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Robotics in Chinese manufacturing industry

A qualitative study of the robotics impact on Chinese manufacturing industry

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Abstract

For as long robotics has been a research topic, their impact on the traditional manufacturing industry have been discussed. Several theories have been presented through the years in how robotics will change the business climate. The Chinese labor market is facing big transitions and the question of what the effects on employment rate and economy will be remains uncertain.

In this thesis, the focus in this thesis is to present the positive and negative effects of robotics in manufacturing industry and how it will affect the labor market. This is conducted by analyzing empirical findings from interviews and second-hand interviews. The collected findings will be compared with previous research regarding digitalization and robotics in China.

The outcome of this thesis will show the positive and negative effects of robotics and manufacturing industry and its impact on the Chinese labor market. The thesis will show the correlation between robotics, education, quality, labor and the Chinese economy.

Key words: Robotics, Manufacturing industry, China, Digitalization, Labor market, Economy, Positive, Negative.

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1 Introduction

In this part of the thesis, we will present the subject for the report and the background of the phenomena of increasing robots in the manufacturing industry. Thereafter we will formulate the purpose for the thesis and conduct a problem discussion which will be the foundation for our research questions. Definitions of purpose and delimitations will be included in this part as well.

1.1 Background

China has provided foreign companies with a low-cost workforce which has proven beneficial in recent years; more companies have decided to move their production abroad to emerging markets. Since China opened up to foreign direct investment and implementing free-market reforms in 1979, China has been among the fastest-growing economies in the world. China has, on average, doubled its gross domestic product (GDP) every eight years, which has resulted in 800 million people being raised from poverty (Morrison, 2019). The positive economic impact of the FDI and free-market reforms that has enabled foreign companies to enter the Chinese market has resulted in a growing middle class and has made China the world's largest economy in the highest purchasing power parity (PPP) terms (Morrison, 2019). Hence, the enormous transition that has created jobs for the people in these emerging markets is facing changes in innovation and technology that drive the industry forward with machines and robots that are a substitute for people.

Digitalization has influenced the international business environment for several decades and has impacted companies and countries in different

aspects. In the early years of digitalization, the most common features were to transfer analog documents into the digital world. This method has been present since the 1960s. However, it was in 2016 where today's form of digitalization took shape. The most remarkable example in digital development is 3D – printing, which has revolutionized the manufacturing industry (Henriksson, 2020).

This thesis will focus on one particular field in digitalization: robotics in the Chinese manufacturing industry. The world's largest user of robotics is the automotive industry. The use of robotics in the world has increased continuously, year by year. It was estimated that 414 000 robot units would be active in 2019 (Karabegovic, 2017). China is the world-leading country in using robotics in their industries. The high application of robotics in the Chinese production industry has resulted in the development of the automotive industry. China is estimated to be the world's largest industrial robot user, and they are planning to implement their automation in more sectors than the automotive industry. Including electronics, rubber, plastic, and metal industry (Karabegovic, 2017).

These digital technologies, mentioned above, have been made possible by technological innovations that have enabled digital development to be one of the most palpable changes in the international business environment, where almost none uses analog solutions for their operations (McNeil, 2002).

Industrial robotics has evolved into a central feature in the manufacturing industry and has changed the traditional way of manufacturing. China is, as mentioned earlier, the world's largest user of industrial robots, and that has changed the labor cost in the different industry sectors. Haichao Fan, Yinchuan Hu, Lixin Tang (2020) argue that labor costs can increase in China as an effect of automation. Further, they argue that higher minimum wages

affect a firm's chances of adopting robotics in a suitable manner over some time. Hence, their research shows that higher minimum wages to some extent help the adoption of robots for Chinese firms, but not in all industries (Fan, et al., 2020). Their research is an exciting contribution to the debate over robotics effects on the Chinese economy since most of the research argues that robotics will decrease labor costs since smaller workforces will be required.

According to IMD (2019), the Chinese digital competitiveness index indicates that China is a market that is ready to compete with digital changes. The overall performance of China placed them at a ranking of 22 out of 63 investigated countries. However, for future-readiness of Digitalization, China is positioning themselves in the first place regarding business agility and world distribution of robots (IMD, 2019). Considering the regulatory framework China has gained 14 places from 2015, putting them at rank 20, where their top strength is enforcing contracts, while their greatest weakness is intellectual property rights. In conclusion of this index, one can see that the distribution of robots in China is world-leading and that the future readiness is excellent, which is a necessity for the digital changes in the manufacturing industry (IMD, 2019).

All the mentioned aspects above are why the authors have been interested in this subject. Moreover, these are the decisive factors for investigating, analyzing, and discussing this particular subject. The presence of the foreign companies operating in China using the cheap labor force. Creates an interest to see whether these companies will seek other countries to exploit or continue operating in China. Depending on the decisions by the companies, it will be motivating to see how the growing middle class will react to companies moving from their country. However, the leading interest for this thesis will be to see how the economy in the Chinese market will be affected

by the increased usage of robotics in the manufacturing industry. And, to see if there are positive or negative effects on the labor market.

1.2 China

China, or the people's republic of China (PRC), is located in East Asia. China has the world's largest population, approximately 1.4 billion people. China is nominally a unitary one-party socialist party. After China's economic reforms in 1978 and their entry into the World trade organization in 2001, China has become the second-largest economy globally by nominal GDP. Further, China has also become the world's fastest-growing economy and world-leading manufacturer and exporter (IMF, 2021).

China is a country that differs from other emerging markets, even from the countries included in the BRIC. The term "BRIC" stands for Brazil, Russia, India, and China. For instance, China is very sensitive to product quality compared to other emerging markets, and that their exports far exceed what would be expected concerning their development. Moreover, the Chinese GDP growth has seen significant improvements and has increased rapidly. In 1990 the Chinese GDP made a total of 1,5% share of the world's GDP rate; however, in 2009, China's GDP made 8,5% out of the total share of the world (Yifu Lin, 2011). One factor contributing to this growth is the free-market reforms that have allowed more foreign direct investment and increasing exports, resulting in that 800 million people have been raised out of poverty (Morrison, 2019).

The manufacturing sector has dominated the FDI inflow to China. The manufacturing industry in China is characterized by the fact that the industry is divided into low tech and high-tech classes. This indicates that China is in a transition stage, moving from traditional low-tech activity to a high-tech environment. The shift from the traditional manufacturing industry to more

advanced manufacturing, which includes machinery and robotics, has led to the increased labor cost as a reflection of the quality and quantity of labor (Liu & Daly, 2011).

The ministry of industry and information technology released guidance on the promotion and development of the robot industry. The report contained goals which read as follows, develop 3- 5 world-leading robot companies, increasing China's global market share of high-end robot products by 45%, and promote the use of robots in the manufacturing sector with the target of reaching a density of 100 robots per 10000 workers (Cheng et al., 2019). This is in accordance with IMD's numbers, where they listed China as the country with the highest potential to cope with this transition, where their score on business agility placed them first of all nations. And that the enforcement of contracts is a possibility for Chinese firms (IMD, 2019).

1.3   Problem discussion

We are living in a fast-moving world. Globalization and digitalization are pushing society forward with new innovative solutions, Big-tech companies dominate the stock exchange markets and more modern times are ahead of us. Digital technology has significantly changed the speed of operations in the economy. The internet and digital devices are drivers of economic growth (Afonasova, et al., 2019).

 Many emerging countries have seen their middle class increase due to internationalization, where companies locate their production in foreign countries to save money in labor costs. Asia, for example, has the world's largest growing middle class (Buchholz, 2020). A big denominator for that has been that western companies have employed their people in their factories. China, for example, has become the world's largest economy in terms of purchasing power parity (Morrison, 2019).

The digitalization of the world has changed the manufacturing industry with new technologies, especially robots that substitute people; how will these affect the people in the emerging market of China. The 800 million people that have been lifted from poverty in China will they lose their jobs when machines take over? What will be the socio-economic effects of these changes in the manufacturing industry be for the workers and people in China.

The digital revolution is an ongoing phenomenon. In addition to transforming jobs and skills, it is also overhauling industries such as retailing and publishing and perhaps in the future banking and trucking (Mühleisen, 2018).

Furthermore, the job market will face changes; the jobs of up to one-third of the US workforce, or approximately 50 million people, could be transformed by 2020 (Mühleisen, 2018). The study estimates that about half of all paid activities could be automated using existing robotics and artificial and machine learning technologies (Mühleisen, 2018).

The core value proposition of an industrial robot is to perform tasks continuously and accurately in the work environment, and scales are difficult for humans (Heyer, 2010). Robotics that can perform tasks more efficiently and more accurately in the work environment opens up a problem. Is there a positive or negative impact for the workers when a higher degree of automation is implemented?

Earlier research regarding this matter has been conducted. Several scientific articles have investigated digitalization's effects on the workforce and employees. The discussion of whether machines and robots will replace humans has been on the radar for a long time. However, we believe that a

perspective about how the Chinese economy will change is relevant to research more.

1.4 Purpose

This bachelor thesis aims to analyze how the robotics part of digitalization will affect the manufacturing industry in the emerging market of China. The purpose is to find both the positive and negative effects of the increasing use of robotics in manufacturing and its impact on the Chinese economy.

1.5 Delimitations

This study will focus on how digitalization, particularly robotics, affects the emerging market of China and its manufacturing industry. The authors will limit the thesis to focus on both the positive and negative effects of robotics on the economy. The thesis is delimited to the Chinese manufacturing industry to create more depth in the research from a geographical standpoint. Another delimitation the author has made is to focus on the labor market perspective on the economy.

1.6 Research Question

How will the manufacturing industry be affected in China due to robotics?

1.6.1 Sub question

- Are there positive or negative effects that robotics will bring into the manufacturing industry?

- How will the economy in particular the labor market be affected?

1.7 Outline

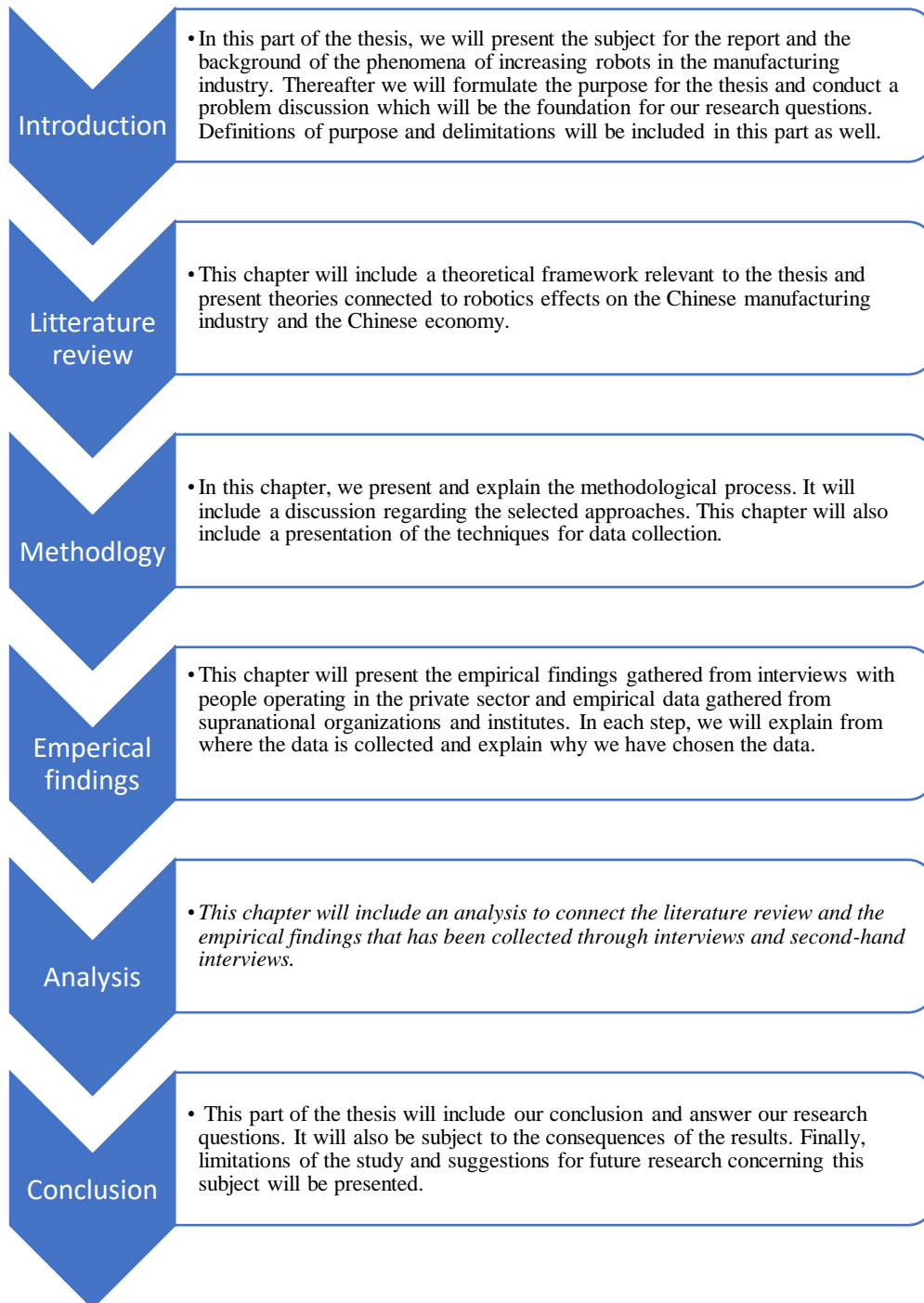|	
Introduction	• In this part of the thesis, we will present the subject for the report and the background of the phenomena of increasing robots in the manufacturing industry. Thereafter we will formulate the purpose for the thesis and conduct a problem discussion which will be the foundation for our research questions. Definitions of purpose and delimitations will be included in this part as well.
Litterature review	• This chapter will include a theoretical framework relevant to the thesis and present theories connected to robotics effects on the Chinese manufacturing industry and the Chinese economy.
Methodlogy	• In this chapter, we present and explain the methodological process. It will include a discussion regarding the selected approaches. This chapter will also include a presentation of the techniques for data collection.
Emperical findings	• This chapter will present the empirical findings gathered from interviews with people operating in the private sector and empirical data gathered from supranational organizations and institutes. In each step, we will explain from where the data is collected and explain why we have chosen the data.
Analysis	• *This chapter will include an analysis to connect the literature review and the empirical findings that has been collected through interviews and second-hand interviews.*
Conclusion	• This part of the thesis will include our conclusion and answer our research questions. It will also be subject to the consequences of the results. Finally, limitations of the study and suggestions for future research concerning this subject will be presented.

FIGURE 1. Own creation 2021

2 Literature review

This chapter will include a theoretical framework relevant to the thesis and present theories connected to robotics effects on the Chinese manufacturing industry and the Chinese economy.

2.1 What defines digitalization?

Digitalization is the generic term for the digital transformation of society and the economy. It describes the transition from the industrial age characterized by analog technologies to an era of knowledge and creativity characterized by digital technologies and digital business innovation (Innolytics, ND). Globalization and open market economy have become the driver that has created the rise to the fourth industrial revolution or industry 4.0. Industry 4.0 has initiated the amalgamation of the internet, information and communication technologies, physical machinery with the coinage of words, such as internet of thing, industrial of things, collaborative robot, big data, cloud computing, virtual manufacturing, and 3D printing. All of these innovations have made their presence in our daily lives (Kumar, et al., 2020). Digitalization has had a radical impact on the economy. Digitalization will drastically change the economy's future in society and different industries (Innolytics, ND).

2.2 Digitalization effects on the manufacturing industry

Future manufacturing will be completely different from the present industry. Future manufacturing will involve each production element that operates independently, shares information, and triggers tasks in the CPS machines. This industry future would run totally in the influence of digitization and decentralization in production mechanism, which presents an autonomous system without any human interventions or errors. Some inputs and outputs by humans will exist, but most tasks will be performed by smart machines that are fully aware of the environment or communicating with the physical world and within machines to take the most appropriate decision (Kumar, et al., 2020).

In recent years, higher expectations have developed concerning the digitalization of industry and its potential to increase manufacturing performance. Digitalization regarding manufacturing companies refers particularly to upgrading manufacturing processes and, in other words, integrating robotics, advanced automation, and other digital technologies. Digitalization enables manufacturing companies to manage and control their internal production system and their involvement in value chains (Horvat, et al., 2019).

2.3 Digitalization effect on the Chinese economy

Digitalization has opposing effects on labor markets. The labor market is facing severe structural changes, and therefore challenges for society at large will occur. According to Christian Bührer & Christian Hagist, the interesting question regarding the digitalization effect on the economy is: How will digitalization change the division of work? Which jobs are at stake? and will demography be a factor in this regard? (Bührer & Hagist, 2016). In earlier economic literature, a standard assumption is that technology drives growth

and positively affects employment. At the beginning of digitalization, that thesis was accurate since technology helped workers be more productive since they could focus more on other things. However, technology has developed so fast and successfully that many workers aren't needed in the same amount nowadays. In addition to the general digitalization changes of the work process, society might have to react and adapt regarding their demographic situation and education system (Bührer & Hagist, 2016). Digitalization can impact the labor market in different directions, both positively and negatively. If AI and robotics start pushing more workers out of employment, it's possible to create severe effects on a region's GDP and PPP because unemployment rates have increased.

A report by Ballestar, Diaz-Chao, Saiz, and Torrent-Sellen argues that robotics, AI, ML, and big data are inseparably linked within the innovation economy, especially the industrial sector. As they have evolved, firms have focused on the need to offer better products with higher quality and used technology to improve their performance and open space for further developments (Ballestar, et al., 2021). The effects of this technological revolution is complex and not fully understood. The effect on employment has attracted a large amount of interest since the problem is not a simple matter of those workers who are going to be replaced by robots (Ballestar, et al., 2021). In 2019 the Economic Co-operation and Development (OECD) organization estimated that 14% of current jobs might disappear because of automation, and 35 % can be seriously affected by automation. The report further states that the effect of automation on the labor market is absolute, either directly or indirectly, because of the successive displacement of human capital expelled from its previous posts to other posts that need a more traditional set of qualifications (Ballestar, et al., 2021).

2.4 China as an emerging market

The term emerging market is referring to rapidly growing economies with a rapid industrialization process. Emerging markets are also characterized by transitioning from developing to developed markets because they are rapidly growing concerning the economy and industrialization. The differences between less developed economies and emerging markets are:

• that increased levels of improvements in living standards.
• commitment to sustained growth.
• efforts to catch up with the industrialized nations.

The term "BRIC," which stands for Brazil, Russia, India, and China, is an example of how emerging markets are progressing. These countries are the fastest-growing economies and may potentially overtake the world's largest economies (Cavusgil et al., 2013).

Moreover, China's annual wage growth rate during 2006 - 2015 in the manufacturing sector was 9,3%. They are resulting in an estimated labor cost to be $3.30, which is higher than those in Malaysia, Vietnam, India, Thailand, and Indonesia. To deal with the challenges of labor shortage and increasing labor costs, Chinese manufacturers have been pressured to automate, use machinery, and adopt robots (Cheng et al., 2019).

2.5 Digitalization's effect on the emerging market of China

Further on, Cavusgil, Gauri & Akcal (2013) present the outlook of the emerging markets. He argues that the view is bright for these economies since barriers to trade and investment have been reduced, facilitating the ease of doing business between multinational companies. This has been made possible by India's and China's free-market reforms and development in IT.

The progression regarding IT has mainly changed the way of communication and computing. This has led to the business structure worldwide has changed, which has enabled the technology and economy to be very mobile (Cavusgil et al., 2013). Research has proven that foreign transfer of technology has been possible due to the mobility and thereby gain from technological spillovers. For instance, Taiwanese electronics companies have gained knowledge from foreign investors (Ho et al., 2011).

2.6 Robotics in Chinese manufacturing

Industrial Robots, designed for performing operations with agility and precision to increase efficiency, have a long heritage in the manufacturing industry. Industrial robots can be found in various sectors of the industry (Heyer, 2010). The core value proposition of an industrial robot is to perform tasks continuously and accurately in the work environment, and scales are difficult for humans. Robots integrate with other factory systems, which enable so-called just-in-time production, which supports a new level of economically viable bespoke manufacturing (Heyer, 2010).

In 2005, China only had 221 registered robotic firms; in 2015, that number had risen to 6478. This has been a reflection of the population growth in China, as the working population (16 - 64) has declined since 2003 (Cheng et al., 2019). Interestingly, this corresponds to the rise of robotics used in the manufacturing industry, which started in 2003. China is the world's largest industrial robot user; in 2016, industrial robot sales in China reached 87,000 units, which accounted for approximately 30% of the global market. In China, the manufacturing sector was responsible for over 80% of China's industrial robot use in 2016 (Cheng, et al., 2019).

In the book robotics for electronics manufacturing, written by Karl Mathia (2010), the author listed four economic factors of why investment in

industrial robotics over human labor is important. Which are, reduced labor cost, improved productivity, improved and more stable product quality, and resource conservation. Other reasons are the increased workplace safety, increased flexibility of production systems, and labor shortages (Mathia, 2010). Mathia also stated that robots are competing with humans, at least based on an economic perspective.

2.7 Conceptual framework

The literature review has shown the fundamental ground of robotics in digitalization and its part in the Chinese manufacturing industry. It also provides a groundwork for the effect digitalization has on the Chinese economy. As the model below contemplates is the point to search for the positive and negative effects robotics can have on the manufacturing industry and how that will relate to the future for the labor market and Chinese economy. The literature review has indicated that there have been changes in the manufacturing industry and the Chinese economy. The conceptual framework aims to bring an overall picture and help the authors organize devices in the empirical research.
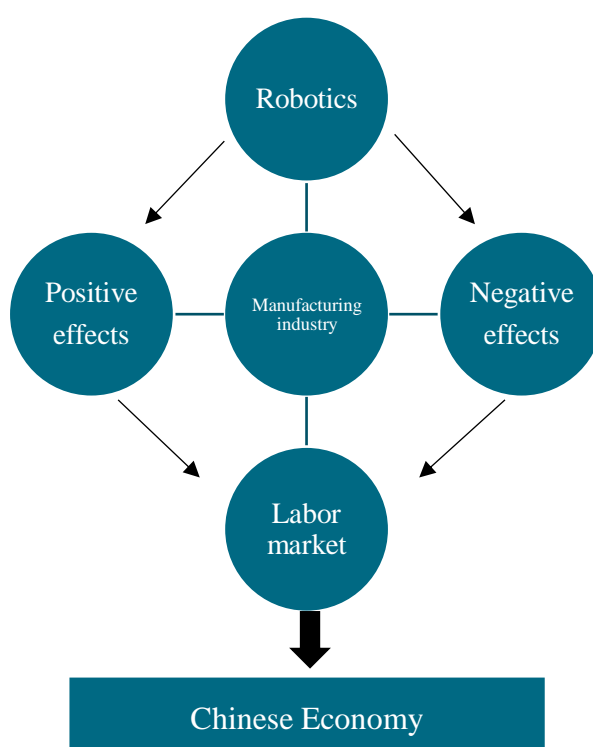
TABLE 2. Own creation 2021.

3 Methodology

In this chapter, we present and explain the methodological process. It will include a discussion regarding the selected approaches. This chapter will also include a presentation of the techniques for data collection.

3.1 Research Approach

The deductive approach represents the most common perception about the relationship regarding theory and practice. From statements within a specific area or subject, the theoretical arguments guide the researcher to one or more hypotheses, making the foundation for the empirical study. However, the researcher needs to create a hypothesis and translate it into operational terms. The deductive approach is also known for causing unexpected results, which the Hawthorne Studies is an example of. The hypothesis for the study was to see the correlation between tiredness, conditions, and monotony. The researchers regulated the lights in the factory, and the assumption was that the workers would be negatively affected by lights, but the results showed that it had a positive effect because the employees felt like they were being watched, and therefore they performed better not to be exposed as an incompetent employee. This example responds to the criticism that the deductive approach has experienced, that it sometimes is linear and follows a precise sequence. Which evidently does not have to be the case (Bryman & Bell, 2017). However, Lewis, Saunders, and Thornhill (2019) argue that the deductive approach is highly structured and characterized by large samples and measurements (Saunders, et al., 2019). Moreover, there is a palpable risk regarding the deductive approach: one can lose premature fresh insight into the studied real-world conditions (Yin, 2016). Considering the different arguments for and against the deductive approach, the researchers chose not

to use this approach since it is highly structured and considering that there is a risk of missing out on fresh insights from real-world conditions.

Grönhaug, Strange, and Ghauri (2020) define the inductive approach as the systematic process of establishing a general proposition based on observation or particular facts. Further on, the authors explain one advantage by using the inductive approach: the inductive approach is useful when researchers want to include a social context to understand a specific phenomenon (Ghauri, et al., 2020). This argument is also strengthened by Saunders, et al., (2019) who argue that when using an inductive approach to reasoning is likely to be particularly concerned with the context in which such events take place (Saunders, et al., 2019). Which is an essential part of this thesis, to see how the labor market in one of the largest emerging economies will react to the changes in the manufacturing industries. Another advantage is that one can collect first-hand information in a natural setting. Holme and Solvang (1996) argued that most research has elements of the inductive approach (Holme & Solvang, 1996). Considering these arguments and advantages, the researchers of this thesis will conduct an inductive approach.

3.2   Qualitative vs. quantitative approach

The qualitative research approach in the business and management field has recently increased in interest because of the application level and opportunities that the qualitative method approach provides. Qualitative research can be found in many different businesses, management, and organizational research areas, including areas that traditionally are seen as objectives, facts, numbers, and quantification. For example, one can now see qualitative research in accounting, entrepreneurship, finance, human resource management, and international business, which is a decisive factor for choosing the qualitative approach. The progress towards usage and acceptance of the qualitative approach has experienced differential progress

depending on various geographical locations. For instance, in Europe, it is not unusual to see training on focus around research, with courses about quantitative and qualitative methods. However, postgraduate training usually focuses on knowledge extension in the US, for example, teaching accounting, organizational behavior, and marketing. In China, the attitude towards qualitative research is that they see challenges regarding this approach since they argue that the qualitative approach is subjective, biased, and unrepresentative (Cassell et al., 2018). The issue regarding whether qualitative research is subjective is also strengthened by Bryman and Bell (2017). They also argue that there are complications to replicate an examination due to the nature of qualitative research being unstructured and dependent on the researcher's ingenuity (Bryman & Bell, 2017).

The increased numbers of qualitative research have resulted in an emergence of debates about the status and quality of a qualitative approach. However, recent commentaries have been focusing on the extent to which level of acceptance the qualitative approach has made into top journals. Some argue that the progression of the quantitative approach has not made global advancement, which can be correlated with the cultural differences mentioned in the previous paragraph (Cassell et al., 2018).

On the other hand, the quantitative approach is much more dependent on measurement, causality, generalization, and replication. The reason why causality is of such great importance in the quantitative approach is since researchers want to see the reasons behind a specific phenomenon rather than just the result. Another crucial part of the quantitative approach is replication to reduce the risk of subjectivity and increase the validity of the research (Bryman & Bell, 2017).

Considering these aspects, the two research approaches have different characteristics that provide dissimilar sources for data collection. For this thesis, the most appropriate option of the two is the qualitative approach. First and foremost, due to the nature of the qualitative approach, it is flexible and has been accepted by top journals. Secondly, the quantitative approach often provides an artificial and incorrect sense of precision and accuracy (Bryman & Bell, 2017). Therefore, the choice of approach will be qualitative, and because of the particular reason, that the qualitative and inductive approach complements each other well (Yin, 2016).

3.3   Research design

The research design is the overall plan for relating the conceptual research problem to relevant and practicable empirical research. In other words, the research design provides a method or framework for data collection and analysis (Ghauri, et al., 2020). Research strategy is used to answer the research question by comprising three different variables: a plan, structure, and strategy. These three variables could help researchers formulate hypotheses, methodology, interpretation of collected data, and data analysis (Bloomfield & Fisher, 2019).

The research in this thesis focuses on how robotics will affect the manufacturing industry and see which positive and negative effects it will bring. The most suitable way for analyzing the positive and negative impacts in this thesis is qualitative research, where the authors will use an inductive approach to gain valuable insights from individuals operating within the robotics manufacturing industry in China. This thesis will focus on previous research findings in this field. By comparing previous research and interviewing people with insights into the industry and use second-hand interviews, the authors will draw their conclusions based on primary data, secondary data and an inductive approach.

3.4   Purpose of research

Research can be designed to fulfill either an exploratory, descriptive, explanatory, or evaluative purpose or some combination of these. An exploratory study valuable is means to ask open questions to discover what is happening and gain insights about a topic of interest. Exploratory research questions are likely, to begin with, What or How (Saunders et al., 2016).

The purpose of descriptive research is to gain an accurate profile of events, persons, or situations. Descriptive research questions often include Who, What, Where, When, or How. Descriptive research may be an extension of a piece of exploratory research or a forerunner to a piece of explanatory research (Saunders, et al., 2016).

Explanatory studies are studies that establish causal relationships between variables. The emphasis in explanatory research is to study a situation or a problem in order to explain the relationships between variables. Explanatory research question most likely includes Why or How (Saunders, et al., 2016).

The purpose of evaluative research is to find out how well something works. Research questions that seek to evaluate answers are likely to begin with How or include What in the form of to what extent. Evaluative research in business and management is likely to be concerned with assessing the effectiveness of an organizational or business strategy (Saunders, et al., 2016).

The authors of this thesis have chosen to combine these different studies for the research. Since this is a qualitative study with semi-structured interviews, the combination of the studies enables the questions to be more open, which

gives the interviewees more chance to elaborate on the answers. The interview questions in this research contain why, how, and what could be seen as a combination of exploratory, descriptive, and explanatory. The researchers believe this combination will give the most suitable answers to the research questions.

3.5 Data collection

Data is nothing more than ordinary bits and pieces of information found in the environment. They can be concrete and measurable as in-class attendance or invisible and difficult to measure, as in feelings. Data conveyed through words have been labeled qualitative, whereas data presented in number form are quantitative. Hence, whether or not a piece of information becomes data in a research study depends solely on the interest and perspective of the researcher (Merriam & Tisdell, 2016).

There are two main parts of data collection which are primary data and secondary data. The researcher collects primary data through surveys, interviews, or experiments specifically for the research problem in question that is being studied. The researcher is able to specify exactly which data should be collected and how much. Secondary data are data that have already been collected by, for example, government agencies, market research agencies, firms, or other organizations or individuals, which are publicly available. For the researcher, the main advantage of using secondary data is that it's already been collected, and the researcher just needs to collate the data (Ghauri, et al., 2020). The data that will be used in this bachelor thesis has been collected in a variety of ways. Scientific articles have been found through portals like LNU one search and google scholar. Second-hand interview for empirical findings has been found on YouTube. Another way of data collection the authors will use is interviews with people with insights regarding robotics in manufacturing.

3.5.1 Primary data

As mentioned earlier, primary data is collected by the researchers themselves by interviews, surveys, and experiments suitable for the specific study. The researchers of this study will conduct interviews in order to collect the primary data. There are three main ways to collect preliminary data: through personal interviews, telephone interviews, or e-mail (Ghauri, et al., 2020). The most appropriate option for this study will be to collect primary data by personal interviews with individuals operating in the Chinese manufacturing industry. Furthermore, the authors argued that interviews are the most effective way to collect data. With these aspects in mind, the collection of primary data will be conducted by interviews, and in order to secure the validity of the primary data will be presented in a separate paragraph.

3.5.2 Secondary data

The authors of this thesis will collect and work in a large amount with processing secondary data. There are several ways secondary data can help a researcher answer the research question or solve research problems. Assisting in problem formulation and devising more concrete and focused research questions, deciding on the appropriateness of research methods or suggesting better research methods, and finally providing benchmarking methods and other findings that can be compared later on with the results of the study at hand (Ghauri, et al., 2020). Since the authors work within a limited period of time, secondary data will be efficient since the significant advantage of using secondary data is enormous savings in time and money. Since a large amount of secondary data is available with open access in a wide variety of variables. There are, however, some disadvantages regarding secondary data; the first and main disadvantage is that the data were collected for purposes other than those of the researcher, so the data may not map precisely onto the theoretical concepts in which the researchers are

interested. There are several places secondary data could be found. Secondary data can be divided into five broad categories. First, there is an enormous amount of publicly available data via the websites of supranational organizations such as the World Bank, the world trade organization, UNCTAD, and OECD but also independent research institutes. The authors, however, have collected most data from independent institutes (Ghauri, et al., 2020).

3.6 Quality of research

In order to draw conclusions from the collected data, it's important to evaluate the quality of the data and the measurements used for analyzing its validity and reliability. There are several different times validity and reliability exist, and it will be explained further in the text below.

3.6.1 Validity

Kumar (2014) defines validity as the ability of an instrument to measure what it is designed to measure. Another definition of validity refers to the extent to which an empirical measure adequately reflects the real meaning of the concept under consideration (Kumar, 2014). With the usage of a qualitative approach, there is a greater chance of achieving validity due to the fact that the researchers come much closer to the studied subject than if the researcher would apply a quantitative approach (Holme & Solvang, 1996). However, the authors argue that there are still some issues regarding the validity, even when using an inductive approach for several reasons. One example could be that the researcher misinterprets the situation or that the researcher does not understand the motives, or the signals expressed by interviewees.

There are different ways to increase the validity of the research; one way could be to apply respondent validation, which is a part of the triangulation.

Nevertheless, respondent validation involves the respondents of the qualitative interviews to make sure that the researcher has interpreted and gathered the information correctly. This will result in that the interviewees validate the researcher's empirical findings and thereby verify the researchers' interpretations (Torrance, 2012). As mentioned earlier, that respondent validation was a part of the triangulation. However, the essence of the triangulation is to use the same set of data from multiple sources to best achieve the objectives set for the thesis. Triangulation is based on the belief that using the same set of data, collected by different approaches to concluding and its examination from various perspectives will generate a greater understanding of a problem, situation, phenomenon, or issue (Kumar, 2014).

However, the researchers will apply the respondent validation for this thesis because the authors want to eliminate potential misunderstandings, misinterpretations, and subjectivism. The researchers of this thesis believe that validity is of most importance to increase the credibility of the research and that respondent validation is the most appropriate option to choose. And due to the fact that the information from the interviewees does not get distorted.

3.6.2   Reliability

Reliability is defined as if different independent measurements of the same phenomena or topic give approximately the same result. A high degree of reliability is a necessity to actually test the statements that the research question scope (Holme & Solvang, 1996). The authors argue that there are several ways to increase the reliability of research; one is to apply an operationalization. An operationalization resulting with relatively same results indicates that reliability is high. Furthermore, one can increase reliability by establishing instructions and routines for each phase of the

research. The researchers of this thesis have decided to apply an operationalization, to strengthen the reliability and also to follow an interview scheduled with predetermined questions for the interviewees.

The risk of not achieving internal reliability can be reduced by having more than one researcher in the study (Saunders et al., 2019), which is the case with this study since there are two researchers of this study. Saunders, et al., (2019) mentioned that internal reliability ensures that the research will be consistent throughout the whole research project. External reliability ensures that the data collection techniques and analytic procedures would produce consistent findings if other researchers would replicate the study. In order to establish external reliability, the researchers must be transparent, and the study cannot contain any logical leaps nor false assumptions (Saunders et al., 2019).

3.7 Research ethics

The ambition of ethics in research is to ensure that no one is harmed or suffers adverse consequences from research activities. This subject is usually achieved; hence, unethical activities are pervasive and include violating non-disclosure agreements, breaking participant confidentiality, misrepresenting results, deceiving people, using invoicing irregularities, avoiding legal liability, and more (Cooper & Schindler, 2014). The authors of this thesis will follow the basic principle of article 5 of the data protection regulation. The regulation sets out several basic principles that need to be followed for personal processing to be lawful. The principles are the following:

•The data must be processed in a legal, correct, and transparent manner in relation to the person whose personal data we process.

•The data shall be collected for specific, explicitly stated, and justified purposes and not subsequently processed in a manner incompatible with those purposes.

• The data must be adequate, relevant, and not too extensive in relation to the purposes for which they are processed.

• The information must be correct and, if necessary, updated.

• The data may not be stored in a form that enables the data subject to be identified for a more extended period than is necessary for the purposes for which the personal data are processed.

• The data must be processed in a way that ensures appropriate security for personal data.

<div align="right">(Linneunivesitetet, 2021)</div>

Throughout this thesis, the authors have been transparent with the respondents regarding the purpose of the study. The authors have been consistent in explaining the purpose of the research and have been regardful to the participants' role in the study. Before interviews, the respondents have had the possibility to read through the interview questions. Interview recordings have been conducted with consent from the respondents. The respondents have also been offered to read a post-draft of the thesis before publishing.

The role of research ethics in this report has been important since the respondents operate in the private sector and therefore represent their companies in the interview; research ethics give them insurance that nothing from the interviews would be presented in the wrong manner or changed.

3.8 Interviews

In qualitative research, interviews are of great importance in order to collect primary data for the thesis. Interviews can be structured in different manners, either it's a structured interview, where the researcher uses a standard format of the interview, emphasizing fixed response categories and systematic sampling and loading procedures combined with quantitative measures and statistical methods. The other interview technique is unstructured interviews, where the respondent is given a large amount of liberty to discuss reactions, opinions, and behavior on a particular issue (Ghauri, et al., 2020). The authors of this thesis have, however, chosen a semi-structured interview approach. The semi-structured approach differs from both the structured and unstructured interview methods. The differences because of the topics and issues to be covered, sample size, people interviewed, and interview questions have been determined beforehand (Ghauri, et al., 2020).

The authors have chosen a semi-structured interview as a framework for the interviews; the semi-structured interview gives the interviewees a chance to elaborate more on their answers and allows new ideas to arise from the answers by the interviewees. The mix between the structured and unstructured methods allows the researchers to get answers to their questions but still leaves spaces for a discussion that can develop into interesting directions with relevance for the thesis. The operationalization table and the theoretical framework will operate as the guidelines for the interview process and the questions. Hence, the guidelines will not be followed in a strict manner since the semi-structured technique gives the researchers more flexibility.

3.9 Sampling strategy

There are two sampling strategies that are divided into groups: probability sampling and non - probability sampling. The purpose of a sampling strategy is to select the most appropriate cases to study to get the required knowledge for answering the research questions (Saunders, et al., 2019). Probability sampling is traditionally associated with random sampling, allowing the researcher to make statistical generalizations of a sample. Therefore, Merriam (2009) argues that probability sampling is more suited for a quantitative approach.

Due to the fact that the probability approach is better suited for a quantitative approach, the choice for this research will be the non - probability sampling. The main advantages of the non-probability sampling are that non-probability sampling techniques are generally easier to administer and provide valid insights (Merriam, 2009). According to Ghauri, et al., (2020) there are three major forms of non-probability sampling used by business researchers.

- Convenience sampling. Is to select conveniently available interviewees. Using this form of sampling, the researcher interviews persons that the researchers know (Ghauri, et al., 2020).

- Judgment (purposive) sampling. With this form, the researchers select individuals subjectively to obtain a sample that appears to be representative of the topic (Ghauri, et al., 2020).

- Quota sampling. The main aim of quota sampling is to select a sample that reflects the main characteristics of the topic. The

researcher might well have some knowledge about the gender composition to ensure the representation (Ghauri, et al., 2020).

For this study, the researchers will conduct a purposive sampling because the purposive sampling strategy is often used when working with small samples, such as in case study research and when the researchers want to select particularly informative cases (Saunders, et al., 2019). To identify the interviewees, they must achieve some requirements, which will be presented below.

The interviewees in this study must:
- Operate in China
- Operate in the manufacturing industry
- Have insights in robotics/automation/digitalization

Due to the lack of time and the corona pandemic it was challenging to collect primary data that complied with our sampling strategy. So,
in order to complete the primary data collection, the researchers have decided to use secondary interviews. The decisive factors of choosing the secondary interviewees were that interviews had to deal with the Chinese manufacturing industry and increased robotics usage. The secondary data also had to be reliable. Therefore, the researchers decided to choose reports from trustworthy sources. So, the authors have to decide to use articles and interviews from large and well-known news agencies. Considering these aspects, the choices of articles and interviews are Industrial robots replacing the dwindling workforce from CBS, and Robots are taking over China's factory floors from CNN and Reshaping the Chinese economy from CGNT.

3.9.1 Second-hand interviews

3.9.1.1 *CBC NEWS*

CBC news is Canada´s publicly owned news and information Service. CBC has journalists stationed in over 40 cities across Canada. But they also have bureaus in London, Beijing, Washington, New York city, Los Angeles and Moscow. Saša Petricic is a senior correspondent for CBC specializing in in international coverage. The last decade Saša Petricic. Has been CBC Asia correspondent focusing on China, Hong Kong and North and South Korea (NEWS, 2021).

3.9.1.2 *CNN BUSINESS*

CNN Digital is the world leader in online news and information. CNN has bureaus around the world. CNN digital platforms deliver news from 4000 journalists from every corner of the world. Andrew Stevens is the Asia Pacific editor for CNN international based in Hong Kong. Stevens is an award-winning journalist specialized in business journalism (CNN, 2021).

3.9.1.3 *CGTN*

CGTN or China global television network is an international media organization. CGTN is headquartered in Beijing but has offices in London, Nairobi and Washington DC their TV channels are available in 160 countries and regions worldwide. Ge Yunfei is a reporter covering business journalism for CGTN (CGTN, 2021).

3.9.2   Interviews

3.9.2.1   *Scanfil*

Scanfil is a manufacturing partner and supplier to customers in international electronics industry. Scanfil has ten production facilities in Europe, USA and China. Scanfil was established in in Sievi in 1976, since the start Scanfil has become the market leader in the Nordic countries and is among the largest companies in its sector in Europe and a household name in the global market (Scanfil, 2021). The reason for choosing Scanfil is because they are an electronic manufacturer operating in China which makes them highly relevant for thesis.

3.9.2.2   *Edmo Lift*

The company was founded in Härnösand, Sweden in 1964. Edmo lift is one of Europe's leading manufacturers and suppliers of hydraulic lifts also known as scissor lifts, pallet handling products and aids for material handling. Edmo lift has supplied their products to industry sectors such as workshop, manufacturing, packaging, processing, healthcare, and research (Edmolift, 2021). The reason why the authors choose Edmo lift for an interview is because they have a production plant in China and operate in the manufacturing industry.

3.9.3 Sample set

This table represents a summary of the interviews. It allows the reader to get an understanding of the duration of the interviews with respective interviewees. The table also demonstrates that both authors participated in the interview and took equal responsibility for the interviews.

Interviewee	Author performing the interview	Date of interview	Time spent on interview	Authors attending the interview
Christian Kesten	David Ahlén Pettersson & Ludwig Sjöström	2021-05-14	50 minutes	David Ahlén Pettersson & Ludwig Sjöström
Thomas Edmo	David Ahlén Pettersson & Ludwig Sjöström	20210-05-17	25 minutes	David Ahlén Pettersson & Ludwig Sjöström

TABLE 3. Own creation 2021.

3.9.4 Operationalization

Operationalization will help the authors turn conceptual ideas into measurable observations. Operationalization helps identify specific indicators that will be taken to represent the ideas we want to present in this study.

Concepts Primary data	Interview Questions	Reasoning
General information	1- 4	To get a general understanding of the respondent and some brief information about the respondent's company.
China	5-9	To get an understanding of the Chinese manufacturing industry and China as a market. And get the respondents perspective.
Digitalization	10-12	To see in which degree robotics part of digitalization has affected China.
Robotics	13-18	Get the respondents, knowledge, and inputs on how robotics effects the manufacturing industry and what visible changes robotics has brought to the sector.
Secondary Data:	Themes	Relevance
The Secondary data, has been collected from interviews conducted by reporters from large news agencies.	All secondary interviews followed a specific pattern. All secondary interviews have been with the CEO or senior staff at a manufacturing company in China. Moreover, all those manufacturing companies have implemented robotics to some extent in their production lines.	The relevance in searching for these themes in the secondary data interviews is to understand the reality in the Chinese manufacturing industry and get the thoughts and ideas from a Chinese perspective on how robotics has changed their reality.

TABLE 4. Own creation 2021

3.10 Author's contribution

Two authors have written this thesis, and the workload through the process of the thesis has been equally divided. Each of the authors has taken responsibility to execute their respective parts in the best way possible. The analysis and conclusions have been written together in order to get nuanced discussions. The authors take equal accountability for the study.

4 Empirical Findings

This chapter will present the empirical findings gathered from interviews with people operating in the private sector and empirical data gathered from supranational organizations and institutes. In each step, we will explain from where the data is collected and explain why we have chosen the data.

4.1 Second-hand interviews

4.1.1 Industrial robots replacing dwindling workforce

In a report by CBC news named the future of "made in China": industrial robots replacing dwindling workforce. The reporter Saša Petricic visited a manufacturing site in Foshan, China, and concluded that robots are slowly replacing aging workers in China's factories. In Ying Ao kitchen utensils manufacturing, nine robots are doing the work for 250 people. The deputy manager at the factory Chen Conghan says when asked by the reporter: *"robots cost less, are easier to manage, they can operate 24 hours a day seven days a week and does not get sick or makes mistakes like human do"*- *Cheng Conghan* (Petricic, 2016). The reporter states further in his more comprehensive article about the subject that the supply of cheap labor is drying up. China's dwindling supply of low skilled cheap labor, which for three decades has been the magic ingredient that has pushed China's economy to the second largest in the world (Petricic, 2016). Deputy manager

Chen Conghan states that *"it is becoming harder and harder to recruit workers and keep them. This work is intense and tiring, so we have to pay people more and more to lure them and keep them"- Chen Congham* (Petricic, 2016).

The reporter from CBC later interviews Jia Jinfu, who is a 56-year-old student at Suzhou Technical College. The reporter stated that Jia Jinfu has been laid off from a chemical plant and now studies to become an electrician. Furthermore, Jia Jinfu states, *"this kind of labor turnover will be the trend, low-end jobs will keep disappearing, and we'll need to know special skills"- Jia Jinfu* (Petricic, 2016). The reporter also interviews another student that states, *"My friends who don't get trained will be competing with machines, I will have a better life through this learning- until I get replaced by a robot as well"- Hou Bingtao* (Petricic, 2016).

4.1.2 Robots are taking over China's factory floors

In a report by CNN Business named: robots are taking over China's factory floors, the reporter Andrew Stevens visits a factory in the Beijing area and showcases "the new phase of China's workforce." Furthermore, he states that China has become the world leader in the usage of industrial robots and that the interest in low-level jobs decreases in China as a consequence of increasing urban wages (Stevens, 2015). The factory that CNN visits have changed their division of workforce. Three years before robots entered the factory floors, 40 people worked in a product line producing 800 computer mice per hour. Now when robots have been implemented, ten people produce the same amount (Stevens, 2015). Pboll Deng, the general manager at Rapoo technology CO, states that "*As long as the price of robots is decreasing and as long as the cost of labor continues to rise, the robot investment is worth it, and more and more automation will happen"- Pboll Deng*. The reporter later

states that the Beijing grand plan for the Chinese economy is to employ the workers in the growing service sector (Stevens, 2015).

4.1.3 Reshaping China´s economy

A report conducted by CGTN showcases the new reality for the Chinese economy. The report is named Reshaping China's economy: Migrant workers, engineers, and robots. The reporter Ge Yunfei states that the cheap labor force is aging and gets more expensive. The average wage has increased 50% over the past six years, and factories desperately search for migrant workers. The reporter states that Chinese manufactures have three alternatives which are leave, die or change. Furthermore, the reporter visits a cashmere clothing factory in Dongguan to showcase a manufacturer who has chosen to change their work division. CEO of Ingio clothing Li Shengli states that "*in three years it will be totally different here, automated machines that can weave clothes will fill this rooms"- Li Shengli* (Yunfei, 2019). The reporter further asks what will be happen to the 200 workers at the factory. Li Shengli says that in three years, only 60 workers will be needed. Cheng Li further, states that their revenue has grown from 10 million Yuan to over 100 million Yuan due to the breakthrough they made in smart manufacturing. The reporter further explains a pattern with increasing labor costs, and manufacturers more and more are using robots to replace humans. With the uncertainties of the trade frictions between the US and China, the reporter states that many factories are leaving China for other low-cost countries to find cheaper labor. Harley Seyedin, the China American chamber of commerce president, tells the reporter, "*labor-intensive products will naturally move to other markets as they transition their economy from export manufacturing to consumer-based economy"- Harley Seyedin* (Yunfei, 2019). He further says they are expecting some industry to move out of China, but they also expect some new industry's moving into China, to

take advantage of China's growth. Later on, the reporter presents the newest manufacturer in Guangzhou Foxconn, an iPhone manufacturer that has recruited 15,000 engineers and 50 000 postgraduates. The reporter interviews Professor Yan Se from Peking University, the professor explains that China's skilled labor cost are one of the lowest in the world and that Chinese engineers are highly productive and extremely hard working for a relatively low price. To end the news report, Ge Yunfei states that China's golden age relying upon cheap labor is over, but they still have the world largest pool of skilled labor (Yunfei, 2019).

4.2   Scanfil

4.2.1   Christian Kesten

Scanfil is a mid-sized global electronics manufacturing service, henceforward EMS, which for example can be telephones and computers, working with contract manufacturing. Scanfil is number three in Europe when it comes to EMS. The company was founded in Finland, where their headquarters also are located. However, they have ten factories located worldwide, for example in the US, Europe, and China. Scanfil are also operating with product outsourcing, which means that they don't own their products, they simply produce the products for their customers. Their customers often focus on low- mid volume, which annual results in about 10000 - 500000 units. The segments that Scanfil are working with are med - tech, life sciences, energy, clean - tech, connectivity, automation, safety, and advanced consumer application.

Christian Kesten, is general manager responsible for Scanfil´s operation in China, Suzhou, with 600 employees. He is also responsible for performance, profit, and local sales activities. Christian Kesten has been working in China for 18 years overall and with four years' experience working for Scanfil.

4.2.2   China:

Christian Kesten mentioned that when he arrived in China, the Chinese economy was characterized by being a powerhouse of manufacturing. He said that a lot of companies established their production in China due to the access of cheap and well-educated labor. The fast-economic growth in China is a result of the increasing middle class in the country which in turn has led to a more local market which has been established in the country.

He mentioned one difference between when he arrived and how it looks today, it was the fact that the costs of production in China have increased, yet it is the largest manufacturing market in the world. One reason behind this particular phenomenon is the five years plan implemented by the Chinese government. The government invested a lot to increase education in the country. Which has resulted in a strong middle-class. Kesten also stated another example which characterizes the Chinese economy, which is the fast changes in society, which in turn leads to that the actors in China are not afraid of changes. Many actors are curious about new developments, which can be utilized by companies. China is also very fast to adopt and implement new technologies.

During Christian Kesten´s time in China, he has really witnessed a trend of robotics in the Chinese manufacturing industry. However, it is not as simple as traditional robots, it is just a part of the digitalization. He mentioned that automation solutions are the most important aspect in the manufacturing industry. Which consists of handling of material, movement of material, and integrated systems. With the usage of smart manufacturing, Scanfil takes advantage of automation and digitalization to reduce the amount of waste, which is a tangible trend in the manufacturing industry. Kesten said that robots are an absolute necessity in order to stay competitive in the business.

Since Scanfil is an EMS and selling services, they need to be capable of producing their products efficiently. With this in mind, they need to cope with changes to stay competitive. therefore, they need to invest in digitization and automation. In order to succeed with this one needs to have well-educated labor, and competent integrators.

According to the respondent there is only a matter of time before China will become the largest economy, which actually accelerated during the corona pandemic. The aggravated relationships between China, USA and Europe, will not have as great impact on the Chinese economy, as it will have on the USA and Europe due to the large domestic market. Nowadays a more local to local approach has been implemented in China, where companies produce units for the local market. Which is a factor for China to continue their economic growth. It is estimated that the GDP growth in China this year will reach double figures.

Since Christian Kesten moved to China about 20 years ago he has seen changes in the Chinese production industry. Back then the companies like Siemens and Nokia, had their productions in Europe and the production lines were automated which included assembly, testing, and packing. However, these production lines were very expensive and took a long time to put together, which led to limitations in the products. Another problem that occurred was that the flexibility was inhibited. Which were the decisive factors for them to move to China. However, the testing remained in Europe, but the assembling was moved to operators in China. The respondent stated that one production line could consist of 50 people, but in the last 10 - 15 years the demands for automatization have increased, especially regarding different test platforms.

4.2.3 Digitalization:

The respondent has seen indications that the division of work will be changed, which will lead to that they can offer services to the customers due to better traceability and to connect different systems with each other. This means that they require higher competence of the production personnel in order to take care of the automatization equipment. The demand for competent technicians will also increase. Another consequence is that workers in the production line will be replaced by technicians and engineers to a larger extent due to increased automation. This means that the Chinese market will continue to be a competitive market even with the increased production costs in the country.

The respondent answered that the purpose is not to be fully robotized, but rather a question of increasing efficiency. Since Scanfil are operating in low - mid volume one advantage that Kesten mentioned were the increased flexibility when using the robots. He stated that the standard processes will be automatized to a greater extent than the product unique solutions which will still remain as manual work. The interplay between the robots and the manual work will also increase the flexibility in the production process. Once again, the respondent mentioned that the traceability is a great advantage, in order to go component level of the product.

4.2.4 Robotics:

The respondent said that *"increased wages in the manufacturing industry is one of the largest challenges for china, where the estimated wage increase is to be at 4 - 5 % annually, which has been even higher earlier. The main factor for usage of robots/automation is to increase the non - manual work"*.

The respondent said that there is a recognized trend that the robots are overtaking jobs in the Chinese manufacturing industry and are designated in the five years plan. The Chinese government has initiated a program called "China 2025 initiative", which intends to give China the opportunity to advance in the global value chain. One tangible goal is to increase automation and robots. China has for a long time been after Europe and Japan in the development of robots, but with this program they intend to surpass them in order to advance in the value chain. Another change in the labor market is that Chinese employees are working in India as technicians and engineers while Indians are working as operators. Which was the case in China when Europeans started their production in China.

Regarding the technicians there has been change for the workers. However, the low skilled workers have not changed their tasks to such a large extent. This is a result of the fact that the requirement on technicians increases as the development of automation becomes more advanced. This is a development that according to the respondent will continue.

In order to stay competitive Scanfil needs to introduce robots, digitization, and automation solutions. The respondent mentioned that in order for the systems to work, one needs integrators to connect the systems with each other. One advantage by being located in Suzhou, is the emergence of clusters of integrator companies being established in the area, which have led to high skilled labor is a demand around this area, as a result of the introduction of robots, digitalization, and automation. The respondent answered that profits are invested in technologies with the purpose of increasing productivity. A third of Scanfil´s profits is reinvested in new technologies to have a competitive edge. With the investments in digitalization Scanfil can offer better professional services for their customers. One example is producibility where Scanfil can offer DFN, DFT,

and DFA analysis with tools that can calculate risks. Which gives the customer an indication of how they can reduce the costs of their production, which is one opportunity that has arisen due to investment in digitalization, robots, and automation. The job opportunities that have arisen are connected to these services. Which results in that Scanfil can offer a complete solution for their customers.

4.3 Edmo Lift

4.3.1 Thomas Edmo

Thomas is a co-owner of Edmo Lift who, on a daily basis, works with business development with the Netherlands, Italy, England, and the Baltic states as an area of responsibility. Edmo lift manufactures and sells material handling equipment. Their core business is hydraulic lifts, also known as scissor lifts, that can be used in most industries related to material handling. Edmo Lift has representatives in almost all parts of the world. Thomas has been active in this business for 30 years.

4.3.2 China:

On the question regarding the characteristics that has made China the fastest growing economy and one of the largest economies in the world he answers that: China is a dictatorship but a dictatorship that has worked hard to add jobs and infrastructure. In a dictatorship, decisions processes happens fast when they decide on something "*if they decide to build a motorway and make the decision on Friday, they will start on Monday*".

Edmo lift has had a partner in China since 1996. Thomas states that during all these years, the Chinese state has subsidized steel to some extent, and they have done so to boost the economy and create a more lucrative offer for foreign companies. Edmo Lift has viewed this as lucrative since hydraulic lifts contain steel to a large extent.

Thomas also states that the salary situation has been lucrative. When Thomas traveled there for the first time in 1996, the monthly salary was approximately SEK 800 for a worker, but today the same worker earns SEK 6,000 per month, so he has seen development.

Thomas mentions that when they visited the factory in China for the first time, all the workers came from another province and lived for a year at the factory and were very eager to work.

4.3.3 Digitalization:

Thomas says that they have seen the development of technology. He says that they have adapted to Western technology quite a lot. Thomas states that the journey from when they were there for the first time is palpable compared to how it is now. *"Now they have welding robots, powder painting, and more automated facilities." In the beginning, there was a lot of hands-on while handling the products. They used human resources instead of machines"*.

4.3.4 Robotics:

Thomas also says that robots have had a positive impact on the industry in the sense that quality has increased to a large extent. *"The first order we made for a lifting table came in a container, and when we unloaded it, the products were in the wrong color, and when we tested the product, we loaded a table with 1000kg, welding cracked, and the table fell to the ground"*.

Thomas claims that robots in the Chinese industry will increase all the time, but he does not believe in an excessive difference in the number of employees *"if they are 100 employees in a factory, I do not think they will be 50. Instead, a reduction of 20% labor will come as a result of automation"*. Thomas does not believe in halving the workforce. Even though there is talk

of industry 4.0 where one should not touch the products, it will still take humans to verify and see that everything is done correctly.

Thomas believes efficiency and quality will be improved due to robotization regarding robots' effects on the industry. When asked if Thomas has seen any correlation between the increased number of robots in the industry and increased salaries, he answers that the technical knowledge for those who will handle these robots is higher than before when workers were used. He generally thinks that one can see a difference in the purchasing power of the Chinese population as well. He means that in the past, the workers lived in the factories and sent the money home to their home province, but now that has changed, and people prefer to get an apartment and want to consume more as an effect of the increased wages.

When asked if he thinks robots will take over the jobs in the industry, he answers that he thinks human interaction will be necessary, and as he mentioned earlier, he believes more in a 20% reduction in labor instead of 50% if he were to make his estimate.

On the theory that the emergence of robots creates more job opportunities than developing would not happen. Thomas answers Edmo Lift has seen a business opportunity by using a robot called AGV to avoid trucks inside the factory. So, they have seen more business opportunities than job opportunities so far.

He finally states that even if robots increase, there will still be a need for workers managing robots. He believes that development is driven to be implemented in industry 4.0. Thomas thinks that even if everything is to be automated, a certain amount of human interaction will still be needed. He sees robots as a good way to ensure quality and increase production volumes when required in the event of a large order intake. He means that instead of

having to call in an extra shift of workers, you start the robots another round. Robots enable companies to stay productive despite less staffing.

Thomas also says, *"when we were in China for the first time in 1996, the workshops looked much like they did in Sweden in the 50s and 60s, with large-scale presses and outdated machines in general. But only after ten years had they caught up with western countries, within workshops industry, they are no stranger to changing their production processes"*.

5 Analysis

This chapter will include an analysis to connect the literature review and the empirical findings that has been collected through interviews and second-hand interviews.

5.1.1 China

In accordance with Cavusgil et al., (2013), China is classified as an emerging economy, which is characterized by a transition from a developing economy to a developed economy (Cavusgil et al., 2013). This statement is confirmed by both interviewees, who have seen changes in the manufacturing industry. Both regarding quality and an increasing local market, Thomas Edmo has experienced changes in the environment in the industry during his years in China. When he first arrived in China, the factories were outdated, and however, nowadays, the factories are using high technological solutions, which according to Cavusgil et al., (2013), is an attribute of an emerging market (Cavusgil et al., 2013). Kesten has seen another occurrence in China that is a feature of an emerging market, viz the fact that China is making attempts to advance in the global value chain. With the "China 2025 initiative", China has the goal to surpass Japan, the US, and Europe regarding the development of robotics and automation. Also, the five-year plan implemented by the Chinese government has resulted in the middle-class in China has increased, which has led to Chinese companies approaching a more local to local business environment, especially regarding consumer-based services. Thomas Edmo has seen that there has been an increase in consumption regarding apartments and televisions, which also corresponds to Harley Seyedin's statement, *"labor-intensive products will naturally move to other markets as they transition their economy from export manufacturing to consumer-based economy"*- Harley Seyedin (Yunfei, 2019). This occurrence

is a significant characteristic of emerging markets, transitioning from low-developed technology to high technology production (Cavusgil, et al., 2013). This is also a result of the substantial middle class in China because the Chinese population has stronger purchasing power than before. This circumstance reflects the increasing GDP rates in China, which are estimated to reach double figures in 2021.

As Cavusgil et al., (2013) stated, that the ease of doing business in China has increased due to India's and China's free-market reform (Cavusgil, et al., 2013), is to some extent confirmed by Kesten. He said that Chinese companies had moved some of their technicians to India while the Indians are working as operators. So, the Chinese companies have internationalized their production, enabled by the technological developments. This is also in line with Ho's statement that foreign transfer of technology has been made possible by digitalization which increases mobility. Kesten mentioned that one of the greatest advantages of digitization is the movement of material. This is also true in accordance with the report "reshaping China's economy," which states that manufacturers are leaving China for other cheap-labor markets (Yunfei, 2019). This strengthened Kesten's statement that he has seen manufacturers move their production abroad, which according to previous statements by Cavusgil et al., (2013) and Ho, et al., (2011) is a tangible result of the digitalization and increased numbers of robots (Cavusgil, et al., 2013) (Ho, et al., 2011).

Both the interviewees had noticed that there has been an increase in the production costs and that there have been increased wages in manufacturing industries. As Cheng, et al., (2019) mentioned, the annual growth rate between 2006 - 2015 was 9,3% (Cheng, et al., 2019). Thomas Edmo mentioned in his interview, that he had experienced an increase in wages. And as Christian Kesten said, that the estimated increase of wages is 4-5%

annually. However, Christian Kesten has witnessed that the wage rates have been higher earlier.

5.1.2 Digitalization

Bührer & Hagist mentions that in earlier economic literature, a standard assumption is that technology drives growth and positively affects employment. At the beginning of digitalization, that thesis was accurate since technology helped workers be more productive since they could focus more on other things. However, technology has developed so fast and successfully that many workers are not needed in the same amount nowadays. In addition to the general digitalization changes of the work process, society might have to react and adapt regarding their demographic situation and education system (Bührer & Hagist, 2016). Christian Kesten mentions in the interview that cheap well-educated labor is very accessible in China. He further states that the Chinese government has invested a lot in increasing education in the country. Education has been a redline and is mentioned in all interviews. Jia Jinfu, a 56-year-old student who was laid off from a chemical plant, says in the interview with Petricic that *"this kind of labor turnover will be the trend, low-end jobs will keep disappearing, and we will need to know special skills"- Jia Jinfu* (Petricic, 2016). Another student at the university states that *"my friends who do not get trained will compete with machines, I will have a better life through this learning"- Hou Bingtao (Petricic, 2016).*

As Bührer and Hagist (2016) mentioned, society reacts and adapts regarding their demographic situation and education system (Bührer & Hagist, 2016). Thomas Edmo states that the technical knowledge of the persons handling robots is higher now than earlier. He further states that he has seen a change in the demographic situation. He mentions that a pattern of instead of traveling from the provinces to factories, they now stay, buy an apartment, and consume more. Ge Yunfei also mentions that Foxconn in Guangzhou has

recruited 15,000 engineers and 50 000 postgraduates to their new manufacturing plant (Yunfei, 2019). Furthermore, Professor Yan Se from Peking university explains that China's skilled labor costs are one of the lowest globally and that Chinese engineers are highly productive and extremely hard working for a relatively low price (Yunfei, 2019). Ge Yunfei also mentions that China's golden age relying on cheap labor it's over, but they still have the. World largest pool of skilled labor (Yunfei, 2019).

5.1.3   Robotics:

 Cheng, et al., (2019) stated that China is the world's largest industrial robot user. In 2016, industrial robot sales in China reached 87,00 units which back then accounted for approximately 30% of the global sales. The manufacturing sector was responsible for over 80% of China's industrial robotics use (Cheng, et al., 2019). Ballestar, et al., (2021) further argues that the effect of this technological revolution is complex and not fully understood. They further contend that the effect on employment has attracted a large amount of interest and that in 2019 the organization OECD estimated that 14% of current jobs might disappear because of automation and 35% can be seriously affected by automation (Ballestar, et al., 2021).

Both interviewees have witnessed the increasing numbers of robotics and their effects on the labor situation. Christian Kesten said that there is a recognized trend that robots are overtaking jobs in Chinese manufacturing. He further explains that the Chinese government has initiated a program called the "China 2025 initiative," which intends to give China the opportunity to advance in the global value chain. And with a tangible goal of increasing automation and robots. Christian also stated that Scanfil does not aim to be fully robotized but rather a question of increasing efficiency. Since Scanfil is operating in low-mid volume, Kesten mentioned the increased flexibility when using the robots. He stated that the standard processes will

be automatized to a greater extent than the product's unique solutions, which will still remain manual work. The interplay between the robots and the manual work will also increase the flexibility in the production process.

Thomas Edmo follows the same line and claims that robots in the Chinese industry will increase all the time, but he does not believe in an excessive difference in the number of employees, he states "*if there are 100 employees in a factory, I do not think they will be 50. Instead, a reduction of 20% labor will come as a result of automation*".

Thomas does not believe in halving the workforce. He explains that even though there is talk of industry 4.0 where one should not touch the products, he still believes human interactions are needed to verify and see that everything is done correctly. Both Thomas and Christian have stated that human interaction will be needed in some extent which also follows what Kumar, et al., (2020) who argued, that Some inputs and outputs by humans will exist, but most tasks will be performed by smart machines (Kumar, et al., 2020).

In the report by CNN business, a more excessive presentation on the question of robotics overtaking jobs, Andrew Stevens argues that interest for low-level jobs has decreased (Stevens, 2015). While visiting a Chinese factory, he further showcased that their production line has decreased from 40 workers to ten since robots entered the factory floors. Pboll Deng, the general manager at the factory Stevens visits, states that *"as long as the price of robots is decreasing and as long as the cost of labor continues to rise, the robot investment is worth it. Moreover, more and more automation will happen"- Pboll Deng* (Stevens, 2015).

In the book robotics for electronics manufacturing, Karl Mathia (2010) lists economic factors of why investment in industrial robotics over human labor

is essential. Which is reduced labor cost, improved productivity, improved and more stable product quality, and resource conservation (Mathia, 2010). On the question regarding the perception of robotics in the manufacturing industry, a common denominator between the interviewees and the second-hand interviews is that they have a positive perception of robotics in the manufacturing industry. Thomas Edmo mentions that robots have had a positive impact on the industry in the sense that quality has increased to a large extent. "*The first order we made in 1996 for a lifting table came in a container, and when we unloaded it, the products were in the wrong color, and when we tested the product, we loaded a table with 1000kg, welding cracked, and the table fell to the ground*". Thomas further believes efficiency and quality will be improved due to robotization. Deputy manager at Ying Ao kitchen utensils manufacturing Chen Conghan states that: *"robots cost less, are easier to manage. They can operate 24 hours a day, seven days a week, and do not get sick or make mistakes like humans do"* (Petricic, 2016).

Christian Kesten further mentions that Scanfil takes advantage of automation and digitalization to reduce the amount of waste. He also states that robots are an absolute necessity in order to stay competitive in the business. Horvat, et al., (2019) argues that digitalization enables manufacturing companies to manage and control their internal production system (Horvat, et al., 2019), which to some extent follows Christian's statement regarding reduced amount of waste in production.

CEO of Ingio clothing Li Shengli states that their revenue has increased from 10 million Yuan to over 100 million Yuan as an effect of the breakthrough they made in smart manufacturing (Yunfei, 2019). Clint Heyer (2010) states in his report human-robot interaction and future industrial robotics applications that the core value proposition of an industrial robot is to perform tasks continuously and accurately in the work environment, and

scales are difficult for humans. Robots integrate with other factory systems, which enable so-called just-in-time production, which supports a new level of economically viable bespoke manufacturing (Heyer, 2010). Thomas Edmo and Cheng Congham have emphasized that the flexibility of producing high volumes during times of big order intake and quality assurance has been a result of robotics entering the factory floors.

6   Conclusion

This part of the thesis will include our conclusion and answer our research questions. It will also be subject to the consequences of the results. Finally, limitations of the study and suggestions for future research concerning this subject will be presented.

The general conclusion one can draw from the empirical findings and the analysis is that there have been obvious changes in the manufacturing industry. The division of work has changed to an environment where there are more technicians, engineers, and integrators than traditional manual workers. Another significant change that has emerged due to this phenomenon is that Chinese manufacturing companies have moved some of their production to other countries with less wages and production costs overall, taking advantage of cheap operators but still using well-educated Chinese workers as technicians, engineers, and integrators. The fact that they are moving some of their production abroad has been the most unexpected finding from this thesis. However, a more elaborated conclusion regarding the research question and the sub-questions will be presented in the following paragraphs.

6.1 Answering the research question

In response to the research question, the authors have seen an impact on the manufacturing industry due to the increasing robotics, automation, and digitalization. One obvious consequence is the growing middle class in China which in turn had led to a more domestic and local market characterized by consumer-based services. Which was not the case when the interviewees of this study first came to China, back then china was characterized by being a manufacturing powerhouse with cheap and low skilled workers. Nowadays, the manufacturing industry is developed with high technological automation solutions. The growing middle class has enabled the domestic market to grow due to the increased purchasing power, resulting in the GDP in China having seen drastic increases during the last years, where the estimated GDP rates are predicted to reach double figures. So, there have been positive effects on the Chinese economy due to the modernized manufacturing industry, to the requirement of a more competent workforce where the Chinese government has put much effort to promote education in order to cope with the digital challenges. In the large picture, there have been mostly positive effects. However, the old, uneducated workforce is suffering from this development.

6.1.1 Answering the sub question

After analyzing the robotics effects on Chinese manufacturing the authors can conclude that robotics has created both positive and negative effects for the manufacturing industry and the Chinese Economy.

6.1.2 Positive effects

After comparing the theoretical framework with statements from our interviewees and the content in the second-hand interviews, we can draw the

conclusion that increased higher-level education has been a common denominator as an effect of robotics in manufacturing. The transition from low-skilled labor has resulted in the Chinese population choosing education to find a good job and avoid competing with robots that are taking over the production lines in traditional low-skilled labor factories. China has made a tremendous transition from the world's largest pool of cheap labor force into the world's largest skilled labor pool. Robotic effects on education are positive for the manufacturing industry since it results in more competent personnel and positive for the Chinese economy since higher education results in higher wages for the workers, which means they will have more money to consume.

Another positive effect on the manufacturing industry is the increased quality of the manufactured products. Both interviewees have mentioned that there has been a severe change in quality since they first visited China. Robotics has enabled a new level of quality insurance, enabling the companies to decrease manufacturing waste and increase their volumes, quality, efficiency, and revenue. Robotics has created a higher standard for Chinese manufacturers, which is good since foreign companies can see quality assurance as beneficial. The authors can see that robotics has created a higher standard with well-educated staff in the manufacturing sector.

The financial aspects for the manufacturing companies have also been positive since robotics entered the factory floors. Robots have enabled companies to decrease their labor cost. On the other hand, a conclusion can be drawn that robots help companies increase their revenue since robotics can operate 24/7 and produce high standards; it has helped companies expand and maintain or develop their competitive edge.

6.1.3 Negative effects

The negative effects of the increased number of robots and automated solutions mostly affects the elderly labor without any education as Hou Bingtao said that his friends without any education or training will be competing and, in the end, replaced by machines. Bingtao is aware that machines will replace him as the development of robots will continue to be a tangible trend in the Chinese manufacturing industry. This could be problematic since the elder has to change their career at a late stage in their life, which is an issue because the elder is not an attractive selection for the employers to hire. As mentioned in the interviews, the respondents have witnessed a more consumer-based market with a focus on services.

Another consequence of robotics and automatization is that Chinese manufacturers are leaving the domestic market and exploiting foreign markets, for instance, in India, where the product cost is less than it is in China. This affects the elderly population in China negatively because the work opportunities for uneducated workers are reduced when large manufacturers are leaving the market. However, this is an opportunity for workers with an education, especially technicians responsible for the robots to function effectively. So, it is evident that the labor market has changed in China due to robotization, where the educated gain from the changes while the uneducated workers suffer, as the wages in manufacturing are increasing. The increased wages are a reason why manufacturers are leaving China to seek opportunities in countries where the costs and wages are less than in China. However, as Kesten mentioned, there is still a demand for manual workers to some extent, but there has been a significant reduction regarding that matter. Nevertheless, as the development of automation continues, the demand for low educated labor will decrease, leading to continuously

increasing wages as the demand for competent integrators, technicians, and engineers increases.

A paradox with the increased robots and automatization is that the main purpose of these solutions is to increase efficiency in production. But as the development continues, the complexity of integrating all the systems becomes more difficult. So, there might be some issues regarding this matter because companies in the manufacturing industry have to choose to which extent, they want to implement robots, respectively, how many integrators they want to include in their operations. This necessarily does not have to be a negative effect. However, it is an important aspect to consider to meet the demand of the number of robots and the number of integrators. Without taking this into account, a company can have a shortage of integrators, which will result in that it will be difficult to connect the system with each other, and thereby, the production efficiency will not be optimized as well as it could be. The other way around, i.e., that there is an abundance of integrators will result in the companies' facing unnecessary costs in their operations and harming their business. So, it is of most importance to have a balance between robotic systems and integrators to optimize the effectiveness of the production. Therefore, the companies in the manufacturing industry need to decide to which extent they are capable of implementing robots and still have the right amount of integrators.

6.2 Theoretical implications

Robotic effects on the manufacturing industry are a well-researched topic. The impact robotics will have on humanity is a subject that has been researched for many years. However, the researchers of this thesis assessed that a small research gap could be identified regarding the positive and negative effects robotics have on the Chinese manufacturing industry and

how that affects the labor market. There is previous research about robotics in Chinese manufacturing and on the Chinese labor market, but the authors of this thesis assessed that the gap in earlier research was to present the most relevant positive and negative effects of robotics in a clear fashion.

Previous literature on robotics in manufacturing has mainly focused on the spectra of Industry 4.0 and how it will change the business climate for companies in terms of production and their willingness to change their company infrastructures and traditional business models. Hence, earlier research has touched upon the subject that the researcher of this thesis investigates. But the authors felt the need for further evidence-based research that could contribute to the theory of this subject and present the general positive and negative effects of robotics in manufacturing and with a particular focus on how the labor market is affected.

6.3 Practical implications

The empirical findings that have been collected through interviews and second-hand interviews showcase the positive and negative effects of robotics in Chinese manufacturing. The findings aim to create a broader understanding of the characteristics of manufacturing's correlation with education, quality, and the labor market in terms of robotics. The findings in this thesis show that education has played a significant role in the changes of the division of work and that robotics has contributed to an increase in quality and efficiency in Chinese manufacturing that can enable revenue for companies. The findings also contemplate the changes when low-skilled labor increases and how complex the integration systems can be for companies. The findings of this thesis might be interesting for other researchers aiming to investigate how robotics changes the manufacturing landscape in China.

6.4   Limitations

During the process of this thesis, certain limitations have been identified that influenced the quality of the empirical findings and on the thesis overall. One limitation that became apparent early in the research was the coronavirus, which precluded the researchers from having interviews on-site. The authors then had to have digital interviews, which could have hampered the chance of collecting data in a natural setting. However, the authors believe that this obstacle was overcome in an effective manner. Another limitation that occurred was the difficulties in finding interviewees that matched the sampling strategy. However, it was complemented with secondary data which were relevant to the subject. A third limitation was that the authors believe that there was a lack of time to conduct interviews and compile the empirical findings. Almost all literature, journals and articles from the literature review could be matched with the empirical findings in the analysis to some extent. However, the "what defines digitalization" part in the literature review, didn't fill a purpose in the analysis, due to the fact that the part was too broad, and therefore, it could not be connected to the empirical findings and the analysis. Nevertheless, the authors still believe it fulfills a purpose for the literature review and the thesis in general, since it creates a greater understanding for digitalization. Yet, the authors are satisfied with the results of the empirical findings.

6.5   Suggestions for future research

Research regarding robotics/digitalization/automation in the Chinese manufacturing industry has been subject to earlier research and has been discussed to a relatively large extent. However, just regarding how it will affect the Chinese labor market, which this thesis has discussed, has been lacking research. The authors suggest that a subject for future research will

be to see how economies in nearby countries will be affected by the fact that Chinese manufacturers are moving their production to these countries. And to see if these countries will face the same development as China has faced.

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8   Appendix

Appedix A:

8.1   Interview Guide

General information:

1. You work at? What services does your company offer?

2. What is your position in the company, and what are your tasks?

3. Which country do you operate in?

4. For how long have you been working with this?

China:

5. What do you believe is the most palpable characteristic of the Chinese economy that made them the fastest growing economy and one of the largest economies in the world?

6. What is your perception of robots in the manufacturing industry?

7. And how will the increased numbers of robots affect the industry?

8. What's your opinion on the future for China regarding society and various industries in terms of economics?

9. What changes have you witnessed in the Chinese production industry since you started work there?

Digitalization:

10. How do you think Digitalization will change the division of work?

11. Do you think that Digitalization/robots will change the future of the economy in society and the manufacturing industry?

12. What do you believe are the largest advantages for you as a company in the manufacturing industry, with a higher degree of usage of robots?

Robotics:

13. Have you noticed a correlation between the increased wages in the manufacturing industry and the increased numbers of robots in China?

14. Is there a trend of robots overtaking jobs in the Chinese manufacturing industry?

15. Have you witnessed a trend where workers change their tasks at the workplace due to technological developments?

16. One theory states that the emergence of robots creates more job opportunities than if the development would not occur. Do you think this is true? If so why?

17. Due to technical progress and a subsequent fall in prices generated by the technology. These profits are invested, and new productions and jobs are created as a result. Do you think this is a reasonable statement? If so why?

18. Have you seen that new work opportunities have arisen due to the increased numbers of robots?

8.2 Interview protocol

In order to make sure that the authors of the thesis follow GDPR directives, an interview protocol was established to ensure both the interviewees and the authors that GDPR was followed during this thesis.

Interviewees:	Thomas Edmo	Christian Kesten
Do you want to be anonyms?	No	No
Do you accept the interview being recorded?	Yes	Yes
Do you accept to have your name mentioned in the thesis?	Yes	Yes
Do you accept having your statements mentioned in the thesis?	Yes	Yes
Do you accept that your company´s name is mentioned in the thesis?	Yes	Yes

TABLE 5. Own creation 2021