# Industry 4.0 and the impact on the World of Work

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**ABSTRACT,**
***The purpose of this research paper is to identify the effects Industry 4.0 has on the world of work in purchasing. Industry 4.0 is a current trend within the business world, which mainly revolves around the topic of automation and data exchange. The initial stage of this research paper involves a semi-structured interview with multiple firms to find out which firms have implemented Industry 4.0 applications, and which have not. Information from previous research papers on Industry 4.0 have been used to validate the answers which were given during the interviews. The final stage of this research paper involves examining the answers given during the interviews and applying it to the topic. Results implied that future implementation of Industry 4.0 may require workers to be retrained and skill gaps to be closed. Thus, the study at hand shows that the world of work is definitely impacted through the implementation of Industry 4.0, however, the magnitude and sign of the impact is industry and company specific. Research implications include smaller companies not having the financial and human labor capabilities like bigger companies, and therefore are less likely to implement Industry 4.0 applications. Hence, reflecting on the company characteristics and the employees working there.***

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# 1. INDUSTRY 4.0 AND HUMAN LABOR: A STUDY INVOLVING DIFFERENT INDUSTRIES

There has always been a concern within the world of work that technology will take over a vast majority of our activities, such as purchasing items for supermarkets or other stores. Items are stored in a database, and once the items reach a certain limit, the database sends out information to its suppliers for restock. As we entered the fourth industrial revolution, the chances of something like that happening has increased. Along with the fourth industrial revolution came a trend which integrates real world of work (including employees and machinery) with virtual computer networks, creating a so called cyber-physical system. In 2011, the German Government introduced a visionary concept called 'Industry 4.0', of which different topics can be seen in Figure 1 in Appendix A. "Industrie 4.0 (Industry 4.0 (I40)) is a national strategic initiative designed by the German Government through the Ministry of Education and Research (BMBF) and the Ministry for Economic Affairs and Energy (BMWI). It aims to drive digital manufacturing forward by increasing digitization and the interconnection of products, value chains and business models. It also aims to support research, the networking of industry partners and standardization". (Klitou & Conrads, 2017). Therefore, these production systems will have the ability to autonomously optimize themselves without the intervention of a human. Due to such interconnectivity, large amounts of data are being transferred between systems. This paved the way for the term Internet of Things. Internet of Things, or IoT for short, allows objects such as machines to communicate with each other through the internet on a real time basis. Moore's Law, which states that the number of transistors on an integrated circuit doubles about every two years because the processing power has increased exponentially (Staff I, 2003), largely justifies why it is possible for such developments to be made. With the years to come, Industry 4.0 is becoming more of a priority than anything else. Both Universities and Companies are already adopting Industry 4.0 applications and will continue to do so. As it is a difficult and lengthy process to implement, and still a relatively new topic, to many the term is still quite vague. A statement made by Reuters online says that, "99 percent of companies with up to 500 employees that form the backbone of Germany's export-led economy, known as the Mittelstand, are still working out how to get with the program, dubbed by German politicians as Industrie 4.0" (Copley & Prodhan, 2016).

Having briefly discussed the background of Industry 4.0 and other factors like cyber-physical systems and internet of things, it is possible that these systems might cause more harm than good to both organizations and employees within the organization in the near future. For example, a study finds that by 2030, around 800 million jobs worldwide could be lost due to automation (Vincent, 2017). This might not only affect low skilled employees but also those of high skill including management representatives of a company (MIT, n.d.). Germany, being the "fifth largest economy in the world and Europe's largest in terms of Purchasing Power Parity (PPP) (C., 2018), can be hit very hard. Germany has a very large industrial base compared to other countries, accounting for 30.1% of total GDP. (C., 2018). This places the workforce within the industrial sector under immense pressure as they try to stay employed.

With the implementation of Industry 4.0, all companies in all sectors would need to change their decision and business processes. For small and medium enterprises this can be a serious struggle. Despite being one of the five largest economies in the world, Reuter online states that if smaller enterprises "continue to drag their feet on implementing Industry 4.0 practices, Germany could lose a 425-billion-dollar opportunity" (Copley & Prodhan, 2016).

However, even if smaller companies have their doubts about Industry 4.0, they are being forced into doing something they might not want to do. Consequences of this however is that they could go bankrupt due to the increasing amount of competition that is being created due to Industry 4.0 and loss of jobs. This will be discussed further in the sections below.

The structure of the thesis will outline the following: First the research question and sub questions are presented. This is followed by the literature on Industry 4.0 and the implications it has on the world of work. After that the theoretical framework and the research methodology of this study is explained. Next, findings based on six companies will be presented, which includes a discussion of those findings. Lastly, the thesis discusses limitations and directions for future research.

# 2. RESEARCH QUESTION AND SUBQUESTIONS

In order to get the best overview of Industry 4.0, this research focuses on companies that are pursuing or willing to pursue Industry 4.0 in the future. To get the appropriate information, this multi-firm qualitative study consists of both Primary (field) research and Secondary (desk) research for collecting and evaluating information regarding the topic of Industry 4.0. Given the potential harm that Industry 4.0 could do to both workers and organizations, the following research question was posed:

*How have workers' tasks and job descriptions changed within purchasing departments with the implementation of Industry 4.0 and how will it affect the future?*

In order to understand the answer to the main research question, a few sub-questions need to be highlighted and understood. These are important because they explain the main research question to some extent, yet also provide more information on the companies themselves. Below are the sub research questions with a short explanation of why they are relevant for this research paper.

## *Sub-question 1*

*To what extent have firms implemented Industry 4.0?*

- To know whether or not different companies already implemented some Industry 4.0 applications.

## *Sub-question 2*

*What are the risks and opportunities employees and companies face when implementing Industry 4.0?*

- to get a better understanding of the risks and benefits employees and companies face because of Industry 4.0

To answer these two sub questions and the main research question, theory needs to be compared to thoughts from the companies which are involved in the study. The results of the study will clarify to what extent and what risks and opportunities there are through the implementation of Industry 4.0 in purchasing.

# 3. LITERATURE REVIEW ON INDUSTRY 4.0: REPERCUSSIONS OF AUTOMATION ON HUMAN LABOR

The following section states relevant publications about industry 4.0, cyber-physical systems, internet of things and how these affect human labor.

Martin Ford, who wrote the book "Lights in a Tunnel" in 2009, designed a scenario which talked about the implications technology like cyber-physical systems and other fast-growing technology may have on the employability of humans. In his analysis of how technology impacts peoples' jobs, he mentions that these rapidly evolving technologies like artificial intelligence will not only affect jobs which do not require much skill (which are also usually low-wage jobs) but will also take away highly skilled jobs. This is due to the fact that the new technology will have the ability to adapt to changes and learn from mistakes which enables computers to do the same job at a faster rate compared to humans who need to go through significant training to learn how to do the job. Hence, Ford states that those jobs would be threatened by machines (Ford, 2009).

Ford continues by saying that the opportunities for workers with low-skilled jobs will continue to decline due to the ongoing and increasing progress of automation within manufacturing firms. Hence, he believes that the routine jobs which are performed by low-skilled workers will be performed by technology, as these computerized machines will eventually outperform the typical employees who do those types of jobs. He concludes that there could possibly be structural unemployment due to these developments, which would not only affect people with no degrees but at all levels including those with under- and graduate degrees (Ford, 2009). Unemployment is a big problem, in 2018 there are a total of 192.3 million unemployed all around the world, this is shown in Figure 4 in Appendix A (Statista., n.d.). With an increase in automation, it is quite possible that the business models of all industries are jeopardized. This is because an increase in unemployment would lead to a decrease in product purchases as the amount of customers being able to buy products decreases. Hence, an increase in unemployment will harm the entire economy. As S.D. Simpson (2017) explains, "Unemployment leads to higher payments from state and federal governments for unemployment benefits, food assistance, and Medicaid. At the same time, those governments are no longer collecting the same levels of income tax as before - forcing the government to borrow money (which defers the costs and impacts of unemployment into the future) or cut back on other spending (perhaps exacerbating the bad economic situation)." This therefore means that countries would need to implement a new tax system with higher taxes on capital in order to be able to finance and nurture the unemployed.

Furthermore, Frey and Osborne, the authors of 'The Future of Employment: How Susceptible are Jobs to Computerization?' have a similar perspective. They conducted a study on the US labor market to figure out the probability of computerization for 702 detailed occupations (Frey & Osborne, 2013). In order to conduct the study they used a Gaussian process classifier, which is a "generic supervised learning method designed to solve regression and probabilistic classification problems" (Sci-Kit Learn, n.d.). Through the use of the Gaussian process classifier, Frey and Osborne estimated that about 47% of the total US employment is at risk due to the increase in computerization. Frey & Osborne, just like Ford, state that robots are becoming more advanced causing those machines to be able to not only perform routine jobs but also more complex ones. Frey and Osborne also state that "over the past decades, industrial robots have taken on the routine tasks of most operatives in manufacturing. Now, however, more advanced robots are gaining enhanced sensors and manipulators, allowing them to perform non-routine manual tasks" (Frey & Osborne, 2013). In relation to Martin Ford, this US labor market study by Frey and Osborne provides another perspective about the consequences of automation on jobs.

# 4. THEORETICAL FRAMEWORK: PAST, PRESENT, FUTURE OF INDUSTRY 4.0

The following section states information on the previous three and most recent industrial revolution, followed by the important elements which are encompassed in Industry 4.0 and possible reasons why Industry 4.0 could be implemented.

## 4.1 History on the four Industrial Revolutions: from steam engine to machine-machine communication

### *4.1.1 The first industrial revolution, the beginning of change within industries*

The first Industrial Revolution introduced countless new innovations which transformed the industrial sector. Starting off with the invention of the steam engine during the mid to late 18th century in Britain (The Economist, 2012). The steam engine was possibly the greatest invention of all during that time, as it completely transformed the textile industry: creating a countless number of new jobs that were less labor intensive while additionally requiring a new organization of work - the factory system. This system allowed for an increased division of labor as well as specialization of function (Encyclopedia Britannica, 2018). However, such divisions were so minute that workers often were not aware of the significance of their work in the overall production process, while additionally not being able to introduce variety into the task (Delamotte & Walker, 1976).

### *4.1.2 The second industrial revolution, the dawn of mass production*

The developments of the first industrial revolution helped pave the way for the subsequent revolutions within Industries. The second industrial revolution is known as the technological revolution and began towards the end of the 19th century with the invention of the light bulb by Thomas Edison. Little did people know that this was the dawn of electricity and mass production. The latter was possible as a consequence of the emergence of moving assembly lines, invented by Henry Ford (The Economist, 2012), and power stations, all of which allowed factories to automate their production and increase their output. As the first revolution, the second created jobs for people and allowed for increased urbanization and migration, yet at the cost of an individual's working conditions and income. Inequality amongst the population started increasing as only a minority of individuals received higher paying, white-collar jobs.

### *4.1.3 The third industrial revolution, the start of the digital era*

The third industrial revolution was recognized as the beginning of the digital age, allowing companies and individuals to switch from mechanical/analogue to digital technology, marking the beginning of computers, computer networks, the internet as well as robotics. It was the period in which manufacturing was going digital. This meant that information was far easier to access and store and allowed for more automation in the industrial sector as well as the emergence of web-based businesses. While the past had focused on mass production, the third industrial revolution allowed for mass customization (The Economist, 2012). The

consequences that this revolution has on the world of work is yet to be fully discovered. In the past, such changes have been the source of great discontent as they usually brought about job destruction with very slow compensating actions (i.e. job creation) (ILO, 2016). While automation did reap firm-level benefits including the exponential improvement of firm productivity, increased concerns emerged by workers and the general public, which included the increase in 'technological unemployment'.

### *4.1.4 The fourth industrial revolution, the rise of industry 4.0 through the help of the internet*

Not even a decade after the third industrial revolution, did the fourth industrial revolution surface, allowing for the development of Internet of Things as well as Cyber-Physical systems (CPS). While the Internet of Things reflects the interconnectedness of computing devices via the internet, CPS allows humans to interact with a new generation of systems through many new modalities. Each system having integrated computational and physical capabilities (Baheti & Gill, 2011, p1). Again, increased concerns emerged regarding technological unemployment, as the use of information and communication technologies (ICT), Internet of Things, 3D printing, use of sensors and the spreading of robots in production increased (Ford, 2015). The fact that so little time has passed since the implementation of these products allows for this paper to provide a novel insight into the implications of Industry 4.0 on the world of work.

## 4.2 Elements of Industry 4.0: Internet of Things, Big Data, Cyber Physical Systems and Machine to Machine Communication

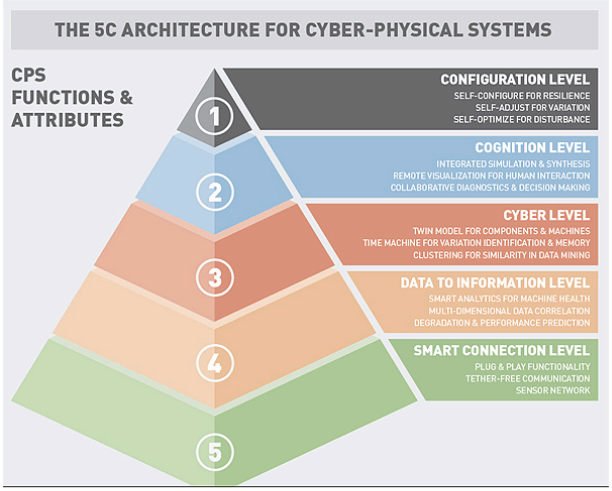
Industries all around the world are adapting to the new trend of Industry 4.0. Internet of Things (IoT) is one of the main drivers of Industry 4.0. IoT is defined as "the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment" (Gartner, 2017). To get an understanding of the growth behind IoT, Statista (Figure 3) shows the number of connected devices installed from 2015 up to 2025. By 2020 there will be a total of 30.73 billion devices connected and by 2025 a total of 75.44 billion devices (Statista, n.d.). This is a 245.5% increase of connected devices in just 5 years.

With the increase in devices being connected to the internet, an increase in data collection and transferring occurs, which leads us to the important development of Big Data. Big data is "a term applied to data sets whose size or type is beyond the ability of traditional relational databases to capture, manage, and process the data with low-latency" (IBM, n.d.). By analyzing these data sets, organizations obtain insights which help them with decision making and strategic business moves.

Through better decision making and strategic business moves, organizations can not only improve their performance but also to come up with new ideas. Ideas which include cyber physical systems like autonomous vehicles or improved sensors within robots.

As mentioned earlier, Cyber-Physical Systems are systems of collaborating computational elements that control physical entities, generally using feedback from sensors they monitor. This means that the system calculates actions which the worker needs to perform. Data Scientists have defined a model for the manufacturing industry which revolves around the so-called 5C architecture. According to Bagheri & Lee (2015) data scientists have labeled these C's as:

1. Connection: Within this level, data is created and collected by machines and other tools.
2. Conversion: After collecting the data, the data is converted into information using algorithms.
3. Cyber: Once the data has been converted, the cyber level acts as a hub for information where complex algorithms are performed. This information is then used to create extra value. (Conversion focuses more on individual assets while Cyber focuses more on data from the entire system).
4. Cognition: This level allows to compare information which machines signal in order to convert it to health information, which is the diagnosis by the machine itself of its potential failure based on historical data and algorithms. Through this the maintenance costs of the machines can be reduced by nearly 40%.
5. Configuration: Similar to the Cognition level, the configuration level allows the machines themselves to track their own health, and through this they are able to provide feedback on when the machine needs repairs. Below is a representation of the 5C's.




*Data scientists have conceived a five-layer architecture to depict the way a cyber-physical system is implemented in industrial settings. The sense of the pyramid shape is that lower levels collect data that is analyzed and condensed at each upper level. So information fed to each higher level is more valuable than information coming into the level below.*

**Figure 5. Source: Bagheri, B. & Lee, J. (2015). Big future for cyber-physical manufacturing systems.**

An example of an application of this architecture is regulating a machine's output performance. However, for the human to regulate the machines output performance, he/she needs information. This information is provided by other machines, which leads us to the last element of Industry 4.0.

Machine to Machine communication is "the automatic communication between devices without any or with very little human intervention. It often refers to a system of remote sensors that is continuously transmitting data to a central system. Agricultural weather sensing, automatic meter reading and RFID tags are examples" (PC Mag, n.d.).

## 4.3 Possible reasons of implementing Industry 4.0

To understand the relevance of the analysis between the implementation of Industry 4.0 and the change within workers' tasks and job descriptions two theories will be analyzed. These are obtained through literature that study the fundamental theories that relate to the implementation of new systems.

Application-Pull and Technology-Push can be considered relevant concepts to analyze in the relationship between the

implementation of Industry 4.0 and in the change of tasks and job descriptions of workers.

Application-Pull "induces a remarkable need for change due to changing operative framework conditions" (Lasi & Kemper, 2014). The reason for change through application pull include; political, economic and social changes. These include (Lasi & Kemper, 2014):

-*Short development periods:* Improving product innovations and reducing the time needed for developing helps to stay competitive.

-*Individual on demand:* The second industrial revolution focused mainly on mass production, however over time and having entered the fourth industrial revolution, customers' needs have become the main priority of companies. This allows the customer to have increasing power over the individualization of the product that is wanted.

-*Flexibility:* Due to changes within the business environment, companies as well as employees need to become more flexible in product development in order to satisfy customer needs.

-*Decentralization:* Due to changes within the business environment, it is important for companies to have quick decision making otherwise it can cause problems, such as customer dissatisfaction. Reducing the organizational hierarchy is a way to improve decision making as the number of people in charge are less.

-*Resource efficiency:* As resources become more scarce and expensive, it is important to focus on sustainability in industrial contexts.

Technology-Push refers to the development of new technologies which then leads to new products being pushed onto the market. Technology push includes (Lasi & Kemper, 2014):

-*Increasing automation and mechanization:* Faster production, machines have independent control and can optimize manufacturing.

- *Digitalization & networking:* Being able to access information anywhere at any time drastically improves not only decision making but also manufacturing, research & development and other sorts.

- *Miniaturization:* For example, computers are important, in the past they were big and heavy, nowadays they have better performance and can be carried around without any problems. Having the ability to create smaller things allows for a larger potential use depending on the product.

# 5. METHODOLOGY

## *5.1 Multiple-case study design*

Not a lot of previous literature describe the consequences which Industry 4.0 has on the purchasing departments, therefore pointing towards potential gaps that could be delved into by research. By using a qualitative multi-case study method, this paper aims to gain insight on how Industry 4.0 influences jobs within different sectors.

Problems can occur anywhere, they can either be small or big, and can occur a vast amount of times depending on what it is. Within companies, problems related to changes in technology or job/ task descriptions can occur on a regular basis, which makes it a suitable study for qualitative research. This research uses six firms to examine the potential risks Industry 4.0 has on jobs within those firms. As mentioned earlier, previous literature does not offer sufficient information regarding this topic.

A total of six firms within different sectors were interviewed. These interviews were either held in person or by other means of contact such phone. Through online research and direct communication with the firms, it was found that these firms are willing to implement Industry 4.0 applications now or in the future.

## *5.2 Data Collection*

In this paper, the outcomes of the qualitative multi-firm study are used to assess the implications Industry 4.0 has on the people who work in the purchasing department.

First, secondary research will be used to acquire relevant information regarding the definition of Industry 4.0 as well as other topics, including the main drivers such as 'Internet of Things (IoT), Big Data, Cyber-Physical Systems and Machine to Machine communication.' Once enough secondary information was gathered, a questionnaire was developed with the help of the literature. To get more information, the set of questions evolved as the interview progressed, meaning questions were asked which were not part of the original question sheet. This is a so-called semi-structured interview. The interviews were conducted to understand the implications Industry 4.0 has on the purchasing department of different sectors. These interviews were held either in person, via skype or phone; this depended on where the company is situated, meaning either close by or far away and whether the contact person preferred the interview in person or other means of contact. The interviewees were asked to describe their thoughts on Industry 4.0 and whether it has already affected them. When they mentioned something in regard to their work and their employees, they were asked to elaborate. The interviews lasted between 5 minutes (due to the person having little time) to up to 30 minutes. Two of these interviews were recorded while the other 4 asked for it to be not recorded. These interviews were then transcribed in either German or English depending on which language was spoken, this can be seen in Appendix B.

# 6. RESULTS & ANALYSIS

This section will discuss the results which were collected during the interviews. A total of six interviews were conducted. The interviewees were either specialized in procurement or had a deeper understanding of the topic than others, such as the owner of the company. According to the International Standard of Industrial Classification of all economic activities (ISIC), the interviewees were representatives of the following industries: Manufacture of pharmaceuticals, medicinal chemical and botanical products, ISIC: 2100, Manufacturer of watches and clocks, ISIC: 2652, Manufacture of ovens, furnaces and furnace burners, ISIC: 2815, Plumbing, heat and air-conditioning installation, ISIC: 4322, Other professional, scientific and technical activities n.e.c., ISIC: 7490 and Manufacture of machinery for mining, quarrying and construction, ISIC: 2824. The company sizes range from very big (over 4500 employees) to very small (only five). By having such a vast range of companies, we can see whether smaller companies are trying to increase their competitiveness with the larger ones through the implementation of Industry 4.0. Regarding the interviews, the respondents were asked to answer the given questions (in appendix B) as precisely as possible to get a better understanding of whether they have implemented Industry 4.0 in their company. Based on their answers, further questions were asked. The questionnaire and its corresponding answers are shown in Appendix B.

## 6.1 To what extent have firms implemented Industry 4.0.

Industry 4.0, Big Data, Cyber-physical systems, and Internet of Things are all relatively new topics. To many companies those terms are still vague in concept. Depending on whether or not the

company focuses on the use of technology will influence the extent to which they have implemented Industry 4.0 applications within their day to day activities. This multi-firm case study does not focus on any of the automotive industry companies that rely heavily on machines to do their day to day activities like the building of cars. However, some of these companies outside the automotive industry have machines that do a vast range of things (see section 6.3 for further details). Four out of the six companies rely on machines in their day to day activities to a certain extent. And the other two rely more on human labor.

When compared to previous research (Process Engineering, 2016; Cunningham, 2018), the findings highlight that, although Industry 4.0 is a popular topic, many companies are struggling with knowing what it is. In our research, only half of the respondents were aware of what Industry 4.0 really is. For the ones who didn't know what it is, only after a brief description were the respondents aware of what is meant by Industry 4.0. Following this, each of the companies have been asked whether they have implemented any applications on Industry 4.0. The results show that only one out of the six companies has implemented Industry 4.0 within the purchasing department. In terms of size, this is the largest of the six. The next two biggest companies have heard of Industry 4.0, while the smallest firms lacked any knowledge on the topic. The exception to this was the consultancy firm, which knew about Industry 4.0 as a result of the firm's clients, which are large telecommunications firms. Hence, we can make a preliminary conclusion that larger companies compared to smaller ones are more likely to implement Industry 4.0 applications within their companies. Of course, the sample size of the study is not representative, however it is in line with secondary research (Hall & Khan, 2002). Furthermore, research also shows that increased implementation of Industry 4.0 amongst larger firms is due to them having more resources to spend and a need to be an early adopter of Industry 4.0 in order to stay competitive. This is in line with findings of other studies, such as Suttle (2016), Feldman (2014) & Schröder (2017).

## 6.2 What are the risks and opportunities employees and companies face when implementing Industry 4.0?

In order to get a better understanding of the risks and opportunities involved with the implementation of Industry 4.0, a SWOT analysis was conducted. For the complete overview of the SWOT analysis, see Figure 2 in Appendix A.

Every investment can either be a risk or an opportunity. This is the same in the business world. When implementing a new technology into the company, which requires a complete makeover for that company, it can either be very risky or rewarding in the long run. To start off, the strengths which are included when implementing Industry 4.0 into the company will be talked about. These key points within the SWOT analysis are based on information which were mentioned by the interviewees either only briefly or in depth.

### *6.2.1 Strengths*

Higher transparency was a main topic when talking about the visions and expectations of Industry 4.0. Quotes like

*"höhere Transparenz mit den Lieferanten"*

Which was retrieved from case 6, means higher transparency with the suppliers was mentioned a few times. Higher transparency with clients and suppliers is important because it improves the company's overall image, respect and staff and customer loyalty. The latter was proven by a study undertaken by Label Insight, which found that when companies are more transparent towards their customers/suppliers, the chances that those customers/suppliers stay loyal to that company is about 94%. Furthermore, the study found that 73% are willing to pay a price premium for a product that offers complete transparency (Label Insight Inc., 2016).

A further strength is the ability for higher product customization. As mentioned in the paragraph on transparency above, product customization also increases the brand image and company loyalty. Industry 4.0 allows manufactures to switch from old production techniques such as mass production to mass customization, allowing customers to get exactly what they want. An example of such would be NIKEiD or Dell computers, companies which allow the customer to choose the look/composition of their product online and send the information directly to the assembly line. Thus, Industry 4.0 allows customers to provide direct inputs into the design process, thereby reducing cycle-times and costs when compared to standardized, mass production techniques (Wang et al., 2017).

Moreover, interview results show that Industry 4.0 could also provide companies with a more sustainable business plan and decreased costs in the long run through the optimization of value chains and the creation or enhancement of lean production systems. This not only is environmentally friendly but also allows companies to invest their resources in other projects, where human resources might be more important than the technological ones. For example, in a McKinsey Global Institute report, 66% of all executives surveyed believed that addressing skill gaps and encouraging skill upgrades related to automation and digitalization was one of their top ten priorities (Illanes et al., 2018). Such an investment would allow for an increase in the productivity of the company as it spends its resources in a more appropriate and cost-effective way by letting the machines do the more routine aspect while the human workforce focuses on more difficult/technical/non-routine tasks. Machines may not have the capability to do such tasks as they may require fine motor skills or human intuition, creativity and care (Reynolds, 2018). By investing into the retraining of humans, the percentage of people who may need to be fired due to increased automation may be reduced as well (ibid.).

With the increase in automation comes faster production, higher flexibility and easier monitoring of the production process. Faster production allows companies to produce products at a quicker rate, which in turn leads to lower energy costs. Higher flexibility allows companies to respond quicker to changes within the business environment, for example a change in customer preferences. Easier monitoring of the production process allows a higher level of overview of the production process. As machines record the information, the overseer just has to check the information to see if everything went smoothly. This saves time and allows the overseer to spend the saved time on something else. This was shown to a certain extent by the following answer of an interviewee from case 2:

"*It will oblige Firms to change their Process, improve Communication Possibilities and eventually reduce the Bullwhip effect.*"

Further strengths found through secondary sources would include: intelligence along the product life cycle, more responsive supply chains, as well as more direct communication with end customers (Clearpath, 2017). Additionally, the introduction of Industry 4.0 allows firms to be held accountable for their procurement choices, while also having the ability to hold their suppliers accountable for the choices they make (Ashodian, 2016).

### 6.2.2 Weaknesses

This section will highlight the weaknesses that emerge by implementing Industry 4.0 into the company. These weaknesses arose from responses obtained through interviews with the relevant companies.

Time is a valuable resource. As many people say time is money. It can be very difficult for some to make decisions which could lead to either success or failure. Implementing Industry 4.0 is such a decision. As we have only scraped the surface of what is to come in terms of Industry 4.0, it is difficult to invest a lot of time into it. The interviewees concluded that to implement and completely adopt Industry 4.0 it would take decades. Some of the interviewees explicitly stated that, for example from case 5:

*"for most companies it will take between 10 and 20 years"*

Two decades to implement a framework is a very long time. No one knows whether in that time frame something new evolves which requires more attention than a lean and automated production system. The longer it takes to implement something the costlier it gets, this is for both opportunity cost and actual costs. For companies to spend a lot of time and money on implementing new technology, a compromise needs to be made. This in turn could lead to the dismissal of employees to finance the new technology.

Another weakness of technology is its dependency. It might be better and faster at doing activities, however, the human brain compared to machines has the advantage in that it can process far more information and thus react to problems better (Paasschen, 2017). The chance of a machine breaking down during a working day is quite possible. Now, if the whole production system consisted of only robots and no humans, this would be a problem. Thus, in a way, humans may be more reliable than technology. If something goes wrong during the production process it can be fixed quicker due to better information processing and reacting.

Even though transparency is considered a strength, it is also a weakness. This is due to cyber-physical systems making the management of the processes and activities more challenging for employees. A lot more information needs to be processed before making decisions, which can lead to confusion and false decision making (Strupczewski, 2015). As a result of the increase in complexity of the work, the demand for higher skilled specialists will be needed which in turn decreases the amount of low skilled jobs (Walwei, 2016; Nübler, 2016; MIT, n.d.).

### 6.2.3 Opportunities

Implementing Industry 4.0 has the possibility for new opportunities. Especially in terms of increasing the companies competitive advantage. Just like any other new innovation, Industry 4.0 can allow companies to invest in something that they previously didn't have the resources for. Through this, it allows these companies to expand into new/emerging markets and create new jobs (Marr, 2016; Newness, 2016). Some of the interviewees agreed that Industry 4.0 technologies will destroy jobs but at the same time create new ones. These new jobs would be in areas which are specified to the use of technologies (IT Jobs). One of the interviewees specifically case 2 stated that:

*"because technology is evolving so fast, new jobs will appear while old ones disappear. This means that there might be some people who lose their jobs due to not having the appropriate skill set, however other jobs will be created. So as a final thought it's a win/lose relationship between the two."*

Furthermore, results of the interviews as well as secondary literature suggest that technological evolution does not necessarily involve the loss of employment for individuals. In fact, many job descriptions and tasks may not even be altered by the implementation of Industry 4.0. An example of such would be the Bosch Rexroth plant in Hamburg, which has implemented Industry 4.0 on a specific manual production line that was facing challenges in keeping up with production, quality and costs. Instead of replacing workers by technology, the company adapted the technologies by creating autonomous, intelligent workstations, which allowed adjustments in the workstation based on a workers characteristics (language, workstation height, font size, etc) (Fell, 2017). A further option for companies would be to re-train workers, so that they can either be employed in different areas of the company or are trained to work with the newly implemented IT systems.

Another opportunity for companies and employees are that they will be able to cooperate with other parts of the firm to either come up with new innovations or produce items based on customer needs from the different sectors. This conclusion was drawn from the answer on an interviewee from case 6:

*"es würde wahrscheinlich die Möglichkeit geben das verschieden Sektoren in der Firma zusammen arbeiten können"*

### 6.2.4 Threats

When a company implements a new technology the chances that some parts of the firm get affected more than the others is normal. With the introduction of Industry 4.0 technologies, the ones who get affected the most are the employees (MIT, n.d.). It was mentioned before that jobs might be lost, and new ones are created, however in some cases those people won't get new jobs because they are unqualified for others. One of the interviewees (case 6) mentioned this:

*"es kann gut sein das die älteren Mitarbeiter ihre Jobs verlieren da sie nicht so schnell auf den neusten Stand kommen können wie die Jungen"*

Translated this means that there is a possibility that older employees will lose their jobs over younger ones as a result of them not being able to adapt as fast to new technological or environmental changes.

Another threat that comes with the implementation of Industry 4.0 applications is data security. Many people are worried that their private information might be leaked. Which could lead to identity theft. However, it not only is about private information, it also implies company secrets. These company secrets might involve information about how they stay market leaders or just competitive in general. If that information were to be leaked, other firms would follow in the company's footsteps, resulting in a loss of their competitive advantage. Another topic which is related to this is the increase in competition. Firms which have implemented industry 4.0 applications will gain new ideas through analyzing data which could lead to them getting an advantage over other firms, or just entering other markets with their new technology.

To conclude, many ideas have been brought up by the interviewees about their thoughts on the strengths and weaknesses on Industry 4.0. It is interesting to see different perspectives on how people interpret the future of Industry 4.0 technologies. However, performing a SWOT analysis does not completely answer the main research question, thus the next section will focus on the changes in a workers' task and job descriptions.

## 6.3 How have workers' tasks and job descriptions changed within purchasing departments with the implementation of

## Industry 4.0 and how will it affect the future?

Industry 4.0 technologies are still relatively new, and the ones that already exist are evolving all the time. By asking purchasing specialists and people who are involved within the purchasing departments, quite a few answers to our research question were introduced. When Industry 4.0 was first announced by the German Government, it was something companies were not ready to implement yet. Over time, this changed, and changes were being adopted mainly in the automotive industry. However, not all companies had the resources to implement such technology, and up until now many companies do not have any or only very few Industry 4.0 applications or technologies implemented within their firm. According to our interviewees it will still take some time for all firms to completely implement Industry 4.0 as mentioned before. The interviewees were asked specifically on whether or not their jobs have been affected due to the implementation of Industry 4.0. In the following subsections, the answers from the firms will be discussed.

### *6.3.1 A large Pharmaceutical Company*

This company is a contract manufacturer for the Pharmaceutical Industry and was the only company in which Industry 4.0 applications were implemented within the company. This was through having two teams, one team which focuses on creating a 4.0 Strategy, and the other team works on topics like Big Data. The representative of the company stated that even though they implemented these two teams, the workers job description and job tasks have not been affected by it. The interviewees job description and job tasks have not been affected by the implementation of Industry 4.0 applications as of yet.

### *6.3.2 A Luxury Watch Making Company*

This is a company, which creates luxury watches, it has not yet implemented any Industry 4.0 applications or technologies. The interviewee stated that, "Our company creates Luxury Watches, so it would not work at first because it is a very "Hand Made" Industry. It could be interesting on 100% Machine Manufactured Parts." With this said, the future implementation of Industry 4.0 would not affect the workers descriptions and tasks as it would only apply to 100% automated production systems. In terms of the job description and job tasks for the interviewee himself, he stated that: "I am Purchasing components for all 3 next year's projects: from the R&D development to Production." Hence, it can be concluded that his job and task descriptions have not changed either.

### *6.3.3 A Manufacturer of Large Household Items*

It is a manufacturer of heating systems, solar collectors, burners and heat pumps. This company has not yet implemented any Industry 4.0 applications or technology within their day to day activities. The interviewee states that "nach dem Entgelt-Rahmenabkommen (ERA) sind 18 Arbeitsbewertungen für Niederlassungen mit definierten Tätigkeitsbeschreibungen für tariflich eingestufte Mitarbeiter festgesetzt", which translated means that the employees job descriptions are set in writing according to a framework agreement. If Industry 4.0 were to be implemented, either the tasks and job descriptions would stay the same or the agreement would have to change. The interviewee is the leader of a profit center and has not stated that his job description and job tasks have changed.

### *6.3.4 A Company Specializing in Installing Household Items*

This company is a specialized in heating and sanitary technology. This is another company that has not yet implemented any Industry 4.0 technology/applications, and therefore, the job descriptions and job tasks of the employees has not changed. For the Interviewee himself, it has not changed either, but he says that: "Industrie 4.0 ist die Zukunft, ohne das wird es nicht gehen." Which simply translated means, Industry 4.0 is the future. From this statement, conclusions can be drawn that if the company implements Industry 4.0 technology there could possibly be a change within the workers job and task descriptions.

### *6.3.5 A Consulting Company*

It is a consultancy firm which focuses on the telecommunication sector. This company has not yet implemented any Industry 4.0 applications or technology. The interviewee stated that if his company or one of his clients were to implement such technology, then the job descriptions and tasks of employees would be affected to include more IT related aspects. The interviewee states that, with the implementation of Industry 4.0 within an economy, "all areas of work and life, all industries and the government" itself would be affected by it. However, since the company has not yet implemented any, the employees job descriptions and tasks have not yet been affected.

### *6.3.6 A Manufacturer of Mixing Plants*

This company is a manufacturer of a wide range of mobile and stationary concrete mixing plants. It has not yet implemented any Industry 4.0 technologies or applications. The tasks and job descriptions of employees according to the interviewee have not been affected. However, the interviewee did state that "es kann gut sein das die älteren Mitarbeiter ihre Jobs verlieren da sie nicht so schnell auf den neusten Stand kommen können wie die Jungen.". This translated means that, with the implementation of Industry 4.0 there is a possibility that the elderly workers would lose their jobs due to them not being able to catch up with technology like the younger generations. In terms of the interviewees job description and tasks, just like the other employees it has not changed, due to them not having any Industry 4.0 technology implemented.

# 7. CONCLUSION

Since the beginning of the second industrial revolution, machines have been known to handle routine tasks, however, algorithms for big data for example are now allowing machines to enter new domains within companies. Hence, allowing companies to substitute these machines for manual labor in a variety of non-routine tasks.

Within this paper, the following question was confronted: How have workers' tasks and job descriptions changed within purchasing departments with the implementation of Industry 4.0 and how will it affect the future? The results from the interviews found that larger companies are more likely to see prospects for the implementation of Industry 4.0. This could be due to the fact that larger firms have more financial resources than smaller firms and are thus more likely to implement Industry 4.0 technologies (Suttle, 2016, Feldman, 2014 & Schröder, 2017). Furthermore, although Industry 4.0 was introduced by the German government a few years back, little has been done by firms to fully implement Industry 4.0 technologies/applications. Only one out of the six companies which were interviewed have designed a new system, however it did not affect the job tasks or descriptions of the employees within the company. Thus, the change in such task and descriptions may be highly dependent on the industry, the extent of the implementation of Industry 4.0 as well as the company's situation and future goals. The other five companies have not implemented any Industry 4.0 technologies therefore the employees job and task descriptions have not changed either. However, results also suggest that these companies would expect a change of descriptions if they were to implement Industry 4.0 technology. More specifically, they hinted at the fact that workers may be retrained, or skills gaps may be closed by

pushing older workers out of the labor force, while preferring younger workers with more IT-related skills. Conclusively, the study at hand shows that the world of work is definitely impacted through the implementation of Industry 4.0, however, the magnitude and sign of the impact is industry and company specific.

# 8. LIMITATIONS AND FUTURE RESEARCH

## 8.1 Limitations

Limitations occur within every research. It would be impossible to account for everything one can think of as this would make the research too complicated. This is why studies make assumptions or abstractions: to work with a simple model. This includes using samples to represent larger groups or making interpretations of statements made by interviewees.

In regard to the research, the group of interviewees were selected based on company approvals for interviews. With this said, the companies were not randomly selected. On top of this, the sample size of the selected companies was only 6. Having such a small sample size limits the representativeness of the research. Having a larger sample size allows the results to approximate the population, which leads to a more reliable conclusion. Small sample sizes however, have a higher chance of being unusual. This means that there is a possibility that these 6 companies do not act the same way as others.

Furthermore, being a single coder (only one person interviewing the companies and analyzing the results), limits the ability to compare interpretations with someone else. Many researchers recommend using two or more coders, this increases the reliability of the codebook. Hence, results could have been different to those of someone else who interviewed the same companies. Hence, the reliability of the results need to be strengthened. With the problem of reliability also comes the topic of social desirability bias. This is a bias in which the respondents of the interviews respond to questions in a manner which is seen as more favorable to others. The respondents might answer in ways which make their company sound better.

Each company in the world has a different number of employees, and no two companies are the same in terms of their business environment. The companies which have been included in the research paper all vary in sizes. The smallest firm employing only five employees and of which the interviewee is the owner himself. This leads to another problem as this company will not have the opportunity to further invest into Industry 4.0. Having such a vast range of company sizes can lead to uncomparable results. As larger companies have more resources than smaller ones, the chances they implement Industry 4.0 is higher.

Furthermore, the companies are all from various industries, varying from watch making to consulting to manufacturing different products. This also leads to different results. As a consulting firm might focus less on Industry 4.0 than a manufacturing firm.

Another limitation is that four out of the six companies which were chosen to be interviewed were companies located in Germany. This could lead to different results as some countries are more technologically advanced, and therefore might have more Industry 4.0 implemented.

With all that being said, this paper brought a new insight on the topic of Industry 4.0. However, the aforementioned limitations prevent from concrete conclusions to be drawn. For more concrete interpretation of the effects this technology has on organizations, further research needs to be conducted.

## 8.2 Future Research

Existing literature lacks the information on how Industry 4.0 affects specific departments within companies such as purchasing. It was very difficult finding relevant information on how the purchasing departments and employees within those departments of companies have been influenced by these new practices. To fully answer the research question, further research will be needed in order to prove the results to be accurate. This includes increasing sample size, undertaking statistical analysis on a random sample and narrowing research to only include one industry. A further specification of this research could include more companies from around the world and subsequently comparing the results between countries. This allows for identifying different trends in different regions of the world as culture, ethnicity and social norms may largely impact the results.

The research could also be extended further into the world of work by analyzing the impact Industry 4.0 has on the national economy in terms of unemployment rate, employment rate, working conditions and wages.

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# 11. APPENDIX A

(Industry 4.0)

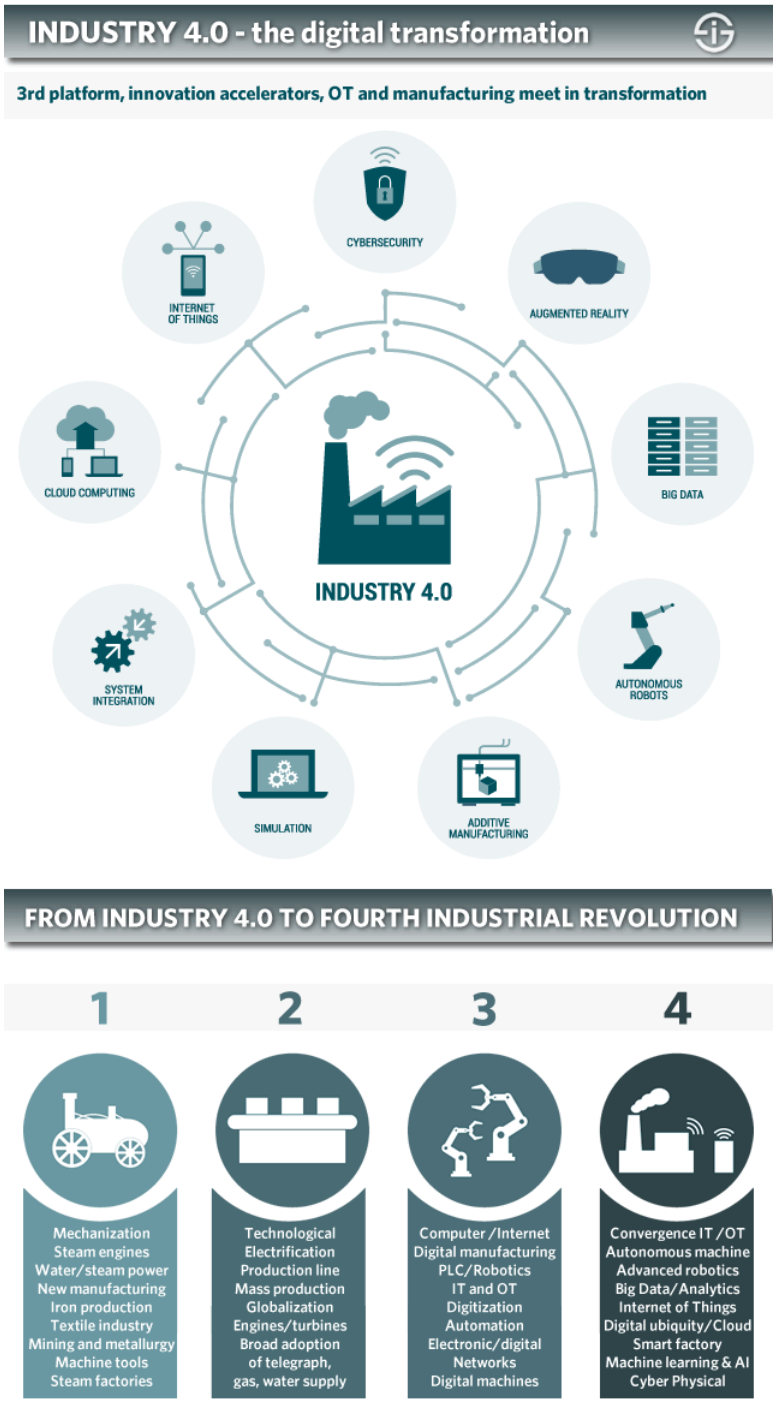


**Figure 1. Source: iScoop. (n.d.). Industry 4.0: The fourth industrial revolution - guide to Industry 4.0**


**Figure 2. SWOT Analysis of Industry 4.0**

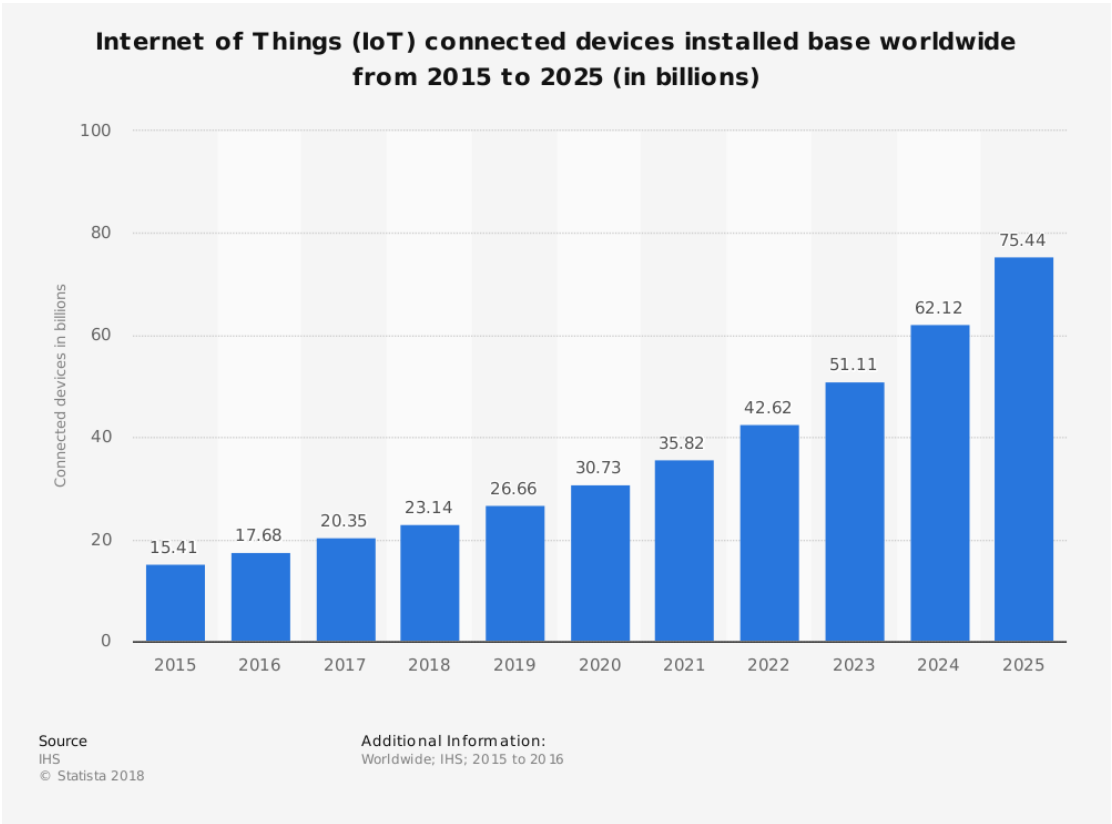


**Figure 3. Source: Statista. (n.d.). IoT: Number of connected devices worldwide 2012-2025.**

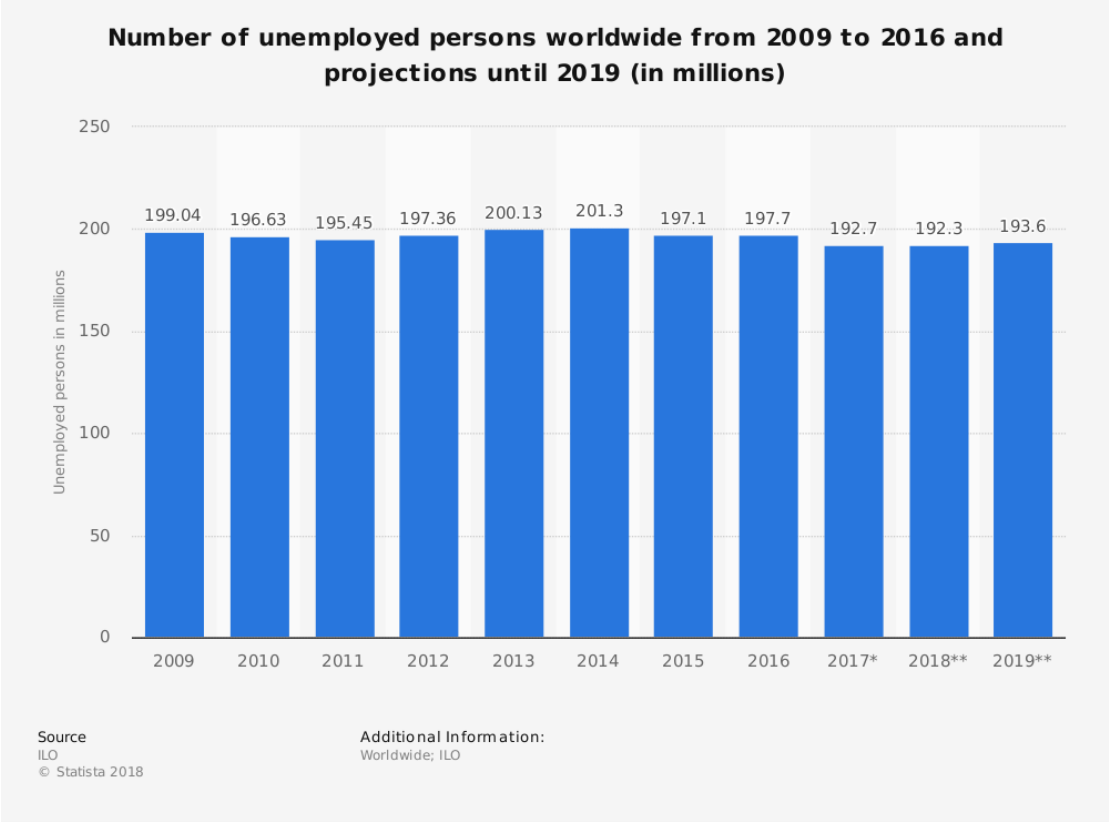


**Figure 4. Source: Statista. (n.d.). Unemployed persons worldwide until 2019**

# 12. APPENDIX B: INTERVIEW QUESTIONS & ANSWERS

**Interview Questions:**

**English**

1. What is the name of your firm?
2. What is your position in the firm?
3. Are you aware of Industry 4.0? **(If No: go to question 12 below)**

**If Yes:**

4. To what degree does your firm have industry 4.0 implemented?
5. Does your firm have a consistent industry 4.0 strategy for purchasing?
6. What is the status of industry 4.0 implementation in the purchasing department?
7. How has/will Industry 4.0 affect(ed) your job description?
8. How has/will industry 4.0 affect(ed) your work tasks?
9. How will it/did it affect your employees? **(question to be answered by managers/supervisors only)**
10. How do you feel about industry 4.0 being implemented in your firm? (Is it good or bad? Please explain.
11. Is there anything else you want to tell me about industry 4.0?

**If No:**

12. What are your expectations regarding Industry 4.0?
13. What is your vision for industry 4.0 in purchasing?
14. What are your employees tasks and job description at this moment? **(question to be answered by managers/supervisors only)**
15. What are your tasks and job description at this moment? **(for employees)**
16. How do you feel about the prospect of industry 4.0 being implemented in your firm? (Is it good or bad? Please explain).
17. Is there anything else you want to tell me about industry 4.0?

**Deutsch:**

1. Wie heißt Ihre Firma?
2. Was ist Ihre Position in der Firma?
3. Kennen Sie Industrie 4.0? (Wenn Nein: gehen Sie zu Frage 12 unten)

**Wenn ja:**

4. In welchem Ausmaß hat Ihre Firma Industrie 4.0 implementiert?
5. Verfügt Ihr Unternehmen über eine konsistente Industrie 4.0-Strategie für den Einkauf?
6. Wie steht es um die Umsetzung von Industrie 4.0 im Einkauf?
7. Wie wirkt sich Industrie 4.0 auf Ihre Stellenbeschreibung aus?
8. Wie wirkt sich Industrie 4.0 auf Ihre Arbeitsaufgaben aus?
9. Wie wird sich das auf Ihre Mitarbeiter auswirken? (für Manager)
10. Was halten Sie von Industrie 4.0 in Ihrem Unternehmen? (Ist es gut oder schlecht? Bitte erläutern.
11. Möchten Sie mir noch etwas zu Industrie 4.0 sagen? (bei ja und nein)

**Wenn Nein:**

12. Was erwarten Sie in Bezug auf Industrie 4.0?
13. Was ist Ihre Vision für Industrie 4.0 im Einkauf?
14. Welche Stellenbeschreibungen und Arbeitsaufgaben haben Ihre Mitarbeiter in diesem Moment? (für Manager)
15. Was beinhaltet ihre Stellenbeschreibung und was für aufgaben machen sie jetzt?? (für Angestellte)
16. Was halten Sie von der Aussicht, Industrie 4.0 in Ihrem Unternehmen einzuführen? (Ist es gut oder schlecht? Bitte erläutern).
17. Möchten Sie mir noch etwas zu Industrie 4.0 sagen? (bei ja und nein)

**Names of the firms are left out.**

**Case 1: A Large Pharmaceutical Company**

| | |
|---|---|
| Question 1 | - |
| Question 2 | SAP Key User MM, also eine Schlüsselperson im ERP-Projekt. |
| Question 3 | Ja |
| Question 4 | Es gibt 2 Teams zu Industrie 4.0. Ein Team hat eine Strategie 4.0 erarbeitet, mehr kann ich dazu leider nichts sagen und ein anderes Team arbeitet an dem Thema Big Data. Einzelne Ideen in Richtung Industrie 4.0 werden durch das Innovation Management bewertet und auch voran getrieben. |
| Question 5 | Nein |
| Question 6 | Da haben wir noch nicht begonnen |
| Question 7 | Aktuell hat es keine Auswirkung auf die Stellenbeschreibung |
| Question 8 | Aktuell hat es keine Auswirkung auf die Arbeitsaufgaben |
| Question 10 | Da wir noch nicht wirklich begonnen haben, kann ich es noch nicht einschätzen |
| Question 11 | In der Zukunft versucht Vetter einen 360-Grad- Prozess mit internen und externen Impulsen zu sichern, um neue Anregungen zu finden. Die Ideen fließen in einen mehrstufigen Innovationsprozess ein, der mit einer Potenzialeinschätzung beginnt und mit der möglichen Markteinführung endet. Im Fokus stehen neue Fertigungsprozesse und Technologien. |

**Case 2: A Luxury Watch Making Company**

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|---|---|
| Question 1 | - |
| Question 2 | Project Buyer |
| Question 3 | No |
| Question 12 | To bring a standardization through Technology – It will oblige Firms to change their Process, improve Communication Possibilities and eventually reduce the Bullwhip effect … if new reporting's & new KPIs are available |
| Question 13 | The objective is to give as early as possible without human filter accurate data's/forecasts & orders – it eventually implies at first dedicated machines for each type of client/supplier |
| Question 15 | I am Purchasing components for all 3 next year's projects: from the R&D development till stable in Production. |
| Question 16 | Our company creates Luxury Watches so it would not work at first because it is a very "Hand Made" Industry. I could be interesting on 100% Machined Parts. |
| Question 17 | No |

Extra Questions:

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|---|---|
| Question 1: | Do you believe that through the implementation of Industry 4.0, that jobs would be affected? |

| | |
|---|---|
| | As mentioned earlier, our products are handmade, so it will be quite difficult for machines to take over for quite some time in my opinion, therefore, I do not believe that jobs will be affected in the next few years, however as more time passes and better technology hit the markets, it is quite possible that jobs will be affected. |
| Question 2: | In some industries like the car manufacturing industry , robots do most the work, do you believe that these technologies might cause more harm than good? |
| | To some extent, as technology becomes more developed and more autonomous, the less human intervention it needs, unless the machines need maintenance. With this also comes increased flexibility and production speeds. However, because technology is evolving so fast, new jobs will appear while old ones disappear. This means that there might be some people who lose their jobs due to not having the appropriate skill set, however other jobs will be created. So as a final thought it's a win/lose relationship between the two. |
| Question 3: | In your opinion what are the strengths and weaknesses of Industry 4.0? |
| | Strengths: higher flexibility, customization and transparency |
| | Weakness: high costs, data security threats, increased competition |

**Case 3: A Manufacturer of Large Household Items**

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|---|---|
| Question 1 | -, wir stellen Heizsysteme, Brenner, Wärmepumpen und Solarkollektoren her. Diese Systeme Zeichen sich durch Sparsamkeit, Langlebigkeit und Zuverlässigkeit im Betrieb aus. Sie werden in Deutschland und in der Schweiz hergestellt |
| Question 2 | Leiter einer Niederlassung bzw. eines Profit-Centers |
| Question 3 | Ja aber wir benutzen es nicht in unserer Firma |
| Question 12 | keine konkreten Vorstellungen, da alle strategischen Entscheidungen von der Unternehmensleitung getroffen werden |
| Question 13 | keine Vision, da Einkauf zentral über Stammhaus erfolgt |
| Question 14 | keine „Manager" als meine Mitarbeiter im Personalstamm der Niederlassung |
| Question 15 | nach dem Entgelt-Rahmenabkommen (ERA) sind 18 Arbeitsbewertungen für Niederlassungen mit definierten Tätigkeitsbeschreibungen für tariflich eingestufte Mitarbeiter festgesetzt, deren unterschiedliche Aufgabengebiete viel zu umfassend sind |
| Question 16 | Thema ist viel zu komplex, aber es ist die Zukunft. |
| Question 17 | Nein |

Extra Questions:

| | |
|---|---|
| Question 1: | Denken sie das in der Zukunft Jobs betroffen werden wegen Industrie 4.0? |
| | Die Möglichkeit ist auf jeden Fall da, jedoch kommt es drauf an in welchem Sektor es ist. Für uns, da wir viel mit unseren Klienten reden müssen ist die Chance geringer als zum Beispiel in der automobil Industrie. Wir passen unsere Produkte so an wie es unsere Klienten möchten. |
| Question 2: | Um Industrie 4.0 komplett zu implementieren, wie lange denken sie das es brauchen wird? |
| | Schwer zu sagen, da wir noch relativ am Anfang sind. Aber ich würde sagen ein paar Jahre auf jeden Fall. |
| Question 3: | Was sind ein paar Stärken und Schwächen von Industrie 4.0 in ihrer perspektive? |

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|---|---|
| | Zum positiven gibt es höhere Transparenz und schnellere Herstellung<br><br>Zum negativen gibt es Jobs die verloren gehen, und es gibt Möglichkeiten das die Arbeiter es nicht akzeptieren. |

**Case 4: A Company Specializing in Installing Household Items**

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|---|---|
| Question 1 | - |
| Question 2 | Abteilungsleiter für den Bereich Heizung, für die Projektierung der Anlagen, für den Kundendienst. |
| Question 3 | Nein |
| Question 12 | Es ist ein großes Thema, es kommt auch immer mehr von uns, wie gesagt es wird immer wichtiger das man eine Zentralle Steuerung bekommt die man über das Internet zugreifen kann für die individuelle Wünsche der Kunden. |
| Question 13 | Wir haben die nachfragen das man auch zum Bezug dahin was machen kann über Apps/Handy. Da schauen wir auch das wir die Hersteller auch zu uns einladen welche kompatibel sind, wo sowas auch können. |
| Question 15 | Unsere Aufgabe ist es die Hardware zu verarbeiten, so das alles zusammen funktioniert. Techniker programmieren es für Kunden und geben ihnen Anweisungen so das sie es dann selber machen können später. Unsere Aufgabe ist es auch das Bedürfnis der Kunden zu realisieren, und ganz individuell auf die Bedürfnisse einzusteigen. |
| Question 16 | Industrie 4.0 ist die Zukunft. Ohne das wird es nicht gehen. |
| Question 17 | Wie vorhin gesagt, es ist die Zukunft. |

**Case 5: A Consulting Company**

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|---|---|
| Question 1 | - |
| Question 2 | Owner of MAS Consulting International |
| Question 3 | Yes, as a telecommunication consultant I am aware of Industry 4.0 and IIoT. As telecommunication service providers are enablers in terms of infrastructure and services |
| Question 4 | We have not yet implemented any industry 4.0 applications in our firm |
| Question 5 | We do not have a consistent industry 4.0 strategy |
| Question 6 | None, not implemented within the firm |
| Question 7 | With the implementation of industry 4.0 job descriptions would need adjustments in terms of digitalization etc. |
| Question 8 | Work tasks would be affected due to increase in online processes |
| Question 10 | Good, more efficient, more e-tendering , e-auctions, collaborative work, better transparency etc |
| Question 11 | consider the field a wide subject which will affect all areas of work and life, all industries, and government |

Extra Questions:

| | |
|---|---|
| Question 1: | How long do you think it will take for Industry 4.0 to be implemented completely in companies.<br><br>It depends on what company we are talking about. Alot of the automotiv industry already have Industry 4.0 applications implemented. However, for most companies I believe it will take between 10 and 20 years. |
| Question 2: | Since Industry 4.0 is becoming so popular, and many companies are trying to implement it, how do you think this will affect the people within the companies in terms of their jobs?<br><br>Depending on which sector, there are more or less likely to lose thier jobs to automation. In the automotiv industry the chances are higher compared to a consulting company, as we have to interact with out clients and repsond to their demands/needs. |
| Question 3: | What are you thoughts on industry 4.0 in terms of strengths and weaknesses?<br><br>Strength: increased flexibility, new job opportunities<br><br>Weakness: employees would need to adapt otherwise they lose their job |

**Case 6: A Manufacturer of Mixing Plants**

| | |
|---|---|
| Question 1 | - |
| Question 2 | Strategischer Einkäufer |
| Question 3 | Ja und Nein, ich kenne den begriff, jedoch nicht im Bezug von Einkauf. |
| Question 4 | Noch nicht implementiert, es gibt keine Projekte für Industrie 4.0 im Einkauf, jedoch wahrscheinlich welche im Herstellungsbereich. |
| Question 5 | Nein |
| Question 6 | Wir haben ein Prozess wo die Daten ausgetauscht werden mit den Lieferanten, jedoch ist der Prozess noch in der Entwicklung. |
| Question 7 | Momentan nicht da wir noch nichts implementiert haben. |
| Question 8 | Momentan nicht da wir noch nichts implementiert haben |
| Question 10 | Ein gutes Gefühl, da wir dadurch immer mehr Daten vernetzen können mit unseren Lieferanten und Klienten. Also würde es die Arbeit ein bisschen leichter machen da die Technik schon alles regelt. |
| Question 12 | Im Bezug von Industrie 4.0 erwarte ich höhere Transparenz und flexibilität mit den Lieferanten. Es wird möglich sein das es ein offenen Daten Austausch geben wird, und in dem Prozess können wir dann sehen wo Fehler auftreten. Bessere Planung und Forschung von Produkten und eine 1 zu 1 Lieferung Zeit, wo wir dann sehen können wo unsere Lieferung ist. |

Extra Questions:

| | |
|---|---|
| Question 1: | Denken sie das in der Zukunft Jobs betroffen werden wegen Industrie 4.0? |

Auf jeden Fall, es kann gut sein das die älteren Mitarbeiter ihre Jobs verlieren da sie nicht so schnell auf den neusten Stand kommen können wie die Jungen. Aber ich glaub auch das wenn wir mehr in den Technologie Sektor gehen, also unsere Maschinen verbessern durch Machine to Machine Kommunikation, das es neue Jobs entwickelt. Aber ja generell wird es Jobs beeinträchtigen.

Quesiton 2: In welchem Zeitraum denken sie das Firmen Industrie 4.0 implementieren können.

Vor ein paar Jahren, hat sich darüber niemand Gedanken gemacht, und auf einmal war es da. Ich kenne schon ein paar die ihre Jobs verloren haben wegen Technologie. Also würde ich mal sagen 5-10 Jahre auf jeden Fall.

Question 3: Was wären ein paar Stärken und Schwächen von Industrie 4.0?

Stärken: Höhere Transparenz, höhere Produktion Leistung, neue Märkte und es würde wahrscheinlich die Möglichkeit geben das verschiedene Sektoren in der Firma zusammen arbeiten können.

Schwächen: höhere Anzahl an Firmen in einem Markt, Daten Sicherheit könnte beeinträchtigt werden