers in the future (Bolle o.fl., 2015). This chapter will attempt to answer the main question of this thesis. Some changes on the workforce will be discussed, such as where jobs will be lost and where additional jobs will be made.

With the application of Big Data in manufacturing there will be a decrease in demand for workers that specialize in quality control. However, there will be high demand for Industrial Data Scientist. The Industrial Data Scientist must have good grasp of both IT systems and manufacturing processes. He will extract data, conduct analytics and apply
his findings to improve products and productivity. Factories will have robots that will be similar to humans in regards to their hands and size. Cameras and sensors will allow them to interact with their environment. This will reduce the demand for manual labor in production but create a need for a Robot Coordinator. This job will require overseeing of robots and to see to routine as well as emergency maintenance tasks. Another example, Production simulation will increase the demand for industrial engineers and simulation experts, and predictive maintenance will not only increase the demand for workers in systems design, IT and data science, but create a new kinds of jobs such as digitally assisted field-service engineer, though it will reduce the need for service technicians. These are just a few of many examples of the upcoming changes in the workforce. These are just a two samples of what is to come (Bolle o.fl., 2015).

In the report made by the Boston Consultant Group, which has been mentioned before, the writers applied use cases to analyze the quantitative effects on the industrial workforce. They mention 10 use cases that they consider will be the most influential to the industry. These specific use cases were chosen because of their overall impact on the workforce and the extent to which new skills will be required to complete the related tasks (Bolle o.fl., 2015).

These use cases include:

- **Big-Data-Driven quality control**: Using algorithms based on historical data, machines will be able to analyze quality control data in real-time and identify issues in quality. Furthermore, they will be able to identify the cause and find ways to minimize failures in production as well as minimizing waste.

- **Robot-Assisted Production**: Robots with cameras and sensors to interact with their environment. They can be easily trained to take on new and simple tasks, such as assembly and packaging. They will also be used for heavy lifting.

- **Self-Driving logistics vehicles**: Fully automated transportation systems will be able to navigate itself within factories. Therefore, there will be no need for logistics personnel.

- **Production line simulation**: With production line simulation, manufacturers use innovative software to simulate production lines before they are even installed. This simulation lets them apply insights to optimize operations. This will increase the demand for simulation experts and industrial engineers.

- **Smart supply network**: With a smart supply network, manufacturers can use technology to monitor the company’s whole supply network. This enables better supply decisions and will reduce the need for personnel in operation
planning but create the need for supply chain coordinators who will handle deliveries in smaller lot sizes.

- **Predictive maintenance**: With real-time remote monitoring, sensors can sense any abnormalities in equipment as soon as they occur. This way, manufacturers can monitor their equipment 24/7 and will be able to repair machines before they break down. This will increase the need for personnel associated with IT, systems design and data science as well as creating need for digitally assisted field-service engineers.

- **Machines as a service**: Instead of selling a machine, manufacturers set up machines at a workplace and sells its produce. The manufacturer sees to regular maintenance and upgrades to the equipment. As well as promoting growth in production and service, this business model will increase the need for sales personnel.

- **Self-organizing production**: Production lines will be programmed to coordinate themselves automatically and boost the utilization of each asset. Even though this will reduce the personnel in production planning, it will increase the need for experts in data modelling and interpretation.

- **Additive manufacturing of complex parts**: With technologies like selective laser sintering and 3D printing manufacturers will be able to create complex parts in one easy step. This eliminates the need for assembly and inventory of individual parts, again decreasing the need of personnel in assembly. A demand for personnel in 3D modeling and 3D computer-aided design will be created.

- **Augmented work, maintenance, and service**: New technology such as so called “augmented-reality glasses” will allow for remote assistance with simple maintenance tasks, provide packaging instructions specific to each customer and get exact location of the item they are looking for. This type of technology will significantly increase process efficiency for service technicians, at the same time if will require companies to shape new capabilities in R&D, IT and digital assistance systems.

  (Bolle o.fl., 2015)

All of the above mentioned use cases show different scenarios of how technology will become taking over human jobs or helping us perform different tasks that our jobs include. In all of these scenarios, people with good knowledge of IT and computer skills are in high demand.

### 3.5 Preparation

In the implementation process of Industry 4.0, like with Lean manufacturing, there is no standard approach that applies to every company. Each and every company must figure out the best way of implementation for themselves (Breunig o.fl., 2016). There are a number of things that companies must do to prepare for the upcoming changes that
Industry 4.0 will cause in the workforce. The Boston Consultant group identifies 3 main things to focus on in preparation of Industry 4.0. For starters companies must completely retrain their employees to work with machines, and do so regularly to keep up with technical advances. New work and organization models must be adopted as Industry 4.0 will create a new type of communication between man and machine. Therefore, company ways of recruiting will have to change as focus should be set on capability over qualification. Lastly, companies should engage in annual strategic workforce planning to be able to master the variety of challenges ahead (Bolle o.fl., 2015).
4 China and industry 4.0

In recent years, China has shown annual growth rates often double or triple that of developed market peers. The country has delivered the highest economic growth of any global economy for the past 10 years. Their low wages, high investment rates and export driven market has been a big part of this phenomenal growth (Snowden, N.d.). Yet China’s economic growth has been slowing down in recent years and countries such as Vietnam, Cambodia and Indonesia are starting to offer cheaper cost of labor. The Chinese are getting ready for hard days ahead as manufacturers start moving their production elsewhere. As of now, China is still considered “the factory of the world” accounting for about a third of the global total of output value for equipment manufacturing (Lee, 2015).

As competition from international competitor’s increases, demand decreases and economic growth slows down, the Made in China 2025 strategy finally emerged (China daily, 2015). With these big changes in the industry, experts expect China’s GDP to grow by an average of 5.7% between the years 2017 to 2020. This makes China one of the world’s fastest growing economies (Snowden, N.d.).

4.1 Made in China 2025

Made in China 2025 is a strategy made by the Chinese government to comprehensively upgrade the Chinese industry. It has very clear principals, goals, tools and sector focus (Kennedy, S., 2015). The plan will span the whole manufacturing sector, applying advanced ideas from countries such as Germany, Japan, the United States and Great
Britain. This is China’s first ten-year plan that sets ambitious targets and timelines for the countries transformation from a manufacturing giant into a manufacturing powerhouse in the likes of Germany today (Markus & Marro, 2015). This ten-year plan will then be followed by two other ten-year plans which purpose will be to transform China into a leading manufacturing power by the year 2049. This year will mark the 100th anniversary of the founding of the People’s Republic of China. This will also be crucial to helping China maintain a medium to high level of economic growth and allow the country to keep climbing the global value chain (China daily, 2015).

The main idea of the strategy is so called “Intelligent manufacturing”. This means applying tools of information technology to production. (Kennedy, S., 2015). The overall purpose of “Made in China 2025” is to transform China’s manufacturing power and drive economic growth (China daily, 2015).

The inspiration for the Made in China 2025 strategy comes directly from Industry 4.0, however, the Chinese idea is much wider as the quality and efficiency of their production is far from even. China has many hurdles to overcome in a short amount of time if they intent to be able to compete with newly emerging low-cost producers as well as be able to compete with other advanced industrialized economies (Kennedy, S., 2015).

4.2 Key contents
Having manufacturing be more innovation driven and to focus on quality over quantity is the Chinese government’s main principals for the Made in China 2025 strategy. Furthermore, they want to nurture human talent, optimize the structure of the Chinese industry and achieve green development. The main goal is, as mentioned before, to comprehensively upgrade the Chinese industry and make it more efficient and integrated (China daily, 2015).

So far, there are nine main tasks that have been made priority. These tasks include

- Improving manufacturing innovation
- Integrating information technology and industry
- Strengthening the industrial base
- Fostering Chinese brands
- Enforcing green manufacturing,
Advancing restructuring of the manufacturing sector,

Promoting service-oriented manufacturing and manufacturing-related service industries

Internationalizing manufacturing

Promoting breakthroughs in 10 key sectors

(China daily, 2015)

The 10 key sectors that the Chinese government will be focusing on are the following:

- New advanced information technology,
- Automated machines and robotics,
- Aerospace equipment,
- Maritime equipment and high-tech ships,
- Railway equipment,
- New energy vehicles and equipment,
- Power equipment,
- New materials,
- Biological medicine and medical devices,
- Agricultural machinery

(China daily, 2015)

4.3 China’s future plans with Made in China 2025

China’s plan is to become a manufacturing powerhouse in the likes of Germany. They plan is to promote manufacturing as well as the nation’s competitiveness and to not fall behind other countries development. Furthermore, they plan to see lead time of products shorten by about 20% of the current average by the year 2025 (China Daily, 2015). It has also been mentioned that the Made in China 2025 strategy is merely the first stage in a loosely defined plan to pass rival manufacturing hubs in the likes of Germany, Japan and the United States. They hope to make this happen before the year 2049 (Lee, 2015).

As labor cost in China becomes higher, foreign companies have started to move their production elsewhere. India has now replaced China as the top destination for Foreign Direct Investment (Green, 2016). However, the Chinese plan to get back that title by
improving their “robot density”. The market for robotics in manufacturing is expected to keep growing an average of 6.19% to the year 2020 and much of that growth is expected to take place in China (Demaitre, 2016a). Chinese companies have been investing in foreign “robotics companies” in increasing amount and just in June of 2016 the Chinese company Midea Group co. made a cash offer for German company KUKA Robotics AG. This would be that largest unsolicited takeover of a German company by a Chinese company so far (Demaitre, 2016c).
5 Tajco Manufacturing

Tajco is a manufacturing company that develops and manufactures premium exhaust trims for the global automotive industry. Tajco will be used as an example as it was during an internship at the company that the writer was first introduced to the concepts of Industry 4.0 and Made in China 2025. During her internship the company was in the implementation stages of the strategies.

The company started out on a small scale in provincial Denmark in 1946 and is now a market leader in their field as they currently occupy about 64% of the premium car brand market. The company employs over 1100 employees and supplies their premium exhaust trims to car brands such as Mercedes, Audi, BMW, Bentley, Rolls Royce, Lamborghini and just recently Jaguar, as well as many more. They pride themselves on being very forward thinking and strive to be the preferred solution provider of premium trims to the automotive industry. Currently Tajco has sales offices and warehouses in Denmark, Germany, Slovakia, South Africa, The United States and China. Tajco’s production currently takes place solely in Ningbo, China, however, the company will soon open an assembly factory in Slovakia and is in the process of opening another in The United States. This means that semi-finished parts will be sent to these factories in Slovakia or The United Stated for welding and final assembly and then be sent to the customer (Tajco, N.d.; Ragnar Oddsson, Personal communication, September 5th 2016).

Even though Tajco occupies over 60% of the market of luxury car brands they are still 20%-30% more expensive than their competition. With a mixture of lean and automation in their factories they want to be able to cut their cycle time by close to half. With automation of their factories, Mr. Oddsson expects that the number of employees will not change but that the company’s productivity will increase significantly to keep up with growing demand. Currently Tajco produces 10 million exhaust trims per year and they estimate that with the implementation of machines and robots to their factories they will be able to produce up to 16 million parts per year. This means a 60% increase in production per year. 12 million of those parts will be fully finished in the factory in China, 2 million semi-finished parts will be sent and assembled in Slovakia and another 2 million in The United States. In addition to increasing productivity, Mr. Oddsson sees automation as a way to make the workplace safer and production more precise, as welding for
example will be done by robots. Current employees will be retrained regularly to keep up with new technology (Ragnar Oddsson, Personal communication, September 5th 2016).

The company sees many opportunities in partaking in the Made in China 2025 strategy. It has recently come to their attention that the Chinese government is planning on opening a so called “industrial cluster” in the city of Ningbo in collaboration with Ningbo University of technology. This Industrial cluster will be a kind of center of excellence for Made in China 2025 and will give companies the opportunity to work side by side with the university and its students (Ragnar Oddsson, Personal communication, September 5th 2016).

The implementation of Industry 4.0 and Made in China 2025 means implementation of high tech machinery which increases the requirements for highly educated people. One of the biggest hurdle in implementation of the strategy is lack of knowledge. This collaboration with Ningbo university of Technology will not only help the company get in touch with highly educated people to help them to get started, but it will also give Tajco the possibility for grants from the Chinese government. Through the years Tajco has received millions in Renminbi from the Chinese government (Ragnar Oddsson, Personal communication, September 5th 2016).

Until today Tajco has mostly used European and American technology but it has been quite expensive as the company must get specialists from Europe or America to help set up the machinery and on top of that, there is a 25% tax on all foreign machinery brought to China. Luckily, in recent years has been an increase in companies that offer this kind of technology and Tajco is already in cooperation with two of the biggest automation companies in China (Ragnar Oddsson, Personal communication, September 5th 2016).
6 Conclusion

Industry 4.0 and Made in China 2025 are both massive strategies. This thesis attempted to investigate the effects that these strategies will have on the workforce in the coming years. From reviewing research from The Boston Consultant Group and McKinsey Firm, among others, this thesis concludes that technology will promote big changes in how industrial workers perform their jobs as computers and robots will come to aid workers with manual labor among other things. This will allow workers to stay in the workforce for longer. New jobs will be created while others will become obsolete. Automation will increase productivity, competitiveness and change the workforce as we know it. Uneducated factory floor workers will lose their jobs and there will be a significant increase in the demand for highly educated people with experience in working with machines and robots.
Sources


Appendix 1

An interview with Vincent Boucherville, Graduated Mechanical engineer from Ningbo University, China.

A: So, Vincent. Thank you for taking the time.

V: No problem at all.

A: So, I guess you know the reason why I asked for your help so probably we should just jump in.

V: haha, yea. Let’s do it.

A: To begin with, would you explain the concept of Cyber-physical systems to me? ...As if you were trying to explain it to a 5-year-old please! Haha.

V: Sure, sure. Ok, say for example a normal system works this way. Your device gets some input tasks, then your sensors in your device picks up information in order to carry that task, but this information cannot be analysed by the sensor.

A: Ok

V: So it is sent for instance to a computer or chip within your device or outside of it that processes the information and sends it back to other components in your systems. The system can now understand and carry out that task.

V: But then such devices become relatively big in size because they need a lot of other devices to carry out a task. However, systems working with CPS are different. The core system is linked to a network right? So when your sensors pick up information, it is sent using the internet network to a server. Then algorithms crack the information down and sends it back to the device.

CPS makes more efficient use of any mechatronics component you use. It sends data logs to a server and from there algorithms just optimize the task better. Does that make sense?

A: mm yea, I think so.

A: Ok. So next topic. Cloud Computing
V: Ok. Well, Cloud Computing is basically hosting applications in „the cloud“ instead of physical computers and CPU’s and hard disks. Say you are creating applications, and these applications can be anything. Programs, services, servers etc. But instead of having to store, and in most cases back up whatever you created, which is in many cases loads amounts of hardware equipment, you do it on the cloud system. Those systems are available by providers, so they build the network for you and they take charge of worrying about the handling of the hardware. ...For money ofcourse.

A: Right!

V: So basically you are only coding your application and they provide the rest. They allocate computing power, data storage and back up, internet bandwith and network for you to access whatever you have created.
Appendix 2

An interview with Ragnar Oddson. Managing director of Manufacturing excellence at Tajco manufacturing.

A: Til að byrja með langaði mig að byðja þig að segja mér lauslega frá fyrirtækinu, Tajco, í eigin orðum

R: Já

A: Hvað þið gerið og svoleiðís

R: Já, við erum, við erum semsað fyrirtæki sem að býr til þessi púströr. Við erum 1.100 starfsmenn. Við erum... umsetjum fyrir um það bil... í grúppunni fyrir um það bil 800 milljónir danskar og framleiðum um 10 milljón svona endarör á ári. Hérna í Ningbo erum við með 30.000 fermetra og hér gerum við eiginlega alla hlutina, svokallaða vertigal integration. Við framleiðum allt frá hrástáli (riðfrítt stál) í mjög góðum gæðum, svokallað 304 og við framleiðum þetta frá stáli í tilbúið, þá er búið að meðhönda það í svokölluðu electrolectic chrome plating. Við erum með staðst í markaðshlutdeild heims fyrir það sem heitir premium brands. 64% markaðshlutdeild og pemium brands er þá Mercedes, Audi, BMW, General motors, Volvo, Ford, núna nýlega Jaguar og svo er um við með Rolls Royce, Lambourghini, Bentley og við erum semsað lang staðst í heiminum. Við erum líka að framleiða fyrir minni merki, svokallaður medium segment. Við eurm ekkert mjög stórir þar. Við erum sérstaklega stórir í þessum premium brands. Ef við lítum á alheims mælikvarða þá erum við með 18% markaðshlutdeild. Það eru framleiðir 85 milljónir bíla á ári í heiminum í dag þannig að já, við erum með 16-18% markaðshlutdeild.

A: Af öllum bílum sem eru framleiðir?


A: Þú segir að það séu um 1.100 starfsmenn hjá Tajco. Er það bara hér í Kína eða er það allt í allt?

R. Allt í allt erum við 1.150 . Næstum því 1.200. við erum með skrifstofur í hérna... Aðalskrifstofurnar eru í Danmörku. Fyrirtækið er upprunalega danskt og svo erum við með skrifstofur í Slovakíu þar sem við erum líka með Lager og erum núna rétt að byrja framleiðslu þar, samsetninga framleiðslu. Það er byggt á því að hluturinn sé búinn til

A: Og þið eru að fara opna verksmiðju líka í bandaríkjunum?


A: Og þið eru að fara opna verksmiðju líka í bandaríkjunum?


A: Og þið eru að fara opna verksmiðju líka í bandaríkjunum?


A: Og þið eru að fara opna verksmiðju líka í bandaríkjunum?


A: Og þið eru að fara opna verksmiðju líka í bandaríkjunum?
R: Við erum að hugsa um að taka þátt í þessu, já, að taka þátt í því að... Okkur langar til þess að komast uppá þetta þrep og notfæra okkur möguleikana sem finnast í Industry 4.0 og/eða Made in China 2025. Ekkki bara vegna þess að þetta er mjög hagkvæmt en líka vegna þess að það eru miklir möguleikar á allskyns opinberum stuðningi. Tajco hefur alltaf verið framarlega í því að sækjast eftir opinberum stuðningi og við höfum fengið fleiri milljónir í gegnum árin. Og það sem að er að koma í ljós núna er að það verður sett upp svona „industrial cluster“ í ningbo í sambandi við tækniháskólann í Ningbo sem á að vera eitt af svona, center of excellence fyrir Made in China 2025. Og okkur langar til þess að taka þátt í því vegna þess að þá höfum við möguleika á bæði styrkjum og líka aðgang að menntuðu, hámenntuðu fólkí og tækní verkfræðingum og tækní fólkí til þess að aðstoða okkur við það að komast í gang. Vegna þess að það er eitt af aðal hindrunum þess að komast í gang með Industry 4.0 er einmitt þekking. Þekkingarleysi. Og hér erum við að tala um háþróaða tækni sem þaraf mjög, mjög háa þekkingu og kunnskap að öllu leiiti.

A: Algjörlega


A: ok. Hvað áætliði að framleiðsla aukist mikið við innleiðslu vélmenna og aukinnar tækní?

R: Strategían fyrir Tajco er 16 milljón endarör framleidd hér en ekkert endilega að þessi 16 milljón verði sett saman hér. Málmurinn, eða svokallaður semi-finished, verður að
öllum likindum frmaleitt hér og svo komum við tikl með að sjóða saman allt að 2 milljónum í evrópu og svipað í bandaríkjunum. Þannig að þá fórum við upp í 12 milljón samsett hérna í Kín a, 2 milljónir í evrópu og 2 milljónir í bandaríkjunum fram að 2020. Eftir það þá erum við, þá þurfum við líklega að stækka þessa verksmiðju eða setja upp eina verksmiðju enn.

A: Hér?

R: Já, það er ekki víst hvort hún verður í kína. Það gæti vel verið að, ef að ameríski markaðurinn þróast eins og við erum að vonast eftir þá getur vel verið að við setjum upp málm verksmiðju í Mexico. Eða bandaríkjunum ef Trump býður okkur uppá góð kjör. Þá getur vel verið að við gerum það.

A: hefur einhverjar hugmyndir um hvað þessar breytingar munu hafa á vinnuafl.


A: Einmitt.. jæja, ég held þú sért bara búin að svara öllum spurningunum minum, haha.

Takk