Uniquely Human Abilities in the Digital Age

- A qualitative exploration for a Successful Transformation of the Workplace during the Fourth Industrial Revolution

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Abstract

Nowadays, the public debate on the future development of technology and its impact on the labour market seems to focus on the replacement of human abilities and the dominant approach how to do so. This becomes evident in discussions on automation, AI/ML or industry 4.0. The debate about AI also has to consider the characteristics that make humans indeed human. When the boundaries between humans and machines start to blur, the machine is no longer merely a tool, but an autonomous unit that can make complex decisions.

This study intends to achieve a broader understanding of uniquely human abilities and areas of technological superiority, the application of future skills to the future workplace, and the potential of human-machine interaction. These topics were surveyed in a qualitative study interviewing 30 experts and moderating three focus groups, and which followed an extensive review of existing literature in the field. Concrete implementation recommendations are provided.

The result of this study is a taxonomy of uniquely human abilities, which highlights the high importance of social skills that are required for the future of work. It further suggests that the human abilities social interaction, creativity and cognition are indispensable in the ongoing technological change. These abilities further need to be joined with more advanced human-machine collaborations.

This study generates a valuable contribution to the field through new insights in human abilities and the future of work in the era of industry 4.0. It contributes to the field by suggesting necessary future skills at the workplace, as well as a change of the educational system. The findings of the study are particularly relevant for current and future employees and may be able to support them on their journey to develop a skillset that best fits for the future. The study might also serve as a basis for personnel and management development, recruitment and science.

Keywords human abilities, future skills, social skills, future of work, artificial intelligence, fourth industrial revolution, human-machine interaction, qualitative research

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List of Abbreviations

AI	Artificial Intelligence
HR	Human Resources
ICT	Information and Communication Technology
IT	Information Technology
ML	Machine Learning

1 Introduction

1.1 Motivation

> *"Even highly automated systems, such as electric power networks, need human beings for supervision, adjustment, maintenance, expansion and improvement. Therefore, one can draw the paradoxical conclusion that automated systems still are man/machine systems, for which both technical and human factors are important"* (Bibby et al., 1975, p.664).

Despite this positive view of the future by Bibby et al., technological progress seems to have become unstoppable during the last years. Recently, a machine defeated the world champion in AlphaGo, once seen as a game that is impossible to win for a machine.

Ke Jie didn't stand a chance, although the twenty-year-old Chinese player had mastered the almost three-thousand-year-old Chinese board game Go like no other player before him. But in May 2017, Ke found his champion. He was defeated in three rounds of the game by his overpowering opponent: AlphaGo, a computer developed by Google (Huang, 2017).

On that day, one could say humans' last 'domain' fell in the race against the machines – at least in the world of games: The extremely complex strategy game Go with its almost infinite number of potential moves – the number is greater than that of all atoms in the universe – was previously considered invincible for computers (ibid.).

AlphaGo is a self-learning system, which means that only the basic rules of Go were programmed by humans. AlphaGo "learned" the rest by memorizing the patterns from millions of moves and playing against itself in countless games. And it got better and better. "The future belongs to AI," Ke said after his defeat (Huang, 2017b). Is this argumentation true? What can society learn from this "success over humanity"?

The triumph of AlphaGo raises concerns by many people that robots could take over the world. At the same time, however, it is worth to look behind the curtain of AlphaGo. This victory was only possible through an immense teaching effort by Google and DeepMind, in which a high number of employees were involved, in supervising the algorithm (DeepMind, 2019). Thus, in order to beat the one world champion, a significant number of jobs have been created to facilitate this win. This development and change is exemplary for many discussions in the field of future of work. It leads to

the expectation that society and humans need to prepare for a changing world environment in the era of digital technologies and industry 4.0. Such transformational changes have however already occurred in the past during industrial revolutions and have constantly accompanied humans over time.

Heraclit of Ephesus hit the nail on the head: “Nothing is more constant than change”. This quotation is now more topical than ever, as the example of AlphaGo has shown – whether it is in the fields of economy, politics, technology or the environment (Frischmann & Selinger, 2018). Today, the rapid pace of change – a technological development that has occurred since 2016 (Schwab, 2016) and is characterized by a massive digitization of industry, technological progress and global interdependencies – indicates that digital transformation will take place in all sectors and across all industries. With it, work descriptions will change, and technological innovations will then alter the products and services that are provided through the work. This requires an equally fast paced transformation of knowledge and skills of workers. Information and communication technologies (ICT) have a very special role to play in shaping the work of the future.

The debate about artificial intelligence (AI), the underlying algorithmic structure that enabled AlphaGo’s win, stands exemplary for this development. It touches on core areas of the human being, when the boundaries between humans and machines start to blur. The machine is then no longer merely a tool, but an autonomous unit that can make complex decisions. In the near future, robots and intelligent machines will in all likelihood be able to perform even more impressive tasks than they have done so far already. The consequence of this development is that humans and robots will compete with each other in many professions. At the same time, however, new production perspectives and tasks emerge that did not exist in the past, like the maintenance and teaching of an AI, as it was necessary in the case of AlphaGo. Ultimately, the development path of the labour markets and the world of work will be driven by four central driving forces: Digitalisation, globalisation, demographic change, and institutional change (Schwab, 2016). Areas of work where advanced technologies and human work complement each other will become increasingly important.

The ongoing digitalisation of work therefore raises central questions about the future of work: What effects does it have on work and production? How are activities, competences and professions changing? How can the process be designed to be humane? Which skills will be important? Ultimately, it has to be determined what characteristics really make the human unique, because the future of work will most likely circle around those characteristics. The simple routine tasks known so far can be taken over by technology, but tasks requiring human creativity, an

emotional mode of expressions, human interactions and cooperation will become more important (Eichhorst & Buhlmann, 2015). By using qualitative interview data from 30 experts in different kind of industries, this study therefore aims to answer the following research question:

What are uniquely human abilities in the digital age for the future workforce?

The thesis thereby brings together different perspectives from HR, education, business and technology to identify some of the most promising and cherished human abilities that need the attention of those stakeholder groups. These uniquely human abilities are taxonomized in a stringent way. It can be shown that so-called “soft skills” are formed through these uniquely human abilities from all expert stakeholders and that a synergy between humans and machines is highly appreciated, whereby these human abilities are building the basis for a comparative human advantage over machines.

In addition, the study provides a broader understanding of the implications and the application of future skills to the future workplace and the potentials that lie in human-machine interaction. Further, it tries to answer how these specific skills can be trained, and which tasks can be “outsourced” to technology and robotics.

This work can be used as a starting point for executives to determine which human competencies are worth to rely on in the future. In addition, it can point out initial possibilities of how these competences can best be conveyed in order to use an organisation’s training budget sensibly and purposefully. Personnel selection and recruitment processes can benefit from this study and use the named competencies as a basis for developing a requirement profile for future positions and for coordinating the recruiting measures. In addition, this work also has relevance in the field of science and academia. As described in the later problem definition (2.4), there is hardly any comparable work on this topic. It is recommended to use the gained findings for the development and revision of curricula for degree programmes.

1.2 Outline of the Thesis

To understand the structure of the thesis, a detailed outline will be provided in this subsection, and the content of each chapter will be briefly be presented:

- In this introduction, the relevance of the topic was highlighted, and the research question posed.
- In the second chapter, a literature review is conducted. First, the approach of the narrative literature review is described. A narrative is developed that explains the interrelations of past industrial revolutions and employment, the changes occurring in the course of the current fourth industrial revolution and its impact on work. The research gap is finally derived.
- The third chapter reviews the methodology and introduces the reader to the research philosophy, approach, strategies, techniques, and procedures. The chapter explains the chosen methods of qualitative data collection, analysis and the research design, which were used to ensure research quality.
- The results of the data analysis and insights from the interview-based study of 30 experts from diverse different industries are presented in chapter four.
- After that, the fifth chapter discusses the results in more detail.
- It is followed by a sixth chapter that points out the limitations of the thesis.
- The seventh and final chapter provides normative suggestions for the stakeholders involved in the field of the research: politics, education, as well as private sector companies.

2 Literature Review

This chapter describes the theoretical background of the thesis and provides a historical overview about industrial revolutions and their impact on employment, as well as models and theories regarding the future of work.

2.1 Approach of the Narrative Literature Review

The purpose of the literature search was to gain an overview of existing research in the field and thus to create a basis for qualitative data collection. For this purpose, the narrative form of literature review was chosen (Pare et al., 2015). The aim was to search literature as systematically and comprehensively as possible, but following a narrative developed by the author. Academic publications were exclusively retrieved from following databases: EBSCO, Google, Google Scholar, JSTOR, Springer and SAGE. In addition, institutions, companies and books were searched for interesting angles on the topic.

The literature search was initiated by a keyword search. Through creative techniques like brainstorming, search strings were generated for the internet-based search. The search strings included, for example, "human skills", "human-centred perspective", "AI & Humanity", "future of work", "future of skills", "21st century skills" and "human abilities" or “non-human abilities” (see Appendix A for further search strings in German, as well in English).

Quality criteria for inclusion and exclusion decisions comprised impact of the journal, reputation of the author, and relevance of the viewpoint for the research question. Furthermore, the lists of references of the retrieved articles were reviewed and further relevant authors, papers and journals identified.

Since the thesis touches two main points, one of them being technological advances in industry, the other skills for the future workplace, the reviewed academic literature can be grouped into two main parts: 1) Review on human skills, human abilities, and their applicability and importance during industrial revolutions; 2) Review of human-centred perspectives and their connection between humans and machines.

Figure 1 Literature Review Process

2.2 History of Technological Revolutions and Employment

The industrial revolution, in the narrower sense, is the period of intense industrialisation at the end of the 18th century in England, triggered by the invention of the steam engine and upcoming factory production (Hendrickson et al., 2014). In a broader sense, the term refers to the rapid change in production techniques enabled through scientific progress and technical development. It is thus associated with changes in society, for example caused by the transformation from an agricultural state to an industrial state (ibid.). The term “industrial revolution” has been established for this transformation (Fitzsimmons, 1994). Since the first industrial revolution, scholars identified two further, ground-breaking transformations that changed societal structures through massive changes

in production. Their progression lead to general technological progress, accelerated development of certain technical disciplines, advancements in knowledge, an enormous increase in productive power and also to social upheavals (Schwab, 2016). Recently, there have been discussions about a fourth industrial revolution that is currently occurring (ibid.).

The societal changes associated with such important transformations were well-described by John Maynard Keynes, who published an essay in 1930 about the "Economic Possibilities for our Grandchildren". In this piece, the British economist warns against "technological unemployment", if the use of machines in an economy makes human labour obsolete. Human labour is then replaced more quickly by machines than new productive employment relationships can emerge. Impressive advances in digital technologies in demanding fields of activity, such as medicine or finance, revive the theory of technological unemployment. However, as Keynes adds, this is only a temporary phenomenon and historical considerations as well as current developments regarding the change of activity profiles by digital technologies do not permit the conclusion that a world of technological mass unemployment is imminent (Lorenz and Stephany, 2018). However, a new necessity arises to think about the idea of money without working, which could eventually call for an unconditional basic income. When people are working less, the work they are doing has to be remunerated higher, or differently compensated for in order to maintain the same wage level as before. What would be more important is the realisation that technological progress promotes general prosperity in the long term and allows people to work less. Keynes predicts that “the standard of life in progressive countries one hundred years hence will be between four and eight times as high as it is today” (Keynes, 1932, 365-66). Furthermore, three hours of work a day and fifteen hours a week would be enough (ibid.). At last, Keynes concludes that people will be able to live comfortably and contentedly and that they have enough time to devote their lives not only to paid work, but also to other, “higher pleasures”. The current debate on the need for an unconditional basic income should take this into account (Schneider, 2017).

Through a historical overview about the past industrial revolutions, it can however be illustrated how the production landscape and related social and employment structures changed. For that, the following sections will provide a journey through the long history of the interplay between the human and machine.

2.2.1 First Industrial Revolution

In 1589, inventor William Lee travelled to London for visiting Queen Elizabeth I, in order to apply for a patent for a mechanical stocking knitting machine. To his disappointment, however, the queen showed no interest: «Thou aimest high, Master Lee. Consider thou what the invention could do to my poor subjects. It would assuredly bring to them ruin by depriving them of employment, thus making them beggars» (cited in Acemoglu and Robinson, 2012). This rejection possibly prevented an earlier occurrence of mechanical machinery and illustrates guaranteed clashes between humans and machines in recent times.

The first industrial revolution began in England then two hundred years later, in the late 18th century (Wyatt, 2009; Wilson, 2004). The use of the steam engine – invented in 1712 by Thomas Newcomen in its modern version and substantially further developed in 1769 by James Watt – allowed the mechanization of manufacturing processes in the textile industry (Deane,1965). Work previously carried out at home and in small manufactories now migrated to modern factories (McAfee & Brynjolfsson, 2011).

Later research shows that the greatest impact of the first industrial revolution was not in the form of mass unemployment, but primarily in the distribution of wealth: In the sixty years between 1790 and 1850, while the British economy achieved significant productivity gains and growth, real wages of workers stagnated during this period (Clark, 2005). And with this, at the end of the first volume of "Capital", Karl Marx closes the circle to his earlier ideology critique: according to Marx, the distribution of capital is related to a class system in capitalist societies. The capitalist receives his capital (plus added value) – the worker preserves himself and his misery (Marx, 1890).

Industrialization was thus revolutionizing both the world of living and the world of work; in conjunction with a rapid population growth, it is at the same time producing a social mass misery that raises the social question as the most urgent problem. Consequently, the new factories lead to unemployment of former craftsmen, a volatility of production caused a volatility in employment and waves of unemployment, and a politic influence of workers did not exist at first to improve their situation (Reiners, 1951, p.74).

2.2.2 Second Industrial Revolution

The second phase of industrialisation began around 1870 and built on the first phase (Stearns, 1998). While the first industrial revolution paved the way for an industrial society and made human muscle power superfluous in the goods production process, the core of the second phase of industrialization was the effective use of new forms of energy such as electricity, the combustion engine and the electric motor. The symbol of this era was the automobile, above all the Ford Model T, the first vehicle to be mass-produced on an assembly line in large numbers. In Berlin, Kaiser Wilhelm II made the legendary remark "I believe in horses. The automobile is a temporary phenomenon" (Wedeniwski, 2015, p.30), but motorization could no longer be stopped.

However, the second industrial revolution led to various socio-economic problems. When machines replaced people, the unemployment rate rose (Jevons, 1931). Two depressions shook the world economy during the industrial revolution in 1873 and 1897, displacing workers. The revolution created both extremes of wealth and poverty in a capitalist manner. The industrial working conditions during the second industrial revolution were dangerous. Long working hours, inadequate protection of work with machines, inadequate compensation and insurance, and constant exposure to air pollutants were everyday realities for industrial workers (Hopkins, 1982).

Influenced by Karl Marx and his ideology, the political situation for the workers did however improve. An important example for this can be found in Germany, a country at the forefront of industrial development. Through newly formed trade unions and the birth of the social democrat party in Germany, the discussion about the social question was emphasized and shortened to the "workers' question". Politically, the social question in Germany was primarily dealt by Bismarck's social legislation (van Meerhaeghe, 2006), which lead to the establishment of an equally financed statutory social insurance system and which institutionalises the class conflict. Such a development can be seen exemplary for many other industrialized countries at the time and later onwards, where work and social policies were slowly created and improved the situation for workers (Henkel, 2011).

With such a social legislation, Bismarck created the basis for the development of the welfare state in Germany (van Meerhaeghe, 2006). Similarly, in the United States of America, President Roosevelt supported a number of economic and social measures coined as the Second New Deal, including poverty alleviation, measures against unemployment through job offers and the development of a social network (Valli, 2018). This development towards more social standards in employment and related issues became increasingly important after the second world war and dominated the agenda during the soon occurring third industrial revolution, as well.

2.2.3 Third Industrial Revolution

The third industrial revolution began in the early 1960s with an automation of factory jobs on a grand scale (Fitzsimmons, 1994). The third industrial revolution is based on the further development of electronics and information technology, as well as their continuous increase in performance. Based on this technological advancement, it became possible for the first time to coordinate complex automation solutions and the worldwide networking of cooperation in production networks (Ziegler, 2005; Kagermann, Wahlster, & Helbig, 2013). The first large calculating machines were introduced into corporations in the 1940s and with them the first programmable controllers. About 30 years later, the personal computer found its way into offices and private households and formed a new branch of industry. Industry 3.0 is thus characterized by a successive (partial) electronics-based automation of work steps. Human resources are increasingly replaced by machines in series production (Ziegler, 2005).

The fear of job losses is so high in the US during this period – as it is in Europe – that President Lyndon B. Johnson sets up a committee called "The Ad Hoc Committee on the Triple Revolution" to investigate the upheavals in the economy (Levy & Murnane, 2004). The committee concludes that technological progress should be welcomed, because it promotes general prosperity and enables the population to live in "abundance and comfort". Due to increased job losses through automation, the presidential commission recommends the establishment of free state-educational institutions and the introduction of a state basic income for all inhabitants of the country – a discussion that has re-emerged today in the form of the universal basic income. Further, the committee warned the president of long-run threats because of the changing environment and the increasing computer power: the new era of production and cybernation revolution would result “in a system of almost unlimited productive capacity which requires progressively less human labour. Cybernation is already reorganizing the economic and social system to meet its own needs” (Levy & Murnane, 2004, p.10).

To the third industrial revolution, the following applies: it is not the problem of mass unemployment that had to be solved, but the question of distribution. The futurologist Herman Kahn writes in 1967 that a four-day week and thirteen weeks of holidays a year are only a matter of time for workers in the USA (Kahn & Wiener, 1967) – a view that has been suggested by John Maynard Keynes thirty years before already (Keynes, 1932).

2.2.4 Lessons Learned from the First Three Industrial Revolutions

All earlier industrial revolutions show that technological innovations have always led to major economic upheavals, and that these have always been accompanied by fears of job losses.

The gloomy forecasts have never come true though. Despite numerous jobs having become obsolete, at the same time new, generally higher-quality jobs have been created around the newly evolved technologies. New companies were founded and some had to close: whenever in the history of mankind technical progress has made human work redundant, new jobs have been created elsewhere. That's what the Austrian-American economist Joseph Schumpeter called *"creative destruction"* in 1942 (Schumpeter & Stiglitz, 2010, p.71).

The economic history of the last two hundred years should strengthen the assumption that the fourth industrial revolution will not cause too much concern either. Old jobs are disappearing, new jobs are being created, productivity is rising, the economy and general prosperity are growing. Nevertheless, the question remains: What if things are different this time?

There are two reasons why today's transformation is not just an extension of the third industrial revolution, but rather a fourth, different type of transformation (van Tulder et al., 2019). First, the speed of technological progress (Autor, 2015). And second, the kind of automation that will be possible through the use of self-learning systems (ibid.).

The three earlier industrial revolutions have in common that they took place over a period of time. In other words, they were long, intergenerational processes that allowed companies, workers, politics, the education system and the whole of society enough time to adapt (ibid.). Compared to previous industrial revolutions, the fourth is developing exponentially and not at a linear pace (Schwab, 2016). Today's development is characterised by major technological breakthroughs at ever shorter intervals. The breadth and depth of these changes lead to the creation of entirely new manufacturing systems, involving production, management and governance. In 2015, economist David Autor wrote in a study on the effects of AI on labour markets that the performance of self-learning systems in fields like speech or image recognition is still pathetic (Autor, 2015). In contrast to earlier industrial revolutions, the focus is no longer on hardware – i.e. factories, production lines and huge robots – but primarily on software and computing power. And it's getting cheaper all the time (McAfee & Brynjolfsson, 2011).

This leads to the second big difference from the past: the type of automation that will be possible in the future. While in the earlier industrial revolutions, it was always muscle-based, manual work that was taken over by machines, today it concerns more high-skilled work: the last “domain” of human beings (Daughtery & Wilson, 2018). Every work process that follows defined rules can therefore be coded and be taken over by machines. Because they can access millions of empirical values within seconds, self-learning systems are already more accurate than doctors in diagnosing clinical pictures (ibid.).

Looking at the past industrial revolutions, it can be concluded that all revolutions have triggered a fundamental change in the dimensions of technology, organization and people in production. Some jobs will disappear, and in a transition period, it needs time for creating new jobs and adaptation (ibid.).

2.3 The Ongoing Fourth Industrial Revolution

After the first stages of industrialization, which essentially focused on machines, plants and energy, the digital revolution now introduces digital technologies. Their basis – computer hardware, software and networks – are not new, but are increasingly complex and integrated, and used for production purposes. On the macroeconomic level, they advance a fundamental social and economic structural change, both nationally and globally. For this reason, the professors Erik Brynjolfsson and Andrew McAfee called this epoch "the second machine age" (2014). They claim that the world is at a turning point: the effects of the new digital technologies would manifest themselves with "full force" through automation and the production of "completely new things" (ibid.).

According to Karl Schwab, founder and executive chairman of the World Economic Forum, the fourth industrial revolution is not just about intelligent systems. Its characteristics is the fusion of technologies and blurry boundaries between the physical, digital and biological spheres (Schwab, 2016). In the fourth industrial revolution, new technologies and innovations are spreading much faster and much further than in the earlier revolutions still underway in some regions of the world (ibid.).

In Germany, the term “Industry 4.0” was introduced at the Hanover Industrial Fair in 2011 (Deutscher Bundestag, 2016). It is a highly politicized term that describes a changing world of production and work in the global age through digital technologies (Platform-i40, 2019).

For the development of industry 4.0, an essential framework condition exists in the convergence of different technologies: Convergence of the technologies necessary for "Cyber-Physical-Systems" to control engineering, production, logistics and management processes, as well as convergence with human-machine interfaces, robotics, materials and artificial intelligence.

However, the effects of the fourth industrial revolution on the economy, labour markets and society are not yet sufficiently researched and still uncertain; even though it is a global phenomenon that does not only occur in the highly developed nations, but also in strong emerging economies (McAfee & Brynjolfsson, 2011).

In the end, the effects of the fourth industrial revolution will again be determined by distribution issues: How are individual countries shaping their education systems to prepare people for the new realities of the modern world of work? How do they tackle the problem of growing inequality? How are they changing their tax systems to accompany the shift from human to machine labour? And how do they deal with employees that experience a disadvantage through technological change? (Morcaret et al., 2017). These are major challenges for the different political systems in West and East: If they are negated or wrongly resolved, the states in Europe and North America will become even more vulnerable to populist tendencies (McAfee & Brynjolfsson, 2011). Issues like the unconditional basic income or robot taxation will soon be back on the political agenda.

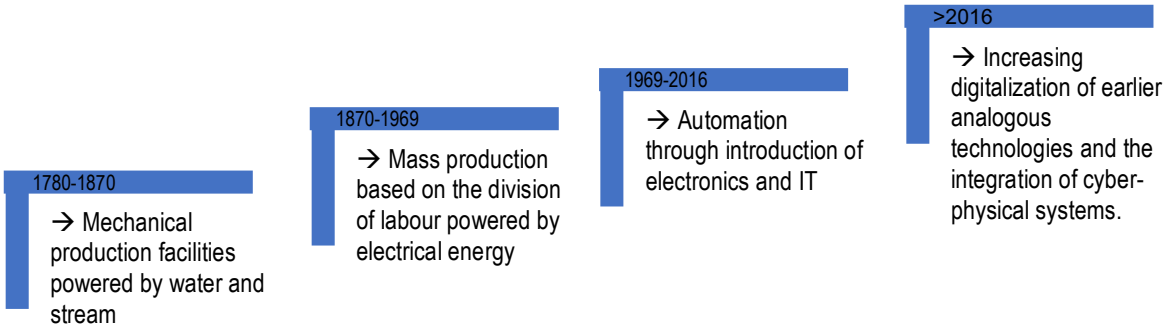

Figure 2 Summary of the Four Industrial Revolutions

2.3.1 Megatrends: Drivers of Change

The fourth industrial revolution creates many new opportunities for companies, but at the same time, several challenges are arising from the ongoing automation and digitization. In this sub-chapter, the drivers of change, known as megatrends, are described. They alter the competence requirements for employees and the demands placed on employers, as well as for society and economy.

Furthermore, they are long-term processes of change with enormous dimensions and effects. The following summary is taken and adjusted from Davies et al. (2011, p. 3-5).

1. *Extreme Longevity:* This expression means a significant increase in human life expectancy (Stock-Homburg, 2013). Already today, this change is observable. Japan, for example, has a clearly aging population. In Europe, this development is still glossed over by immigration, but the demographic trend is an age pyramid that is upside down, with comparatively few young people and comparatively many older people. This, of course, has massive implications for the welfare and pension systems, as well as health insurance. Sooner or later, the retirement age will be at a higher age. This will affect careers and the way of learning. Life-long learning is already a popular buzzword today, in the future it will probably be even more important (Brühl, 2015; Gronau et al., 2015).

2. *Rise of Smart Machines and Systems:* The growing importance of intelligent machines and systems will lay-off human workers and more and more routine tasks. This trend can already be seen today. However, it is imaginable that within a few years, machines and systems will take over more and more activities. This raises important questions: What is the "comparative advantage" over machines, computers and robots? And what does the future vision of a human-machine world look like? (Davenport & Kirby, 2016).

3. *Computational world:* The significant increase and use of sensors and computing power leads to a programmable and data-driven world through the use of big data. This makes it necessary to being able of nterpreting, controlling and using data in a meaningful way. At the same time challenges arise in data security and protection (Huber & Kaiser, 2015).

4. *New Media Ecology*: This means that new media systems and offerings need to be understood and correctly used. Everyday life is strongly influenced by digital media and rapidly developing (new) structures and communication tools. For the participation in a social discourse, a new media literacy is needed, in order to be able to decode, understand and interpret the media content (Koc & Barut, 2016).

5. The emergence of "*superstructured" organizations* allows for the creation of new forms of organizations in business and society that were unimaginable just a few years ago. This can be seen in new services and providers such as Uber, which have completely turned existing ideas of work organization and dependent work upside down. Social technologies drive new

forms of production and value creation towards a changed form of collaboration and worldwide communities (Joerres et al., 2016; Daheim et al., 2014).

6. *Globally connected world*: This expression describes the further development of globalisation, enabled by digitalisation progresses. So far, globalisation has been primarily thought from the perspective of large corporations. Now, digitally driven globalisation allows individuals in developing countries to participate in knowledge and markets from spatial distance and across cultural and national borders. A different competitive situation emerges as local markets are partly being dissolved (Matula, 2010).

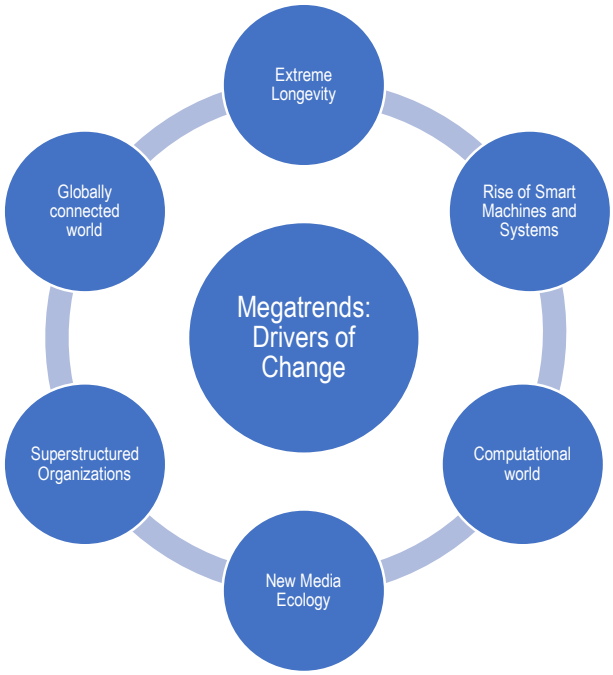

Figure 3 Megatrends: Drivers of Change

2.3.2 Impact on Human Labour

The previously described megatrends have shown that the world could possibly change dramatically during the next years. Such a development would affect every part of peoples' lives, but especially their work and employment situation. Megatrends like the rise of smart machines and global connectivity will change job requirements and necessary skills. Indeed, many authors have begun to discuss such a changing professional landscape during the last years.

In line with the challenges and megatrends ahead, the question arises what advantages humans have over intelligent systems. In this context, the ability to empathise and the possibility of finding

creative solutions are mentioned. But also, the ability to work together across different cultural boundaries and to create meaningfulness (Davies et al., 2011). In the future, these discussions have to be conducted proactively. Not only: where does the computer replace humans? But also: how can a repositioning in the confrontation with these developments take place, where can added value be found and synergies be added; and finally, what can humans do, what the machine cannot do (so well)? (ibid.).

2.3.2.1 New Professional Requirements

Borghans et al. (2014) differentiate between “people” and “non-people jobs” (ibid, p. 295). They underline that technological and organizational changes increase the importance of people skills in the workplace. People skills are defined “as the ability to effectively interact with or handle interactions with people, ranging from communication with to caring for to motivating them” (Borghans et al., 2014, p. 289). They found out that in countries like Germany and the US, people skills are especially important for nurses, teachers, sales workers, and administrative personnel (Borghans et al., 2014). This underlines the need for society as a whole to adapt to changing professional requirements induced by megatrends of the fourth industrial revolution.

At the same time, non-routine activities in analytical and interactive tasks are more strongly influenced by the people who perform them. These activities require a higher degree of communication, (self-)organisation and the disposition to independent, flexible work, which can increase the psychological workload especially in combination with an intensification and acceleration of the processes (Eichhorst et al., 2012). The associated performance-related assessment and payment can also increase the psychological pressure on the employee (ibid.). At the same time, however, such activities tend to offer more scope for autonomous design and decision-making, which is generally associated with higher job satisfaction (Eichhorst & Tobsch, 2013). The compatibility of private life, family and work can in principle be improved by flexible forms of work with regard to place and time. Mobile working and alternating teleworking, for example, can significantly ease compatibility problems. This particularly affects traditional office jobs and fewer manufacturing jobs. Whether this is applied in practice depends to a large extent on how extensive the transformation problem from manpower to work performance is (Kuhn, 1997), or how well it can be judged which performance was achieved at work outside the office. If this is not possible, then work will continue to take place mainly in company buildings in the future, as this offers supervisors better control.

Currently, however, with increasing digitalization and networking, a potentially new, radical change is coming to the forefront of society. In the past, it was rather the case that jobs with low or medium qualification requirements in the production sector had come under pressure as a result of technological change, namely when these jobs were characterized as routine activities. Consequently, the number of jobs in the non-routine sector grew, especially in the low-skilled and highly qualified sector (Goos, Manning, & Salomons, 2009; Autor & Dorn, 2013). Currently, however there is much discussion amongst experts as to whether high-skilled jobs could come under pressure due to automation, for example trough AI (Autor, 2019).
This could also lead to a higher fluctuation and volatility of jobs and jobs searches. According to the theoretic model by Aghion and Howitt (1994), new technologies lead to higher growth, creating new companies and jobs. This so-called “capitalization effect” creates more new jobs and unemployment decreases. In addition, new technologies also lead to a stronger reallocation of labour. Reallocation increases because human skills become obsolete more quickly and employees have to look for new jobs more frequently. The duration of employment contracts decreases, which requires more frequent job searches and leads to higher (search) unemployment – a further effect of creative destruction (Schumpeter, 1942).

In response to the discussed trends for the working world of the future a picture emerges that suggests a growing diversity within the labour market. It can be expected that with technological progress and further automation and digitisation, the demand for highly qualified workers, who perform more complex cognitive, analytical or interactive activities, will increase (Cedefop, 2010). However, it can be assumed that the main trends towards consultancy, innovation and creativity will shape new professions, particularly in a technologically influenced, digitised environment (Frey & Osborne, 2013).

2.3.2.2 Increasing Human-Machine Interaction

At the same time, humans will have to learn to adapt to the new changing world, and this includes learning to interact with machines (Boy, 2011). Human and machine interaction can be described as follows: Humans and machines constantly share a common working area and can constantly interact with each other. Human and robotic work are directed towards a common task. Parts of the task are performed by the human and other parts by the robot (Botthof & Hartmann, 2015). Complementary abilities of humans and robots are used optimally: humans have superior perceptual abilities, are creative, have an unsurpassed versatile and sensitive gripping system (the human hand), are mobile

and can adapt very quickly to new situations (ibid.). The robot, on the other hand, is extremely precise, always delivers a consistently high quality, carries out dangerous tasks and does not tire even during very monotonous activities (ibid.). The model of Autor et al. (2003) assumes that routine activities can be replaced by machines. Routine tasks are defined as "job activities that are sufficiently well defined that they can be carried out successfully by either a computer executing a program or … a less-educated worker" (ibid., p.1-2). These activities are often referred to as manual or non-cognitive tasks. Classic jobs, in which routine activities are part of everyday life, are those that are physically strenuous. With the substitution of such jobs by technology, physical stress will also be reduced on average (Frey & Osbourne, 2013). Borghans et al. (2014) note that „through dramatic improvements in processing speed and memory, computers have become relatively better in interactive tasks" (p.291).

Entwistle (2003) emphasizes the increasing importance of human-machine interaction: "communication between humans and computers is a prerequisite to employing computers as an effective human tool" (p.127).

MacCrory et al. (2014) thus calls for a "redesign of jobs to rebalance the tasks performed by machines and humans" (p.5). In their study, using O*NET data, they discuss three choices for human workers in how to compete in an era of fast-moving technology: racing *against* machines; racing *with* the machines, and running a *different* race. They thus recognize a new kind of threat for jobs. Previously, factory workers were in the spotlight of simple automation, now lawyers and journalists are (ibid.). This bears further inherent problems of degrading social cohesion. As a solution presented by the authors, the future human-machine interaction should be a race and collaboration with the machines, because workers can do tasks then faster, augmented and more accurate because of the support of technology (ibid.).

Campbell (2016) agrees by stating that "computers plus humans do better than either one alone". AI and other intelligent technologies can then support the decision-making process with data-driven analytics. With the human-machine symbiosis, "machines should take care of mundane tasks, allowing humans to focus on more creative work" (ibid.).

Jarrahi (2018) underlines that "in line with the vision of human-machine symbiosis, it is more meaningful to view AI as a tool for augmentation (extending human's capabilities) rather than automation (replacing them)" (Jarrahi, 2018, p.585). Jarrahi (2018) considers intelligent technologies as assistants for human decision makers and state that they can (1) generate fresh ideas through probability and data-driven statistical inference approaches and (2) identify relationships among

many factors, which enable human decision makers to more effectively collect and act upon new sets of information (Jarrahi, 2018). The best of both worlds of AI technology and human intelligence can collaborate to achieve a better output, e.g. in decision-making processes: “AI is likely to be well positioned to tackle complexity issues and humans can focus more on uncertainty and equivocality, using more creative and intuitive approaches” (p.582-83).

In summary, “Human-AI symbiosis means interactions between human and AI [that] can make both parties smarter over time” (p. 583.). Furthermore, the rise of AI calls for a new human-machine collaboration, requires that machines should perform mundane tasks and humans therefore focus on creative work (ibid.).

Jarrahi describes with an example of a decision-making process, displayed in Figure X, how AI & humans could work together.

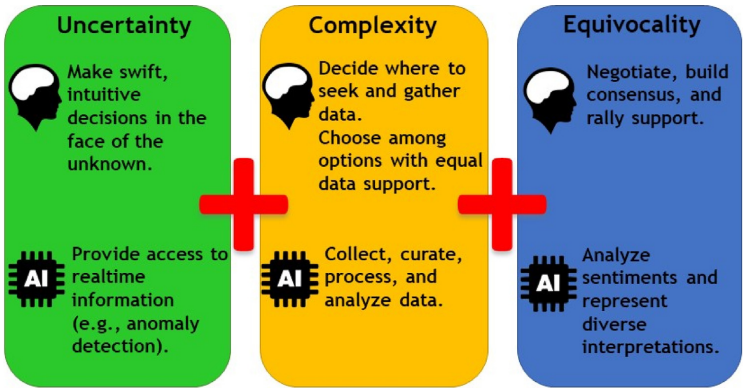

Figure 4 Decision-Making Complementarity (Jarrahi, 2018, p.583)

Orlikowski (2007) introduces a human-centred perspective with the focus of how humans “make sense and interact with technology in various circumstances” (p.1437). According to him, “the technology is not [to be] black-boxed but to be different” (ibid), depending on the various applications assigned to it and the different ways people engage with it (Orlikowski, 2007).

Automation in a human-centred way should then “create systems that retain the human operator in control loops with meaningful and well-designed tasks that operators are capable of performing well in order to optimize the overall human-machine system functioning” (Kaber & Endsley, 2004, p.115)

Further, Endsley (1987) created a hierarchy of how to use expert systems to complement human decision-making: (1) manual control with no assistance from the system; (2) decision support – by the operator with input in the form of recommendations provided by the system; (3) consensual AI –

by the system with the consent of the operator required to carry out actions; (4) monitored AI – by the system to be automatically implemented unless vetoed be the operator; and (5) full automation with no operator interaction (ibid.).

With regard to human and machine interaction or collaboration, the concept of „fusion skills" is introduced (Daughtery & Wilson, 2018). It means that humans and machines come together to form new kinds of jobs and work experiences. Figure XYZ describes 'humans' & 'machines'-only activities.

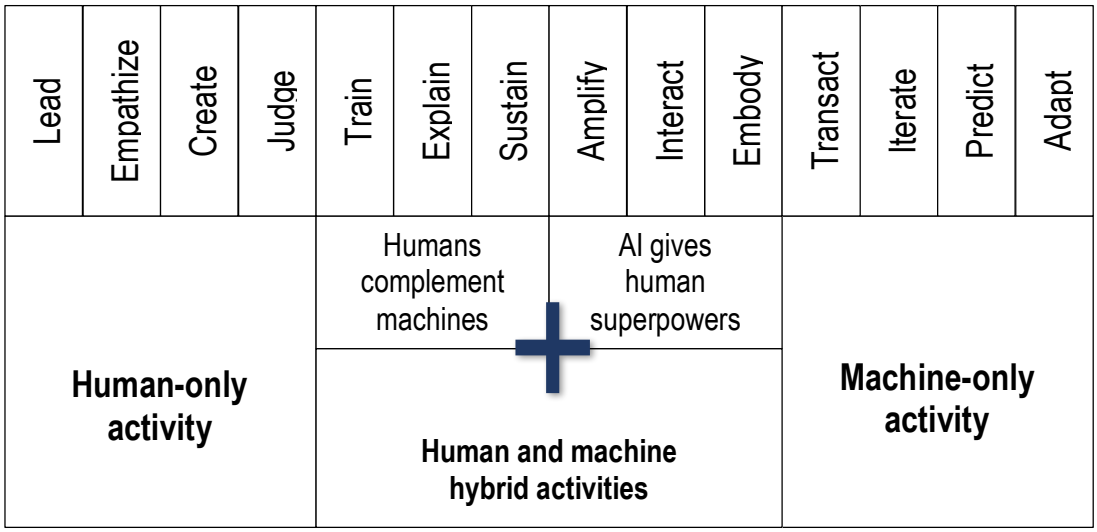

Figure 5 The Missing Middle (Daughtery & Wilson, 2018, p.107)

2.3.2.3. Changing Labour Markets

Two points of view dominate the current discussion about the impact of AI on work. One assumes massive distortions in the labour market due to the widespread displacement of workers through the use of AI. For the other, the interaction between people and AI offers many opportunities to enhance the value of work and thus improve the quality of work (Daughtery & Wilson, 2018). The two scenarios do not necessarily stand in direct contrast to each other.

However, as Acemoglu and Restrepo (2018) mention, "alarmists" would argue that the ongoing advances in AI and robotics will mean the "end of work by humans", others might think that this new technological change will be a chance for developing new skills and creating new competencies, as well as new jobs (ibid). In a framework that they developed, Acemoglu and Restrepo came up with the observation that robotics and current practices "are continuing what other automation

technologies have done in the past: using machines and computers to substitute for human labour in a widening range of tasks and industrial processes" (Acemoglu & Restrepo, 2018, p. 3).

Indeed, a study in 2013 by Carl Benedikt Frey and Michael Osborne found for the American labour market that 47 percent of all employees work in occupations for which there is a high probability that they will be replaced by automation in the next 10 to 20 years. On the one hand, they argue that there is a polarisation of the labour market between highly-skilled and low-skilled workers with the erosion of the middle range, but, referring to Brynjolfsson & McAfee (2011), they note that the possibilities of replacing human activities with embodied algorithms in software will increase sharply, including intellectual activities. According to Frey and Osbourne, the replacement of human labour is not limited to routine tasks. It can be criticised that, no separate evaluation was carried out for industrial activities, and they miss out a quantification of the effects they wanted to analyse. Moreover, they assume a linearity in the availability of technological possibilities and their immediate implementation in working environments (Arntz et al., 2016). Therefore, both the occupation- and activity-based projections of the employment consequences of industry 4.0 are based on partially questionable assumptions and on initial statistical data that is not very reliable. Reliable forecasts are therefore still a long way off.

According to estimates by Bonin et al. (2015), who make an activity-based estimate study with PIAAC data of the OECD, the automation potential is 9% of jobs in the USA and 12% for Germany. Accordingly, the probability of automation is quite low for the occupations of managing directors and board members, managers in production, academic health professions, teachers and academic ICT specialists. On the other hand, the following occupations have a relatively high automation probability: office and secretarial staff, office staff in finance and accounting, machine operators and assemblers, unskilled workers in agriculture, forestry and fisheries, unskilled workers in food preparation and street traders and service workers working on the streets (Bonin et al., 2015, p. 34).

The individual-based PIAAC data allows for several types of activities to be assigned to one occupation. However, this method also has its limits, since it can be assumed that the weighting of individual types of activity within an occupation may be fundamentally different depending on the occupation. There is also great uncertainty as to what exactly can be automated in an individual type of activity and where the use of the technology will have a supportive, rather than job-destroying effect. Experience to date has shown that a large part of adaptation to computerisation takes place through the adaptation of activity structures within occupations (Autor et al. 2003, Spitz-Oener 2006).

Other related studies, in which the technological change alters the macroeconomic labour-market situation have been presented by Autor, Levy, Murnane (2003), Borghans and ter Weel (2004), Autor, Lawrence, Kearney (2006) and Borghans, ter Weel and Weinberg (2008).

2.3.3. The Remaining Comparative Advantage of Human Work

Herbert Simon, Nobel Prize winner in economics explained in his essay "The Corporation: Will It Be Managed by Machines?" from 1960 why computerized work would not lead to mass unemployment, but rather to substantial shifts in the economy's mix of jobs. He predicted that "personal services involving face-to-face human interaction will be an important part of the job" (Simon, 1985, p. 38). Furthermore, Simon uses David Ricardo's principle of comparative advantage, explaining that "employing humans is still worthwhile in tasks in which they have *comparative* (that is, relative) advantage" (Levy & Murnane, 2004, p. 34). The previous section has highlighted that the future of work might be different to what can be observed today. Some professions will disappear, and their tasks be automated; others will have to adapt and work more collaboratively with robots. Altogether, it can be expected that such a change might lead to changing labour markets on the macroeconomic level. The development raises the question what each individual's place in the working world might be. To answer this, it is necessary to more deeply investigate the abilities, skills and fields in which humans still possess a comparative advantage over machines. Only then, it can be assumed that human employees are needed and necessary for performing future tasks, especially in a manufacturing environment that has traditionally been prone to high automation rates. In the existing literature, it can be seen that the traditional definition of human intelligence, certain soft skills and non-routine tasks will likely remain important for the future of human work, as the remaining of this section will show.

2.3.3.1. Human Intelligence

There are a lot of advancements in the field of robotics, AI, ML and other technologies that can increase productivity and perhaps even eliminate some of the work that is unsafe, difficult to perform, or not rewarding for humans to take on. But despite all the innovations in AI, there is still the distinct trait of human intelligence that cannot be substituted by machines yet.

One of the pioneers of AI, Alan Turing, developed in his ground-breaking work "Computing Machinery and Intelligence" in 1950 a test procedure to investigate, whether a machine can imitate a person's thinking. He introduced the "imitation game", the so-called "Turing-Test". A test subject

chats with both a human and a computer. Then the test subject has to decide which one he was talking to. According to Turing (1950), “a computer would deserve to be called intelligent if it could deceive a human into believing it was human” (cited in Kaku, 2014). However, it is controversial if any machines have really passed the test yet and what the exact threshold and conditions for that are (Berrar, Konagaya & Schuster, 2012).

Therefore, at the present moment, a fully cognitive AI is not yet developed, and human intelligence remains in the complexity of thinking a trait that cannot be simulated (Drozdek, 1998). Indeed, when taking the definition of the Oxford Dictionary as basis, the definition of AI refers to “the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between language”. The success of an AI is therefore measured by its ability to simulate human sensory patterns.

The French philosopher René Descartes (1637) argued the difference between man and animal lies only in the soul – aside from that, all organisms function according to mechanical principles. In his thesis, the spirit and matter are separated: spirit is human's provenance and therefore a machine is above all one thing: spirit-less. For a machine, however, the question of spirit or soul is obsolete. Descartes had predicted in 1637 “although such machines might execute many things with equal or perhaps greater perfection than any of us, they would, without doubt, fail in certain others from which it could be discovered that they did not act from knowledge, but solely from the disposition of their organs” (Descartes, 1637, p. 33). After 400 years of technological development, this forecast seems to have kept its accuracy until today.

2.3.3.2. Soft Skills

There are a number of soft skills associated to this human intelligence that can hardly be automated according to authors in the field.

Deming (2017) explores the growing demand for social skills over the last several decades. He argues that “computers are still very poor at simulating human interaction” (ibid., p. 28) and understands it as an “unconscious process” (ibid.). This kind of skill has evolved in human history over thousands of years. As indicated by Deming, the human connection in a work environment includes group formation, with specialists playing off of one another's qualities and adjusting adaptably to evolving conditions. He affirms that non-routine interactions are building the human advantage over machines (Deming, 2017). The skills and tasks which cannot be substituted through robotization are often supplemented by it, and social cooperation has demonstrated to be hard to

computerize (Autor, 2015).

MacCrory et al. (2014) investigated the skills of which machines (thus far) could not yet develop sufficiently. They highlight the importance of interpersonal skills, which include for example the interpretation of visual and auditory information, show social orientation, interpersonal cooperation, adaptability, or concern for others in the way only humans can (ibid.). MacCrory et al. (2014) have discovered "significant increases in the importance of Interpersonal skills and decreases in the importance of Perception (e.g. voice recognition or vision) and Supervision" (MacCrory et al., 2014, p.15).

A subsection of these interpersonal skills is communication. Brynjolfsson and McAfee (2016) argue, that "computers are not yet as good as people at complex communication" (p.22), but they are approving as we can see in automation translation services: "while computers' communication abilities are not as deep as those of the average human being, they're much broader" and are on the one hand impressive, but rarely error-free (p.23).

Levy and Murnane (2004) underline the importance of complex communication as a human advantage over machines: "conversations critical to effective teaching, managing, selling, and many other occupations require the transfer and interpretation of a broad range of information. In these cases, the possibility of exchanging information with a computer, rather than another human, is a long way off" (Levy & Murnane, 2004, p. 29).

Leadership skills have gained importance (Weinberger, 2014) and have underlined the integral nature of "people tasks" (Borghans et al., 2014, p. 290).

When making decisions, "humans tend to perform better in the face of decisions that require an intuitive approach" (Jarrahi, 2018, p. 580). The comparative advantage thereby lies in the superior intuition, imagination and creativity. Because of their intuition, humans have the overall 'big-picture thinking' (ibid.). This enables strategic thinking that includes a degree of reasoning, to understand the world beyond specific decision contexts of which only humans are competent in (Jarrahi, 2018). Levy & Murnane (2004) predict that expert-thinking – the ability to judge when a problem-solving strategy is not working and the ability to utilize facts and relationships for problem-solving and complex communication will be increasingly important (ibid.): Computers still have "the advantage over humans in carrying out tasks that involve *some* kinds of information processing. But humans retain an advantage over computers in tasks requiring other kinds of information processing. At any moment in time, the boundary marking human advantage over computers largely defines the area

of useful human work" (p.13). The authors argue that computerization accelerates the pace of job change and that rapid job change supports the value of verbal and quantitative literacy (ibid.).

According to Brynjolfsson and McAfee (2016), 'ideation', the process of introducing new ideas or concepts can be characterized as a human advantage over machines. The authors argue that computers can indeed "easily be programmed to generate new combinations of pre-existing elements like words. This, however, is not recombinant innovation in any meaningful sense" (p. 191). Although these types of activities are supported through technology, none of them are directed by them (ibid.). Machines are good in generating answers, but generally not in posing interesting new questions. As Brynjolfsson and McAfee (2016) highlight, idea creation "still seems to be uniquely human, and still highly valuable" (p. 192), and they quote Voltaire: "Judge a man by his questions, not his answers" (p. 192). Abilities can then be categorized into outside-the-box-thinking through ideation, creativity and innovation and indicate "another large and reasonably sustainable advantage of human over digital labor" (p. 192).

MacCrory et al. (2014) highlight flexibility in the skill development as a very important tool for workers (ibid.). Technology has not been able (yet) to develop this kind of skills. However, machines are making rapid progress, for example in voice recognition of customers at call centres (Hernandez et al., 2011).

2.3.3.3. Non-Routine Tasks

The capacity to read and respond to others depends on implicit learning, and according to Autor (2015), machines are still poor substitutes for assignments where software engineers don't know "the rules". This type of human interaction calls for a "theory of mind" and means to "put oneself into another's shoes" (Premack & Woodruff 1978; Baron-Cohen 2000; Camerer et al. 2005). Deming furthermore affirms that non-routine interactions are building the human advantage over machines (Deming, 2017). Non-routine activities are complementary to capital expenditure (Autor et al., 2013).

Spitz-Öner (2006) uses in her analysis the Autor-Levy-Murnane model (2003), which explains measurable changes in skill-biased technology and in the composition of job tasks. She argues that there has been an increase in non-routine cognitive tasks, for example through performing research, planning or selling. Goldin and Katz (1996, 1998) provide a historical perspective on this topic. Furthermore, routine and non-routine activities can be characterized as „the relationship between the respective task measure and information technology (IT)" (Spitz-Öner, 2006, p. 239). According to her, routine tasks can be seen as computer capital, whereas non-routine tasks are vague and

programmable and cannot be practiced by computers. The latter are further clustered in five different skill categories: non-routine analytical tasks (researching, analysing, evaluating and planning, designing, interpreting rules); non-routine interactive tasks (negotiating, lobbying, coordinating, managing personnel); routine cognitive tasks (calculating, bookkeeping, correcting texts/data); routine manual tasks (operating/controlling machines) and non-routine manual tasks (repairing or renovating). The analytical category is the „ability of workers to think, reason, and solve problems encountered in the workplace" (ibid, p. 240). Interactivity not only includes communication skills, which means the ability to communicate effectively with others through speech and writing, but also to be able to work with colleagues and customers (ibid.). For a more detailed discussion of interactive skills see Borghans, ter Weel, and Weinberg (2005).

Non-routine tasks can occur in two ways. Abstract tasks include problem solving, intuition, persuasion, high levels of education and analytical capability (MacCrory et al., 2014). In comparison, manual tasks call for situational adaptability, visual and language recognition, and in-person interactions. As already noted by Moravec (1988), these tasks are all difficult to automate and have not yet been mastered by machines.

2.3.3.4. Towards a Categorization of Human Abilities

Whilst the authors in the field cite many soft skills through which humans retain a comparative advantage over machines and affirm that routine tasks might be automated in the future, very few authors try to systematically categorize the human abilities required in the future of work.

Elliot (2014) categorized in an exploratory article-based survey, human capabilities that together provide the full range of competences, which people typically have in four areas: *language, reasoning, vision and movement.* Language capabilities include the understanding of speech, speaking, reading and writing. Elliot highlights the importance of involvements in adjusting "to the needs of the person who is being communicated with and the requirements of the situation" (ibid.). Reasoning capabilities mean the recognition of a problem, the application of general rules to solve a problem, and the development of new rules of conclusions (ibid.). Under vision capabilities, the author provides examples like the location of a soccer ball, finding the registration booth, identifying people or moving around a cluttered environment without collisions. As summary, the movement capabilities include systems that involve spatial orientation, coordination, movement control, and body equilibrium (ibid.).

Frey and Osborne (2013) forecast three categories of labour inputs that are hard to automate in the future: *Perception and Manipulation Tasks*, *Creative Intelligence Tasks* and *Social Intelligence Tasks.* Perception and Manipulation Tasks are activities based on the ability to navigate complex and unstructured environments. The human has then a comparative advantage over machines. In these activities, there are technical bottlenecks, for example in the identification of faults and subsequent repair, such as the accidental dropping of an object during transport. For engineers, planning the processes for a robot to perform the transport of an object is also of great difficulty. Frey and Osborne do not believe that these challenges will soon be resolved by engineers (ibid.). The second category includes "*creative-intelligence*" activities, i.e. activities that require creativity. Under creativity, the authors understand based on the definition by Boden (2003) the ability to develop new and valuable ideas or artefacts. This includes, for example, concepts, rhymes, musical compositions or scientific theorems. In principle, activities in this field could be automated. However, society's perception of creativity changes over time and differs between cultures, making automation more difficult. Overall, the authors do not believe that professions with a high need for creativity will be replaced in the coming decade (Frey and Osbourne, 2013). *Social-intelligent* are activities that require social intelligence to be mastered, such as negotiating, persuading or caring for others. Despite new research, the recognition of emotions and especially the intelligent reaction to them remains a challenging activity for machines (ibid.). In order to be able to imitate human emotions completely, more knowledge about the functions of the brain would be necessary, for example to recognize which information is relevant at all. Frey and Osborne do not expect this problem to be solved by engineers in the coming decades.

The mentioned categories by Elliot (2016) and Frey and Osbourne (2013) are useful to understand the nature of technical changes in skills. These categorizations "however tend to be defined a priori" (MacCrory et al., 2014, p.4) and are therefore restricted by the logical inference of assumptions. A handful of very specific categories cannot represent the „varied economic impact of biased technical change across a variety of human skills and capabilities" (MacCrory et al., 2014, p.4).

Schallock et al. (2018) concentrate in their research on the human potential in Industry 4.0 and how learning factories should train different kind of skills: technical, transformational and social skills. They list skills such as teamwork, knowledge transfer, knowledge acquisition, collaboration for synchronization of process and delivery dates and analysing defects as important abilities humans should develop during the fourth industrial revolution. They are firm, that "the human resource could be probably even more important in times of Industry 4.0" (p.28).

2.4 Resumé

The review and screening of existing literature of the field have revealed that research about the future of work identifies the required skills, but not explicitly on human abilities. The interrelationship between different human characteristics envisioned from different kind of perspectives is therefore not addressed in a satisfactory manner and requires further research. This research will provide an analysis to identify uniquely human abilities and their implications for the future workplace in the context of human-machine interaction. The present thesis tries to advance this existing knowledge through a qualitative research approach and through the use of empirical data. It poses the research question “What are uniquely human abilities in the digital age for the future workforce?”, which will allow the work to systematically taxonomize human abilities necessary in the era of industry 4.0 to provide a comparative advantage of humans over machines. Further, it discusses the implications of these abilities on the future of work and the changing workplace. Thereby, the thesis bridges the gap between literature on industrial revolutions and technological change, the impact of industry 4.0 on a changing work environment and the labour markets and the literature on skills development in the era of industry 4.0 (Figure 5).

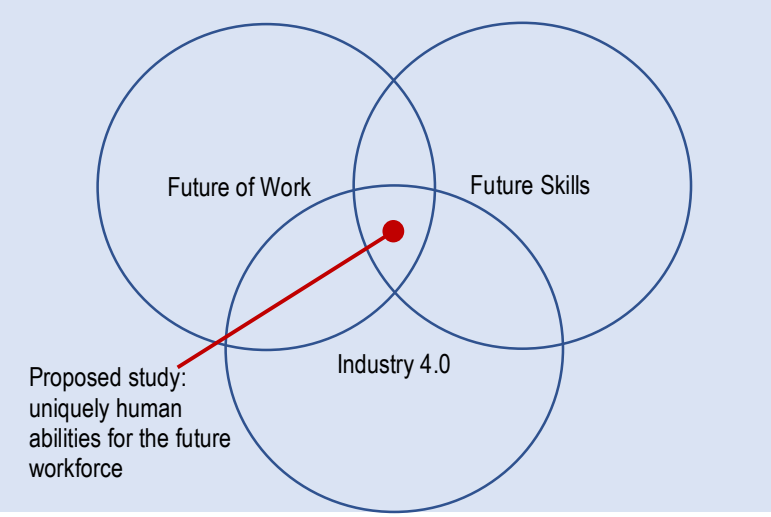

Figure 6 The Research Gap

3 Methodology

This chapter explains the reasoning behind the chosen research design, as well as the methodological approach. After a justification of the research method the qualitative design is described, and the interview techniques are summarized further and in more detail alongside some terminological clarification.

3.1 Research Justification

Nascent research is done predominantly in the form of inductive reasoning, which relies on often unstructured data (Edmondson and Mcmanus, 2007). A qualitative methodology thus offers an opportunity to increase the quality and degree of traceability of knowledge gained in interviews (Buber and Holzmüller, 2007). It is ideally suited to describe a new phenomenon, clearly the case when trying to identify necessary human abilities in the era of industry 4.0. In the present study, the qualitative data analysis also allows for an analysis of differing experiences and skills of employees that were participating in the interview process (ibid.). The qualitative exploration of the research question through expert interviews therefore enriches the understanding of uniquely human abilities needed in the 21st century, differentiated according to the professional context.

3.2 Terminological Basis and Definitions

Before an analysis of findings can be carried out, it is important to provide a terminological clarification of some terms used throughout the remaining part of this thesis.

The general definitions of human competence can be clustered into “abilities”, “skills”, and “knowledge”: In the individual competence definitions, the terms "abilities", "skills" and "knowledge" appear again and again.

Abilities are mental, but practical characteristics of humans that enable the human to perform a task (Springer Fachmedien, 2013). A distinction can be made between innate and learned abilities (ibid.). Abilities form the basis for the development of skills and knowledge (Becker, 2009). In this thesis, it is the main goal to find out uniquely human abilities and this relies upon the definition of abilities presented above.

Skills describe a person's ability to learn, adapt and function. The learning of skills is influenced by the abilities of a person, the already learned knowledge, already existing skills (experience), as well as motivation and will as an inner prerequisite (Becker, 2009). They are components of activities automated by exercise. Through exercises, new skills can be trained and turned into another skill (Erpenbeck & Rosenstiel, 2007).

Knowledge contains both explicit and implicit knowledge. The explicit knowledge can simply be passed on, but the implicit knowledge is bound to the person and difficult to pass on. It arises above all through experience and the exchange of experience (Grant, 1996).

3.3 Research Philosophy

To better understand the research approach of this thesis, the methodological structure in form of a "research onion" based on Saunders et al. (2009) is applied (Figure XYZ). The thesis is thereby embedded in a research philosophy that builds the logical, methodological, and epistemological foundations of empirical work. This should underpin the entire research and remains consistent and coherent (ibid.).

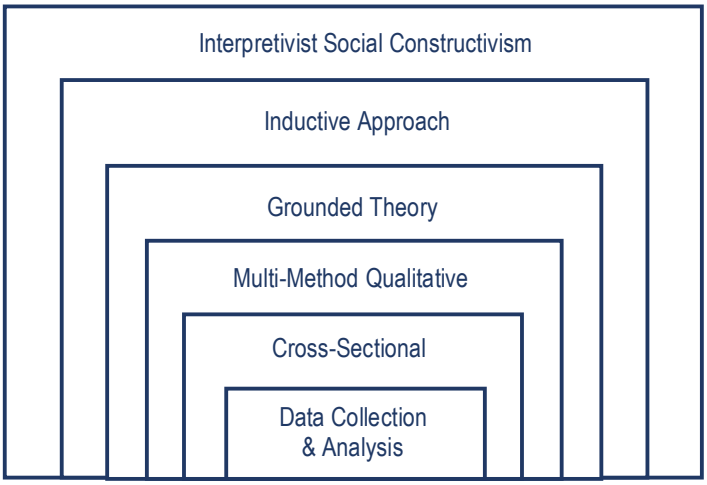

Figure 7 Research Methodology (Saunders et al., 2009, p. 309)

The ontological perspective entails the worldview of the researcher. Epistemology describes *how* the researcher believes knowledge is generated given the ontology. This thesis will follow the research philosophy marked by an interpretivist approach of social constructivism. The work is based on subjective interview data that reflects the personal opinion of interviewees, as the topic is highly future oriented and includes a degree of objective uncertainty. Therefore, much emphasis has to be laid on the unbiased interpretation of the findings by the researcher. Moreover, the topic is highly socially oriented, as the identification of future social need for certain skills is at the core of this thesis. Overall, this approach aims for the creation of a normative theory.

3.4 Research Approach

The next layer of the research onion addresses the choice between a deductive or inductive **approach** (Saunders et al., 2009). In the present thesis, an inductive approach is chosen, as it proceeds from the ontological positions that try to interpret unstructured findings and aims to establish an objective reality. The thesis follows the basic principle of science through an interplay of theory and empiricism in an inductive procedure (Edmondson and Mcmanus, 2007). In the end of the thesis, it is thus possible to induce normative statements from individual observations, which were "used to model the phenomenon under study" (Ketokivi & Mantere, 2010, p. 322). As an exploratory goal, the inductive conclusions then provide innovative hints and insights and contribute to the plausibility of theoretical cause-effect relationships.

3.5 Research Strategies

The third layer of the research onion relates to the research strategies to be adopted given a philosophical position and the choice of the research approach (Saunders et al, 2009). As the present research is based on an induction, the adoption of research designs that involve action research, grounded approaches, or even ethnographic research, would be suitable. It was chosen to use grounded theory as research strategy, as it allows for a continued exploration and adjustment of the research given new insights and preliminary findings (ibid.). Grounded theory is described as method within qualitative social research for generating empirically rich hypotheses and theories of medium reach (Mruck & Mey, 2005), and of which a theory based on the data can be gradually developed from interviews (Strauss & Corbin, 1996). According to the authors, three essential requirements have to be fulfilled: First, an open way of coding is required (Strauss & Corbin, 2008). Coding is theoretical, so it is not just for classifying or describing phenomena. Theoretical concepts are formed which have an exploratory value for the examined phenomenon. Second, theoretical sampling is essential, meaning that it is important to start with the evaluation of data already after the first interview and to write memos and to formulate hypotheses, which then suggest the selection of the next interview partners. This was done during the research process. Third, comparisons are crucial that are made between the phenomena and contexts and from which the theoretical concepts emerge (Strauss & Corbin, 1996).

3.6 Methodological Choice

As a next step, the methodological choice was carried out between a mono-method and a multiple method approach. As Figure XYZ) shows, the multiple methods approach can be divided into multi-method qualitative or mixed-methods processes. For the present thesis, a strictly qualitative method is selected due to the nascent character of the topic, the difficulty of finding or generating reliable and valid quantitative data and the future-orientation of the topic. Furthermore, a multi-method qualitative approach is selected, as qualitative data was collected through predominantly interviews with experts, but also three focus groups as pilot projects for triangulation purposes (Saunders et al., 2009).

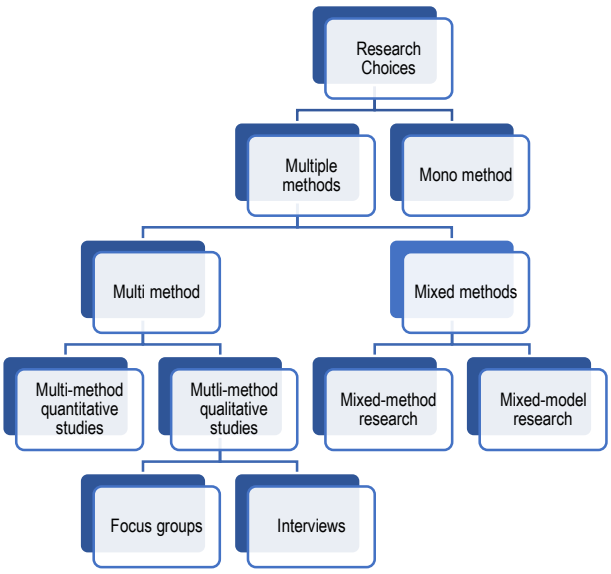

Figure 8 Research Choices, after Saunders et al. 2009

3.7 Time Horizon

A forward-looking cross-sectional method was chosen and is reliable, as the phenomenon was studied at a particular point in time within a limited time frame, however including a "preview" of future circumstances.

The topic of human abilities in the digital age and new technologies is developing as a relatively new field of research. Additionally, the tight time constraints of the master thesis only allow for a “snapshot” in a certain time frame. Although longitudinal studies would be very beneficial for the field, it was therefore decided to conduct the interviews on a cross-sectional basis.

3.8 Techniques and Procedures

The inner layer of the research onion foresees a deep dive into the data collection technique, which is detailed below for the present case (Saunders et al., 2009).

The qualitative approach uses expert interviews for primary data collection. The selected experts are insiders, whose experience and operational knowledge allow for inductive theory building. The analysis of operational processes, programmes or action structures is then carried out based on specialist insider knowledge. Questions, hypotheses and theoretical explanations related to this can be explored, answered and clarified from the perspective of the experts (Kvale & Brinkmann, 2009).

3.8.1 Interview Background

In this thesis, a semi-structured interview approach is used (Myers & Newman, 2007). Expert interviews are investigations which can reconstruct (social) situations or processes based on experiences and options of experts. These should give the researcher access to specific knowledge (Gläser & Laudel, 2010). Semi-structured interviews do not require a complete interview guide. They include an interview guideline as a reminder for the interviewer to cover the full range of relevant content but allow for a flexibility of the interview structure. This procedure provides a more intensive natural conversation situation. The researcher prepares the questions beforehand, so there is little need for improvisation. The interviews conducted in this study follow the outlined method by Gläser and Laudel (2010), according to which the interviews are based on an interview guideline with open-ended questions, lasting between 15 to 60 minutes (∑00:29:31). The aim of each conducted interview was to answer all the questions in the guide. However, depending on the interviewee, the order of the questions could vary – or, in rare cases, questions were left out if they had already been answered in the context of another question. In addition, individual questions were asked when further context was required. The interview guideline therefore supported the semi-structured exploratory interviews. Accordingly, an important part of the interview built on the inference of indirect observations, which was facilitated through the collection of demographic background information for each interviewee (Kale & Brinkmann, 2009)

Personal consultations of professionals in their corporate environment were advantageous in two different ways. Firstly, the semi-structured interviews would allow for the exploration of the topic from within the experts' natural work environment (Saunders et al., 2009). Incorporating an agents' perspective, this approach owns the unique capability to reveal certain aspects and dynamics in their

relative importance, which is only to be experienced from an internal perspective (Burman, 1994). Secondly, qualitative data from different experts in the field of AI, HR and technology would allow for a provision of further recommendations.

3.8.2 Participants and Recruiting Process

In the present context, the most important issue was to find suitable “experts” to be interviewed. For this, different steps should be considered according to Empson (2017).

Building on existing contacts and professional networks of the author, 50 employees in different countries were contacted by email and asked for their participation in the study. The sampling process therefore relied on purposive sampling, as explained by Easterby-Smith et al. (2012). It was aimed to interview professionals with a large variety of personal backgrounds, belonged to different business units and different nationalities –most of them have European nationalities and are occupied in fields related AI or the future of work.

More than half (n=30) of the contacted persons agreed to participate in the research, which is a high conversion rate of approximately 60%. The participants have different backgrounds, including expertise in academia, the private sector or public sector. Furthermore, the sample comprises different hierarchy levels in the research, with some experts having managerial responsibility. The sociodemographic details are presented in Appendix F.

The 30 different interviews were divided in five subgroups to portray a diverse picture of the research field (Figure 9). The interviews are labelled as follows: (*number of group # number of interview*)

- First, experts from the technology, IT and AI industry influence the current debate from a daily perspective and give insights why technology matters and which role the human being in this industry could play.

- Second, HR managers and HR experts develop new training tools and implement future recruiting and HR strategies. Their opinion about the future of work and which competences are needed are crucial.

- Researchers from philosophy, sociology and psychology are building Group 3. They reflect critically about ethical and social procedures of the current debate and the relevance of the thesis.

- Corporate consultants are building the bridge between research and industry. They have a good overview and perspective from their customers and can give practical recommendations.

- Lastly, the educational sector knows how to rethink education and which challenges can occur when implementing new structures.

Finally, it must be highlighted that the methodological approach, in line with the stated research interest, is based on the concept of triangulation. If this approach is applied to qualitative research, it means that different methodological approaches are combined within a qualitative method. These include different objectives and theoretical backgrounds, but do not go beyond the scope of one method (Flick, 2011). With the combination of different methods of empirical investigation, the weaknesses of one method are compensated for the strengths of another, and increase the validity of results (Blaikie, 1991; Gläser & Laudel, 2010). To satisfy this requirement, data collection has covered several successive steps and different methodological elements. Starting with an intensive study of literature, a strong understanding of the research field was gained. Awaiting empirical examination and possible clarification or inductive extension, theoretical assumptions mounted into the interview guide's structure and later served as categories of the qualitative analysis. In a second step, the data was triangulated through three focus group interviews at two pre-organised workshop sessions. Therefore, data triangulation was carried out as a parallel process and found its way into the qualitative synthesis (Figure 9).

During the Brave New Learning Conference in Amsterdam from the 09th to the 12th of February, nine participants from various backgrounds were interviewed in an interactive and highly exploratory workshop that served as a focus group. The experts had diverse backgrounds, ranging from philosophy, IT and Technology to Learning & Training. They were education professionals from educational institutions in four different countries: the Netherlands, Germany, Finland and Switzerland. This format differed from the normal expert interviews, as the interviews were grounded in a group discussion and directly tried to answer the question *"What are uniquely human abilities in the future?"*

A second focus group session took place at a workshop for young professionals organized by the United Europe Organization at the Institute for Manufacturing in Cambridge from the 05th to 06th of April 2019. The professional background of interviewees was slightly different. Eleven young professionals in the age between 24 till 34 years, with diverse backgrounds in fields including Chemistry, Human Resources, Law, Data Science and Risk Management, provided predominantly Europe-centric viewpoints in two focus group workshops. The participants came from Austria, Ukraine, Czech Republic, Germany, Spain and Poland. However, an important focus was put on participant's views on the abilities, the processes, the strategies, skills and competences that employees need and will need in the future of work. The first focus group investigated the question *"Human monopoly: which human abilities should not be augmented by technology?*" The second focus group discussed "*The intrinsic value of work: should we worry about running out of things to do*?". Thereby, these two later focus groups served as a confirmatory purpose of the interim results that were gained in the semi-structured interviews.

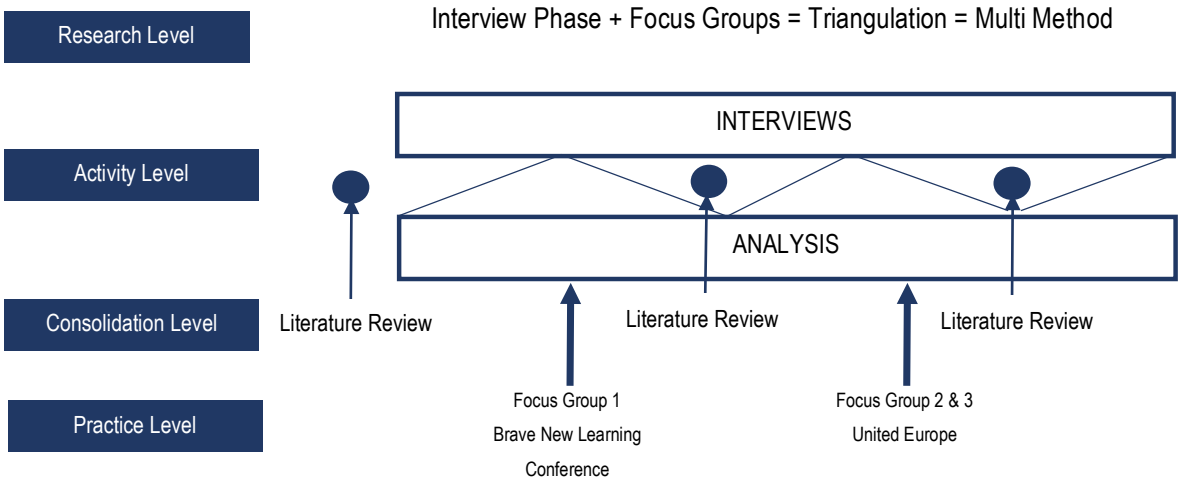

Figure 9 Qualitative Data Collection Process

In Appendix G more detailed insights of the workshops can be found. For the data analysis itself, only the semi-structured interviews were taken into account, as the three focus groups were held for triangulation of the data. In the end, the interview and workshop data was found to be congruent. Figure 10 demonstrates the different expert groups and the focus groups workshops.

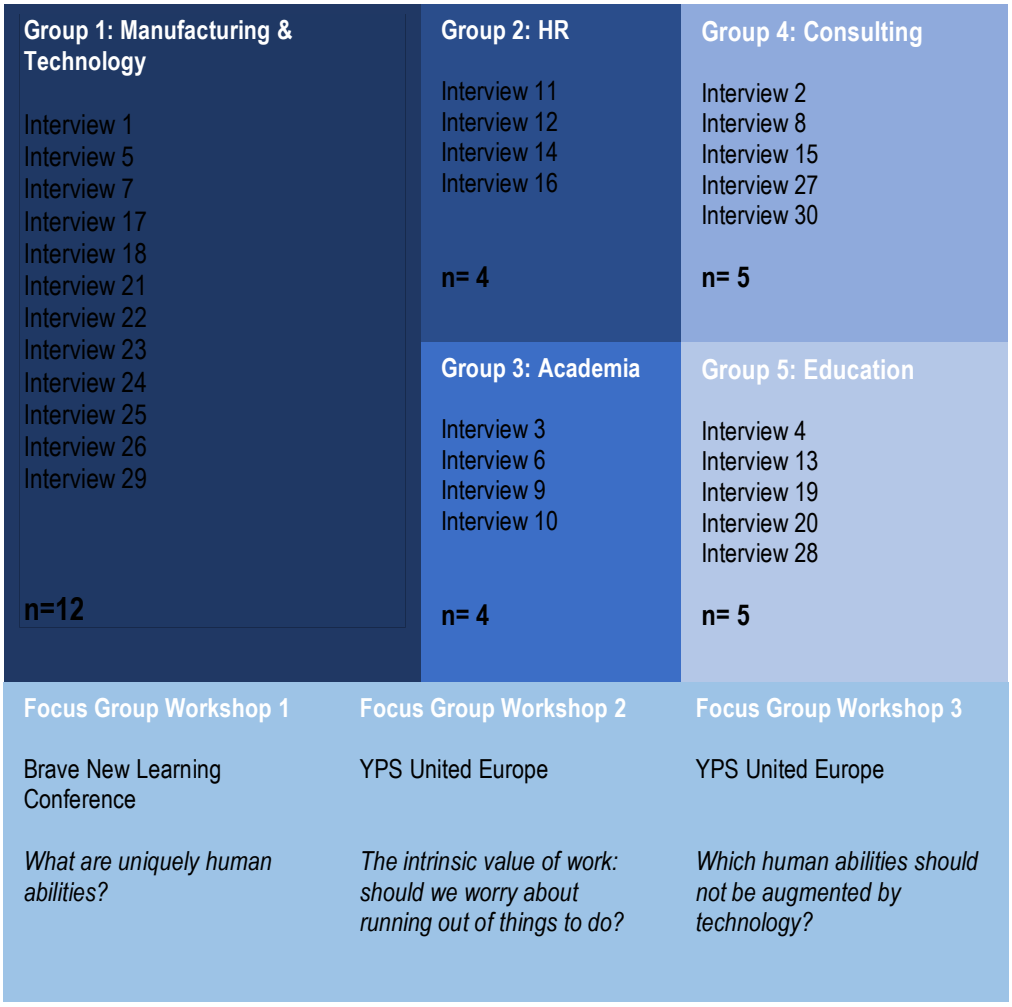

Figure 10 Configuration of Primary Data Sources

3.8.3 Interview Guideline

The interview guideline was developed based on aspects derived from the literature review. This allowed for a close methodological alignment between the separate parts of the thesis. The interview protocol comprises theoretically deduced categories and mixed question formats, encourages narrative descriptions and flexible conversation, as well as a possible validation of the later qualitative interpretation. Furthermore, the principles of openness and flexibility are ensured by many open-ended questions that offer narrative stimuli and allow for an adjustment of the order of questions according to the flow of the conversation (Gläser & Laudel, 2010). The first version of the interview guideline was shortened throughout the research in order to gain more precise answers.

The guideline contains five themed sections and in total 20 questions. Depending on the background of the expert, the focus is laid on pre-selected questions, with some questions being posed in every interview. The full interview guideline can be found in Appendix D.

The interview guideline starts with a clarification of the topic. As an introduction to the conversation, several terms and definitions were introduced and clarified, such as the meaning of the term future skills, AI or AR. It allowed for a baseline understanding of the expert's knowledge about the research topic. In a second step, questions around human and non-human abilities were asked, in order to gain a deeper understanding about the future work capabilities that will be required in a (manufacturing) context. The central theme section circles around the future of work and required skills at the workplace. Furthermore, the potential and challenges of human-machine interaction were inquired. Depending on the expert's background the implementations for an educational change were discussed.

3.8.4 Setting and Procedure

The interview guideline was pretested prior to the actual interviews with a fellow researcher, who is well experienced in qualitative interviewing, but new to the field of the future of work. The focus is on the interviewee's personal perspective and the semi-structured form, which allows much space and time for answers (Bryman, 2004; Froschauer & Lueger, 2003). It was taken due care to ensure that the interviewer meets the quality criteria for interviewers following Kvale (1996) and Bryman (2004). These criteria include the application of a questioning technique that allows for a "structuring", "sensitive", "open", "controlling", "critical" and "balanced" interview. As Lavrakas (2008) mentions, interviewers must be convincing, professional, friendly, knowledgeable, and empathic.

Depending on the availability of the participants, the interviews were conducted face-to-face or via video and phone calls. With the participants' permissions, the interviews were audio taped and anonymized with the prior consent of the interviewee (Mosley, 2013). Some interviews had to be transcribed verbatim. In some cases, the interviews were translated into English, if the expert was not able to speak English fluently.

This approach could outbalance the natural limitations of human memory and the intuitive remarks which the human makes indirectly (Heritage, 1984). Moreover, the audio-recording allows the interviewer to actively question interviewees' worldviews and answers while listening to their responses, instead of focusing on taking notes (Saunders, 2009). The transcription of the expert

interviews is based on Flick's transcription rules (2016). Dialect, filler words, slip of the tongue and pauses were not transcribed.

A declaration of consent to the tape recording of the interview was signed before the interview process started, since it is of high importance and a responsibility for any researcher to protect the privacy and the personal data of the interviewees (see Appendix C). To verify personal and job-related information, a short semi-demographic questionnaire (Appendix E) was sent out upon the completion of the interview.

3.9 Qualitative Analysis

As a proven method for analysing textual qualitative data, content analysis is recognized for its usefulness to categorise and reduce the material under investigation (Flick, 1994). Pursuing a systematic and rule-guided analysis (Schreier, 2013) of the transcribed interview content, the method of qualitative content analysis introduced by Mayring (1983) is applied throughout the present thesis.

3.9.1 Synthesis Approach

The synthesis method is considered inter-subjectively comprehensible and helps to make replicable and valid inferences from data to context (Krippendorff, 2004). Janis (1965) defines it as a technique for the classification of words, which carries meaning, falls into categories and relies solely upon the judgement of the analyst. The analyst's judgements are the report of a scientific observer. Thus, a qualitative content analysis describes the meaning of qualitative data. Three advantages characterize a qualitative content analysis. First, it reduces information and data, second it is systematic and third it is very flexible. This method helps to reduce the amount of material and requires the researcher to take a focus on those aspects, which relates to the overall research question (Mayring, 2010; Schreier, 2012).

The interview content was structured along the main categories introduced in the interview protocol. After searching the transcripts for relevant quotes, insightful sub-clauses, phrases or paragraphs were assigned to the respective categories and coded accordingly. An example can be found in Table 1.

Interview	1st order coding	2nd order coding	3rd order coding
Interview 13	"I don't necessarily have to be able to write an algorithm by myself, but I have to be able to assess my awareness and why I get a different result than someone else in Google search and what that means".	having an understanding of how data-driven processes work	Data literacy

Table 1Example of Coding

The raw transcripts contain codes, such as keywords, phrases or numbers, which signal an occurrence of specific information. These codes allowed the researcher to cluster the texts relating to the particular research question. The qualitative content analysis distilled the words of the text into fewer content-related categories. This clustering sets the stage for the analysis. The purpose of building categories is to describe the phenomenon and to increase and generate knowledge (Cavanagh, 1997; Miles & Huberman, 1994). Through interpretations and abstractions, the words were clustered into the same categories. If codes shared the same meaning, they were subsumed under the same category. If content was described in different words, but referred to the same topic, it received the same code. The assignment of codes and categories was revised with regard to the theoretically deduced propositions and potential inductive explanations, which enabled clarified (sub-)categorizations or content clustering. Finally, examining the characteristics' salience, the relative frequency of the coded fragments and respective (sub-)categories were assessed in order to gain an impression of their qualified importance for the topic.

Mayring (2010) provides approaches for a summarizing and an explicit content analysis, while aiming to reduce material and to generalize content through the steps "construction", "integration", "selection", "bundling" and "omission". Figure 10 shows the exemplary procedure of a summarizing content analysis.

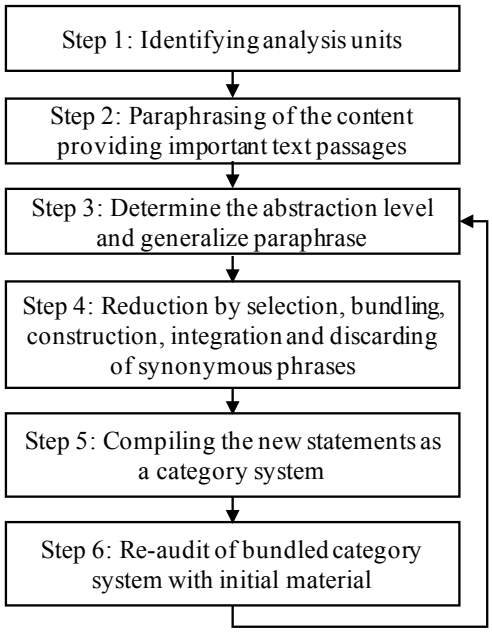

Figure 11 Procedure of Summarizing Context Analysis (Mayring 2010)

As a result of this iterative analysis process, the code system consisted of 462 codes, organized in eight structuring categories and 35 subcategories. Subsequently, codes were followed by an indication of occurrence frequency. For illustration purposes, certain original quotes are included in the descriptions, functioning as qualitative anchor examples (Mayring, 1983).

3.9.2 Analysis Tool

The described processes and the entire synthesis work are conducted computer-based in the software MaxQDA. This is a software for computer-aided analysis of qualitative data, which has been used by other researchers before (see Oliveira et al., 2016). The advantages of MaxQDA are its user-friendly approach and applicability for Grounded Theory research. The interviews are fed into the program as texts and automatically provided with paragraph or line numbers. In the next step, codes can be assigned that are visualized next to the text. After this, the codes are clustered in different categories.

Of course, the interpretation remains with the researcher. The benefit of the program lies only in the simplified management of the text and data volumes and in its visualization options. This allows data collection and analysis to be conducted as an iterative process and in parallel, a central value proposition of grounded theory (Easterby-Smith, 2012).

4 Findings

This chapter structures and presents the findings resulting from the qualitative content analysis of the 30 conducted semi-structured interviews.

First, necessary human abilities that cannot be automated will be described. They are considered to be uniquely applicable to humans and can hardly be learned or simulated by machines, as the problematic of the Turing Test shows. In order to determine these abilities, experts answered questions like “what are human abilities?”, “how can they be used in a working environment?” and “how can we train those human skills?”. These uniquely human abilities will be opposed by characteristics of machines that allow them to gain superiority or comparative advantage over humans in certain tasks.

Acknowledging the strengths of the qualitative methodological approach, several insights could be found that do not directly relate to the formulation of the research question. Additional results were found in relation to the future workplace and challenges of the digital transformation, as well as influencing factors for the symbiosis between humans and machines and accepted technological superiority.

In the following, the findings are described. They highlight which abilities are considered to be human and non-human, where technology is considered superior and which challenges humanity has to face. Afterwards, a theoretical discussion of the findings will follow.

4.1 Uniquely Human Abilities

Many experts had severe difficulties to answer the question what uniquely human abilities are: what is it really that makes the human species unique, where do humans have a strategic advantage against technology, where lies the true potential and how to best identify this potential?

Throughout the different expert groups (Appendix H), the interviewees agreed that some abilities are hard to automate and can therefore be described as “uniquely human”. Experts from technology industries, HR, consulting, academia, as well as education highlight social interaction, creativity and cognition as the main groups of abilities. They are presented below and further detailed.

4.1.1 Social Interaction

The first category that was identified can be coined as *social interaction* and is further differentiated into conversational ability, empathy, and collaboration. Humans are individuals, and equally social beings. As individuals, they are always in (potential or actual) relation to communities and societies. All dependent skills need some form of relational content and therefore human interactions.

Interpersonal skills are central to socially appropriate behaviour in situations where the ability to interact socially is needed. They cover a wide range of skills that involve observing and correctly recognising and interpreting clues in social situations. Humans then respond effectively and appropriately to them and to the demands of the situation.

> *“In an interrelation situation, there are so many things to read, like individual elements, facial expressions and gestures, as well as body language or maybe intercultural differences and language barriers. There are so many small elements that we need to describe in a social situation and that makes us just very human” (3#10).*

Therefore, (social) interaction is characterized by the experts as uniquely human.

"What makes us human for me is that there is this kind of social interaction" (1#18).

Some of the experts see a generational discrepancy, because millennials would face the problem of direct confrontation and communication. The younger generation prefers writing an email, messaging or other written communication over a direct conversation with a person. In addition, inter-personal skills turned out to be slightly in danger because people are increasingly interacting online (1#18). Although this is in line with the underlining ability to interact socially, it could prevent the emergence of certain soft skills required for the interaction in the physical world.

Central in the debate about interpersonal relationships is therefore the human touch, which has a positive effect on the human body.

"I think the human touch is the ultimately uniquely human ability. The human touch is about creating this interpersonal relationship, both physically and mentally" (2#11).

Interaction in the relational sense is mentioned in almost all groups as uniquely human, except in the technological industry – not a surprising finding given the importance of social media for this group.

4.1.1.1 Conversation

Conversational ability is the prerequisite for humans to build relationships, for being aware of leading a meaningful dialogue and having a face-to-face conversation. According to the expert groups, it is hard to automate this ability.

Moreover, communication with body language, including interaction through facial expressions, voice tones and different communication styles, as well as being able to use the voice is important. In the business world, conversational abilities are essential to ensure good customer relations. One HR expert notes:

"The more automated the processes are getting, the more [the customers] want to talk to someone, to a real human being. It would be great to have more time for example with customers" (2#14).

E-mails and chat programs have long been an integral part of the daily exchange at work. However, depending on the situation, other means of communication are better suited. For example, important conversations should not be conducted in writing, but in person (1#18). Chat programs, on the other hand, are suitable for spontaneous questions or notices, such as reminders from a work colleague who still awaits a reply. For the organisation of appointments or the distribution of (sustainable) information, e-mails are recommended. Nevertheless, an expert from the industry sector prefers a face-to-face communication over writing time-consuming e-mails (1#18).

4.1.1.2 Empathy

Empathy as the ability to read emotions, empathize with motives, thoughts, feelings, and personality traits of other people was mentioned by many experts as hard to automate.

> *"It's very hard to automate empathy because it's an emotional ability" (2#16).*

Furthermore, empathy includes understanding the counterpart, its needs and the ability to recognize his or her potential. Empathy also comprises the ability to react appropriately in a social situation, which is important for building relationships.

Empathy seems to be more important for the experts from group 2 and 4 than from group 1. Therefore, empathy appears less important in the manufacturing and technology industries. Empathy can be identified as a prerequisite for social interaction, as it is important for interrelation situations and interactions between humans. The fact that group 1 has only mentioned empathy once makes clear that for the technology industry, empathic behaviour is less relevant, whereas it is essential for the HR or general management.

4.1.1.3 Collaboration

The ability to work collaboratively in an entity can be seen as a necessary prerequisite for any form of teamwork. Through the introduction of new technologies, teamwork is perceived as increasingly important, no matter whether online or offline collaboration is supported. The power of human collaboration is indisputable, because the human factor is becoming more and more decisive when it comes to interaction, as experts note:

> *"The ability to work in a team is very important, being part of the whole, to take responsibility and to contribute to the project and having a meaningful work" (#12).*

Collaboration in form of face-to-face interaction and communication is essential. The success factors are direct communication, open structures and close cooperation. For the workplace, face-to-face collaboration and exchange of ideas can be helpful for further success.

> *"One of my standard phrases is that the work today is way too complex and complicated that the issues can be solved by a single individual. It's all about teamwork and collaboration. You must be open-minded, otherwise you cannot create new ideas. I always tell my folks if you want to go on a shore, go on a shore, I don't care. You need to get your work done. But there are some activities where you must collaborate well and you must see other people, and this is something you cannot do if you don't see and interact with them" (1#18).*

4.1.2 Creativity

The second major ability that is unique for humans is found to be creativity, an ability that can have many dimensions. Creativity is the ability to think outside the box, to be enthusiastic and to promote innovation. This is a process that involves original thinking and performance: it can be associative, sometimes the phases have a different order, are skipped, are repeated and lead to the objective of finding several original and novel solutions to a problem:

> *"Today in the working world, I have to create something new if I don't know yet what the output is, I have to communicate and collaborate more and think much more interconnected than before, therefore you need creativity and empathy" (4#8).*

Creative problem-solving addresses the handling and solving of open complex problems. New and innovative products and processes can then be developed (5#13). The focus of creativity is on originality. The goal is to find several original and novel solutions to a problem (3#13).

One expert states that creativity is a product of social forces (5#13). Interpersonal relationships are important for behaviours that generate creativity. They encourage the individual to come up with new ideas and provide a basis for evaluating them. The socio-psychological support that individuals receive helps them to be persistent in pursuing exploratory activities.

Creativity is the imaginative way of thinking and acting in order to create new combinations from existing information and thus to solve poorly structured problems like search, analysis and selection of problems. As such, creativity is seen as a human ability, as one expert notes:

> *"And in my perception what distinguishes us so far or where we have advantages over the machine are areas such as creativity: finding solutions that haven't been thought of before" (3#13).*

But limitations to human creativity are mentioned as well:

> *"And itself, computers are not creative because it's us humans that program the computer. But I think, what we think is creative thinking today, can computers already do tomorrow" (5#4).*

4.1.2.1 Curiosity

Curiosity is an important prerequisite for creativity. It can be defined as the desire or motivation to consciously expose oneself to new and unfamiliar situations and ways of thinking (#12). It requires an open mind-set for learning, a forward-looking perspective and the desire to try out new tasks. Therefore, it is directly related to a person's (intrinsic) motivation. Throughout all expert groups, it was often listed as an important soft skill under the designation of motivational abilities, thereby considered as an ability itself. It incorporates the thirst for knowledge or desire to learn.

> *"If you do not try to learn something new and stay curious - curiosity is really important in this aspect, you'll fall behind. I mean, I have to learn new tools and new work habits all the time. I have to be the one introducing the change an being the early adopter of almost everything" (1#18).*

4.1.2.2 Lateral Thinking

According to the experts, creative solution-based thinking is another human ability. It refers to the ability of solving a problem with previously unimagined or non-existing means and to reformat or recombine information and break out of thought patterns. Furthermore, looking at problems from different perspectives, having new ideas and working for new ideas and asking the right questions is an important step in order to generate solutions. The corresponding inner mental occupation is often an additional important prerequisite for problem solving. Moreover, problem-solving with its different parts can be seen as a human ability, as one expert notes:

> *"[It] starts with understanding a problem, being able to frame it, being able to use different frames, and to use different frames. This is a kind of an ability that the human being uses to look at a problem and to find solutions and this is something AI can't do right now" (4#2).*

AI only artificially imitates in the best possible way of what human intelligence has previously created. It can only repeat, to a certain extent, what it has been taught to do before. According to experts, this principle is stable and cannot be changed, and it also makes clear that AI cannot develop its own ideas (1#5).

> *"When it comes to rethinking things, developing them further and setting things on a larger scale, I find that these are the tasks where people can develop further, that's what people should specialize in because routine activities can be taken over by machines" (3#10).*

4.1.2.3 Innovativeness

One expert says, the focus of innovation is on effectiveness and feasibility (3#10). As such, innovation can be interpreted as the exploitation of an idea (5#13), which can be seen as an ability. Innovation includes both invention and implementation. Innovation means doing things differently and better, and for this reason, it is essential to promote growth. Innovation is the continuous identification of new needs under the condition that they are realized through products or processes. New ideas rarely emerge on their own. Rather, it requires a pronounced interaction with other people, in order to broaden one's own perspective and develop innovative ideas.

“In the field of creativity, I have to know that it might not always make sense to go the same way, but to try out new things” (3#13).

4.1.3 Cognition

Through cognitive abilities, humans can develop diverse competencies. This includes both the development of a balanced personality and the acquisition of relationship skills and the ability to self-regulate (2#11). Cognitive abilities play an important role in understanding human characteristics. Therefore, emotions, gut feeling and the body-mind connection have a cognitive level and can be further developed through social interaction.

4.1.3.1 Emotions

All experts, regardless of their sectoral focus, agreed that emotions are hard to automate when it comes to interacting with the social environment. The following quote summarizes this finding:

“What is usually still missing from machines is the linking of emotions with the environment. It is already possible that robots show emotions, but this only works in a previously learned context. In humans, of course, many things are innate through evolution, where machines have a hard time. Machines can’t combine emotions and environment” (1#7).

Emotions include all varieties of feelings and the overall understanding what makes humans happy, and the ability of an individual to understand and control its own emotions, as well as the ability to perceive and handle the feelings of others. Thus, an emotionally intelligent person needs self-confidence and must be able to subtly regulate different emotional responses in different social contexts.

“But I cannot imagine a couple of intense, very deep dialogues with a lot of emotions involved that can be replicated by machines” (4#2).

Interesting is one statement from an AI expert, as he emphasises the importance of emotions in human-robot interaction:

“Emotions are other aspects that have not been programmed properly yet. One might argue emotions are not so important but if we think about human-robot interaction or also about human-human interaction, then emotions can be very important” (1#25).

4.1.3.2 Gut Feeling and Intuition

Gut feeling and intuition are procedures that are hard to describe and therefore hard to automate. This finding is highlighted by experts from group 1.

“For example, intuition is something we have not been able to program yet. It's difficult to kind of capture that and understand where it comes from” (1#25).

Intuition is the ability to gain insights into facts, views, laws or the subjective coherence of decisions without discursive use of the mind, i.e. without conscious conclusions. Especially from a HR-perspective, gut feeling cannot be fully replaced by technology.

“I do believe in some ways you need your gut feeling – of course you can underline it by some kind of reports or data, but I still think some kind of gut feeling is needed” (2#16).

4.1.3.3 Experience

With the wealth of experience and the sum of all the experiences someone has already made, situations can be assessed and analysed. This differs from machine-made learning experiences, which are made on a much narrower basis and possibly programmed through humans. Usually, problem-solving methods and planning systems work without long-term memory, i.e. mechanical problem solvers are not able to profit from previous problem-solving experiences. In contrast, human problem solvers are characterized by the ability to learn from experience. As such, experience can be categorized as a uniquely human ability, as one expert notes:

“When you think about what humans do, it’s hard to imagine that a computer can do the same, whereas humans have a much wider experience to draw on” (3#6).

At the workplace, experience is an important ability, as well:

> *"Many jobs do not only require education, but also experience" (1#18).*

4.1.3.4 Body-Mind Connection and Human Intelligence

The body-mind connection describes the interactions between the body (muscle, organ and posture system) and a human's thinking and feeling. Body and mind have to be connected when sending specific signals. The body without mind is not working, and vice versa, as one expert mentions:

> *"The body-mind thesis which describes that the mind can't be dissociable from the body in any meaningful way. When the body changes, the mind changes as well. Long way saying, short: The body is really important to the mind" (3#6).*

Especially experts from Group 1 highlight that human intelligence, brain power and the capability to move around in space and using our hands is uniquely human:

> *"The human body can react very fast to different situations and different tasks. It is the most flexible tool and machine in the environment. Humans have the possibility to think fast and flexible and over limited boundaries above, so the human brain is capable to expand over learned algorithms. And that is the biggest advantage of human beings. If you compare it with the robot, the physical flexibility is very far. It's very easy for the human body to adapt to different situations for the human body" (1#22).*

Further, an AI expert notes the human advantage in the human brain power, as the human intelligence compared to AI is hard to be automated:

> *"Many synapses in our brain can do a very effective pilot process. That has not been achieved through robotics yet. That is the most important difference and definitely it is part of the overall equation. The brain with all its aspects is very important and complex" (1#25).*

However, it can be discussed if the human brain is still ahead of robotics, as another expert is arguing:

> *"That doesn't mean that humans cannot solve complex problems, but sometimes you need a solution pretty quickly and that's where humans probably have challenges because of the capacity of our brain" (1#24).*

4.2 Technological Superiority in Automation

Despite these previously presented uniquely human abilities, there are certain characteristics of machines in the context of industry 4.0 that give them a comparative advantage over humans in certain tasks. Most of these characteristics are somewhat related to the objective of these machines to be used for further automation of tasks.

Indeed, in many areas automation and technology are accepted in terms of support, efficiency and decision-making. There are many domains where machines can outperform humans. All expert groups agree that technology and automation can support humans at work, and it is accepted that machines can do some work, especially repetitive tasks, more efficient and faster than the human being could do (1#25). Technology experts seem to believe more strongly that technology is superior, which is no surprise, as they sell, implement and manage technologies in everyday business. Group 2 and 3 are also aware of utilizing the superiority of technological processes, for example for routine or administrative tasks. But the tech experts emphasize that the uniquely human abilities are gaining more and more importance in the technological age. Through an automation of tasks, the human being can do more of creative thinking activities (1#18).

Technology, however, is considered superior in parallel thinking, processing, calculations, ability to produce and provide the same quality over and over again and the storage and management of big data, as well as dominating in speed, power and energy level (5#4).

> *"I think if you compare what humans cannot do, the difference is in speed and power: there are things that can be done faster. The ability to assess a lot of information within seconds, this is where we are limited, if you look at the power things, anything that is just too heavy, too big – this is something where we have limits" (1#17).*

The largest potential of a technology like AI can be found in its potential to automate repetitive and routine tasks. In business decisions, machine learning provides the greatest added value in situations where many similar decisions have to be made again and again – and it is simply impossible to do so manually due to the amount of data (1#18). Here, technology can increase productivity and highlight significant insights into the analysis and potential of automation, which people can then analyse in more depth (1#7). Although the human being should make the last decisions, technology can help in decision-making and forecasting predictions (3#9).

Furthermore, companies can regularly compare predictions made by machine algorithms with reality and adjust them if necessary. This creates confidence in the analytical capabilities of the new technologies. It becomes clear that if the machine takes increasingly standardized processes away from people, humans will have more freedom and probably more time of pursuing complex, individual and creative activities (1#25).

At present, hardly any company can ignore the trend of automation processes. It is argued that too much time from the human side is spend on administrative tasks. By combining AI with other technologies, routine and repetitive business processes are getting automated. Humans accept the automation of repetitive tasks, because technology can support them in doing these kind of tasks (#8, #5, #13, #4). The automation and digitalisation of processes is increasingly gaining momentum. In particular, the trend towards the automation of administrative processes is apparent.

> *“It is much easier when I leave administrative or physically strenuous work to the machines” (4#8).*

Three areas of activity have the greatest automation potential in the world of work: data acquisition, data processing and predictable physical activities (1#5). These tasks are characterized by repetitive, constant processes that can be supported by technology as one expert states:

> *„I would first get rid of all these bureaucratic and administrative tasks” (3#3).*

Nevertheless, it is clear that every company, regardless of the industry, executes processes that are time-consuming, repetitive and error prone. These require accuracy and speed.

> *“The second component in my kind of view where we’re not good at, is at repetitive tasks. We’re very quickly bored to death when we try to do something, and we have to repeat again and again and again and this usually causes a couple of mistakes” (1#18).*

Each company owns processes that can be completely automated by an independently operating robot. Without human interaction, a robot can collect and execute tasks error-free around the clock. The “24/7-hour ability”, the faster and more efficient work procedure of technology, underlines the strengths of technology tools.

> *“Machines don’t get bored, and are stronger, faster and more efficient” (1#5).*

The latest innovations are creating the picture of a future in which robots, machines and mobile devices based on self-learning algorithms will become increasingly independent and autonomous. Digital assistants and chatbots will gain their own insights, adapt their behaviour in different situations and interact more closely with humans than before (3#3). In the future, mobile devices will be even more interactive and will quickly learn to support day-to-day business – whether planning meetings, translating documents or analysing data (5#4). For many of these applications, "machine learning" is necessary. Through intensive practice in the form of exclusion procedures, the AI also learns to deal with situations within the scope of its task and the error rate of the later transfer performance in practice is reduced (5#4).

4.3 Uniquely Human Abilities and their Impact on the Future of Work

The ongoing digitalisation of work raises central questions about the future of work: What effects does it have on work and production? How are activities, competences and professions changing? How can the process be designed to be humane? It is noticeable that these discussions are essentially very technology-focused and are mainly driven by the field of software development but have to be linked back to the human being (1#17, 1#5, 4#15).

In order to assess the opportunities and effects of the digitalisation of work, the question of the special characteristics and competences of both technology and people must be answered. Clarification is promised by the distinction between what can 'not yet' (but potentially, possibly soon) be adopted by technology and what 'not' (i.e. never) can for certain reasons be translated into the

logic of technology. According to the interviewed experts, the future workplace and competencies are changing through technological advances. Working in an interdisciplinary way, as well as investing in human resources will be more important in future.

New jobs, as well as new concepts like working from home or the basic income arise in this discussion (1#21). The push for technical innovations and the urge for freedom are more present than ever before. Many employees are looking for purpose in their lifestyle business (5#13). Work systems should not be designed in such a way that the persons concerned see it as a devaluation of their tasks, but as a relief. Therefore, time and opportunity should be given to perform higher quality tasks. Employees should be engaged in more meaningful activities (2#12).

4.3.1 Required Future Skillsets

After having identified uniquely human abilities, the question arises which skills are relevant for the future workplace that can be supported and enabled by those human abilities. As already pointed out, social, creative and cognitive abilities are highlighted by the interviewees as particularly important and indispensable (5#4). In the digital transformation, it is not only a question of building up technological capabilities and structures. With its deeply human component, it also means a "social transformation" that demands new personal competencies. Companies and managers must take this into account (1#24).

> *"To conclude, all in all we need this kind of soft skills, that characterize us humans and have to specialize in and train them" (3#10).*

But not only "classic good old social skills" (3#16) are highlighted, the future skills of the 21st century are a mix of digital and human skills (1#7).

> *"You need both a technological understanding and human skills, because it's more important to implementing ideas together" (4#8).*

Reference is made to knowledge-based skills, like coding, computer literacy or technology affinity and a mix of emotional and digital intelligence (4#15). Digital know-how needs to be trained in universities and implemented in the university curriculum (1#21). A basic level of digital literacy is indispensable. In this kind of discussion, the technology experts indeed stress the importance of digital skills, whereas the latter are not that important for HR experts, for example (2#12).

Furthermore, media wisdom and media literacy to use the media according to one's own needs and purposes and to be able to deal with them responsibly requires more attention (1#1). Having cognitive abilities, skills dealing with challenges, as well as handling load management and managing complexity have been mentioned as future skills that are necessary for the future workplace (2#11).

Whatever work is being performed by humans in the future, the focus on non-routine and non-repetitive tasks highlight the increasing importance of flexibility for the human – a flexibility of thinking, living and working. Initially, it means nothing more than fast adaptability to changing requirements and circumstances and dealing with last-minute changes (2#12, 1#17, 1#18). Making flexible decisions and having flexible thinking processes can be supported through a flexible working schedule (1#18). For experts, it is clear that there has to be more flexibility in job changing or other parts (1#7). In terms of the profession, this means that the structure of commitment and behaviour is rather relaxed and offers room for possible alternatives in a decision-making situation. This requires a person who is open to change and capable of adapting to rapid change (5#16):

> *"What we can see today in Manufacturing, but also in Logistics, is that the ability to be flexible can't be replaced by machines. Flexibility in the sense of reacting to certain changes in the environment in a very fast way" (1#17).*

The pace of change has increased in recent times and organizations need to become more agile and flexible to respond faster to sociodemographic developments and employees have to deal with insecurity (1#17, 3#3).

> *"Environments have changed, they are more flexible and usually they have to deal with a lot of uncertainty, and I have no idea how we want to automate this" (1#18)*

Working in an interdisciplinary team and sharing knowledge through different disciplines and departments (1#24), leads to cross-disciplinary communication, which creates added value through the exchange of content that goes beyond the sum of the individual disciplines (1#1).

> *"And I also think to look at the world through different lenses and perspectives is important" (5#20).*

Another skill that was mentioned is the entrepreneurial spirit in a company, the so-called “intrapreneurship”, which is key to further innovation developments in a company (1#1, 4#27). Through different cultural global approaches, a cultural understanding is indispensable. Intercultural learning aims at the acquisition of social and intercultural competences, and also offers concrete knowledge and instructions for dealing with a different culture (3#13). Besides social and intercultural skills, concrete knowledge about the different cultural conditions is essential, in order to be able to communicate with other disciplines and the same across cultural borders (1#1, 1#l9).

4.3.2 The Future Workplace

The changing requirement in skills is accompanied by a change in the characteristics of the future workplace. A good mix of home-office and presence at the workplace, depending on the task, must be actively defined (1#18). According to the experts, the offices of the future should not only enable better work, but also protect the health of employees (2#14). The first steps in this direction are already being taken today and not only the design of the workplace will change in the future, but also the way of working and the corporate culture of every employer will have to adapt to developments in order to remain competitive (5#28). The future workplace is a mix of modern interior and open spaces.

> *“I'm a great fan of something that somehow facilitates meeting people in an office environment. And this does not mean an unlimited open space. You must also create a work environment, where people have breakout rooms for sign and work. You must tell them if they really have to do something in silence, like writing or reading an article or finding any kind of IP, that they can do that from any place they like to” (1#18)*

The concepts of outsourcing and demand-oriented workforce, like freelancing and contracting, are gaining importance in the age of the so-called "gig economy", where employees are paid per order (gig) (3#9).

4.3.2.1 Changing Occupations

As already highlighted in the literature review, in the debate about technology and robotics, an important question is which kind of new jobs will arise. It has been argued that:

> *"rather than the jobs being replaced, new jobs will be created at the same time, but it's hard to predict which ones that will be" (3#9).*

It is predicted that not only low-skilled workers will lose jobs through automation, but also highly qualified jobs are affected. (3#13). As an employee, it is therefore necessary to be open-minded to job changes and adopt a flexible thinking (2#12).

The remaining and not-automated jobs (3#10) will likely have a higher quality and will provide a higher value-add (4#15). Nevertheless, it is important to identify the potentially occurring employment gap during the phase of transition in an economy, as this period is crucial for maintaining the social cohesion in a country (1#5, 1#29).

The jobs that require a high human touch will belong to the future, as one expert notes:

> *"It's going to be more jobs that are fundamentally based on human skills" (3#10).*

4.3.2.2 Purpose- and Value-Driven Work Environments

Finding and having purpose in life and work is essential to stay motivated. When it comes to designing work processes, experts from technology, HR, and consulting are noticing that the need for meaning is growing continuously (5#4, 4#8,2 #12). Employees should make sense and give sense to their daily work (3#3). It is about showing employees a meaning in their work and thereby stimulating their intrinsic motivation. Furthermore, by identifying a meaning in life and by perceiving one's own actions as subordinate to a certain goal or mission, which is the basis of one's own values, one lives and works more intensively and consciously. Therefore, work standards have to get re-valued:

> *"My hope as a human because of all this technology and because of how the world is changing, is that we will be better capable than ever to make our own dreams come true, fulfil ourselves and become, who we want to be – that's my hope! Become more mindful, fulfil our destiny and find our*

purpose – and I hope technology can allow us to do more of this purpose driven things" (1#4).

Technology can therefore play a big role and can help finding fulfilling work:

"Many people go to work, not because they enjoy what they do, but to earn money. And of course, this is important, but fulfilling work is much more important and machines can help us" (4#8).

4.3.2.3 Remote Work

Working from home can be an alternative to reach work-life balance and support flexibility. Each company could give their employees the option of working from home. On the other hand, working from home means a cut in social collaboration, as one expert notes:

"This is something where I truly believe humans can do better. At [anonymized] we have the rule that you can work from home and discuss with your manager if you'd like to. What we experienced after a couple of weeks, sometimes already after a couple of days, colleagues get disconnected. Now they're not part of the game anymore, you don't think about them when you're trying to fix something. They also disconnect themselves. Pretty promptly, they miss the gossip, they miss all the information that is somehow transmitted between the lights and not just following the straightforward communication, which is relevant as well" (1#18).

4.4 Symbiosis between Humans and Machines

Having discussed the superiority of technology, an understanding of both digital and human skills is important in the discussion about the future of work. Experts agree that the real potential lies in the symbiosis between humans and machines (1#18, 1#17, 4#15). Technology experts are highlighting that even though they are surrounded by machines and other technologies every day, the human factor has to be integrated. And in industries like consulting or education, where the focus is more or less on human intelligence, the technology is part of the discussion, as well (5#4, 5#20).

As defined briefly in the literature review, human-machine interaction deals with the interaction between humans and machines. Unlike earlier generations of industrial robots, new robots are equipped with the ability to perceive, understand, act and "learn" through their software (5#20). Against this background, work processes are emerging that can adapt themselves – fixed assembly lines give way to flexible "human-machine teams" that can be formed ad hoc.

AI is not intended to replace human beings, but to help society developing for the better (1#24). The so-called "*humachine*" ideally forms a symbiosis of human creativity and machine intelligence (4#27). People should benefit from this combination and be able to position themselves well for the future.

> *"When AI is combined with human capabilities, they are right 100%. And that's the future of AI, to combine human intelligence with artificial intelligence" (5#4).*

It is emphasized that an interaction of humans *with* machines is indispensable for a successful future workplace.

> *"I still think that the combination of humans and technology adds the most value than human or tech alone" (#1)*

In any case, there remains some time before the cooperation of humans and machines can cause ethical problems. Up to now, robots have been performing boring tasks in most cases. Since machines are getting smarter and smarter, innovative companies should not ignore ethical issues. At this point, the discussion about AI and ethics comes into play. Awareness about the opportunities and risks of AI should be raised and discussed (1#1, 1#22, 1#29).

Table 2 shows the main categories of human abilities and their distributions to the different expert groups. A more detailed version can be found in the Appendix G.

Groups Human abilities	1 Tech	2 HR	3 Aca	4 Con	5 Edu	Illustrative Quotes
Social Interaction Collaboration	✓ #1, #5, #18, #21, #24, #25, #29	✓ #12	✓ #3	✓ #2, #27	✓ #4, #19, #28	*"the ability to work in a team is very important, being part of the whole, to take responsibility and to contribute to the project and having a meaningful work" (#12)*
Conversation	✓ #1, #5, #7, #17, #18, #25, #28	✓ #12, #14, #16	✓ #3, #9, #13	✓ #2, #15	✓ #19	*"communication skills, that are based on the ability to build a relationship, to understand the counterpart, to have empathy, the nonverbal communication, to react properly, that's what we find under communication skills" (#2)*
Empathy	✓ #22, #24, #26	✓ #11, #12, #14, #16	✓ #10, #13	✓ #2, #8, #15, #27	✓ #4, #19	*"It's very hard to automate empathy because it's an emotional ability" (#16)*
Creativity Innovativeness	✓ #1, #7, #18, #21, #22, #24	✓ #12, #16	✓ #3, #6, #9,#10, #13	✓ #2, #8	✓ #4	*"And in my perception what distinguishes us so far or where we have advantages from the machine are areas such as creativity" (#13)*
Lateral Thinking	✓ #18, #21, #24, #29	✓ #16	✓ #13	✓ #2, #8	✓ #4, #19	*"being able to cut a complex problem in smaller pieces so that it can be solved either by humans or machines. It can be paraphrased as common sense or critical thinking" (#24)*
Curiosity	✓ #18	✓ #12, #14, #16	✓ #3, #9	✓ #8	✓ #19, #20	*"Here, framework conditions must be created, […] and develop curiosity, meaning the thirst of knowledge and exposure to new and complex situations" (#16)*
Cognition Emotions	✓ #5, #7, #23, #26	✓ #11, #12, #14, #16	✓ #3	✓ #2, #15	✓ #4, #19, #20	*"What is usually still missing from machines, is the linking of emotions with the environment. Machines can't combine emotions and environment" (#7).*
Gut feeling & Intuition	✓ #18, #23, #25, #26	✓ #16	✓ #6	✓ #27	✓ #20	*"I do believe in some ways you need your gut feeling- of course you can underline it by some kind of reports or data, but I still think some kind of gut feeling is needed" (#16)*
Body-mind connection & human intelligence	✓ #7, #18, #22, #23, #25	✓ #16	✓ #3, #6	✓ #27	✓ #19, #20	*"when the body changes the mind changes as well. Long way saying, short: The body is really important to the mind" (#6)* *I mean so many synapses in our brain that can do a very effective pilot process. So that has not been achieved yet through robotics. That is the most important difference and definitely it is part of the overall equation. So the brain with all its aspects is very important" (#25)*

Table 2 Human abilities and Distribution Expert Groups

4.5 Summary of Findings

In the previous chapter, the uniquely human abilities in the era of industry 4.0 have been taxonomized based on a qualitative methodology and expert opinions. Interestingly, answers slightly vary depending on the expert group. In summary (Table 2), social interaction, creative and cognitive abilities have been characterized as uniquely human. These abilities are still difficult to be automated by technology. Furthermore, human intelligence as such was highlighted to be fundamentally human because technologies only do what humans tell them to do (so far).

However, it was also found that machines possess a considerable comparative advantage over humans when it comes to the execution of routine and automation of repetitive tasks. When taking both the uniquely human abilities and technological superiority into account, it could further be shown that the future of work will require new skillsets from employees, lead to a changing workplace situation and demands from humans to work more collaboratively with machines. Indeed, it was

surprising to see how accepted technology and automation processes already are by all expert groups.

Finally, many experts are worried that the technology discussion in society has become too much fear oriented. But experts agree, that it should be concentrated more on the positive impact of technology, by nevertheless taking ethical considerations into account.

5 Discussion

This chapter elaborates on the main findings and discusses them in relation to the state of the art of the literature. Whilst AI, automation or robotics can provide many exciting opportunities for business development and capacity building, human capabilities will continue to be the most valuable asset for any employer (1#18). As emphasised in the research question, introduced in the first chapter, this dissertation unravels the question of which abilities are characterized as uniquely human:

"What are uniquely human abilities in the digital age for the future workforce?"

The taxonomy provided in the findings has answered this question extensively on a qualitative basis. Although research has made substantial progress in identifying and classifying future skills (e.g. Deming, 2017), such intensified research on human abilities as presented in this thesis is yet missing in the academic literature. Therefore, the present thesis makes an important contribution to filling this gap.

In the following sections, the theoretical implications of the findings on human abilities, technological superiority and human-technology symbiosis are discussed in comparison with the literature. Furthermore, implications for the future of work are derived.

5.1 Perspectives on Uniquely Human Abilities

First of all, across all expert groups it can be noticed across all expert groups that many experts perceive soft skills or "21st century skills" as human skills (1#1, 3#10, 5#4, 1#7). This is interesting because future skills have in the eyes of many experts the connotation of being human-driven. This is in line with literature, as MacCrory et al. (2014) investigated the skills that machines (thus far) have not yet been able to adopt for example in interpersonal skills. Machines can complement or take

over many aspects of life. But in their social interaction, their empathy, their emotions and their ability to listen actively, they are still inferior to humans.

In the literature, human skills are generally seen equal with social skills (Deming et al., 2017; Autor, 2015; Borghans et al., 2014; MacCrory et al., 2014). The findings in the present thesis offer perspectives from different backgrounds. Interviewing experts about their opinion on necessary human abilities revealed a large variance of possible future skills. Those with a technology background consider digital skills as most important: three experts with technology, HR and education background highlight this (2#16, 1#17, 5#19). However, experts from consulting or academia advocate human skills, or so-called soft skills, more rigorously.

On the basis of three examples, the differences between the diverse expert groups are highlighted.

5.1.1 Creativity – Major Difference between Humans and Machines

Literature mostly portrays creativity as an artistic process and the creation of the "new" (Frey & Osborne, 2013, Brynjolfsson & McAfee, 2016). The empirical results in this thesis found the formation of creative thinking to be essential for the activation of human abilities (3#6, 1#7, 3#9). This was expressed frequently in the interview setting throughout all expert groups. As the experts state, creativity, in form of innovation, originality and lateral thinking is seen as a human ability.

Even though technology can already build up creative processes, as mentioned by one expert (5#4), the question has to be asked if it is the same creativity that humans would exhibit (1#19). Of course, technology can reproduce pictures and even paint them with a brush, but they don't know why they are doing it (5#4). Economists are certain that creativity is a human advantage over machines (Brynjolfsson and McAfee, 2016).

Robots usually lack creative qualities, with some exceptions in AI (1#24). Thus, creativity is seen as a process that should be still in human's hand, because the "courage to think differently" is exactly what makes humans unique. Creativity requires further risk taking (5#19). This also means getting involved in decisions that initially seem wrong. It is hardly possible to program a computer with this kind of intuitive, creative thinking (1#25).

Interestingly, creative processes have been mentioned by experts with technology background, who state creativity as the process of creating something new. This is a prerequisite for developing new

technologies in unknown environments (1#18, 1#21, 1#24). Academia is certain about the importance of new innovations (3#6, 3#9), and consulting experts highlight the potential of designing creative work process areas (4#2, 4#8). Companies have to strengthen the creative mind-set, which can also go along with a new office interior concept. HR managers encourage companies to strengthen the creative design thinking in daily business (2#12, 2#16). Design thinking, service design and other innovation methods are highly valued by managers (2#12, 2#16). But especially in automation, creativity plays an important role as a unique selling point. While machines are built to solve problems efficiently and logically, they are not yet able to produce truly original and creative content (1#5). Having a creative mind-set and extrapolating from a known and well-defined state into something that hasn't been exposed before (1#18), will not only in the manufacturing set-up be relevant, but also in any other business, as well (1#18, 3#13).

5.1.2 Empathy and Emotional Intelligence – Roadblocks for Automation?

The mechanisms of human interaction and social cooperation, as well as emotional intelligence should according to different experts (5#4, 4#8, 1#24, 2#11, 2#12, 2#16, 3#10, 4#8, 5#19) not be automated. This is in line with the literature and arguments presented by Autor, Premack & Woodruff, Baron-Cohen and Camerer et al. (2005). But in difference to the literature is that these authors describe a generalized view of the debate.

The empathetic behaviour was mentioned by experts from different backgrounds as an important ability. Interestingly, those who demonstrate a more technical mind-set according to their background highlight the empathic behaviour as a main human ability. They affirm that empathy and social interaction cannot be automated by robotics. What machines are still missing is to link emotions with the environment (1#7). Therefore, in a technical environment empathy needs to be strengthened and is seen as crucial to support human interaction on an emotional level. One expert from Group 1 brings up the example that empathic and human behaviour is in a social context environment, for example in a hospital, probably more important than working in a factory and producing a car (1#5). But the same expert is forecasting that emotional interactions can never be fully replaced by technology (1#5) and therefore, the human being is irreplaceable in a technical surrounding.

It is interesting that experts from the manufacturing and logistics industry state that empathy is a human ability, because it could have been expected that this ability is not much needed in this kind of work environment (5#19, 1#24). But it is clear that for instance in logistics, only tasks to some degree can be automated, therefore the human is still essential in carrying out certain tasks (1#17).

In a new leadership style, emotions and empathy are needed, also in the manufacturing and technology industry (1#24). From the HR perspective, empathy is a prerequisite skill not only for an employee, but also for a client-driven organization itself (2#16).

The discussion about empathy and emotions in the technological industry is interesting to register. As many processes in the manufacturing industry have been or are automated, the scenario of a machine-driven workplace has become the reality (1#5). In the end, the human's empathy and emotions in interactions with each other are also important at the factory workplace. This could be an explanation why experts with a technical background classify emotional intelligence for their kind of workplace as relevant: They are the ones who are most familiar with capabilities of robots and know the limitations of automation well. Keeping this in mind, a new training concept for manufacturing with regard to soft skills training should be implemented.

As technology gains importance in more and more industries, there is a need for people to guide others in the use of these new technologies. Pure technological expertise alone does not suffice anymore (1#5, #1#17). As technology becomes more sophisticated, "empathic nerds" (2#14) are needed who can communicate not only with each other, but also with the customer. As tasks change, jobs are redefined. At the same time, companies will have to become more agile, which aims to ensure that companies and parts of companies remain adaptable and constantly reinventing themselves (1#24).

5.1.3 The Human Brain – Distinct Trait of Humans

Highlighted by four different experts from the technology industry, HR, academia and education, human intelligence with all its different manifestations is identified as a unique human ability. According to them, human intelligence cannot be automated, as the human brain is too complex to be taken over by robotics (2#16). The human brain consists of different spheres and has a processing speed that technology cannot handle in this construct (5#20, 1#25). This highlights the inherent complexity human intelligence masters, and which would have to be performed by an equally intelligent machine. Therefore, it is highly disputable, at what time in the future a machine will achieve cognitive intelligence or whether it will be possible at all (1#25).

In order to be able to imitate human emotions entirely, more knowledge about the functions of the brain would be necessary, for example to recognize which information is relevant at all (1#25). Frey

and Osborne do not expect this problem to be solved by engineers in the coming decades (Frey and Osborne, 2013).

This is related to intuition or gut feeling, because intuitive mechanisms are controlled by the human brain. In decision-making, data can help, as agreed by some experts (5#19, 3#13, 2#16), but in the end, intuitive decision-making by a human being is classified as more important (5#19, 1#23). Machine intelligence complements the human intellect but cannot replace it in decisions requiring emotional and social intelligence.

5.1.4 Superiority of Technology – a Fact to Accept by Humans

Furthermore, the findings suggest that a superiority of technology has to be accepted in areas where humans cannot play out their human advantages. Also, expert groups that are not working in logistics, manufacturing or with AI technology agree to the superiority of machines in routine or administrative tasks. There is however not a rejection of the technology itself; on the contrary, for the automation of monotone or boring tasks, the use of technology is appreciated. Ideally, machines should take over activities that are repetitive or associated with particular health hazards. On the other hand, they should complement human decisions where their specific abilities are able to recognize complex interrelations better than a human being, e.g. in medical diagnostics.

Autor et al. (2003) accept superiority of technology from a generalist point of view, but they don't ask where this perspective is coming from. According to the experts with a technology background, the superiority of technology is obvious, as humans should concentrate on their human skills (1#24, 1#18).

Besides the obvious acceptance of technology by experts from the technology industry, it is interesting to find the same acceptance by other experts. HR experts claim that everything that can be standardized should be standardized (2#12). Inefficient processes (2#16), as well as speedy calculations can be directly automated (2#14). Academia is finding advantages of technology in the following procedures: in decision-making (3#6), information filtering (3#10), as well as predictions of several scenarios where technology, like AI, is quicker and more precise (3#9). With Machine Learning, it is easier to create new knowledge or new images (3#3), and the combination 'AI + human' is emphasized. For the educational sector, it is advantageous that algorithms are better in speed of data processing and memorization (5#13). Due to their 24-hour energy level, algorithms are faster and quicker in processing and analysing (5#4).

5.2 Implications for the Future Workforce

In the following, implications for the future workforce and organisational settings are pointed out. The results of this study strongly emphasize the importance of strengthening human abilities in the future workplace. According to experts, teamwork, human-machine interaction, life-long-learning, as well as the right mixed skillset will be important for the future workplace.

5.2.1 Teamwork

Intelligent automation and more widespread teamwork between people and intelligent machines will lead to profound changes in companies. Previously widespread hierarchical structures will increasingly contradict the possibilities of AI-supported project and teamwork across structural and organizational boundaries, as well as across time zones (1#24). In the course of globalization, the size and diversification of groups and culturally heterogeneous teams will increase the importance of social intelligence in the future working life (2#11). Further, MacCrory et al. (2014) highlight flexibility in skills development as a very important tool for workers. Employees will have to undergo continuous further training, and the shift to cross-functional, team-based work is increasing. Having in mind the human abilities that enable skills for the 21st century, it needs to be a priority, especially in times of quickly advancing technology. Not only financial investment but investing in people will be important. Therefore, specific HR strategies are being developed to foster talent: recognizing the potential, motivating and supporting the talent (2#16). Here it is interesting that this kind of aspect was mentioned from an expert from the tech industry (#18). He argues that through the technological processes, investing in people is more valuable and worth the investment.

5.2.2 Life-long Learning

The society is in a permanent state of change, and the demands put on individuals by their profession and everyday life are changing accordingly. Adaptability, the will to develop and the ability to acquire new skills are therefore becoming increasingly important. The concept of “life-long learning” aims precisely at this: it describes the ability to learn independently throughout one’s entire life (Gehrke et al., 2015).

It is becoming clear that learning, as the personal willingness to face changed conditions in all areas of life, to remain curious and to actively shape the personal and social environment (1#18), are

important. Not only for society and the economy, but also for the personal development of each individual (3#3, 4#15, 5#19).

Implementation of life-long learning should already start at a very early stage in the educational system. It is argued that it does not make sense to teach children facts anymore. The change should include the education of students to active based, as well as to more linked and interdisciplinary learning (1#4). New ways of learning, such as e-learning platforms, can help to change learning tools. Schools can therefore offer more personalized teaching (1#4, 5#13, 5#19, 5#20).

Life-long learning helps to deal with social changes and to better meet the challenges of the labour market. It creates self-confidence and can decisively improve the quality of life (2#11). Continued education and life-long learning should be central themes of education policy (5#4, 5#20).

New technologies pose many challenges. For instance, it needs to be sure that humans are a priority (#4) in all of the phases of the technology design; and for the way, in which technology is utilized in the workplace. It has to be assured that special training is available (4#27), and that workers have life-long learning opportunities to gain the skills required for using these technologies. And that they are not just substituted by robots and other forms of new machines (1#24).

Finally, in the context of digitalisation, the field of continuing vocational training is often discussed. People from occupations with a high “substitutability potential” are mostly threatened by digital change processes. In the worst case, a disruptive loss of jobs is possible. A return to the labour market is also possible, however, as the overall demand for labour will not disappear. But the question is, how quickly and under what conditions this re-entry is possible in individual cases (1#24). Through a targeted and tailor-made training policy, so-called “mismatch” problems can be reduced by retraining in areas that are less threatened by digitisation. Ideally, such promotion of occupational mobility can even take place with foresight, i.e. before a job loss has actually occurred (Peters, 2017).

5.2.3 Human-Machine Interaction

Especially experts with a background in technology claim that asides “human skills”, digital skills are equally relevant for employees (1#18, 1#24), and therefore highlight the importance of a correctly mixed skillset. This is in line with Daughtery & Wilson (2018) who introduce the “fusion skill” framework to describe a human-machine symbiosis.
In the future, the right mix of skills is indeed necessary. In an engineering environment, data literacy, manufacturing skills and handling technological processes are from high relevance, but so are soft

skills, especially in leadership and social situations (2#11). A knowledge-based skillset is required, as it needs to be known how technology should be handled and how to react properly to machines: but according to expert (5#19), not everyone needs to have the full digital skillset, especially if someone is not working in the technology industry. Another opinion refers to the importance of IT skills: the expert argues that at least on the shop floor, not that much work is left for humans, so they need the skills that are adaptable to deal with this kind of changes (1#17).

A discrepancy seems to exist between human emotions and technology (1#5). That is why it is hard for robots to replace humans, when they are interacting with others – both physically and emotionally. Emotions and empathy are important in the world of work in several aspects. First, emotional and empathic behaviour are still difficult to simulate by technology (Autor et al., 2013) and are characterized as human abilities. Emotional communication and empathic behaviour are irreplaceable at the workplace (2#12, 1#26). The human touch (2#11), as well as emotional intelligence, are helpful at the workplace to encourage better cooperation between employees and to build a more satisfying working environment in general. Furthermore, social and emotional intelligence has always been a core competence of people in collaboration and building trust-worthy relationships (1#18). From a leadership perspective, empathic interaction helps to motivate employees (1#26). As AI becomes increasingly sophisticated and human-like, but is still difficult for technology to adapt, employees must be able to have the right set of soft skills and perform well in an emotional world and work environment. Through change management modules and training sessions, employees can be trained on how to interact with machines, but most importantly with their colleagues (1#26).

Interestingly, the research shows that experts, depending on their professional background, either advocate a more human or a more machine-based future work approach. This means that in a technology-oriented workplace, the machine is more in the focus than the human (1#5). Contrary, however, for teamwork tasks it is stated that a real face-to-face conversation is more valuable than a virtual conversation (1#22).

Working in a targeted manner with machines (both as human-computer and human-robot collaboration), interaction is becoming increasingly important, enabling an effective cooperation and the controllability of machines. Before that, a decision has to be made which activity a human can overtake and where the humans should be supported by machines. Work can then be delegated. Experts agree that repetitive tasks can be automated (3#3,1#5, 1#7, 3#10). Interestingly, business

models where the human being is performing repetitive tasks are supported by experts, and it is accepted that these tasks can be taken over by robotics and technology.

AI will have a lasting impact on knowledge work but will not displace human judgement. It is not a question of playing machines off against people, but of how the two can work together meaningfully. The combination of peoples' relative strengths with the strengths of machines leads to the best kind of AI-supported decision-making. Algorithms find solutions to problems much faster than humans, however often not with sufficient sensitivity, intuition and prudence. HR experts state the example in recruiting: video applications reviewed by robots are tested, as the first step in recruiting processes could be automated. But the real face-to-face interview and selection of the right candidate should not be automated according to the experts, as gut feeling and human interaction play an important role in the decision-making process (2#14, 2#16).

In the future, working with automation and adding human value will be a typical scenario. In these regards, it depends on the industry how much automation will exist. Many experts from Group 1 state that in their industry, automation of specific tasks will be inevitable. The workforce of the future will be working with machines and technology and using their advantages for daily work routines. In this transformation, it should not be discussed whether to use automation or humans, a symbiosis between them has to be achieved. Having a basic understanding of data literacy, combined with a soft skillset and of how to use human-machine interaction will be a strategic advantage in the future work environment. One expert introduces the "*humachine*" term, which calls for a combination and symbiosis between humans and machines. In Figure 12 the main findings - the categorization of human abilities in social interaction, cognition and creativity and the technological superiority in automation of repetitive tasks, power & quality as well as decision-making are summarized.

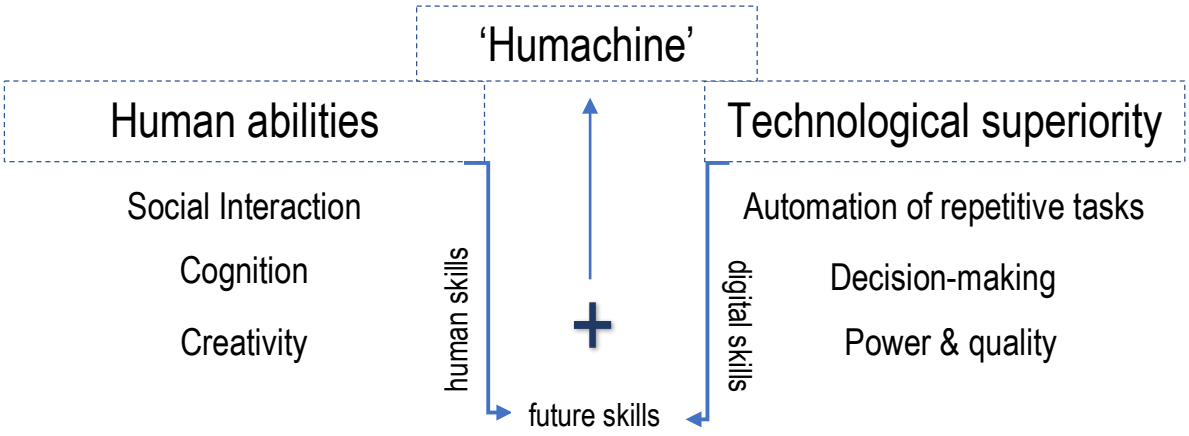

Figure 12 Humachine, after Daughtery & Wilson, 2018

6 Limitations

This dissertation investigated the underexplored field of human abilities and future skills in relation to the development of the future workforce.

The exploratory character of the investigation gives it a preparatory status. Thus, the results collected cannot offer significance in the sense of a statistical evaluation. Although the work focuses on some fundamental questions about human abilities empirically, it raises new questions that can serve as a starting point for further research.

The sample is presently highly skewed towards a German population due to the background of the author. Grounding the study on more diverse European experts could be interesting, in order to see how the different 28 member states of the European Union react to this topic and which kind of strategies they pursue in relation to the USA or Asian countries.

The applicability of the main quality criteria of quantitative research – reliability, validity and objectivity – to qualitative research is controversially discussed in the literature (Flick, 2009, p. 270). Nevertheless, in this section an attempt is made to apply the quality criteria to this research work.

Basically, the following main quality criteria are distinguished (e.g. Hammann & Erichson, 2000; Lienert & Raatz, 1994):

(1) Reliability refers to the stability of the measuring instrument or the reproducibility of a measurement result.
(2) Validity is the degree of accuracy with which a measuring instrument measures what it is actually intended to measure.
(3) Objectivity prevails when different persons who carry out the measurements independently of each other, arrive at the same measurement results.

Within the interpretative paradigm, there is an extensive and multifaceted discussion as to which criteria should be applied to measure the quality of empirical work. This discussion can be described as unfinished, insofar as it has not yet led to comparable uniform criteria as used within the quantitative understanding (Flick, 2005; Corbin & Strauss 2008). In accordance with Flick (2005), four different positions can be identified in the discourse on measuring the quality of qualitative research:

(1) In the first position, either the classical criteria oriented towards quantitative science ideals, such as validity and reliability are applied to qualitative research or reformulated in terms of equivalent standards (Strauss & Corbin 1996, Lamnek 2005).

There are different forms of reliability; if, for example, one distinguishes between external and internal reliability, it becomes apparent that external reliability (as replicability of a study) is difficult to achieve in qualitative research. This would require, among other things, continuous investigations leading to the same measurements and results, and stability of the measurement results or observations over time (Flick, 2016). This was not achievable in the present cross-sectional study. Only the attempt could be made to increase the reliability, by striving for a high quality of the records and by paying attention to a standardised documentation of the data (ibid.). This enables a reinterpretation of the data. Internal reliability is not sufficiently given in a study conducted by a single researcher who assumed the roles of both the researcher, the observer and the evaluator. The review of the guidelines for the interview by other persons and an interview pre-test show the motivation to nevertheless achieve the highest possible reliability.

(2) The second position assumes that every (paradigm-like) research programme always brings its own evaluation standards with it. Thus, in the present thesis, an attempt is made to develop method-appropriate quality criteria that do justice to the specificity of qualitative research by being established from their respective theoretical background and by taking into account the specificity of the research process (Flick, 2005).

(3) A third position is to fundamentally question the value of quality assessments. This can be justified by the transience of social reality, while acknowledging its process characters (Flick, 2005). The researcher was aware of the three types of errors (Kirk & Miller, 1986) that occur in connection with validity and tried to avoid them through several discussions with peers. If procedural validity in the research process is summarized as an "attempt to act sensitively in the field" (Flick, 2016, p. 497), this form of validity was sought in the research work.

(4) A fourth position focuses on removing the quality of research from its ultimately scientific evaluation context and evaluating it with other criteria such as its applicability or originality (Corbin & Strauss 2008) or to consider the quality of research beyond certain criteria (Flick, 2005). The goal of objectivity is only partially traceable in qualitative research. In the present case, objectivity of execution certainly represents a simpler task than objectivity of evaluation

and interpretation (Flick, 2009). Literature research, interview process and the focus groups were mainly organized, guided and led by one researcher.

The assessment criteria that Flick and Corbin & Strauss set out for the evaluation of an empirically based theory and the paths that led to it (linking result and process orientation) relate to three aspects: Firstly, the validity, reliability and credibility of the data, secondly the appropriateness of the research process and thirdly the empirical anchoring of the research results should be critically examined (Flick, 2005).

Scientists such as Lüders & Reichertz (1986) or Glaser & Strauss (1979) questioned the applicability of the above assessment criteria for qualitative research some time ago. As a consequence, alternative criteria have been discussed since the 1980s. Without going into detail, the criteria proposed by Lincoln & Guba (1985) of trustworthiness, credibility and reliability shall be mentioned. With the efforts to pursue the research project with interest, competence and accuracy, the researcher has also tried to meet these criteria.

For the purpose of this thesis, the use of qualitative data was chosen. Therefore, the investigation of the subject through relevant experts and the collection of respective data was necessary. However, as common for qualitative research, the sample size was limited, in this case to 30 interviews. Due to its qualitative nature and a purposive sampling size, the results cannot be generalised, but have a trustworthy reliability (Flick, 2005), because of the description of data collection and analysis.

The sample size is limited to 30 interviews due to timescale and resources of this dissertation, however the principle of theoretical saturation was taken into consideration (Glaser, Strauss, 1967; Guest, Bunce & Johnson, 2006). The interviews were held in different time intervals, the first ones in mid-January and the last ones at the end of Mai. During this exploratory phase, the interview guideline changed, and a different focus was set up. This could bias perceptions of the interviewer despite the pre-determined questions. Furthermore, it has to be taken into consideration that the interviews can have a reactive effect (Lavrakas, 2008). Reactivity means that the interviewees are having close connections to the organization they are working for and could create positive bias and opinions connected to the organization. Finally, the specificity of the chosen organisations, mostly active in the European setting, comes with cultural limitations. Studying the topic more globally, with an emphasis on European operating companies and interview experts, some of the findings may be more specific to European culture and values, than for example to the Asian environment. The

presented study included interviewees from the Netherlands, Canada, Finland, Germany and the UK.

These above-outlined limitations should be taken into account when considering the validity of the findings.

7 Normative Outlook

The work provides further impulses on the discussion about the challenge of anxiety around technological development, and highlights the need to adjust educational systems, in order to accommodate future technology-induced changes.

7.1 Further Research

The presented work is a qualitative, exploratory study of human abilities and its salient characteristics in the context of the future workforce. However, the results can only serve as a starting point for future research, as describes comprehensively in the limitations before. Future research needs to find ways for circumventing these limitations, for example through the development of applicable and valid quantitative measures. Having observed mainly German speaking professionals in a corporate context, future research may also incorporate samples of a different age-set and other fields of society, seeking to identify other distinctive influencing factors and further enriching the understanding of the topic. As one of the limitations implies, insights into the human abilities context may advance a comprehensive, yet culturally sensitive measuring instrument. Furthermore, it could be interesting to concentrate more on one specific industry (e.g. logistics or manufacturing) and doing a quantitative survey amongst decision-makers. Another idea could be the use of current university students as sample, in order to ask about their assessment of future skills, and if they feel prepared to learn those in university.

7.2 Challenges of Anxiety around Technological Development

Digitalisation is perceived as a threat mainly for two reasons. The first is the widespread fear of losing one's job. Secondly, many people fear a loss of control over personal data and that it will fall into the wrong hands. And, of course, there is the diffuse but ungrounded fear that machines themselves could be directed with force against people.

Today, many people are afraid that they will run out of work due to drones, computers or robots. A lot of people fear robots taking over, so that they will be losing their jobs. Fears of one's own economic dependence play a role as do mistrust of a confusing world economy or the rapid development of information technologies (Botthof & Hartmann, 2015).

It is argued by experts that it is typical for technological progress that such concerns and conflicts arise and that this is repeatedly happened in history, when technological revolutions arose (1#18, 1#21, 5#4). Robots might take away some jobs, but new ones will be developed, as well. Neither job is replaced 1:1 by machines, and every technological advance causes shifts.

Rather than fearing to be replaced by robots, workers need to continuously acquire new skills and capabilities in order to function creatively in a manufacturing environment that innovates not just on the R&D side, but in the whole manufacturing network. The goal must be to augment work, and for humans to work side by side with robots and to improve productivity and enrich the workplace.

In order to realize the potential of AI and other technologies, people have to be inspired for a better future with AI and need to be convinced that robots and machines will be able to relieve the work that humans usually do not appreciate. Ultimately, humans are not good machines, and machine activities performed by humans rarely create the feeling of a meaningful task. Instead, the focus should be laid on those skills, in which humans are particularly good – creativity, intuition and interpersonal interaction. Creating this freedom provides great potential for AI and machine learning.

Through technological advancements, companies have to adapt to institutional changes and the environment. An open mind-set and will towards change are prerequisite, and everyone should adapt to different kind of changes (4#2, 1#18). It is not only the question about job loss, more or less needs to be an answer how to re-train those that will lose their job and giving them perspectives. Ideally, the reaction of special training requirements and life-long learning, as well as up-skilling programs can hinder the job-loss of affected employees (1#24).

There are many challenges posed by digital technologies. For instance, it has to be ensured that humans are a priority (5#4) in all of the phases of the technology design and in the way, in which they are used at the workplace. Moreover, it has to be ensured that the necessary training is available (4#27). This guarantees that workers have life-long learning opportunities and get the opportunity to re-train the skills needed to use these technologies, and do not just replace robots and other forms of new machines. To sum up, if society is accepting technology as support and not as a threat, a "normal" handling of technology could be realised (1#24).

7.3 Necessary Changes in Education

A second priority should be the introduction of necessary education changes, in order to create a successful future work environment, where human and machine-based skills can complement each other.

Transformations in society, culture, economy, politics and employment require humans to fundamentally rethink how education is perceived and organized. The current young generation is described as “digital natives”, and is used to combine the offline and online world – why not implementing this in the university life and creating a future-based learning system?

More precisely, the educational system has to change in several perspectives: more future skill-based teaching is needed, combined with new teaching formats and digital expertise, and updated professorships, as well as a new architecture of the university hall (Fries, 2018). Education is going to incorporate competitive skill-based learning and deep learning competencies, like creativity and critical thinking. Decision-making capacities, interpreting data, and skills for interacting with others through emotional intelligence and empathy have to be imparted (ibid.).

Through global networking of knowledge resources and new communication channels via the internet, access to knowledge and education is facilitated. New forms of collaborative working and study-centred learning require students to assume greater responsibility for learning processes and open up opportunities for co-designing teaching, while at the same time promoting flexibility and self-discipline. As with all other media, digital formats also need to be mindful of the cognitive, social, and emotional foundations of learning, if they want to support and encourage learning (ibid.).

How education systems can be prepared sufficiently for this challenge will become a central question for politicians and companies. Education also determines future skills in dealing with AI, i.e. productivity and resilience of the labour market.

Every individual is asked to commit to this change, but so is politics. The improvement of education, training systems and optimization of the concrete application of skills and learning processes in the workplace are recommended. The aim should not be to increase opportunities for short-term employment, but to give people a long-term perspective on the future labour market. Innovative approaches can be institutionalised through training practices or individual "learning accounts". Concepts like online teaching, extra courses for digital understanding and data literacy, as well as interdisciplinary collaborations with research institutions could be efficient.

The change must be set much early and already begin in school education. In addition to schools and educational institutions, industry can also contribute to their promotion, for example within the framework of initial and continuing vocational training.

But what does all of this mean for the competences described above? First of all, it should be clear that a high general level of education across the students should be ensured by the general school system. The gaps that have arisen cannot be closed by initial and continuing vocational education and training, or only with disproportionate effort. The division of tasks between vocational and general education proposed above should not be dogmatically understood. Thus, a foundation of social competences (interpretable as "social general education") has to be imparted already in school education. This has to go along with a reform of the educational system: the educational institutions are responsible to re-thinking curricula, inventing new teaching and exam formats, and implementing creative learning spaces.

In the recent debate, the support of STEM education is in the focus (Holloway et al., 2019). Yes, knowledge of technical skills and having a digital basic level becomes a key resource of the digital society in times of information overabundance. Only those who are able to interpret information and data, and combine them with contextual and experiential knowledge, will be able to make a valuable contribution to a digitised knowledge society. But machines will not be able to take over the interpersonal interaction, whereby soft skills, empathy and creativity make the difference. This could involve redesigning curricula in such a way that pupils acquire competences above all in areas where people retain a comparative advantage over machines, computers or algorithms. Less memorization of facts and repetitive standard procedures, but more promotion of creativity, social interaction and human empathy must be taught. According to the findings, soft skills are the new currency of the 21st century (2#12, 2#16, 5#19, 4#27). Having the STEM education on the one side, social sciences have to get the attention in the digital age, as well (Holloway et al., 2019).

According to the research, technical bottlenecks are in the following areas, among others: Creative-intelligent activities such as the ability to link knowledge, information and ideas and to create something new from them, as well as socially-intelligent activities such as collaboration with others – also in virtual teams and with different cultures; finally empathy and emotional intelligence. Companies therefore need more and more people who are able to bring knowledge together and are not desperate to maintain their status or prefer to collect, rather than share knowledge (2#12). Hence, people who can also question their own views resolve conflicts and argue objectively. People

who are willing to cooperate and have the ability to engage with others will be of crucial importance; so, will be people who are able to organise themselves optimally under increasingly flexible working conditions (1#17). Moreover, social and personal competence are becoming more important than ever before.

Education has to adapt to the 21st century and must open up traditional, outdated teaching and learning sessions. It is time to upgrade learning for the digital age and for using technologies to foster successful education of digital skills. The present research shows the importance of human abilities and soft skills, and education has to concentrate on teaching those skills and offering platforms, where communication training, emotional intelligence and teamwork can be reinvented.

8 Conclusion

The purpose of this thesis was to answer the research question ***what are uniquely human abilities in the digital age of the future workforce?*** Based on a qualitative research design, it was possible to taxonomize these uniquely human abilities in a stringent manner.

Having in mind the example of AlphaGo and the potential automation of ongoing processes, the empirical results do not only emphasize the identification of human abilities but suggest their active appropriation and support for the future workforce.

The findings of this thesis demonstrate that the human being is not only able to observe and analyse but can also put him - or herself in other people's shoes. Empathy, intuition, facial expressions and gestures are (still) difficult to recognize and hard to embody for a machine. Creative processes, as can be seen in the domains of arts and sciences, or as innovation processes, are reserved for human beings. Because these abilities can be utilized to shape the future and drive progress, the future of the digital future lies in the symbiosis of humanity and technology. Over the next few years, individual skills, fostered through an updated educational system, will become even more important: People have to adapt to the new technologies in a quasi-complementary way. Further, it shows that emotional and social skills as well as creative processes and communication skills are declared as something that should not be automated, because based on the interview data and literature, these are characterized as uniquely human. On the opposite, for automation processes and routine tasks, as well as faster decision-making, experts and literature agree that these can be handed over to robots and AI. The understanding and usage of technology at the workplace and the human-machine interaction is seen as important for the future workplace. Employees and machines have to get trained at handling technology and using their potential for daily work by concentrating on human

skills. An interdisciplinary way of working, purpose and value-driven working environment as well as new jobs and new concepts of work have been discussed by the experts. The necessity for life-long learning, personal development and training can be seen as an implication of the current challenges

In conclusion, the analysis emphasizes the important role of human abilities in the digital age and highlights the different competencies needed. The reactions and answers from different expert perspectives highlight how relevant the discussion is and how different the claims of the sectors are: For the technology industry, skills like empathy or creativity are not as relevant as for the other industries. But technology experts stress that human intelligence, brain power, complex problem-solving, as well as gut feeling, and intuition cannot be replaced by machines (yet). Furthermore, all expert groups agree that technology can support humans in repetitive and automated tasks, and that an interaction between humans and machines is not only in the engineering or manufacturing areas already becoming a reality, but also at the normal workplace environment. Life-long learning, personal development and an open mind-set towards change is seen as a prerequisite for everyone in the digital age. It can be said that at the end of every process a human should make the final decision over tasks.

For the workplace, new concepts arise and flexible working environments, as well as remote work are the new trends. The past shows, for example, that technological change has had very different effects on different groups of employees – some positive, some negative. Considering the future outlook, the challenge of preventing a digital divide between tech-savvy insiders and tech-rejecting outsiders is emerging (Daughtery & Wilson, 2018.). This not only raises the question of where AI can replace human activities in the future, but at the same time, it is important to promote people's abilities and to redefine their role in the working world of the future.

As US journalist Thomas Friedman once wrote that i*n future we will work with our hearts because that's the only thing a machine will never have"* (Friedman, 2016). Let's face this technological change as an opportunity, support human skills and try to engage in a human-machine interaction.

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Appendix A- Search Strings

Human	
	Human AND AI
	Human AND future of work
	Human AND 21st century skills
	Human AND machines
	Human-Machine interaction
	Humanity AND future skills
	Human abilities AND future of work
	Human abilities AND soft skills
	Human abilities AND digital skills
	Human abilities AND technology
	Menschliche Fähigkeiten
	Menschliche Fähigkeiten AND Zukunft der Arbeit
	Human-centred perspective AND future of work
Artificial Intelligence	
	AI AND 21st century skills
	AI AND future of work
	AI AND human
	AI AND superiority
	AI AND future skills
	AI AND risks
	AI AND ethics
	AI AND opportunities
	AI AND Human-Machine Interaction
21st century skills	
	21st century skills AND future of work
	21st century skills AND human
	21st century skills AND AI
	21st century skills AND soft skills
	21st century skills AND technical skills
	21st century skills AND human abilities
Future of work	
	Future of work AND human
	Future of work AND AI
	Future of work AND 21st century skills
	Future of work AND Human-Machine Interaction
	Future of work AND digital skills
	Zukunft der Arbeit AND menschliche Fähigkeiten

Appendix B- Summary Literature Review

Authors	Ability Group	Description
Deming (2017)	Social skills	Human connection, group generation
Autor (2015)	Social cooperation	
Premack & Woodruff 1978; Baron-Cohen 2000; Camerer et al. 2005	Relational abilities	Empathy
Borghans et al. (2014)	Social skills	Interaction, people tasks
Weinberg (2009)		Leadership
MacCrory et al. (2014)	Interpersonal skills	having visual and auditory information, show social orientation, interpersonal cooperation, adaptability, or concern for others
	Abstract tasks	Problem-solving, Intuition, persuasion, high levels of education and analytical capabilities
	Manual tasks	Situational adaptability, visual and language recognition, in-person interaction
Elliot (2014)	Language capabilities	understanding speech, speaking, reading and writing
	Reasoning capabilities	recognition of a problem, the application of general rules to solve a problem, and the development of new rules of conclusions
	Vision capabilities	finding the registration booth, identifying people or moving around a cluttered environment without collisions

Frey and Osborne (2013)	Perception and Manual Tasks Creative Intelligence Tasks Social-intelligent Tasks	navigate complex and unstructured environments Creativity negotiating, persuading or caring for others
Jarrahi (2018)	Decision-making Intuition	
Spitz-Öner (2006)	non-routine analytical task non-routine interactive tasks routine cognitive tasks routine manual tasks non-routine manual tasks	researching, analysing, evaluating and planning, designing, interpreting rules negotiating, lobbying, coordinating, managing personnel calculating, bookkeeping, correcting texts/data operating/controlling machines repairing or renovating
Levy and Murnane (2004)	Complex communication Expert-thinking	
Brynjolfsson and McAfee (2016)	Cognitive tasks	Communication, Ideation

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Declaration of consent to the tape recording of the interview

I agree that the interview is recorded with a recording device and then transcribed by the interviewer. For the further scientific evaluation of the interview text all information about my person will be removed from the text and / or anonymised. I am also assured that in the case of subsequent scientific publications, the interview will be quoted only in excerpts to ensure that I am not identified by third parties based on sequence of events in the interviews.

Location	Date	Signature

Interview – Guideline

Interview with: _____

Location: _____ Date: _____ Start:_____ End:_____

| Agreement to the audio recording of the interview

- Is it okay for you to record the interview and then transcript it? All information about your person will be removed from the text/or anonymised.
- Turn on the recording device

| Introduction and Research

- Thanks for the time and for your willingness to communicate & sharing your knowledge
- Short Introduction of myself and of the research field

| Structure of the Interview

- Below, I will ask you a few standardized, but mostly relatively open questions. I am particularly interested in your very **personal opinions.**

Intermediate or further inquiries are possible at any time.

- **Personal Information**

Before we get started with the interview tell me a little bit about yourself, what your research is about and/or what your current position is

Different theme blocks (questions and theme order vary from the expert's background knowledge)

1. Augmented Reality and Artificial Intelligence, Ethics & Humanity

a) How do you define AI & AR?
b) What are potentials for AR & AI in a human-centered perspective?
c) Which tasks can AR & AI already fulfil?
d) Which tasks can only humans do?
e) How can AI help to create a human-centered workforce?

2. Skills for the future workforce

a) Do you know the term *FutureSkills* and what do you think does it mean?
b) What are skills for the future workforce?
c) Which advice would you give students nowadays on which skills should they concentrate on?

3. Human abilities

a) What is an ability in the broader sense?
b) What are human abilities?
c) What are non-human abilities?
d) What are human abilities in the context of future workforce?
e) Are there skills that only human can do and/or are there activities that only can be created through humans- if so- why?

-If more time is available

f) Which of these skills can be taught effectively via online-systems- especially those that are self-directed and other non-traditional settings?
g) Which skills will be most difficult to teach at scale?

4. Future of Work

a) What do you think future of work will look like?
b) Where should humans concentrate on?
c) Which jobs will be important in future?
d) How is the workplace changing?

5. Human-machine interaction

a) What are potentials for AI in a human-centred perspective?
b) Where is the biggest risk?
c) What are you answer people that have fear losing their jobs?
d) How to combine human-machine interaction at work?

6. Education & Politics

a) How can we rethink education?
b) How has politics to react to those changes?

Feedback

a) Which questions would have you asked in this context?
b) If you know interesting people that I can interview as well for my thesis just let me know.

Appendix E- Sociodemographic Questionnaire- supplementary questionnaire

As part of the research project at the Copenhagen Business School and University of Cambridge, this questionnaire has been compiled in addition to the qualitative interview. It serves to complete and contextualise the information that you have described in a personal conversation.

Answering will take no longer than 2 minutes of your time. All data collected will be treated with the same strict confidentiality and anonymity. If you have any questions, please contact isfr17ac@student.cbs.dk.

Thank you for your time and support!

Personal Information

1. Sex
   - Male
   - Female

2. How old are you?

   _____

3. Nationality

   _____

Education

4. What is your highest level of education so far?
   - Apprenticeship
   - High school degree
   - Bachelor or comparable
   - Master/Diploma or comparable
   - MBA
   - PhD

5. If you have studied: Which discipline can be assigned to your studies? (Multiple choices possible)
   - Mathematic, natural science
   - Engineering
   - Economics
   - Law Sciences
   - Social Sciences

- Languages and cultural studies
- Others: _____

Work

6. What is your specific role in the [name of the company]?

   _____

7. In which department of [name of the company/employer] are you active?

   _____

8. Do you have management responsibility?
   - No
   - Yes

Thank you very much for your time and your support!

Appendix F- Sociodemographic Details

Interview	Pseudonym	Age	Gender	Nationality	Role	Management responsibility	Length of Interview
1	1#1	32	Male	Dutch	Head of Corporate Affairs & Innovation Benelux	Yes	00:25:03
2	4#2	54	Male	German	Partner & Head of Taskforce Future of Work	yes	00:41:33
3	3#3	46	Male	Finland	Project Leader & Docent	yes	00:42:36
4	5#4	35	Male	Dutch	Education Lead Benelux	yes	00:34:37
5	1#5	56	Male	British	Director of Apprenticeships & Technical Training	yes	00:39:02
6	3#6	31	Female	Canadian	Postdoctoral Research Associate	no	00:24:19
7	1#7	48	Male	German	Chief Data Officer DACH	yes	00:23:19
8	4#8	50	Female	German	Founder & Managing Director	yes	00:21:42
9	3#9	32	Male	British	Researcher	no	00:25:19
10	3#10	33	Female	German-British	Professor & Entrepreneur	yes	00:28:37
11	2#11	40	Female	French	Founder & HR-Lecturer	yes	00:48:44
12	2#12	58	Male	German	HR-Manager & Entrepreneur	yes	00:31:48
13	5#13	38	Male	German	Professor	yes	00:26:47
14	2#14	32	Female	German	Customer Success Manager	yes	00:16:05
15	4#15	39	Female	Dutch	Founder & Managing Director	yes	00:29:02
16	2#16	34	Male	German	Human Resources Advisor	yes	00:30:14
17	1#17	54	Male	German	Vice President Sector Development Engineering & Energy	yes	00:34:35
18	1#18	49	Male	German	Senior Vice President Automation and Control Technology Leader	yes	00:59:31
19	5#19	41	Male	German	Senior Vice President (CIO)	yes	00:22:51
20	5#20	55	Male	UK	Director Education & Skills	yes	00:16:08
21	1#21	49	Male	German	Head of Factory DACH	yes	00:23:11
22	1#22	58	Male	German	Head of Production System Implementation DACH	yes	00:32:43
23	1#23	56	Female	German	Chief Digital Officer DACH	yes	00:20:15
24	1#24	46	Female	German	Chief Technological Officer DACH	yes	00:22:11
25	1#25	45	Male	UK	Director Advanced Robotics	yes	00:19:05
26	1#26	58	Male	German	Chief Spokesperson	yes	00:47:11
27	4#27	31	Female	German	Senior Consultant Taskforce Life-Long Learning & Corporate Culture	yes	00:25:39
28	5#28	57	Male	German	Senior Project Manager Future of Education & Learning	yes	00:30:17
29	1#29	39	Male	UK	Head of Horizon Scanning & Futures	yes	00:27:32
30	4#30	43	Male	Dutch	Challenge Lead Jobs of the Future	yes	00:15:12
∑ 30		44,7	f=9 m=21				00:29:31

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What are uniquely human abilities in the future?

Participants n= 9

HUMAN ABILITIES

Accuracy (data)
Clear uniting
Cognitive Abilities
Communication
Communication (with others)
Communication skills
Computer literacy
Creative problem solving
Creativity
Creativity, Reflection
Curate, collate + analyse data/info
Deal with uncertainty
Decision making
Decision making (with explanation)
Digital safety
Drive
Emotional & Social Connection
Empathy
Improvisation
Improvisation
Improvisation
Information Literacy
Learning skills
Listening
Looking at Content
Looking for reliable information
Making decisions
Navigate the interpretation of data
Negotiation
Passion
Patience
People, Leadership, support, Growth
Perception
Practical Knowledge
Practical skills
Predicting human behaviour
Presentation Skills
Presenting
Process, Acquire
Reason, Logic
Reflection
Sensual-motoric skills
Spirit

TECHNOLOGICAL SUPERIORITY

Algorithms
Boring tasks
Calculations
Computer connecting to wifi
Computer processing data
Computing
Connecting to server
Creating fails and formats
Forecasting
Formatting
Growth
Organisation
Perfect memory
Recording
Repeated activity
Saving data files
Sending e-mails
Simple requests
Simulation
Sorting & Tracking
Sorting information

Focus Group 2 | United Europe | Cambridge | April 2019

"Human monopoly: which human abilities should not be augmented by technology?"

Participants n=11

mentioned human abilities:

- Responsibility
- Freedom
- Empathy
- Irrationality
- Love
- Respect
- Friendship
- Trust

Freedom	Freedom of will, speech should never been augmented, since this carries the major danger for humans to loose it.
	AI should never be free from guidance of humans.
Empathy	Empathy should not be augmented since there is a major danger for humans to loose what makes them human.
Responsibility	Humans should be responsible for their actions, this should not be outsorced to AI .
	AI should never be made responsible for it's actions, but rather for its creators.
Irrationality	Don't take away the "human factor"
	Humans should still be allowed to make decisions irrationally
	Don't allow AI to make irrational decisions

Focus Group 3 | United Europe | Cambridge | April 2019

"The intrinsic value of work: should we worry about running out of things to do?"

Participants n=11

No	In short term, it is to be expected to have a high degree of technological unemployment (jobs with low-level repetitive tasks), but in long-term we will experience a "skills revolution" --> AI will create as many jobs (or more), as it displaces
Yes and no	We'll have more flexible working load/time and non-standard employment available, therefore more focus and time for social life (family, friends, etc.)
Yes	We'll experience massive challenges about the purpose of our own life, linked to our drive to become more perfectionistic and pressured about our career paths.

Appendix H- Material of Data Analysis- MAXQDA Codesystem

Interview 1

I: What do you think are human abilities?

1#1: You mean what soft skills do we need?

I: Yes

1#1: I think if you look at soft skills, the intra personal skills are a little but under danger because people are getting more and more online. For example in my team, I have a lot of millennials and they are afraid to give a call or walk to someone, they are more likely to send an email or WhatsApp. Even in the life of love Tinder is their favourite than to talk to someone. Second one: interrelations between tech and persons. Tech becomes more and more smart, really smart. I mean- the question is how do we interact with voice control? Maybe for us, we are highly educated, but if you look at the less educated people its really difficult how to interact with tech and as a society we should be aware of that.
Those are two skills I would say. And we just discussed this as well here at the conference- creativity and critical thinking you need them in the job but also in daily life. We always have to more and more differentiate. In the last decade it was more being collective and doing things together. But since the 90s we are more on an individual basis and living after carpe diem and try to make the best out of yourself. I hope that collaboration and collective gets more and more important again. I hope for more synergies of the groups than just following the group. I think if I look at daily business at [company] you really have to be innovative, we have to conquer also competition and attach to citizen and the power of these citizens is getting more important. There is the government, corporates and the media that can use online media, and if you get followed or liked this can have a huge impact for companies as well as the personal lifestyle.

I: Maybe we stay at [company]- what is [company] doing to train these future skills, are their specific trainings or learning experiences?

1#1: To be very honest we are at a world which is changing a lot and we are working at a company which is originally from Asia. Asian people still like facts and figures and this is different to the Western world, where we only talk about 21st century skills. For them it's also important to know specific facts, to calculate and statistics. But apart from that, they see as well that besides the slides and statistics you have to be able to spread a word and a story. Next to this content, we offer training how to communicate, but that's different from European and American countries. Asian people are very well in asking critical questions about the things that are presented for example. Further, we offer training in how to work in interdisciplinary teams and specifically making projects there. Finding new solutions and business models and meeting people from different departments and sharing different views is important. For example the financial departments is doing the controlling but if you think about their opinion on marketing issues you get completely new insights from them. But still facts and figures are also important.

I: You already elaborate on that, but which skills for the future of workplace are important?

1#1: One of them which is really important in my company is 'intrapreneurship'. It means run your own project like its your own company. Make a plan, think about it and try to make it happen- so you're allowed to draw out of the lines. If you do

what you have to do, there's no creativity or no critical thinking. What I try on my team is to challenge them to think holistically. Sometimes you're in your own bubble, so try to talk to other people and see what other people are doing.

I: Are there other skills that we need?

1#1: I think, media wisdom, because more and more is getting online, so we have to comment on the information and the knowledge. Because what is going to happen if AI becomes smarter or even more smarter than Einstein?
I think right now we're thinking AI is doing great things adding a lot of value to our lives- but what will happen if AI is getting smarter than the smartest person on the planet? So before that you should take action on ethics and that kind of skills, and make people aware of positive as well as negative things of AI- it's also kind of critical and logical thinking.

I: One last question: What do you think are non-human abilities?

1#1: Definitely working 24/7. I think with the calculation power computers are already smarter than we are. Will AI or a robot doctor be better than a specified person that studied more than 15 years? Right now, I think it's the doctor but in future this will change. What you see now, for example in the service world, you need more and more real human beings, because people don't want to be served by robots. Or nurses, we need more and more nurses, e.g. in Netherlands we need 30.000 nurses more. Because people want to have close relationships. I still think that the combination of humans and technology, adds the most value than only human or only tech. And I hope that we have a balance between the offline and online world.

I: Perfect- thanks for your time and your sharing your insights about [company] and your point of view.

Interview 2

I: I'm really happy to hear your insights, with your background you can give me a lot of insights. **What do you think are human abilities?**

4#2: You mean how you define human abilities and which kind of skills do we need?

I: Yes, exactly.

4#2: It starts with communication skills, that are based on the ability to build a relationship, to understand the counterpart, to have empathy, the nonverbal communication, to react properly, that's what we find under communication skills.
Then problem-solving: starts with understanding a problem, being able to frame it, being able to use different frames, and to use different frames. This is a kind of an ability that the human being uses to look at a problem and to find solutions and this is something AI can't do right now.
Thirdly, its creativity, which again is a fluffy term, and there are linkages to problem-solving. When you look at problems at a different perspective, having new ideas and working for new ideas in order to generate solutions, this is a creative process.
Finally working together as a team and collaborate. This is where communication, relationship building and creativity flows together.

Does this make sense?

I: Yes of course! **What do you think are non-human abilities?**

4#2: I find it hard to define non-human abilities, do you mean abilities that can be automated or taken over from machines?

I: Yes.

4#2: Okay, that's first of all repetitive work that follows clear schemes frameworks and rules. These frameworks and rules can evolve themselves. I guess AI is able to cope with that, but what it can't do is to switch from one framework to another. But everything that is repetitive has some kind of communication skills basically when you think at chatbots. I wouldn't call them non-human abilities because fundamentally all human abilities have the starting point that they are human beings- so some abilities are now augmented, replaced or taken over potentially by a machine. In some areas, their might be a gap, a leftover when we think about communication. It's interesting to see talking to a chatbot if there is emphasize, the tone and all that can be analysed. But I cannot imagine a couple of intense, very deep dialogues with a lot of emotions involved that can be replicated by machines. But to some extent repetitive tasks or physical and administrative can be automated.

I: What skills in specific do you think are important for the future workforce?

4#2: First of all, all these skills have greater emphasis on these human skills on the digital age across the board. Today when we think about problem solving management position and leadership position whatever it is, if everything gets automated this is what's left in the end: Communication skills, creativity etc.

Jobs, roles across the boards will need more of these human skills in the future on a higher level. And will hence have higher requirements on these cognitive abilities, that people are able to think independently have feelings, and act upon that.
Second a key factor will be “empowerment” of people in the workforce, which puts the focus on higher level human skills- the traditional hierarchical model won’t work anymore. That means much more lateral communication and lateral relationship building will be required, which means working more in teams. So everything will go to lateral relationship building as well as more team-building.

I: What do you think how could companies or employees train this kind of human skills? A lot was invested into digital skills training the last years- are there any trends for HR?

4#2: It’s a very interesting question and one that is overlooked largely at the moment. In our company the greatest challenge lies in this development. Currently, companies are very much interested in hiring the next generations of data scientists, UX Designers and train their staff in digital skills as well Big Data and Analytics.
But I think these human skills are being overlooked in kind of specific trainings so you find them in leadership development but not yet in broad learning and development.
I think it will be required basically leverage leadership skills much more broadly, because this is the area where communication, problem solving, collaboration and different leadership styles are being trained and learned. And if you're interested I can mention 2 examples, that becomes clearly observable.

I: Sure- go ahead!

4#2: One what has happened- was McDonalds that automated their McDrive food- taking everything by computer- now you see no one has been laid out- these people involved in order taking have been re-trained and at the same time McDonalds invented new services, like desk or waitress services and so people have been re-trained to become waitresses or meal preparation assistants- so what I want to say with this example is 2 things:
There’s no ‘one size fits all’ answer- for McDonalds there are different human skills: to serve someone at the people requires other skills, than to make sure that the people are being well treated than being at the end of the telephone line.
Secondly, there's a lot of discussions employees staff due to automation- clearly the fears are there- and I don’t want to argue against. However, this perspective forgets one thing, that the entire environment is not static and constantly changing- it’s hard to catch but there will be new services and new offerings & new products invented where this kind of capabilities will probably be transferred to and can become productive again.
Another example if you look at relationship management or key accountants whatever it is in corporate banking or chemical industry. As a key account manager's time is spend on administrative tasks: it's been spent on preparing for client visits and meetings and then do the follow up. So probably 30-40% of this person's time is spend with clients. If you imagine now the time of big data and digital tools of AI that sales person is equipped with a fantastic tool set that can all do the admin work with a fingertip. What is left? The person can go out meet the client and invest in the relationship and be able to put yourself in the shoes of the client, meaning understanding the clients’ problems and finding solutions rather than spending time on administrative tasks. This is something that will actually take away a lot of excuses on development and trying to invest more in that human capabilities. Because trying to understand the problem, leading a meaningful dialogue around that and finding solutions should be the focus. So salesperson and key account managers around the world have to be retrained and it is a massive challenge that is not being discussed at all at the moment.

I: You've mentioned new jobs will arise- can you predict some jobs that are getting more and more valuable and what are the new jobs of the future?

4#2: There it is really difficult to provide a generic answer what kind of jobs there will be and you have to look industry and industry and go through value chain and how business models and products are changing. Sticking to the examples we just had, McDonalds never had waitresses- for a fast food restaurant having a waiter that's new. If we stick to the key account example then basically it is a new job for standard products and new services, clients will be relegated to digital channels. This might create a new job of a digital navigator- when you struggle with the digital channels into your suppliers or into your bank, someone could help you navigate this digital dschungel and take you by the hand and teach you these tools.
It's pretty difficult to specify.
In a shorter perspective jobs emerge using big data scientists. It's going to be more jobs that are fundamentally based on human skills.

I: Going to the role of HR & future workplace- are there any trends?

4#2: If you think about HR is not up to scratch with the whole development- most of the discussions and the projects we do for our clients, is originally out of their business line and they have to think what is happening to my workforce, how do I have to change my workforce and of course which skills do I need in the future? HR in most organizations, the HR function itself is still stuck very much in an old-fashioned structure- very tactically focused and has very limited strategic resources. And in the HR functions itself there's quite a gap between ambition. HR functions in general want to be leading the effort, be the change agent, be working on a strategic level etc. But the reality is, there are very much focused on efficiency and running the HR function in traditional manner on short term goals. So what this means that there is a fundamental need of HR functions to be upgraded and basically be enabled to build the capabilities to the strategic roles they have to play, being the single most important assets that a company has. HR needs to switch perspectives to personal costs to the value of human beings, value of the staff and developing new strategies from a people perspective.

I: So what does it mean for the future workplace? You already said HR functions have to change- but are there other trends regarding future workplace?

4#2: You mean the office set-up?

I: Not only the office, maybe also the company culture and what does technology mean for the future of work?

R2: Most definitely one of the key challenges that are a lot of companies are struggling with, is because of different company cultures. Let's take a bank like HSBC, it's a global bank with 200.000 employees, traditional structures are on a change developing themselves but very much stacked in the traditional infrastructure. On the other hand they have an incubator working on new innovative trends, that team is around 4.000 people very sizeable, small in contrast to the conversation, it's called the Shortage team. These guys have a digital native culture, meaning they have open offices, people wear hoodies, much faster working style, are used to work with teams, have line organisations and are rethinking products. On the other hand, you have this kind of hierarchical structures, tones of committees, where decision making is transferred to other people. So both have to make an understanding of both cultures. But you divide an organization in 4 zones, legal focus on efficiency, new ideas and many new ideas as possible, the zone of market proving of these new ideas and growing

them then you have the transformational idea that will be complete outdate your business model and they need to be managed in a deductive way.
Different zones, different cultures, different priorities and different strategies.

I: If you would have to give an advice for current students on which skills should they focus on?

4#2: I've been through the traditional German university system, which was very focused on broad academics thinking. I myself studied philosophy, so keep that in mind when you look at my answer. You have to focus on developing your ability to think. To develop creativity, communication skills- first of all develop a growth mind-set and try out different things, different frameworks to look at the world. In basically learning tools have to change: I'm not a big fan of universities that want to teach tools, case studies are alright, but tools that you can acquire very easily is not teaching you how to fundamental think of framing problems. Further, to look at problems from different perspectives and to be able to stand out is something that's very important and that takes time to develop. If it means traveling the world, then do so or doing studies in philosophy that is maybe not helping your job as investment banking, but do so.

Interview 3

I: Thank you so much for your time! It was really nice to get to know you in Amsterdam. As I've already said in Amsterdam, I am writing my Thesis about "FutureSkills- what are uniquely human abilities in the digital age for the future workplace?" **You've said you have some background in AI. How would you define AI?**

3#3: Before answering this- you have to think about what is Intelligence? It is the ability to represent some knowledge or information, that is very useful- information usability. If a person wants to make intelligent decisions you have some information to back up your decisions, if you want to make well-informed decisions. That's the same with AI or Machine Learning- so you have to have some information that is actually usable- if you only have some scratch data it's not useful. So how do we use the information in a way to make valuable decisions. For instance, driving the car from one place to another of course you need map data but other data as well. So for me AI is about the knowledge representation but then also the approach how do we really use the information, so you have to define the tasks. For example, you have a tourist in a new city, what kind of museums do we want to recommend him- what kind of information or data do we need for this and match this person with the information that we have about the environment.

I: What do you think are potentials for AI in a human-centred perspective?

3#3: Well, first of all, I like what has been said around: it's not human vs. machines. It's about human with AI. If you're lost in a new city, what if you don't have AI or a map on your mobile phone? So we're already using AI in a daily basis. Honestly, we should do things without AI because there we learn and grow. But then on the other hand with all the tasks, AI can help us to have more time to concentrate on things, that we think are important for us, or making more fun, for example being more efficiently or being more creativity.

I: Do you have some examples which tasks we can use for?

3#3: I mean if you have more time you can do more activities. Instead, of filling in some stupid scratch that AI can do for us quite easily, we would have more time for example to meet for a longer cup of coffee and strengthen our relationships, being more creative, think big and about what we actually want to do, rather than what we are occupied with tasks, what no one in my opinion wants to do. Just think about how much time is spend on administrative or bureaucratic work. I would first get rid of all these bureaucratic and administrative tasks.

I: When you think about the future workplace- how can AI help there?

3#3: First of all, it can help creating team- Collaboration is one of the 4Cs- so how do we automatically create teams? I think that would be really fantastic if AI could help us. Also think about online teams: if a company is global, with the help of AI they can connect the teams. Because of new technologies, organization have to learn all the time, also leadership strategies have to be updated. We have to ask how can we use AI to help us to learn? For example, AI could recommend materials for learning.

I: Let us move to the FutureSkills section- Do you know the term FutureSkills and do you know what it means?

3#3: Yes, I'm really much into what do we need as 21st century skills and I think these are also FutureSkills. I'm checking and following what different organizations or researchers have found out about this topic. I have visited workshops at

[employer] and of course I have personal interest. If you think about Robots or AI you have to ask what kind of jobs will there be and then of course which kind of competencies do we need? If people have a lot of free time, they are going on YouTube or Social media and then go to sleep- so this is quite passive. So I'm interested in active tasks with the new competencies, with creativity, and two way communications or collaboration.

I: When you think about what are human abilities?

3#3: Well, first of all, one first ability is to be physical and mental so to be able to move around spaces in accessible and difficult terrain, and is it not amazing how people can climb mountains? That is one thing, that is really human. And the mental skills, combined with physical. If you have an image at the wall for example and if you want a robot to understand what is in the background or next to the image, it might be really hard for them, but for us humans we can just use our body and just move a bit, and see what's behind the image. But of course robots are getting better in these tasks as well.

I: So do you mean embodied cognition?

3#3: Yes, if you have seen Boston Dynamics- robots jumped from one house to another, opening doors- I mean I would like to play a tennis match against a robot.

I: Are there more abilities, that are uniquely human?

3#3: Emotions- to be able to feel something and to connect-that is really uniquely human and to show all ranges of emotions, like to love, hate, be happy, sad or angry. And to understand what makes us happy and to work on this continuously. If I know, that if I'm surrounded by people makes me happy, then let's meet more often with your friends. And I don't know if robots can do this in near future, to have a coffee with robots (already not possible with electricity).

I: More abilities?

3#3: Literacy as well, to read and understand something, to communicate. Robots are catching us, but can they really understand a scientific paper and apply this theory to practice? I would say no. As humans, we're making initiatives- having always new ideas, create new businesses and start-ups. Can robots adapt to new situations? Can they create a team? Can they be nice leaders and attract people to trust them and also trust their instincts or intuition? I don't think so.

I: When we now switch to non-human abilities. What do you think are non-human abilities?

3#3: Storing a huge amount of information, that is really inhuman. I mean perhaps we could store it- but honestly we forget some things. Let's put it this way: with machine learning it is easier to create new knowledge or new images. So I think robots are catching up simply, the storage and managing of big information, that's what robots can do better, because its inhuman.

I: What are skills needed at the future workplace?

3#3: I would say, to be able to handle insecurity, that someone is not telling you all the time what you should do. Creativity, to initiative new things, the ability to corporate and communicate and turning ideas into reality. This needs the ability to be curious about the world and also should be based on some values- it's not always the case that people have values.

I: Which values?

3#3: Perhaps they have values, but not beneficial for the society. So I would say there has to be a good balance between positive and critical thinking. But I mean real positivity and creativity as well- I think this comes when we have a lot more free time because of technology in the future. So we have to train positivity more. What are people now doing with their free time- most of them are on Netflix, but we could do something else, maybe something more valuable? We really need ways to stay active!

I: What would you do with your free time?

3#3: I already do- I do sports every single day, I bike to university, play tennis or go running. With more free time, I would drink a lot of espresso with people- create new things and discuss and brainstorming about them.

I: Do you think there are other skills we need?

3#3: I've already mentioned literacy. What can I actually do with all this information? How to combine and structure? We have to make this information more useful and then combine- combine this with AI and even get a better analysis. That's something we need.

I: If we look at the educational framework or companies- how do you think can we train or teach this kind of skills?

3#3: Instead of making it passive and people are just sitting, we need to arrange events, such as your interactive workshop in Amsterdam. So we have to think about what is the setting and which tools do we need. Top-down actions are not really helping the people to get these skills and to learn them. In my project, we have more grassroots activity and more asking communities- and that's really how you can learn creativity for instance.
The most important question is how do you learn these FutureSkills. Because if you only set up an online video, does it exactly help them to develop skills they really need? We have to have certain kind of settings on the blended learning courses. More active settings rather than passive settings.

I: Perfect. Do you have more things to add?

3#3: Of course I'm interested how we can combine your project with our projects here in [name of the company]. Maybe we can discuss this after your thesis deadline?

I: Yes, I think we can talk about a collaboration. Thanks for sharing your insights!

Interview 4

I: Wow, pretty interesting insights. In Germany, I'm also involved as a student speaker/expert. 3 years ago I've met the EMEA Education Leader and I've talked with her about her visions for the future of education and what [name of the company] is doing that everyone has access to have technology.

So maybe we can start right away with the Interview. The first question is not on my guideline but you've bopped it up, so how is technology affecting the human being? Maybe you can go a little bit deeper into that topic.

5#4: Yes, that's a pretty big question, and we could talk days about this obvious. There are lot of theories- I'm really in favour of the theory that does not put the technology as a certain independent actor. If you ask the question like this, you could think if the question is already implicit that technology is an independent actor who then affects humans right? But technology is born from what we are and how we look at society and how we develop the technology. But technology is something that is created by humans and there is no real independent thinking of technology yet. So what we call general AI, does not exist yet. In general, with AI, we see computers doing everything by themselves, so they can write their own code. To develop independently from humans, we don't have that yet. I think, we are lucky to not have it yet. So for me technology is something that is outside who we are. And in that sense or maybe at the same time, I do feel, that it requires a high degree of consciousness as for a human to realize what technology does. For instance, if we give a 3-year-old child a tablet with YouTube videos and on YouTube it is set that videos are played automatically after another video. This kids will stay there with their tablets for 2 hours and forget the outer world. In that sense technology makes children brainless, even adults in restaurant instead of talking they are looking on their phones. We will need a higher degree of consciousness for people to be able to resist on the urges that tech is offering. Sorry, it's a really broad answer to your question but as I already said I could talk for many days about this topic.

I: Yes, to be honest this question was not on my Interview Guideline but I was really interested in your point of view. But now we can go further with the Interview. You've already mentioned the topic about AI, how would you define AI?

5#4: There's a couple of definitions. I've just talked about the general AI definition, which basically says that the computer will think on its own independently on a range of topic, whereas it's also able to program and learn itself. In many perspectives, it will surpass the human capacity. But it really depends on your perspective- so it's really general AI. We also see a lot of specialized AI, technology that is really well in doing one thing, for instance image recognition or voice recognition. I know that McDonalds in the States for instance, they are using AI to recognize orders when you go through the McDrive- and there are more reliable than a human to listen to this orders. Another perspective is if AI is taking over jobs or take over human functions and there we talk instead of AI about Augmented Intelligence- so how can we use computers to sometimes be better than a human, where can we augment the human abilities. There's a famous example of the doctor who can look at cancer cells through a microscope or lab- often there are 80% right of the results, so they miss 20%. The AI is right in 90% of the case, but still not 100%. When AI is combined with human capabilities they are 100% right. And that's the future of AI, to combine human intelligence with artificial intelligence. And as a company we would like to see this, and personally as well.

I: Okay. My next question will be- what are potentials for AI in a human-centred perspective? You've already mentioned some of the aspects, but maybe you can go a little bit deeper into this kind of perspective.

5#4: I think, we're already using AI on a day to day basis, without even knowing about it. Any time you order something on Amazon it will suggest new products, and if you will click on these products, AI will learn & becoming better on making suggestions and if you don't click, it's the same procedure. If you go for example to 'Booking.com' and you see 'there are only 6 rooms left', etc., this system learns how effective the nudges are and I think in this sense AI will become a salestool. A good option would be if we can apply AI to be happier and healthier.
Another effect of AI will be that this technology will take over our activities- mainly the automating activities, and I think I've mentioned some of them in my talk earlier, that are repetitive activities, that can be easily automated. And then the questions would be what will happen to the humans? Will their jobs change? Can they stay home and get a basic income? These are really interesting discussions and these are much broader than technology discussions. How do we want to define wealth in our society? Should companies be able to keep their profits? Or should they reinvest this in higher salaries? There is momentum for governance to think about this and have a discussion with society. I don't know if you're familiar with Montana?

I: No, could you please explain it?

5#4: [anonymized] is our speech assistant. We use [anonymized] within the company with our internal data, where I can send [anonymized] an e-mail and I can ask to help me schedule a meeting with all of these people and she will actually schedule the whole meeting for me and contact these people and fix all of this. This is a big part of what the assistants are doing right now. So what will happen to the assistants? I think we have to make sure that when we bring kids to school today to not only train them to be great assistants of tomorrow, but also of the day after tomorrow. Their jobs will change; they probably have to know a lot about the newest technologies and how AI works

I: You've already talked about that Jobs are taken over and the workplaces are changing- could you give some more examples how jobs & the workplace will change through AI and technologies?

5#4: We did some piece of research on that, I'll share it with you. We did some kind of research in 2015 for preparations for the World Economic Forum. And 'Jobs of the Future' has been one of the main topics. And still every year, and I'm sure you read them as well, the WEF published reports in that topic. But one of these new jobs for instance is, that we think is quite important, is the ethics advocates- ethical technological advocates we call it. It's one of these jobs if companies apply AI and it has an impact on society, and technology and innovation have some sort of effect- what are the unattended side effects? How about ethics? Ethics is a core skill, that we should teach, and there will be jobs in ethics. Journalism, for instance, like a digital cultural commentator- how do we create this new kind of journalist and also what's happening in social media. There is also much room for more freelance jobs. Now when I see the next generations there will be more needs to continuously learn. It would be important to to be able to schedule one day where we only learn, develop our minds and stay relevant and up-to-date. Then maybe we want to do 2 days of giving back in society in the job, as a teacher for instance or, using AI for social responsibility projects. Here, technology will allow us to do so, because we don't have to be at the job the whole time to communicate and we as [company] describe it and WEF describes it as well.

I: I like the shift to AI and social responsibility or giving something back in general. Now we're coming to the section FutureSkills. To start do you know the term FutureSkills and if yes, what do you think does it mean?

5#4: If you look at the jobs of the future with the skills of today- maybe I should start there, the educational system as I just discussed is founded in the industrial society. We've already had a lot of changes in information or digital society where

we are today. And in that society, knowledge or information is available with your fingertip. In this society, it doesn't make sense to teach children facts anymore. I'm not saying you should teach them no facts- but maybe deemphasize facts and truth that's what we should do and this will be the skills for the future. It's more about how do we change students from being 'know-it-alls' to 'learn-it-alls' and these are phrases our CEO [Name] uses. But these are the essentials. Schools are assessed with official state exams for instance, in the believe to prove what people know. I think companies are more and more looking not for what people are knowing, but more how fast they are in learning and what they can actually do, can they be creative thinkers, can they take initiative, can they work in a changing environment (what might be true today might be not true tomorrow), can they work in teams and can they work with computers? These are skills that I think are important. Ethics is another important one, that is needed for the jobs of tomorrow- and to be honest, also for the jobs today already.

I: And what do you think are human abilities?

5#4: The answer today, might be different to tomorrow: Today, we say humans are creative and computers aren't. Actually, last year we had a computer that painted, which was quite creative with AI. I used to do all my power points by myself and thought I would be really creative but now I can just click the designer button and it creates the entire layout with super nice effects. And itself, computers are not creative because it's us humans that program the computer. But I think, what we think is creative-thinking today, can computers already do tomorrow. So the answer is going to be really hard and is telling about 2019- and when you read back this interview or your Thesis, in 10 years back time you'll think 'that was so 2019', how we looked at it. All of the 21st century skills are pretty much human skills, like problem-solving, communication, collaboration, teamwork, negotiations or empathy. And of course Ethics is really important.

I: Why do you think ethics is such an important future skill?

5#4: That sorts back to my first point about consciousness. I think the majority of us in our time, we are not highly conscious- there is even much a bigger number of people that didn't go to Cambridge- they are not as conscious as you or I are. And I think it's going to be really important to constantly make people aware of who they are, help them to get out of life what they want out of life and to not make them a sort of passengers in this train- I think there's a lot of beauty in humans and we can do a lot of beautiful things. But we need to be aware of them. Technology is a really big enabler but it's also a threat of this awareness in general.

I: When we think about the opposite- what are non-human abilities?

5#4: Oh, I have to think about it [thinks around 45Seconds about this topic]. If we go back to technology- there's nothing a computer can't do than humans cannot do, because we're programming them. So tech is a tool for us. It's like calling technology in human is the same as calling a hammer into human- it's both unnatural. For me a hammer is also part of the human- and this is tech. I don't know if I can exactly answer the question. But of course computers can work 24 hours, that humans cannot. They can do parallel thinking which humans cannot, because were cereal. They can do fast and quicker processing & analysing that humans cannot do. The same as a hammer can beat something really hard without even to get damaged. Our arms cannot do that. I would look at that from this perspective.

I: You've already said things about skills that will be important and if we now look into the future of work and the workplace. What do you think which skills do we need particularly for the workplace for the future and already right now?

5#4: I didn't research this personally- but I have to go with the research that we do and this is what I've already presented in Amsterdam. That shows that social and emotional skills predict success in life and in jobs and school careers already and for the future. Social and emotional skills are non-cognitive skills and you can find lists on that- how you collaborate with others, how empathic you are, intro-perspectives to your own behaviour, so it's all types of these skills.

I: And if we now are talking about education- how do you think education has to change to teach this kinds of skills? I know it's a big topic but maybe you can differentiate between the stakeholders involved in this process?

5#4: There's a couple of things, of course when we talk about the educational system- there are many stakeholders involved: we talk about politics, parents, and more stakeholders that's part of the how question and the other part is what should education change into, what do we want to see in the end? Both of these perspectives are really important, because we know that as a politician to do a fundamental change of the educational system it requires a lot of stakeholder management and of course for each countries its different. In democracies it works with different stakeholders, the schools, the teachers, the staff, the leaders (principals), the city, the boards of the school, the government, parents, teacher unions, publishers, a lot of more actors are involved- to do a change we need all of them involved- that's part one. I haven't seen a lot of these changes happening on a big scale yet. I think there are some theories about the skills that we need for human life and where these skills should be taught. For instance, as a person you will never be the centre of the universe all the time, so you will need to accept this that people not always have attention for you when you need it. That's a skill that every person should be taught. Normally in a family with 10 other brothers or sisters this is a skill you would have been taught in the family. Now this is a skill you are getting taught in school. Education has to adapt this kind of skills. Other skills that are taught in school be it math, spelling or stuff like that, you could teach at home, because there are a lot of apps, videos that can teach spelling for example. Some kids, want to learn this already when they are 3. I think we have to look at schools as positions- we used to see the school as an institution where we used to bring kids to learn, and if they come home they started to play. Now we have to look at all the parts where learning can take place, informal such as formal learning etc. and see how the school can create an environment where they can bring this together- schools can therefore offer more personalized teaching/education, what a student or kids needs. But this is a really big vision. I think there's not this one type of education that fits for all.

I: Everything is getting more digital - what will be the role of the human being in the future?

5#4: I only have hope there. My hope as a human because of all this technology and because of how the world is changing is that we will be better capable than ever to make our own dreams come true, fulfil ourselves and become who we want to be – that's my hope! Become more mindful, fulfil our destiny and find our purpose – and I hope, technology can allow us to do more of this purpose driven things: that we can spend as much time with the loved ones as we want, that we can change the world to a greener place etc. And then for everyone- not only for the rich and western countries.

I: Great ending for this interview. Thanks for sharing your visions & insights.

Interview 5

I: Which role do you think will play the human factor in the digital age?

1#5: So we talk about human factors and that are keen today. These are abilities to make decisions, to adapt to a new environment really quickly. So they will be a lot of industries, where the environment is changing quickly- so that's where we need the human factor. I've seen a YouTube video of the Nissan factory in the North of UK, their approach to the car plant is automated. But technology is going around the human and human is managing it. We don't have capability to only program machines going on their own.

I: What do you think in this kind of setting in the training environment- Has training changed or will it change in the future?

1#5: We are very traditional, when I'm going back as I was trained as an apprentice my training looked very basic, so I guess from that perspective in that environment I'm familiar with- has there been a lot of change? No not really. I think where you see the difference the demands to learn a lot more about different aspects of engineering: now you need to have electrical and mechanical & manufacturing understanding and you have to be able to understand stuff, so the variety of range you have to learn is far more than it was in my time. Of course, in my years we had chalkboards, now you have to be more interactive with computers and bring new elements of interests. Videos are making learning easier and you can draw on resources far away from black and white. The depth and richness of information is available and can be used to make the interface and the training more interested. But also it can be really distractive from the message- I think it has to be a balance between the two. What I also notice that young people are very quickly switched off and very quickly distracted. And loose interest. That's my perception. I think when you've look in the room with the students, after 5 minutes you have lost them- I think this is because we're distracted by technology. I don't think we've learned how to use it well or know how to teach it well. A good example is my neighbour- she's 9 or 10 years old, on the street she's having headphones on, watching at her phone and we have to deal with that kind of behaviour. So the question is how do you deal with that?

I: Do you have a plan how to deal with that?

1#5: I think it has to start a lot earlier. In here the big issue is not that we have the technology available in form of our smartphones. In classrooms smartphones, should be used as a form of information sources and not as a messaging tool. But children learn it so young, they automatically are used to this digital tools- and here we've understand the power of the devices that we have around- and if we don't start with that quite early we have a problem, because they are quite addictive. And I think there already is an addiction, so we've banned phones from the classrooms, but this goes against modern culture. Young people expect freedom, so we have to try to teach them how to use these devices efficiently- but the environment is so dangerous in regard of this huge amounts of information and data.

I: Yes, I think this is very important to see how we use these devices powerful. What do you think are human abilities? You've already mentioned decision making.

1#5: That's an interesting question- do they change? If you talk about human functions, I would say how do emotions affect the way we'll work? I've never thought about this- but will emotions in our industry have an impact and is the tech environment challenging our emotions? I guess for example team work and communication is also part of this. I think we'll never can replace our communication or emotional interactions with technology. We interact with facial expressions, voice

tones, and different communication styles. And I don't know if you can do replicate this electronical. I mean of course you can chat and write E-Mails- but that's not representing the real human communication. Maybe it depends on the environment. When you're sitting in a factory or workplace and producing a car maybe communication is not that important, but when you're at the hospital the interrelations and communications are getting more and more important than ever. Are there important human factors- yes I think they are, and can't think it's getting replicated so easy. And maybe that's the definition it's the one that's the one most difficult to replicate.

I: What do you think are non-human abilities?

1#5: I guess all the opposites that I've mentioned. Machines don't get bored and are stronger and faster. What's the worst thing that can happen if the machine is doing the same job? I think all these discussions is limited by technology. Let's play science fiction. If you have the robot in star track they were humanized. But in Blade Runner it was different. If tech could produce a human looking device, then actually the human strengths are getting more and more less relevant. So we have to ask what are the key factors for humans in the future when it comes down to technology?

I: How do you think will the workplace change, especially in an industrial setting?

1#5: If we talk about Terminator where the robots are taking over- I guess the question is do we ever believe that we have the capability to generate a technical solution that is as powerful in terms of processing the human brain? Because this is what makes us human unique. I think it's the processing speed of the human brain that's really important. Because if you're building a device that is that capable then doesn't it by itself starts to generate versions of itself because it learns how to do it. And isn't this the limited factor? We already know that we can build up factories without any people. There just needs someone who's pressing the button. So, we know it's possible but the scary thing is that we don't need the human at all anymore. I don't know whether we've cracked it already. But I think about the moving tasks- robots can walk but only unstable- but once you get to that, and you're talking about AI and self-learning devices- when we get to the step where robots can walk quite easily, there will take the next level of taking away jobs from the manufacturing. It's scary I think.

I: As you've already said, we already could have built up factories without humans, but we haven't yet.

1#5: The question is why we've chosen not to. Not sure if this questions is going now with your topic- but don't you think that there's a part of us which says that we have to have a role?

I: You mean the role of the humans?

1#5: Yes. It's one of the reasons that we create what we create today because it's important to us to have a role, to have an activity. So what would we do if we don't have any activities?

I: Yes, right- and when you look back regarding to work- work was about having status and earning money, this has also changed.

1#5: So why do we work? I think a lot of people still work because of status, money and to survive but I'm sure a lot of people are working because they like their work and get satisfaction. So maybe it appears to this emotional level again. And of course in this whole topic you have to take the educational system into responsibility.

And one of my big challenges here is to also re-train the staff that are another generation or trainers to get updated and train these new kinds of skills. Because they've never had to fundamentally taught how to be a good communicator, how to be creative, how to collaborate, how to be empathic etc.

I: Do you have a solution?

1#5: We have to train the trainers, because there's a skill gap. But this gap is caused by a generation gap and to the big changes as well. So it was 20 years from black/white TV to coloured TV and the other changes were coming much quicker. And they need to be educated of the impact of all these changes. In order to teach the next generations, we have to understand ourselves first. And I think the biggest problems is that teaching in this country has the wrong and old-fashioned skillset. Tutors out there do not understand the younger generation. Everything that applies to school also applies to the workplace.

I: Thanks for your insights and your time!

Interview 6

I: How do you define AI & AR?

3#6: What's being called AI today are software engineering related topics, like machine learning. So certain definitions can fit of AI, but are not matching every definition. Marvin Minsky the philosopher said something like this "if something is done by a human, you would call it intelligence, if by machines, then you call it machines activities". Humans have the intuition to see what's intelligent or not, and if a machine would to that, that's kind of intelligence.

I: Are there different levels of Intelligence?

3#6: Definitely. On the one hand psychologist, would make the distinction between emotional and mathematical intelligence or measurable like IQ tests, if its capturing something. And at the same time there are distinctions between narrow AI, the means-specific AI, where we have computer programs that are very good in, that's a kind of thing humans did, that's what we call intelligence. But that's not really transferable, because humans have more the ability to learn something in one domain and then transfer it to another one, and that is kind of general intelligence, like AGI, Artificial general intelligence, that's what programmers are aiming to build now, you give it a kind of skill and then you can move it in different areas and then within that people think that ability to transfer from different domains to creativity, so we have this kind of creative intelligence, the kind of tasks for creativity, when we have to figure out that kind of problem, and we're thinking outside of the box and coming up with kind of different solutions.

I: **How can AI help us in a human-centred perspective?**

3#6: We have to ask ourselves what are the things we are good in or not? We know humans are bad in some kind of things, so we developed techniques that help us to overcome our shortcomings and some of those are emotional heuristics, like quantitative or decision-making. If you target those, these are the ways machines could help us. Just as an example what humans are good in is distinguishing between quantities 3 and 5, 1 or 2, but once it gets to 300 or 500, for example you have to guess how many are in the room, you're getting in trouble. These differences of 200 are huge, instead of 1 or 2 versus computers can give you in real time the numbers- that could be really helpful for security at airport- there are a lot things where humans are bad at so computers can do it better.

I: Which tasks can AR & AI already fulfil?

3#6: About AR I don't know that much, how it can be used maybe for gaming in therapy in real life. AI does seem that there's a lot being used facilitating decision-making, in the legal domain some kind of decision-making assessments by algorithms, that's something that humans did, but that's now completely automated. There is a famous study how humans are doing research before lunch and after lunch- before they have eaten they were more likely to punish someone much more strongly than after eating with the same information – a computer is not going to do that.

I: Which tasks can only humans do?

3#6: Before this AI Revolution there was a famous book on this topic: "What Computers can't do" And some years later the tile was called "what computers still can't do" In any given context you have to make a decision what is common sense or not. Some of these things are relevant or irrelevant- in order to make decisions in a given timeframe there is something

we need to consider and with a computer you have to program that with the context- so these are impossible, that kind of commons-sense are the golden standards of human intelligence, that computers still trying to get at.

I: Which tasks can AI already fulfil in context of work?

3#6: Making risk assessments. But any case that is with data, and matching similar cases AI is really good at. Making immigrations decisions that shows the human element that is hard to code, in the case of deciding if someone should or should not get in refugee status that's a human element of decision, that's what we can't automate, augmenting the job instead of replacing it and not forcing them.

I: What is in general a human ability?

3#6: There are a lot of things we're doing quite well and that computers don't do. One thing that's coming into my mind is creativity- there are computers that making art- and some are saying oh look computers can make art as well, but all those systems are trained on a dataset and re-producing things from that dataset, it might be a variation or exactly the same. When you think about what humans do and it's hard to imagine that a computer can do the same, whereas humans have a much wider experience to draw on. So creativity for me is hard to imagine that it's getting automated.

I: Do you think something else is important?

3#6: It seems like in education back in the days, in Canada in the 90s, was a lot about memorization and that seems quite outdated because now we are in this post-information world, information is all around us, so you actually don't need to memorize things anymore. Given that change of environment a different skills-set is needed, being able to figure out what's good information or bad information. Because now there's information everywhere, but we also have to differentiate between fake news and misleading sources- so we need kids, that have a critical eye and trust. Besides that all kids should learn to code this is another skillset.

I: What can AI do better than humans?

3#6: Quantitative tasks, Computers are faster for more complex details. If you think about fast decisions humans have to make, we sometimes struggle on this, such as the phenomenon that you are more likely to buy things that your friends buy. We are kind of trend followers and not changing our behaviour- and the computers can help us with that decisions. Computers can help us to improve our differentiations of different things.

I: What are human abilities in the context of work?

3#6: Finding the kind of common sense, being creative and thinking outside of the box. Interpersonally skills: computers are not good in building relationships. Besides all that which are all mental tasks, the disembodiment algorithm, is not as good, in humans. Physical things that we're really good in and robots are not. Then of course human to human tasks (e.g. hairdressing, anything kind of physical). Of course there are the videos of Boston dynamics, but what you haven't seen is that they have filmed it a thousand times. Critical thinking, meaning not just doing what you're told. All those things play an important role in the jobs we're doing, hard to believe that's completely replaced by technology.

I: **What's the role of the human body?**

3#6: Forsby was much into different trends, someone as Descartes (modern philosopher) thought that body was completely dissociable from the mind, whereas today there's a big rejection of that. The body-mind thesis which describes that the mind can't be dissociable from the body in any meaningful way. When the body changes the mind changes as well. Long way saying, short: the body is really important to the mind. If you want to build a human AI it seems important at least they have a really human-mind body, that is able to speak about the kind of things we want. Witgenstein had the idea of aliens, that could speak, but the question was would we understand them? That's the same with machines.

I: What do you think will be the future of intelligence?

3#6: Computers will keep advancing and humans will change with them. It's not about the question if humans are replaced by machines it's more about how can we make the human situation better using these tools? And there are a lot things that can't be done by machines through actually merging body through machines, or brain-computer interface or whether it's just creating the machines or apps too improve us or someone to help us improving.

I: Ok. Thanks for your insights and your time!

3#6: Always a pleasure and feel free to reach out again if you have any questions.

Interview 7

I: I've read through your article from the Stifterverband where you also wrote that AI is becoming more and more important for companies **- on the one hand I would be interested in how AI can already make work easier and on the other hand what are potentials for AI in a human-centred perspective?**

1#7: First and foremost, it's about support, not, as the press is saying, the taking over of jobs. It's much more about where the human ability is really required and to keep them away from stupid activities or machines can do these kinds of activities. Let me say some internal examples: We often have the circumstance of relatively big datasets from different sources. Here the data have to be assigned to a certain company, because we have different industrial customers, and there are 10,000 entries in Excel lists and those in turn have to be combined with data from other sources. These companies do not have a unique key that is not unique by name, e.g. companies with international subsidiaries. Our employees sometimes spend 3-4 weeks working on it and nobody really wants to do that. So we have taught such processes to a machine because AI can help to combine the data better and is a time-saving alternative. The machines can take over 90-95% of the processes and the human can look over the remaining 10% again. 3-4 weeks are minimized to a few days of effort. And the same works in the customer's direction and then also has competitive advantages for us. Nobody likes to fill in applications and forms when it comes to life or health insurance, sometimes there are over 100 questions and if you do this digitally now, you save more time for both sides.

I: Do you know the term FutureSkills and do you know what it means?

1#7: Yes, I'm familiar with this kind of expression. I think FutureSkills are the Skills of the 21st century, both digital skills as well as human skills.

I: So what do you think are FutureSkills in the context of the workforce?

1#7: To think about the skills of people, that's almost a philosophical question. 2 or 3 years ago I would have said the people who are specially trained and highly qualified, don't have to train this kind of skills. Of course, the skills of the future are a mix of digital and human skills. In the low-skilled jobs sectors there will also involve new jobs that we don't know yet in this form. But it is precisely that such people can also benefit from digitisation and AI. If one thinks that also robots and humans can work together and can also lead to the fact that humans with a small qualification can execute more high-quality jobs than today, since they are supported by the robotic and that is actually a good conception. Because one can then assume that digitization creates more jobs than it replaces. In the first industrial revolution, this was also the case: there was also concern that all the workers would have to be made redundant, but they worked later in the factories. And I think we will see these trends in our time as well. But and we must not forget this, there will be new jobs, which is why education and training are so important. For example, in autonomous driving, the profession of taxi driver will become extinct, just as the profession of coachman was extinct. For example, driving a car in 10-15 years' time will no longer be a skill needed as an employee. But the FutureSkills are about human skills and thinking creatively, critical and show emotions.

I: Are there trainings sessions in a company like [company name] for FutureSkills?

1#7: Yes, we have 3 different steps in that kind of setting. But the focus is more on training digital skills: We have Basic Training, Advanced Training and Expert Training. In Basic training, there is an introduction in coding and how to use digital

skills in your daily life. In Advanced training, there are employees that can already code and where we individual help them to get better in that. In the expert training sessions, only people with an academic or professional background get the newest insights in this kind of field. And there's a fourth level, that we haven't explicitly trained yet, and that's the further training for data engineers. There are special courses where they can specifically further their knowledge in their field.

I: I'd like to go back over that again, especially in the third phase, is this training session only about data skills or soft skills as well?

1#7: This is only designed very methodically and technically for data analytics. The soft skills, such as communication training, are not part of the program area, they are found in the competence area of the HR department.

I: What are uniquely human abilities?

1#7: What is usually still missing from machines is the linking of emotions with the environment. It is already possible that robots show emotions, but this only works in a previously learned context. In humans, of course, many things are innate through evolution, where machines have a hard time. Machines can't combine emotions and environment. If I employ a robot in a Japanese nursing home, then it may be very different to understand the cultural context for example in Germany, and a robot would not be possible if I flew him to Germany to understand this cultural difference at first go. But when I bring a Japanese nurse for the elderly to Germany, he would learn so much within a few hours or days that he can find his way around. This means that human intelligence and innate abilities make humans much more adaptable than machines. This means that all areas of interpersonal relationships are still ahead of humans for quite some time, at least in breadth. Which doesn't mean that it can be different in 30-50 years. I hope that there will be interaction between machines and people. Indeed, there is the 'human-brain-project', where the human brain gets simulated. This research group has already managed to simulate the brain of a rat and these are relatively intelligent animals. Here you have already arrived at about 10% of the human brain power. If you continue this at some point, then it might also be possible to simulate human abilities that are innate. I think, this will still take 20-30 years, but then it is still reserved for researchers.

I: Never heard of the human-brain project, so thanks for mentioning it. Because of the time, one last question: What are non-human abilities?

1#7: Well, if we look at AI, that's not sharply defined and even intelligence is not sharply defined. My wife is a psychologist and she said a meaningful but not helpful answer to the question what is intelligence: 'The intelligence quotient' and this is so similar to AI. I would define it that way: Where a machine is able to develop cognitive abilities that have been previously reserved for humans. There the transition is already fluid. AI will play a role wherever we are dealing with unstructured data, text, image and speech recognition, video analysis- here, AI will play a major role because there are also many application scenarios. For face recognition, etc. machines are better, e.g. for Security Control at airports it is faster and safer than before. The topic of autonomous driving will change not only individual driving, but also logistics.

I: Thank you so much for your time and sharing your insights!

Interview 8

I: What is the human factor in the digital age?

4#8: Digitisation is strongly about cultural change and is part of innovation. I have specialised myself in how to put people at the centre, what skills they need and what skills they may not need. I take much more pleasure in teaching people a future-oriented thinking and equipping them with the skills they need, giving them the courage to embark on their journey and to help them to find out which skills they need to work on. This is also the motto of my company and the success factor "human being" and before I answer the question you always have to have in the background that digitalization does a lot with a company on the one hand in culture and on the other hand in people's consciousness. Most people believe that digitisation is the last wave of existence.
Digitization means that customers have infinite transparency and opportunities for comparison and a company is only relevant if they have specific & innovative answers and continuously enter the process of change. This means that I need people who are highly creative and can get involved in something, who can react to change and deal with the future, because no machines can do that. That's really our competitive advantage and that's why the success factor in digitalization is people.

I: Do you know the term FutureSkills- if yes, do you know what it means?

4#8: Yes, I know the term- when I think about competencies back the days, FutureSkills used to be defined as specialist expertise. When we look at our education systems today, we always learn only specialist knowledge, but FutureSkills are above all competencies, not just specialist knowledge. These are competencies such as methods knowledge, personal skills such as curiosity, critical thinking, but also bringing in new ideas and developing new products, but also allowing me to learn from failures. If I have to describe it with a hyperbole, then I would describe it with the competencies you need when you are in an environment of constant change and that has little to do with specialist knowledge, but it is much more about human skills. Methodological competence is not enough anymore, when you can’t collaborate with other people. You need both a technological understanding and human skills, because it’s more important to implementing ideas together.

I: You’ve already mentioned some of the human abilities, like creativity or curiosity- can you say more abilities, that are uniquely human?

4#8: Well, as I just said, creativity and empathy are one of the most important competences. It is very important to be able to empathize with others. Without this quality, I am actually not in a position to create services. These are actually my two core competencies mixed with curiosity. The other is that I am able to work collaboratively and interconnected. Today in the working world, I have to create something new and if I don't know yet what the output is, I have to communicate and collaborate more and think much more interconnected than before, therefore you need creativity and empathy. That's why communication and collaboration are two important future skills.

I: You’ve already mentioned core competences like creativity or empathy- how can you train these skills in your company?

4#8: The situation is that today we have employees in the companies who have been working there for more than 10 years and do not have a view of the bigger picture. Through our training sessions, they have to put their skills into practice and integrate them into their daily work, and see how they can improve their processes or create a customer experience. The most important thing is the opportunity-oriented training. With our tool "Leadership-Challenge" we try to connect employees from different departments and task areas and then we ask them what competences they need and how they can implement them. Then they have to solve a specific problem within 3 days and we show them how to create a prototype within 3 days. But they don't realize that they are learning competences like critical thinking, creativity or problem-solving, because they are already applying them. Design thinking helps to change the processes in a different order and lead to new and original solutions. We show them how to make complex problems un-complex again.

I: The last question: what are non-human abilities?

4#8: It is much easier when I leave administrative or physically strenuous work to the machine. Many people go to work, not because they enjoy what they do, but to earn money. And of course, this is important, but fulfilling work is much more important and machines can help us. In addition, machines can work 24/7 and are also more efficient in certain areas.

I: Thank you so much for your time and sharing your insights in these topics! I really enjoyed our conversation.

Interview 9

I: As you've already said you're doing research in Gig Economy- could you please define the Gig Economy?

3#9: Gig Economy is defined 'as people that follow to sell their labour through a platform'. And the platform is the central actor as it gives access to match freelancers and customers and structures the relationship, but also ultimate some functions. Airbnb would not count as Gig Economy but Uber or Deliveroo are.

I: What part will the human factor play in this kind of gig Economy structure?

3#9: I think the platforms, that I'm looking at, enable people to work remotely and connect them with clients all around the world, which means that workers are competing with other people worldwide. When you think about digital modules or tools, e.g. People in India can do this work as well, because it's like the same kind of costs but customers are getting in contact with much lower wages. What this means for humans and their skills, people talk a lot about how they have to find a niche. You have to be dynamic and unique. You have to find a niche before this gets taken over of other workers. It seems like that university education is really important, but not so much having a degree in XYZ, more having the ability to self-learn and to learn new tools. The ability to organize your self-learning is really crucial. So being curious and open to learn new things are important skills. The other element the skills which are less, where there is not that much competition, is also having cultural competency. Things like Digital Marketing or Marketing is hard for Indian workers to do marketing for an UK firm, because they probably don't know the UK culture. Customer or Virtual Assistants could be outsourced globally, whereas cultural understanding is a competitive advantage. The two main elements are having cultural skills and also an ability to learn new skills and being dynamic. This also refers to automation. The things that are really hard to automate are cultural understanding. I mean how do you for example teach a machine how to market a product for someone in Germany?- That's hard to learn.

I: You've now talked a little bit about Gig Economy, but how do you think in general will the future of work look like?

3#9: Probably what will happen, that the Gig Economy is more like an experiment, because I think not everyone will work in the Gig Economy. Its more for industries that always had contiguous workers, like freelancers or self-employed workers. You'll have more this kind of automation of decision-making of manager functions, using platforms and algorithms in traditional workplaces, that will then impact the discipline.
Rather than the jobs being replaced, new jobs will be created at the same time, but it's hard to predict which ones that will be. And in this new jobs settings there will be of course elements of automation and these will lead to more work intensification.

I: You've already mentioned cultural understanding and the ability to learn- are there more abilities that only human can do?

3#9: Yeah, I mean, this isn't really related to my research but the obvious things would be more caring abilities, social communication and interrelationships. A good example is hairdressing: you could automate hairdressing, but particularly in smaller communities, they are going to the hairdresser because of the communication. The same with care work: In Japan they are developing robots for care work: but my grandma does she wants to talk to a robot? I think not. Those kind of interactive and caring work, that are kind of skills which are hard for robots to replace. But there are also ones which

should be traditionally devalued in our society, because they are seeing this is kind of women's work and paid less. So we also have to revalue work. Also what's important for the future is having flexibility and making this flexibility real. Meaning to get people the flexibility when and where they want to work.

I: What are non-human abilities?

3#9: There are 2 things: robots and AI. Robots can do repetitive tasks, tasks that have to be done on a higher speed. Then we also have AI, which is basically just an algorithm and doing predictions and that could be useful for quick & more concrete predictions.

I: Thank you so much for sharing your knowledge. Now I know a little bit more about Gig Economy.

Interview 10

I: Do you know the term FutureSkills- if yes do you know what it means?

3#10: Yes, since I have a background in psychology and work strongly empirically I know the term FutureSkills. But I would always criticize the concept that it comes predominantly from theory and is not empirically founded. But qualitative research is already very far-reaching.
Where humans can differentiate themselves from artificial intelligence is the crucial question and there are already many different opinions how to do this.
Skills such as creativity or critical thinking are seen as characteristics of human beings, but this is not 100% the case anymore. If you look at creativity in the field of AI, then it's often not the same as what we understand by human creativity, so we have to differentiate even more.

I: What are uniquely human abilities?

3#10: There I am of course already very primed now. Of course, a lot is talked about it and what I say now is my personal opinion. I find there are the two qualities, which are still incumbent on humans: it's creating something new and being empathic and to know how to deal with other humans. We are very, very, very good at it because of our human wealth of experience. The interpersonal and neuronal spectrum that we possess is still far ahead of the machine. And I find these two characteristics are working very well in combination. In the area of innovation, it's not just about this development, but also about looking at what the counterpart needs, how I can reach customers. Therefore, you have to look very closely into the human being, and of course that works quite well in Interplay. I come from the field of psychology and there's the topic of empathy, which means being able to fill in, being socially competent, chatbots can't do that very well yet - there's also research on the therapeutic field, that's where robots still reaching their limits and we can simply draw on our wealth of experience.

I: Can we learn empathy?

3#10: I have the opinion and as I come very strongly from the competence-oriented approach, that almost everything can be learned. Of course, we all have our genetic predestination, but a great deal can be learned and developed with the right methods and tools. In addition to empathy, there is also a lot of research that develops naturally when you have your first child, for example, because you have to deal with a small wonder. And that's when research found out that mothers continue to learn in their empathy.
Then there are framework conditions that you can apply: you can create creative places and spaces. Techniques and methods are therefore particularly important for people who don't have such a space for creativity. Through the creative structures, we get better into the process and can therefore also develop competencies.

I: Alright, that's pretty interesting. When we now switch from human to non-human abilities- what do you think are non-human abilities?

3#10: Well I think what's needed more and more is that we have to link a lot: we get a lot of information every day and we have to filter it, retrieve it at the right moment when it's needed - the machine can do that pretty well. And I can imagine that we as humans can also become better there, because it is new terrain for us. Therefore, it requires us to learn

something new and different. At the moment, it is singular learning without transfer possibilities in the schools, that must change to more linked and interdisciplinary learning.

I: Is it possible to transfer emotions or creativity to machines?

3#10: Yes, there are already examples that it can work, but not so well yet, because the machines lack the wealth of experience. The machine has to learn with every new experience, and there is not yet an infinite amount of experience, as we humans have. In an interrelation situation, there are so many things to read, like individual elements, facial expressions and gestures, as well as body language or maybe intercultural differences and language barriers. There are so many small elements that we need to describe in a social situation and that makes us just very human - I think machines can learn that to a certain extent, but they are not so far yet.

I: Regarding the future workplace, what are the skills we need there?

3#10: We have to ask ‘what happens to routine activities’? and ‘what happens to other activities, such as having overview control’? Then there are interpersonal functions such as leadership or certain parts like customer relations or communication. All of these areas have something to do with people. When it comes to rethinking things, developing them further and setting things on a larger scale, I find that these are the tasks where people can develop further, that's what people should specialize in because routine activities can be taken over by machines.
To conclude, all in all we need this kind of soft skills, that characterize us humans and have to specialize in and train them.

I: Thanks for your time and sharing your insights!

2#11: HR is only about human resources internally but also HR has to look outside. Knowing yourself, networking cognitive skills and have a plasticity in your personality and identity, re-invent yourself and create a continuity if you're going from one career to another, how strong is your continuing line and how strong is your identity? Some people cannot imagine their future itself, Have to find a balance of presence and future-related thinking

I: Do you know the term FutureSkills- if yes, do you know what it means?

2#11: Yes, I'm familiar- it's quite funny because it's a popular word in consultancy. If people use it there's sometimes a lot of bullshit in there- there's this question that Jeff Bezos is asked: 'People keep asking what will be different in 10 or 20 years?' and Bezos said, 'I'm interested what will be the same in 10 years?' And I like his way of looking at it. Some of the skills that are already important today, will be even more important tomorrow. That includes skills to re-invent yourself, empathy towards other people, to always learn every day, even if you're 60years old, and that's not just because of tech, tech will play an important element. A lot of jobs will be transformed, some will disappear, some new will be created. It's also about demographic evolution, e.g. in China this will be a big problem, because everyone gets older and older. If you combine there will be a complete necessity to keep on learning and the problem is that we've been raised with institutions that are built with the 40s ages with 3 faces: face 1 education, face 2 work and face 3 retirement. But now and in the future, there will be a multi-face life. More and more young people that want to work before studying, or doing a gap year, it's becoming more flexible. All that things that once have been so well categorized, are getting now more flexible and unique combinations of choices made by humans, emphasized by technology. Tech is not the only thing that's causing it, but its amplifying it and is creating more options.

I: You've already mentioned some FutureSkills- what do you think are human abilities?

2#11: Well, AI is overrated a lot. In France there was a new book from Cassini, which gives a sceptical view of the narratives of Robots. The Threat of AI and Automation is used that people are forced to accept jobs, that they would never do. We have this growing gap between stagnating wages and stronger inequality, and now every category is filled up with that threat. There have never been more jobs in the world than ever today. And the economies are doing well with low unemployment everywhere.

I: What are human abilities in the digital age?

2#11: I've read a lot from scientists about this topic that are saying that a lot of things we believe are truly human can be emulated by machines and I find this interesting. What is creativity? What is intelligence? When you have machines becoming more intelligent not because they think like human but because they are applying huge and complex forces to be creative. You end up with a definition of creativity that you have to redefine. The same goes for empathy and is obviously a human ability. But what matters when you speak about empathy? What matters is the effect that it produces on others. And because we are inherently flawed and inherently human we are sometimes awkward, not very nice, we have conflicting views and sometimes we don't know how to handle different situations. But if you imagine to use Big Data to find out what the best approach is, the best behaviour or facial expression e.g. when you talk with a 'non-morning' person, then you

have a good emulation of empathy. And you can actually have a better impact. It still is very theoretical, but you can think at applications in medicine for example.
But I think the human touch is the ultimately unique human ability. And human touch is about creating this interpersonal relationship, both physical and mentally. The human touch, especially in healing, when we go into history, talking about witches etc., the human touch has so much positive effect all on the human body, and not just on this. There is a huge crisis of human touch. A lot of people are not touched anymore. Many young people are suffering from loneliness and older people as well. The way we approach the sex market is different than it used to be. I believe there is something absolutely vital in the human touch. We are a bunch of monkeys; all we need is what monkeys have. And also, according to the future of work and it doesn't sound glamorous, but the medical sphere, nurses and doctors we need more of these real people jobs. Domestic workers of all kinds, that bring the human touch and we also need creativity. It's just a question of interpersonal relationships.. And this is what everyone needs! A lot of these jobs where you need human touch have been undervalued. But those jobs can be creative and fulfilling. There's not better purpose than to help each other and provide human touch and makes people happy. When you think about these workers, they don't suffer from having a purpose in their job, they suffer because of lack of consideration, like money, no flexibility, but definitely not the lack of purpose.

I: I totally agree with the human touch- We are more connected than ever, but also lonelier than the generations before. We are all social persons so we need humans around us.

2#11: Yes, you're right- and also the depressions level is unfortunately very high. Are you familiar with Adam Gazzaley. He wrote about the crisis of cognition?

I: No.

2#11: That's also related to tech. He said tech changes have occurred so fast, they've changed every aspect of cognition, the constant simulation, the constant flow of information that never stops. Our cognition hasn't evolved as fast as the environment. That according to Gazzaley is influencing the mental illness issue.

I: When we talk about humans, what do you think are non-human abilities?

R: The competition force. But even also creative intelligence is coming up with mathematical solutions. A lot of things, we've been good with, AI can addict to that. I don't care about intelligence, but much more about emotions. But I think machines are more intelligent. I'm not sure if creativity is a purely human thing- but of course it's all about definitions, what is art, what is creativity?

I: Then let us talk about future of work. What do you think will future of work look like?

2#11: Well again, we are talking about something, that has been structured so well the last decades. When you talk back the day's, work was about having some bundles. The deal of work was having bundle of benefits, meaning having a good salary, status, enrichment, health care, social benefits, pension, sense of identity, political possibilities, possibility to send your children to college etc. Bundles with very good bundles. And you see where I'm getting at: That bundle is already fast disappearing, the pension system won't be longer sustainable anymore; no company is offering stability in job guarantee, there is no job for life; salaries have stagnated; unions have disappeared etc; then you have stagnation of real estate prices. You have the equation that is challenged. If you don't have the bundle of benefits- why would you do the job?

Basically, what will happen people are creating new bundles: volunteering, family, combining several jobs, making purpose, and creating meaningful impact about what I'm doing. Parallel there are all these questions about machines, are we human robots already?
So the future of work for me is, that some people are creating new bundles that work for them, with a certain number of difficulties and challenges. Some of the challenges of the 21st century are about housing (how do you pay for your rent?), geographic inequality and political instabilities.

I: What role does the human factor play in the future?

2#11: I would like to go back to the human touch and having interpersonal relationships. The real value is in human being. It's about the equation: value vs. price. The capitalist society is only concentrating on prices, we're loosing the value. But keep in mind, the things that are the most valuable have a very low price. And that's probably what is shifting- the younger generation are challenging the capitalists so much.

I: Perfect, thanks for your time and your insights.

Interview 12

I: Do you know the term FutureSkills- if yes, do you know what it means?

2#12: Basically, these are human abilities that are becoming more and more important in the digital age. It is important as a human being to further develop and build up these abilities, such as communication, i.e. to listen well. Empathy, that I am also welcome with the interlocutor, that I recognize the potential in someone else is another important skill. A machine is not able to do this - only a person with emotions can do this.
The jobs that have a high human approach will belong to the future. It is important that everyone develops and qualifies in their own learning processes.
In short, humans need humans.

I: You've talked about further qualifications- how can you for example learn Creativity? Are there any examples?

2#12: Everything that can be standardized should be standardized so that someone has time for further education. The factor time is one of the most important factors in the future for HR. Here, framework conditions must be created, such as giving trust or responsibility to others, to develop the maximum potential and develop curiosity, meaning the thirst of knowledge and exposure to new and complex situations. The best companies have the best employees because these employees have their own intrinsic motivation to develop them further.

I: You've already named some skills, such as Communication or Empathy- what are uniquely human abilities?

2#12: Creativity is a very important factor. I can only think as a person around the corner, an algorithm can't. Because the algorithm is programmed.
The second thing that occurs to me is that the human being is empathic - not compassionate. The third is self-motivation: if the employee is intrinsically motivated by himself, he brings added value for the company. There is also self-determination and self-responsibility. This means to take over self-determined tasks, not only in the professional but also in the social area. Also the social aspect is strongly pronounced by the honorary office.

I: What are non-human abilities?

2#12: In speed, the robot is much better than the human and more precise. In pharmacy, medicine and law firms, there are already examples where algorithms enable faster search processes. In law firms, where legal texts are searched for, people need much longer and algorithms only a few seconds. In the future, standardized processes will be replaced more and more by algorithms. In addition, more endurance, people have only a limited energy level and need rest. And even acting without emotions is sometimes helpful and more efficient. Robots have no environment, only their program and cannot be distracted. In addition, humans are also strongly dependent on the daily form and can be influenced.

I: What skills in specific do you think are important for the future workforce?

2#12: To be curious. Improve yourself, be open-minded all the time, evolve and be up-to-date. The ability to work in a team is very important, being part of the whole, to take responsibility and to contribute to the project and having a meaningful work. Since working life has become so complex, much better results are achieved in the team. And of course, it's important to developing new and innovative ideas and to think critical.

I: What do you think future of work will look like?

2#12: New Work needs more and more flexibility. I can plan my day, but the more flexible I am, the more secure my job will be. Example: I have to do a workshop and the leader of the workshop is ill. There it is important, to think about a successful solution and try to come up with a new concept. And of course, sustainable networks help here. As already mentioned, the topic of time is important and of course to have a well-assembled, interdisciplinary team. And here the company has to make sure that it only employs the right people.

I: Going to the role of HR & future workplace- are there any trends?

2#12: The people have good potential, but only 1/3 wants to put themselves in a good position and the others are only in their comfort zone and do not want to enter new 'land' and be curious. Those who belong to the top 1/3 will find a balance and here again the factor time plays a role, because they will not waste any time in their working life and will try to stay passionate about their work. The work to rule is a million-dollar loss for companies, as these people are administrators instead of designers.
The other trend lies in the different generations. Although it is said that generation Y or Z are different from the baby boomers, I think they have other demands, but are still very willing to perform if you let them shape and also include and promote this self-determination and meet at eye level.
Furthermore, the average frequency of a career change used to be 6-7 years, now it's an average of 4 years that you change jobs internally or externally. This shows that it is okay to try out new tasks.
I think that a computer or algorithms can never replace a manager, because leaders also have a certain role model function and the leader often manages to make the impossible possible.
Corporate culture also plays an important role. A good atmosphere has to be a prerequisite and that you are valued and respected, because the employees feel comfortable, and then there is trust and when there is trust, the results are also better. It is comparable to a greenhouse, only where the right temperature is, the plants grow.
Recently, there was a study that also other components are important and sometimes more important than salary: such as intercultural activities, involving the family in the company, a good company health system, company kindergartens, or helping to shape the workplace and meaningful work. Above all, equal pay between men and women is still very important to me and should be priority number 1 in the companies.

I: What are jobs of the future?

2#12: Consulting professions that build trust to clients or patients will play a much greater role in the future. I am not talking about tasks like evaluating facts, but that you are a lifelong consultant in the fields of medicine, finance, lifestyle or fitness.
Leadership can't be replaced by technology - that someone has the courage to take responsibility, brings a team together and gets excited about something are future tasks.
And, of course, professions in IT, digitization and research will become more and more important. And of course, very important, nursing professions will be irreplaceable.
Everything thrives on creativity, social interaction and the courage to tackle things new, then you are usually on the right track.

The human factor is becoming more and more decisive when it comes to interaction. In the future, the collective will be decisive, sharing knowledge and only together we can move the impossible. For this we need to have the courage to fail, but also to get up again and discover new things.

I: Thanks for your time and sharing your insights!

Interview 13

I: What are uniquely human-abilities?

3#13: I think you have to differentiate: on the one hand, it's a very philosophical question what distinguishes a human being or what does not distinguish a human being. This can be answered differently from a scientific point of view. If I look at the philosophical side, I would say the free will, for example, is a human capacity but scientifically not undisputed, what we know from cognitive research in recent years. So I think this is a philosophical question. And on the other hand, is when you consider 'ability' more as a current ability. It is then this demarcation: "What can we as humans do better than the machines might be able to do at the moment? I think you also have to differentiate that from the terminology. And in my perception what distinguishes us so far or where we have advantages over the machine are areas such as creativity: finding solutions that haven't been thought of before. Even when we look at the Go algorithm, we notice that we have to ask ourselves how long this will last. Furthermore: Making sense and giving sense: What makes me happy. Empathy and social interaction are also very important.
This is something where I think we still have great advantages over the machine - I think at first glance these are the most central aspects.

I: If you say "still" big advantages- can you frame this in a time context? How long will creativity or being empathic being typically human? Do you have a concrete idea?

3#13: I don't have something concrete now, but I always see two dimensions. One is what is technically possible. And what arrives on the mass market? These are different points. And then there's the question of whether we're for example really talking about a capacity for empathy or about a simulation of empathy. A system can make me believe that it is empathic or is it real empathy? For example, Google has now developed an algorithm to simulate conversations: there was this keynote where a table reservation was simulated in a restaurant. And in the end the guests had to decide which party was the computer and which party was the real person. This was difficult to distinguish, but the point is to simulate this real-time. Google used certain linguistic tricks to do this. I think you have to keep that apart.

I: What are non-human abilities?

3#13: Well, I wouldn't say "non" again. I would define it is as where the algorithm is better.
That's, of course, everything about the speed of data processing from memory and behaviour to running routine processes at high speed. In this respect, standard processes of heavy physical work can be facilitated by technical support. I would say that these are typical fields of application and then of course we see that this is slowly becoming overlapping. We already have algorithms that can be used for sports reporting where data gets more and more important. There is a study that once asked AI researchers what they believe when which abilities could get transferable. Writing a novel or composing a song for example, which is a middle time perspective, came out.
The much more important question is what is technically possible and perhaps also economically possible. But the other is what is socially accepted. The best example of what is technically possible is Google Glasses, which failed. And we can see this in all technical innovations such as the Chinese social credit system, which is accepted in some societies and can also assert itself as an innovation, whereas it is very questionable at the moment here in the Western society.

I: Alright- we'll talking later as well about challenges for society. But what would you think which skills are already important and will be in future for the future workplace?

3#13: So right from the start: creativity. Creativity not in the German sense of painting beautiful pictures, but developing new possible solutions, recognising opportunities, seeing them and acting. When it comes to designing work processes, we notice that the need for meaning is growing all the time. Then communication and cooperation across disciplines and cultural boundaries. Here we also see that we need to better structure work processes in the context of interdisciplinary teams and problem solving. This means that I have to be able to communicate with other disciplines and the same across cultural borders. And what is increasing is media literacy in the sense of media production and receptivity. It is not only about recognizing fake news, but I also have to be able to produce media content in order to participate in certain networks. What is certainly gaining in importance is a basic data literacy, i.e. having an understanding of how data-driven processes work. This means that I don't necessarily have to be able to write an algorithm by myself, but I have to be able to assess my awareness and why I get a different result than someone else in Google search and what that means. Another exciting field and discussion is bias algorithm. Here it is essential to develop an understanding, to assess algorithm decisions correctly: just because the algorithm says that, it doesn't have to be fair or objective now. It is often a failure when the computer says that it is objective but that it of course starts from certain variables from training materials and someone has written these algorithms. Many people are not aware of that.

This basis is also important to understand on what assumptions our digital economy and society is actually based on and what effects this has. And I think we have to change individual competences to the abilities of lifelong learning: so not only to think now I'm at university and that's it, but to be able to set goals and to design and realize processes again and again. What will certainly also increase in importance are personal competencies, such as cognitive load management, for example. We are already noticing that we overtax ourselves with information. In my view, this challenge will increase. And I believe what will be a central challenge is to be able to individually process the faster changes in society as a whole in terms of economic and media. There will always be new adaptation processes that are necessary, which demand a lot from me. To be able to design and trade these processes will be quite central.

I: Which role will AI and technologies play? And how can they support us?

3#13: First of all, I have to say that I'm not an engineer. I think the basic question behind it is how do we understand this whole challenge? Is it about the robot or algorithm threatening us? Is it taking away our jobs or is it going into a value-added debate? I think these are very exciting questions because it is solved very differently. When I look at the Japanese region, where there are for example support robots, one automatically conducts this support debate due to a lack of manpower. I gave lectures in a clinical environment here in Germany where I brought all these examples with me that all on the one hand moan about too much work and on the other hand still perceive the technical innovations as a threat. That is a fundamental question. And then, of course, there will be systems that can support us everywhere where relatively promptly collected data is available digitally and where gravitational processes are involved, which can then be derived relatively easily.

I think the exciting thing is that we cannot make this clear at different levels of training. The best example for me is always the translator. This is a highly specialised job with a high level of education that can, however, be replaced relatively quickly by computers. Repetitive activities, where data is already available in digital form can be taken over for us. Further, for

especially physically demanding activities, support can be needed. VW has already started to experiment with exoskeletons in car production to make work easier. And here it's all about the interaction between man and machine.

I: What can you say about the low-skilled jobs discussion?

3#13: Translator is the best example he is not a low-slowed worker: Simultaneous translation is a highly qualified university degree. So here we don't even have this example of a low-skilled worker. The joke of the debate is that it's not about replacing only the people from low wage segments but that we have that across all skill levels. I believe that this is not only an individual question, but also a question for society as a whole as to how we deal with it. I believe we have to start very early in the education system on how to implement this desire for learning and this continuous learning. And that does not just concern pupils or students, it concerns us as well. I think we have to live this up to a certain point and when we talk about establishing a lifelong learning culture in the company, it is also about establishing a lifelong learning culture in society. Of course, we also need structures in which I can also realize lifelong learning - i.e. educational offerings that are broader in scope. I have now seen a study in the German context which shows that 80 percent of education expenditure is spent both in companies and publicly up to the age of 25. This will, of course, have an impact on the structure of the provision and also on the question of exemptions. The organisation of continuing education will also have to change. And the second, of course, is that we also have to think about how we finance and organize our community life. Do we maybe have a group of dependents who need to be funded or qualified differently? But do we manage to give a meaning to life, even if we say we have nothing to work because of the basic income? Harari addressed this in his book 21st lectures for the 21st century as well, but on some theses, I don't agree. It's an exciting question of what can have repercussions to a society. We have to think about social concepts and previous consensus. The same goes for the question of how a community finances itself when we have more and more processes that are controlled by computers or robots. Here of course the income tax in these areas is will lapse, so do we find other models of financing the community that might become necessary?

I: What are challenges for society? What is the reality- is it a competition between machines and humans?

3#13: I rather have the feeling that it is still a fear debate. Here, history comes through again: we always see this kind of behaviour when technological revolutions take place. When the railway was introduced, there were also great concerns about what would happen if a person was moved too quickly and whether this would not be detrimental to people. I believe that on the one hand it is typical of technological progress that such concerns and conflicts arise. Or let us take the machine strikers in times of industrialization or when the weavers smash the machines. This is a typical conflict. The question nowadays is whether we
have the challenge that these development cycles are even faster and new challenges arise. And I think it's a big question how we communicate this in the media but also in our education system. Will it really become a danger? Will it be a mix of man and machine or will we totally reject it? It could also be that there is a social consensus that certain innovations simply won't be implemented.

I: What are future trends? How can we as humans stay economically relevant?

3#13: On the one hand there has to be a discussion about content - that's usually the simpler one. The second is the discussion after the mandate of educational institutions. To what extent does life-long learning or the preparation for something that is not part of the subject-specific deepening belong to the task of the university? And the third is that we

have to think about didactic concepts that are also related to content and mission. If we now understand competences as the ability to act in open action contexts, then it consists of various aspects. One thing is, I need some knowledge. In the field of creativity, I have to know that it might not always make sense to go the same way, but to try out new things. The next thing I need is the methodical ability to do that. For example, to design a process so that I can develop new ideas. But that's not enough. But what makes people competent is also motivation and attitude aspects. That means I can ask questions in the course about what they know. Sometimes I have to act differently or I can design creativity processes in such a way that I can ask this question in an exam. But when they are out in the 'wild', they must have worked out the right attitude and motivation to do so. That is of course what we find most difficult in our university system. I can hardly check that out. Here we have to create a didactic setting. At this level, we have to change something and that's very demanding because it can be grasped via very few paths because it's very deeply anchored. The promotion of self-reflection, i.e. thinking about one's own goals and routines, is becoming more and more important. That is what we try to implement at the university. And the other is working about experiencing self-efficacy. I can have this worked out with my students. I can work it out with you and point out that it was successful. And you can, for example, develop some creative self-confidence. I have many students who come to me for my lectures with the self-image of creativity:' I can't be creative because I didn't paint a nice picture before'. And here, of course, we can use various exercises and the experience of successful processes to work on a different self-understanding and leave the lecture to develop the willingness to apply it in open situations.
What strikes me is that these competencies are very often discussed from entrepreneurial perspectives alone. But I think this is not enough, because not only the economy but also society is changing. The fast-moving changes must enable everyone to participate in society and thereby help to shape society. This should become an educational goal. And that's why I don't think you can say alone: we are doing this because the economy wants it that way, but we have to do it so that we can realize social participation and shaping possibilities. And that can also be broken down quite simply: For the tax return, which you can already fill out online today, we need media competence, and that also requires a certain competence.

Interview 14

I**: What are uniquely human abilities?**

2#14: Ah interesting question. I think what a lot of my clients are trying to figure out is what can be automated and what can't be automated. I think everything regarding application will be automated in the future, for example I know at [company], we are also testing video application, having robots reviewing the applications. This would be the next step. What the most important is, that interviews can't be automated yet, because AI does not have the skills of being empathetic, reading the emotions and connecting the dots. This very analytical part is very important, actually in assessing right candidates, also in regards of cultural fit.

I: More in general what is uniquely human? You've already mentioned empathy, connecting the dots, listening and reading- what are other skills?

2#14: I think empathy is the biggest one, because a lot that comes with it, reading, feeling, understanding the counter part- when I look you in the eyes I've already have a first opinion and impression, which a robot does not have, which is also great. Probably a bad thing a "bad human skill" is biased, we already heard that AI can also be biased programmed. But usually empathy is the biggest thing for me. And really understanding you as a human, understanding that you are multi-layered and not just have one issue or one task to do, but you're really the conglomerate of emotions.

I: You've already elaborated that many things are getting automated, what do you think are non-human abilities?

2#14: What humans can't do and should not do: I think before the topic I've just have mentioned I would have said AI is not biased, but we know it can be programmed biased, so its not longer an advantage. I would say what humans can't do, is speedy calculations, and deciding what applicants are good in or not good in. And really fact based considerations.

I: Which skills are important for the future workplace?

2#14: Can I refer to an article, which I can send to you afterwards which I thought described it really well. It was about connection of the analytical and creative skills, so that you're no longer will be successful if they are only analytical or only creative, but creative analysts or analytical creatives depending on how you describe them will be successful, you can no longer be for example a software developer, without having creative ideas. I think the combination and getting a larger skillset, maybe in areas where you did not know or where you haven't been interested in before becomes really really important. You could call them "empathic nerds".

I: Can you give some examples about jobs arising?

2#14: Most jobs will need this combination. When you stay in the HR sector, especially for HR the transition is really important and we see it more in the UK and US already, but in Germany we see that people are struggling with analytical mind-set, although recruiting should be on top of the CEOs or management mind. But recruiting oftentimes don't have any knowledge about their costs or efficiency, this is really important to get to sit at the same table. I think this is the best example where I'm struggling in daily. When I'm in client meetings and saying 'we have to check the data', often the answer comes 'Data- what?'.

I: Are there any tools how to train these kinds of skillsets?

2#14: Here we are really spoiled with training. What we have is a e-learning platform, where every employee has access to- we see a massive growth in this kind of area, especially in Germany its growing, a lot of companies are going to this kind of direction of establishing e-learning platforms. As an employee I can decide which direction I want to go, which skills I want to get more knowledge in. A big rise is in the skill-based recruiting. They don't longer look at the perfect CV, but as well into what skills you have, here you can really train up yourself, not only by online training but also other ways of training. Here we have a training budget, that needs to get specified before and then you get a reimbursement. Although a lot of people don't use it, I for example haven't touched it so far, which is really bad, but I don't have any time for this. Finding time is the most important one.

I: What are HR Trends?

2#14: Chatbots, Video CVs, just automation of the application process in general, filtering candidates, personal administration tasks, that these people can do more valuable tasks. The entire data, people analytics, HR analytics as skills have grown by 60%, here you can see people train up, and really looking at your own company, understanding which skillset you have, and upskilling, reskilling, enabling people moving- especially in the time "war of talent" you have to think about where to train. Flexibility is getting important here. There will be a lot of software changes etc. that people need to adapt to, there still will be a lot of jobs where you don't have to be flexible. And not everyone has to be flexible, because then requirements or expectations are getting other ones. There are still a lot of jobs, like accounting for example where you don't need a lot of flexibility.

I: Jobs of the future?

2#14: Everything about software development will be really really big. Then again cyber security, once there are more software developers, more hackers as well. Everything client related won't go away. The more automated the processes are getting, the more [the customers] want to talk to someone, to a real human being. It would be great to have more time for example with customers.

I: Which role in general will AI & tech place on future workplace?

2#14: Primarily, the data and AI will make decisions smarter, people and companies don't know which data is relevant. People need to be trained to ask and define the relevant questions and then find the respective data and make conclusions. This will help companies to really make the next steps of global competitiveness and to develop their strategy further.

I: Which advice would you give students nowadays on which skills they should concentrate on?

2#14: Definitely Analytics- no matter where you go, Analytics will be crucial. Depending on where you're going: but from business side you need also some programming skills, and if it's just that you know how to talk with programmers and understand their language. And vice versa: If you're an engineer you need business skills as well. But as I've already said, the mix of soft and hard skills is important.

I: Thanks for your time and sharing your insights!

Interview 15

I: What are uniquely human abilities?

4#15: What do you mean with human abilities, competences such as speaking or talking?

I: Yes.

4#15: Yeah, I think it's definitely feeling, thinking, acting and feeling this physical presence. I think basic for humans is the feeling and full physical presence and acting.

I: Okay, if you mention acting for example can you define it like a little bit more what do you mean with acting?

4#15: It's like being able to walk, be able to talk, being able to do things, to have the human touch and being able to close your eyes. So it's literally being able to do things. Further, to have feelings about emotions, being able to feel now and thinking is about being able to know that you have feelings. Thinking is about having thoughts and having the thinking process about emotions. So it is the ability to feel. There is acting: it's speaking. it's listening. Then there is moving in the space it's everything that has to do with a movement now being able to do things and physically feeling so we have hands and we have physical sensations. This is probably if I'm thinking about what are kind of human abilities.

I: Alright. And if you think now maybe about the opposite. What are non-human abilities?

4#15: Yeah. Flying, having sort of objectivity: to have the ability to objectively evaluate things. Because humans are subjective. And technology is also better to connect things faster and recognizing things. I mean it's not that humans are not able to do that but technology can do it faster now. Now physical ability: so we can hold things but we cannot hold 200 kilos. So there is there's a limit in our physical ability, which technology has not. Technology is probably not dependent on environment. Rockets can go into this space. Humans can't. We need oxygen and we need gravity and we need all kinds of things. Machines have the ability to live longer them. So some things are not immortal but long activities do not. What else? I think that's it from top of my head.

I: Alright. What kind of skills do you think are important for the future workplace?

4#15: Are talking we talking about technical skills or soft skills?

I: Maybe you can elaborate on both?

4#15:. So coding is one, knowing, how computer works is second, to know how Excel works all these kind of technical processes and it’s easy to teach and explain these skills. There is a certain knowledge attached to this skill set and they are timeless skills so before it was cloud today's machine learning and AI and all this kind of thing. So it's it comes with time and it's really hard to know the foresides further than a couple of years- nowadays it's data, AI, and it's a machine learning now what is going to be in ten years. Who the hell knows? I mean that be flying through the space. So we don't know the timeless skills. Now the thing is that we will have to learn lots of them during the lifetime now and what they are will be defined by time when technology takes us what's necessary at this point. Machine learning and coding engineering skills, those kinds of things are hot now. Is it gonna be the same way in 5- 10 years time? Mhh, maybe, maybe not. Probably

there’s coming some new stuff. Coding is a great example of this skill because everyone is insanely crazy about the coding nowadays. While if you are this close with people who are coding the skill of the future they say no because in the 5-10 years machines will be doing all the code, so we don't need it. We don't need to be coders, so it's a skill which to some part can be a completely useful skill because it teaches you also lots of other things. But as a skill it's not future proven as everyone thinks. What kind of skills you need depends on which country you're in, which industry, which seniority level and what's your education like. It depends on a number of factors. The answer is: it depends. The content is we become more diverse so you will need to learn more. So we probably still need critical thinking in five years, in 10 years and in 15 years time. Like there are 15000 skills now existing. So those are those skills. It's up to you, which one you prefer. Or it's totally up to the industry, what's the skill of the future for you. I'm more interested in what I'm doing within my company up on the other skills: Skills which are going to advance and change with time but not gonna disappear. Right now, we're talking a lot about the skills as presented with critical thinking or creativity. And I think they are a little bit of bullshit. It's not really a skill, it's a concept. The critical thinking consists of at least other 20,30 skills inside of it like that ability to rate information, ability to work with people and be able to for example facilitate good discussion. There are many skills which are part of the skills creativity, there are probably 2000 skills: ability to do a good design, ability to come up with a good story, ability to present, it's endless. A lot of skills behind what creativity means is endless. I think from my perspective I think those are very nice concepts. They are also vague. I call them bullshit concepts because they are a lot and they say nothing. These are very contextual skills. Those are very contextual concepts. So my first skill is more looking into what kind of challenges do we have in the coming time? What kind of challenges we'll have in the future? And the skills I would define as the ability to deal with a challenge. Because if you are able to deal with a challenge you're having the right skill-set. If you are not, you need more of it. So just to give you an example I think career hacking is a skill. We're changing jobs and careers as a normal part of life. It's said that this generation is having seven careers. You need to go to a whole new path and get yourself a new career. And I think that's a skill because I see lots of people are missing that and being completely stuck in the jobs they don't like doing the things they don't want to do in the companies they don't like. So I think we need to learn career hacking skills: the ability to define where you want to be and make the steps towards the right direction and get yourself comfortable in the new role. For me career hacking is a skill. Another such problem or another such challenge is dealing with our time and attention, because we are more and more busy nowadays. So we are more and more destructive. There's lots of noise we have to make hundreds of choices every day. And we feel missing out. So a lot of management comes to work. Load management is a skill. If you don't have it you fall, you burn out. So if you don't know how to deal with your time and attention you overwork you burn out. You may just succeed in one aspect of your lives while considering other aspects important like people succeed in their work career and forget their family. So load management for me is a skill that you need to learn because in the future there will be more: more information, more possibilities and more disruptions- the future is more. And we have to learn how to deal with it. If we've gone through we're going to be overstressed unhappy overworked individuals which are unable to function and get depressed. So there's a lot of things which are behind this skill now. Further, digital intelligence is the ability to productively and safely be part of digital world. I mean we all need digital intelligence. It's about safety and security, it's about privacy, it's about digital emotional intelligence. So how do you deal for example with bullying online. How do you deal with someone attacks you online. It's about digital identity management. How do you manage to create your digital identity online? Because we all have one. So there are lots of aspects of digital intelligence. And the thing is that this is one of the skills which is going to just advance. So as technology advances the skill is also advancing. So right now, digital intelligence is about how do you for example stay safe online and how about create a strong password. Why shouldn't you log on public wifi ever and stuff like this. In some years time, there will be a more complicated question. So that's another skill. So I'm looking at skills from the perspective of the challenges we have and we will face.

I: In regards to the time, what do you think are the three most important kind of concepts or skills?

4#15: Okay. Oh, I think one of the thing is I think Load management. If you don't know how to manage your time and how to spend your attention and time and energy on things that matter, you'll have huge consequences. There is a huge downside to it now and that's what you see that most people are struggling because there are so many great social media instructions and things to do so I think that's one of the if not the most important skill. So people nowadays are dating less because they're constantly sitting on Facebook. That means that they're not able to build meaningful relationships. So there's like enormous downside. Knowing how to manage your time, how to manage your energy, how to deal with distractions, how to deep-work and how to not doing a hundred things at the same time. This is an enormous advantage and it's hard to getting this skill. So that's what the second part I think is that if we're talking about students I think career hacking. Looking at the real world is very different from what they do in universities or what they teach about it in universities. I think one of the skills which I find also very important is relationship or effective communication. Part of having more technology is that we lost the ability to communicate. Lots of research in that area saying that the increase in technology costs an enormous decrease in our communication skills and communication is the basis for building relationships. It's being able to get the job being able to look someone straight in the eyes during the interview is able to connect with your colleagues. Now able to say something next to the coffee machine. It's being able to mate find your partner-Tinder works for one night but mostly not work to build a relationship and have kids. So it's the same with friends. It's very easy to send an Emoji, but like real human connection is super important for all the roles that we're playing. And that is the skill that we, I think we're losing a lot, because we're hiding behind the screens. And so that's for personal satisfaction or you know being able to play the roles which are important to us. Further, to have building relationships abilities is important and to communicate in reality. Because that's if you're not interested in others there are not interested in you. So it's kind of snowball. But there are more skills. I think those sprung up but if I have to name it I think managing the time, managing a career and being able to build relationships. Yes, these are the three key skills.

4#15: I think the questions we ask about the future are fundamental to wrong. Instead of asking what are the skills for the future which is going to happen, we need to ask what other skills do we need for the future I want to be part of? Because that's a very different question because if you're asking how far should it run to be relevant in the future, that's a different question then what do have to do to be able to create the future I want to be part of? We shouldn't be trying to get on board with what's happening, we should be re-shaping and re-defining what's happening and learning for the whole life instead of what is real and that otherwise very shrewd future where we all have engineering and coding machine learning skills and no empathy and no ability to build and connect with each other. That would be a really shitty future. And it's just a very real one as well. That's where you know all the technical things more coding, writing, more tablets and more attention to digital skills. It's a whole different question: where do we humans stay relevant in the future?

Interview 16

I: What are human abilities?

2#16: So I think that are the typical abilities which are mentioned in many of the studies. You can read about them. Of course the empathy part. And I'm not saying this only because that's an important part of human resources which you need in your private life as well. But it's also an issue. If you go through or through a client driven organization you need empathy. So I would connect empathy also very closely to relationship skills. And that is one part. It's very hard to automate empathy because it's an emotional ability. The second part which I would also connect to abilities are creativity problem solving skills combined with communication. Creativity is not only if you think of an artist. So we have for example if you go to the commercial clients we have a very complex financial supply chain and short transaction which we need to handle for the client. And you cannot do it if you do not have some kind of an overall creativity in the processes. But let me just think, I these are two areas which I think where we stay human. In the end, you also have from my perspective some kind of a judgment ability which you can often not outsource to some automatism to machines, same goes for human intelligence. So it's like to have the bigger picture. I do believe that in some ways you need your gut feeling- of course you can underline it by some kind of reports or data, but I still think some kind of gut feeling is needed.

I: And now if you go to the opposite now, what are non-human abilities?

2#16: These are the abilities that are absolutely repetitive. So I think we often in our company risk to have manual tasks which are for the bin, tasks that absolutely make no sense, e.g. if you're printing out something to scan it in afterwards. So I think that in the corporate world there are a lot of inefficient and still inefficient processes which could be directly automated. Here, there might be some implications which are driven by regulation. Let me say I think we're doing a lot of work right now in the company to translate something into machines. So where do you put your one data set into another and to make it fit. It's absolutely the repeatable work. We are not a manufacturing company, so we don't have the physical skills that are affected.

I: What are the future workplace skills?

2#16: Right now we are in a defining process. You need some digital skills: a digital understanding and it's in the meaning off absolutely IT basics. So you need to understand from my perspective because you're working with excel, let me call them office tools. Here you have to work on an online front end. And you need some basic understanding how things fit together. Because I mean five years ago we still had a lot of paper driven work going on. And to see especially when you have older colleagues. They do not seize up the advantages. They have problems with this transformation. The next point is also that you need to be aware of the change or you must be open to change. So at this point you do not use the same tools for a long time. This this is also changing right now in our workplace. You especially see when you have older colleagues that they have problems to keep pace. And I think it's crucial that you are open minded. And then we have to talk about lifelong learning. It's not just about that you are reading a book on the evening. That's maybe one part. But it's also to learn the next new update from specific programs. So that would be the technical part. I think and that's something which is currently changing in a more negative way. I still think that you need the classic good social skills even if you shift or reduce the amount spent with other people, because you lay out things into machines. But as I said in the end especially for us, we are a very client centric company. So of course the sales people need to have this. But on the other hand, we also have an infrastructure function. Hopefully in the future we would use more and more of the work that we can put into the machine, so that we can spend more time discussing things as humans or let me say the humans which are left. Right

now people spend more time with IT related task and not with human tasks. And it's now shifting or decreasing but I think that opportunity especially with automation or a AI would be to have more time again and spend with the client or the humans around.

I: Alright. In general how do you think the future of work will look like?

2#16: I think we will get a lot of improvements regarding to have a lot of support material, e.g. things which were too costly, which were done by a bunch of analysts, but nowadays the data is easily available. And I think this will enhance the work profile, so I'm absolutely convinced that it's true that the jobs which are still left will be of much more of quality now. I give you a concrete example: So one of the colleagues call you as HR Advisor: I need a meeting to talk with you about my future now. So I'm going into this meeting to test some kind of different components. On the one hand, it is the advice which I can give him. I give him the advice from my experience. It's therefore not real data driven, because I have no data I can see where he stands, but I have the emotional part. But in the future, I will have on the fingertip that the machine can give me a one-pager with the full data and therefore can give advises for his career paths. But still my emotional advices matter most and are from higher quality, because human-to-human conversations are more valuable.

I: **Are there any HR-Trends?**

2#16: If you are talking about HR it's some kind of what is saying it's the keep calm and love administration, because you have a high amount of admin stuff. This is reduced so throughout the last year they tried to take this admin stuff away from the HR Advisor and it was transferred into actual service centres. Now atomisation hits this service centres really hard- we need less and less people for this. So this shows a shift of let me say bad part of a job away from humans. On the other hand you have more and more time and have to be more and more competitive on a higher level. Finding strategic solutions or more relationship parts of a job are two ways of trends. Also from client side its getting much easier and time efficient today to just fill in an online questionnaire with all your data.

I: What do you think about recruiting. What is changing there?

2#16: I think recruitment is a tricky one, because you could atomise the recruiting process completely. On the one hand regarding the process the recruitment is an absolute the technical matching process, which, if you want to you can completely do automatically now. But on the other side it's an absolutely relationship job. So I mean that's a crucial point. This will always depend on how jobs will change. So also future employees are the clients. I'm pretty sure nobody will join a company if you do not get to know at least one human before. So we will still need the recruiter. But we will need less recruiter because much more proactive steps before the process starts is really done automatically. But only for example can also be had any say ethics advocates to do powerful work. For example we as a company have decided not to atomise the first step, so we screen the candidates by ourselves. This is designed by humans.

I: Which advice would you give students today on which skills they should concentrate on?

2#16: Oh skills, that's not easy to answer: So the first part is try yourself out. Do not be too focused. And I think that reflects the skill creativity. Despite empathy: it’s always important that you are curious and have the drive to do something. And this is also in the end one ability that a machine may not get because it's very hard to atomise empathy because it's an emotion ability. But that makes in the end a difference because from an employment perspective we would also see

someone who is passionate who is committed who has drive. Then complex problem solving skill, because the society gets more and more complex. So I'm very alarmed by the fact that especially when it comes to younger people which we are hiring right now I’m seeing that they are already lack some basic social skills, e.g. they cannot hold a normal eye contact. And that's something which is alarming. So that may sound too futuristic but I think that that in the end this kind of skills will be the last ones augmented. So it would be a good advice to especially focus on these skills.

Interview 17

I: What are human abilities?

1#17: Mhh, what is really human, that's hard to define. It's actually a really good question and more a philosophical. The most easy answer you could give, that there is nothing special about humans in manufacturing, because in some point everything can be done by machines anyway- that's the broad perspective and of course differs from industry to industry and from department to department. What we can see today in Manufacturing, but also in Logistics, is that the ability to be flexible can't be replaced by machines. Flexibility in the sense of reacting to certain changes in the environment in a very fast way. Anywhere where you need the only ability to follow instructions this for sure can be replaced by any machine today. In particular the flexibility, the flexibility to adapt to your behaviour by calling the changes in the environment that are not predefined, that you can't find in instructions. Emotions, I think are outside this kind of scope.

I: What are non-human abilities?

1#17: I think if you compare what humans cannot, the difference is in speed and power: there are things that can be done faster. The ability to assess a lot of information within seconds, this is where we are limited, if you look at the power things, anything that is just too heavy, too big- this is something where we have limits. It's the human ability to get tired on one point, that does not mean that you can't do things for 24h, but also your nutrition, your quality decreases over the working day. These are limiting abilities. I don't say, that everything should be automated, but you recognize the difference. In general, it is the speed, the ability to producing and providing same quality over and over again.

I: skills for the future workforce?

1#17: In terms of skills, you need programming and IT, to deal with digitalization and automation, this is a straight forward answer- more important in terms of skills, again different in logistics and manufacturing to adapt and to learn, to be able to deal with those changes. If you look at typical logistics job, there will be much more uncertainty for those people and many don't know what happen during the work day. There will be surprises. Those factories of the future will be highly flexible, modular, changing every day within the working day- whatever humans are doing in this kind of environment, and there's not that much left anymore at least on the shop floor, they have to deal with those changes. It is a skill dealing with uncertainty, to be open enough for change. This will be a big difference and a challenge for people that are not just used to this. Here again flexibility will be important. And also the technical skills, you have to know how to handle with a robot, IT-related issues, that's easy to learn. The hard one is to get this change done.

I: How do you adapt as a company to this kind of change?

1#17: We have a digital strategy, and we have three different pillars- one of those is people & change management. We have a program for that, we train all colleagues, however this is not so much about changeable skills, this is much more about the change perspective I was referring to earlier, it starts with making people aware with those technologies and the changes for each and every part of the company. Creating this awareness, taking away a lot of fear- if you see the robot discussion, will they take away the jobs- yes, for some cases in particular in manufacturing this is true. You cannot atomize logistics to a degree that it can do everything by itself, you need the human there. Taken away this fear is a change things, and of course this training on the job and learning. And with AR. You have pilot projects. Typically you find ambassadors for that from the shop floor –so people that see the opportunity for themselves to become a trainer or administrator for

deep-learning or AR skills training. There is of course a program for that, but however this whole discussion is much broader to training skills.

I: What are trends & challenges for the industry?

1#17: When we both talk about logistics & manufacturing, there is of course no big surprise that IoT will become reality, robotics there's nothing special about robotics anymore- its way beyond projects. We are also using AR for customer warehouses. Anything on self-driving skills, the public discussion is about normal cars, but in the manufacturing and warehouses this is already reality. On the manufacturing side one is called 'servitization', trends of manufacturers coming up with business models based on their products- I was visiting the 'Hannover Messe' last week, and of course another topic is digital twins, we are working on this already, but this will be relevant in 2-3 years. All these things are connected, with IoT etc. And here you see for example Blockchain is not on the list. In the end it is about collaborative situations with humans & machines working next to each other, supporting each other, which is another skillset required.

Interview 18

1#18: There are a couple of things that humans are pretty good at which machines up to today cannot really imitate or represent in a certain way. Number one from my point is creativity, meaning doing things that somehow extrapolate from a pretty known and well-defined state into something that we haven't been exposed to as a human being before. And doing this while still meeting on safety requirements. We're not going to die. No. The whole body and brain network is designed to make us alive. This was not necessarily what we can find in machines as of today when we talk about artificial intelligence or digital transformation. So, this kind of dealing with uncertainty in unknown environments and then extrapolating is the second component and we will always find some kind of solution and if we survive and the whole body and brain network is designed to achieve that then we learn out of this additional exploration how we can operate in an even more expanded environment and we take a look especially at A.I. approaches, we're currently hyping like hell. For me it's personally my third wave of artificial intelligence and they do not even provide us with any kind of indicator. If they operate in a previously known and trained area or not. So that's something I truly believe humans are good at and we have this kind of additional sense that we figured out if it gets too dangerous that we simply don't do it anymore. Machines don't have this at all. So this combination of dealing with uncertainty and creativity to even survive in previously unknown situations is something that I would really describe as unique in human beings.

I: What are non-human abilities?

1#18: I mean humans are not very strong or a biological system is like average. Vision, gearing muscles, body strength whatever it's not unique in the universe. On average it's a good combination of everything but it's not unique when it comes to certain elements of it. But when we take a look to the animals they are the stronger ones, they can run faster. They can listen better. They have a better vision system, like smelling or tasting whatever is way more advanced than we humans have it. So number one the census. It's average but not outstanding. The second component from my point of view where we're not very good at, is at repetitive tasks. We're very quickly bored to death when we try to do something and we have to repeat again and again and again and this usually causes a couple of mistakes. Now there have been several work arounds in the last 2000 years we could even start in old Egypt building additional tools trying to standardize in a way that based on the standard operating procedures humans know what to do and create these kind of boring repetitive tasks. Now even the early 20th century manufacturing lines were exactly designed for that until in the eighties, everybody figured out that it does not help the human beings or rotating shifts assigning people to different workplaces, trying to make their brain still feel alive even in the shop floor is something that we all appreciate, but sometimes if you just follow the stupid procedures we're not good at it anymore. It's not the high standard of quality. Now on the other side that's a very interesting component for me and I use this example quite often. Two of the most admired professions in human society are the ones based on the standard operating procedures like health. So what do we look into pilots or medical doctors. They all do standard work. So we all admire this. I'm not sure if it's only because of the income or because of the professional approach. But when I consider our industry especially in engineering no matter if it's computer science, mechanical engineering or electrical engineering my researchers always claim that they are more artists than researchers thought they don't want to follow standard procedures on the other side, they really claim I should be in a same position like a medical doctor or a pilot, making the same compensation as salary. That is something that for me is a gap between perception self-assessment and what we agree how we see us as humans.

I: Which skills are important at the future workplace?

1#18: There are at least three different kinds of workplaces that we have to define before answering this question. Now what many people refer to when you talk about the workplace is an office environment a standard office environment with a desk, a computer, a telephone. No matter what the phone technology or the computer technology looks like, but it's more of an office environment just like the one we're actually meeting at now. The second one from my point of view is somehow related to manufacturing or any kind of engineering tasks, meaning interfering with the real world not being a computer. Whatever that means in manufacturing and building cars, producing electrical energy or a chemical substances, pharmaceuticals whatever. That's the second kind of workplace. And the third one is related to any kind of services and I would include restaurants, medical doctors whatever it is to where it's really undefined what the environment looks like. Maybe there is a specified location you will work in like a restaurant, a hospital, a medical doctor practice maybe it's undefined because you're visiting somebody at home providing the same service. The manufacturing environment is well defined because you want to produce something and you want to be financially successful. So, when we talk about these future workplaces and how they should look like, what is really going to inspire people. The most ridiculous recent German public political discussion is about having a legal right to work from home. Do I really want to see a medical doctor doing a medical procedure at home on his dining table? That's not going to happen. So, some of the claims are really ridiculous because they are focusing on a subset of the human population. And if we want to talk about this to make you do it even more than these three different categories of workplaces why do we take a look at the office and that's the easiest one. What makes us human for me is that there is this kind of social interaction. And there is a famous German architect I believe it's Prof Vent from Munich, and he designed the Volkswagen factory in Dresden and he gave a very inspiring talk in the early 2000s at our automation conference in Baden-Baden and I was the host that night and was sitting next to me during dinner, next to him was a CTO from a process industry company and they have just build a new German headquarter. That night the CTO stopped their newly designed building environment, fired his old architect, hired in the new one and completely redesigned the place. I still remember one of the core sentences that night: in order to initiate new ideas "*People should see each other but not hear each other during the day"*. I'm a great fan of something that somehow facilitates meeting people in an office environment. And this does not mean an unlimited open space. You must also create a work environment where people have breakout rooms for sign and work. You must tell them if they really have to do something in silence like writing an article or reading an article or finding any kind of IP that they can do that from any place they like to. One of my standard phrases is that the work today is way too complex and complicated that the issues can be solved by a single individual. It's all about teamwork and collaboration. You must be open minded for that, otherwise you cannot create new ideas. I always tell my folks if you want to go on a shore go into shore I don't care. You need to get your work done. But there are some activities where you must collaborate well and you must see other people, and this is something you cannot do if you don't see and interact with them. For me it's essential that people communicate and collaborate. On the other side the German explanation of team ("Toll ein anderer machts") does not mean that you can exclude yourself from participating and contributing. That's another component but I truly believe that humans have a weakness, there's always a minority of people trying to shy away from any kind of heavy lifting and work they just don't want to do it now. And then they pretend that others did it before. So whatever you have in mind, communication, collaborations and finding new solutions are relevant. People just ran into another one, when they had a problem to solve. I still remember my longterm internship at [name of the company]. And the whole R&D department, always every single day when it was not raining cats and dogs we took a short walk of about an hour after lunch. It sounded stupid. It was always the same tour but we solved many more problems during this short walk than in the office during the day. People started talking about it: I have a problem here and they tried to explain the situation. Very often we came up with a solution ourselves just by talking about it to others and not sitting at the desk and trying to solve something that was nuts only because we are limited to our own ideas. But we did not open up to a new space and this is somehow correlated to actual physical activity. Now another example for the office environment. I still remember my very first Innovators Roundtable at

University of Virginia the Darden School of Business here in the United States. This was the time when many European companies introduced lifttable desks so moving the desks up and down and standing. I stand as most of the time during the day standing in front of my desk and my American CTO colleagues looked at me and said ‘you're nuts’. I mean what has this to do with agility. He said OK. I mean flexibility, moving around, creativity, this has something to do with opening up the space and it's not only about the brain, it's also about some kind of physical exercise. So, I had the opportunity introducing this here in this building and everybody was against it at the beginning and now when you take a look everybody stands at the desks. There are certain tasks you cannot do easily while standing still but for phone calls, I walk around all the time with my headsets. It's the easiest way of moving around. This is something where I truly believe humans can do better. At [name of the company] we have the rule that you can work from home and discuss with your manager if you'd like to. What we experienced after a couple of weeks sometimes already after a couple of days, colleagues get disconnected. Now they're not part of the game anymore, you don't think about them when you're trying to fix something. They also disconnect themselves. Pretty promptly, they miss the gossip, they miss all the information that is somehow transmitted between the lights and not just following the straightforward communication, which is relevant as well. And then the third aspect related and then I would really like to finish this kind of office environment. One of the downsides of e-mail is that it's no real communication anymore. It's a single way. You transmit information you digest that without having the context. And very often this kind of information hits the recipient in a situation where it should not be presented to this person. Now for example many people are nowadays doing e-mails in parallel while they're in a business meeting. So they lose both contacts. The one in the meeting and the one in the e-mail then they get upset. Sometimes the meeting is stressful. They respond. They only read two lines of the e-mail on their smartphone and not the entire e-mail. And my most challenging de-escalation in the office were always caused by e-mails, not by humans meeting because the body language is missing. all 80 percent of the communication is nonverbal. And what do we try to do now? We try to eliminate it by verbal communication which is no real communication by e-mail. That is stupid like hell. It costs a lot of time and effort. I have about 200 team members globally, five teams in three locations in China two teams in India, one in Germany, six teams in the US and three different locations. So, if I want to really work with my people I must be there - so you must travel. But this is exactly the opposite of travel cost reduction in companies nowadays. So, you must decide what is more important. And I personally do not believe in transmitting information by email. It's one of the dead-end roads. And also texting. I mean it's nice, you can send a message, while somebody is in a meeting or somewhere else. It's great for heads up. Give me a call. Or there is an urgent topic, we need to talk about etc. But the important things I truly believe in the power of human collaboration and communication in person. The second work environment from my point of view is the manufacturing one. I mean in manufacturing is all about reliability. You want to produce goods as promised. Somehow independent of the humans producing the goods or participating in the production process many of the tasks can be automated today. Already automation is not only about low cost I mean this is what many people don't see anymore. From my point of view and I'm an automation person I've been for my entire business life. Automation is about understanding systems in a way that you can really automate them. It's not about pushing machines everywhere. It requires a lot of understanding of repetitive tasks. You can easily give to a machine increasing quantity increasing throughput so that the humans have additional opportunities in a way that they can get back to the creativity aspect or tool to operate in more uncertain environments and deal with the challenges and instead of being exhausted already by doing the regular tasks. The Toyota Production System only focused on that. I mean their excellent quantity was mainly caused by the fact that they use humans for all the different important tasks and not the other stuff. The boring things. That is something where I truly believe we can do extremely wrong by designing shop floors in a way that it brings people into a situation that they can unleash their creativity that they can even optimize production environments. If you're good with people and you give them the power to decide on certain topics you motivate them. They can be very creative and people optimize whatever is in their environment. Now if you limit their activities and you tell them you just do this and this is where this kind of sorry just say the American model based on

a standard operating procedure the person is just trained good enough to complete the job but nothing else. And this is not necessarily what people like so they move on to the next opportunity and next higher income and more responsibility. And very often optimization requires time. You need to understand the process no matter what the process is in order to optimize it. Some people do it more systematically like engineers, some others do it more hands on when they are doing a job. If you rotate people too quickly that they understand what's going on you will never see a difference in this. This is something where I believe Europe is very good at in empowering people, to provide the best contribution to making things better and also rewarding this by the compensation schemes. In the US being unionized is a no go at the company, not a single one wants to be unionized they're totally against it. When I take a look at some of the impacts that unions had in European companies also with respect to reliability and sustainability aspects having 50 percent of the votes in the supervisory board is a good thing. It's something that I truly believe is a very good indicator for sustainability and reliability. It cannot produce anything without having people. That is something where I truly believe we also limit some kind of creativity, when it comes to manufacturing. I mean if it is three or two shift model if it's twelve hours, 18 hours, 24 hours until 8:00 during the day it is something where we need to redefine flexibility at the workplace. If you need 10 people at a defined production line for doing whatever and people are needed there and they cannot decide that one shows up at 6:00 because he likes to get up early and the last one shows up at 9:00 because he wants to sleep a little longer. Now if you need 10 people you need 10 people so everything that we are talking about flexibility, working from home, to decide whenever you want to be in the office. That is something that does not work anymore when there are certain requirements. I mean if you're scheduled for surgery and it's 8 a.m. and the doctor doesn't show up because he enjoyed a glass of red wine last night and wanted to play golf before he goes to the hospital. Sorry, that's not going to work. That's ridiculous. But we do not consider the consequences. There are so many political statements about flexibility today and humans how to realize whatever they want to realize. I mean it used to be a time when we had to work just in order to secure our survival. Now it's a little bit more separated and isolated and there are different parts how we participate in human value creation and life. This does not mean that a job also has some basic tasks to secure to survival. Producing some kind of income does not come for free. And when we take a look at a mix, some people believe that a basic income for everybody in the machine age is something that should be promoted from a political point of view. I'm not sure I still experience the Iron Curtain I did my military service during a time when there was still an eastern part of Germany and the rest of Germany and we had family on the other side and they were not encouraged to do anything because whatever you did there was no personal gain in the game. And what I really like is what the Chinese government actually did. They analysed the failure in the Soviet Union and former German Democratic Republic very carefully and tried to figure out how are people so successful in the western world even if it's not pure capitalism. And why did the socialism in its pure form failed in the eastern world. And one of the measures it was recently a very famous article in The New York Times about it- they figured it out why they never produced enough in China. Their folks were not encouraged to go the extra mile. There was no incentive in it. There was no benefit for the individual and when they came up with this idea that the company is still owned by the government or somehow indirectly by the government, they have to produce their minimum quota.. By combining these two approaches, they created the shop floor of the world as of today. I mean China is the country producing almost everything. I'm not sure if you have been to China before but I'm very passionate they are well educated and well-trained. I still remember my first trip to China and I made an experience, who is the better and more educated? The one who is only staying in one place the whole time, or the one with international experience? The one went to Highschool in Karlsruhe, went to the Technical University in Karlsruhe and then he moved to Siemens in Karlsruhe. This was all of his international experience. A colleague that I had in my team in China had his master from China, PhD from Imperial College London, worked for five years in United States and other 3 years in Central Europe and then he turned back to China. Guess, who had the better international exposure? That is something, that becomes really ridiculous if people do not compare the facts. And now finally, when we talk about the jobs and environment for work in the service environment. A doctor has to perform

wherever she or he is. First responders, emergency doctors anyway, when they are out of the road- when you work in a restaurant, a good waiter, is a serious job, you can make a lot of money and people rely on you. Environments have changed, there are more flexible and usually they have to deal with a lot of uncertainty, and I have no idea how we want to automate this.

I: Thanks for sharing the three separations of working places. I don't know how much time you still have left?

1#18: I've blocked a full hour.

I: Oh wow, perfect. You've already mentioned some kind of skills that are important- is there something else you would add to this kind of skills discussion?

1#18: It's also about investing in people. When we take a look at machines, it's always a financial assessment, and you always want to have the cheapest solution you can get, what's the return of investment? Humans are and will not be there forever. But there's also no end-of-life definition for machines yet. Sometimes and very often humans have kind of different skills. HR tries to cluster them- are you familiar with the Meyer-Briggs-Indicator?

I: Yes, I'm familiar with it, already worked in HR.

1#18: Very often you have to invest in people and just trust them, they can develop over time. Many jobs do not only require education, but also experience. This is something where we have different path in the company- we have the expert path, PM path and line career path. For some reason, people thinking that the line path is the most successful one. No, its not. The average time of CEO in a company is 18 month and this kind of Chief Entertainment Officer is kind of a good description of the job. You have to entertain your employees, entertain the shareholders and the public. And get tons of money and they are there over a certain number of years and run the show because they have the knowledge of the past. They know where the company really is. And they have no idea how to develop the company and bring it into the future. Let me take a look into experts careers. Many people are having a breakthrough beginning, winning nobel prize or becoming inventors of the year or whatever. They succeed after 10, 15 sometimes 20 years in the same domain. You must have a deep understanding of what is going on. And just because you want to buy it and you have the money does not guarantee that there is a market and you can buy it. What is it that you need to invest in? Many people talk about open innovation. Yeah, that's great. I can sell you everything within an hour presentation on PowerPoint whatever it is. And sometimes people with a deep understanding of the technology they can already see it at the very beginning that this path is not going to be successful. But nevertheless, the thing is that people don't want to see it. But when you take a look at it the mathematics of investment is non-linear. So, when we take a look at this kind of from what is important for the future of work you must invest not only in financial assets you must invest in people. People with ideas, people with passion about a certain topic and you must combine it in the way and I always tried to create what I call convex leadership teams. I don't need clones of myself, I have enough dealing with myself. That's complicated enough. I don't need another 31 personalities that are similar to mine. Now if you want to cover a maximum area it is important that you find people who are really complementary from what you are trying to do. Some of them must be experienced, they must know everything better based on their past experience that's important and they must be open minded enough that they still listen to the more junior one coming up with the crazy idea. On the other side, if a junior comes up with an idea that's crazy like hell and it's not going to work because it's violating mathematics or it's violating physical laws and you don't have to go down this path. Sometimes there is a reason why a specific approach cannot be successful. It's not that one single individual can know it all. So, building

the right teams and investing in junior people they will become the experienced seniors and the future is something that from my point of view is absolutely essential and therefore you must expose humans colleagues teammates however you want to phrase this to new experiences. It's something that is completely different. If you have to implement in a real world if you have to go, there but if you just stay at your desk and decide in a theoretical experiment. I mean you moved on to the UK that's something completely different moving out of Germany. Many people in Germany tell you that they know enough about the UK. So many of my peers tell me Oh Europe you moved to the US: 'that's great, it's nice beautiful weather You can do whatever you want to do. Cars and computers are way cheaper', bla, bla, bla- they know everything better but they never lived here. It's not the same way we're used to it in Germany or in Central Europe. So it's different now. It's not better, it's not worse. It's just different.. Number one you must be exposed in order to create those experiences and the profession which I admire most and I still feel like one and probably still am is that of a project manager. You must trust people in other disciplines, you must ask the right questions and you should not answer your own questions you should wait for a response. Project managers have the skills, that's a human capability. You can sense this if somebody has the skill or not. But you can smell it, you have a gut feeling. And as a PM many situations you only handle from your experiences. So, that's what I mean by investing in people. If you don't invest in people, if you don't create any kind of additional exposure that they can create their experiences, they will never become great. And that's something that really strong leaders and I'm not talking about managers I'm really talking about leaders. Exposing people, trusting people even junior people and sometimes it's just this gut feeling and a few proof points that you figured out. This person is really great. You know he or she can do it and is even ready for much bigger tasks and challenges in the future. And this is something that not a single machine will ever be capable of!

I: Perfect ending of the whole topic, for the last 4 minutes I have one quick question left. What do you answer people that are afraid of losing their jobs because of machines?

1#18: I have this discussion with people afraid of losing their job and with politicians that talk to me and saying automation is killing more jobs. I personally do not believe in this. I believe one of the mandatory requirements for every single human being is lifelong learning. The moment you stop learning you're out of the game. Sometimes I like to compare plane work with muscle work. If you don't exercise anymore the body gets rusty and we can have a look at our parents or grandparents at a certain time they pretend they can hardly do it anymore and I still have friends even my professor at the age of 85 still plays tennis. Still playing tennis of course it's not the same like you used to play it 40 or 45 years ago, forget it. Yes, but compared to my parents, I always tell them my professors are in better shape than you are and he's 10 years older so that is something where I truly believe the same applies for the brain: you must stay interested in topics you must learn and is it going to be perfect? "No"- but having the right combination of experience and practice and exercise and training you can always stay up to date because nobody can compensate for the experience. If you do not try to learn something new and staying curious- curiosity is really important in this aspect, you'll fall behind. I mean, I have to learn new tools new work habits all the time. I have to be the one introducing the change and being the early adopter of almost everything. Five years ago when the first MacBook Pro showed up I have no paperwork in front of me anymore. No paper no regular pen done. Can you change your work habits? Can you learn something new? Yes, we can. Humans can, but you must want to. And that from my point comes with some kind of responsibility. So, providing opportunities but also accepting and taking opportunities. What I truly believe is that companies are seeing human beings in their stuff as assets not as cost. And that's a major human differentiator when you see the people in your company as assets you must provide opportunity as you must help them to learn something new. And now my next meeting is already up. If there is anything left open, you can always contact me. Thank you very much for providing the opportunity to sharing some of my thoughts and ideas about it. If there is anything open for you, let me know. Good luck with the progress!

Interview 19

I: So the first question would be what do you think are human abilities in general?

5#19: That's a good one. I think they're the basic skills something like you learn in school to do calculations, to listen, to write and to read stuff like that. And these are for sure social competencies. There's something like the emotional competencies, like to work in teams, having an understanding for the counterpart.

I: And if you're now thinking of the opposite what do you think are non-human abilities?

5#19: It's an interesting topic because it's the third or fourth wave of robotics and artificial intelligence which is discussed right now and it goes back to the 50s and Turing defined the Turing Test and stuff like that. And right now the algorithms are quite good with pattern recognition. But the question is this is really something like artificial intelligence.
And from my point of view right now we have the bridge. So the computers are quite good and the robot has to do the same task over there in a very precise way. Now for example if you always have to put a screw in the box on a special level or whatever and to sort something- with that computers are very good: they work fast in getting patterns out of something. And so right now we're discussing what would be the next skills? Will it be something a computer is able to think and to be creative for example or do we need something more what human beings have? From my point of view we have always to see that we have to compare the approaches somehow. So if you have a great chess player for example in a chess game. Humans need two or three cups of coffee and a meal perhaps. And right now our computers we have deep mind and in chess they are getting better right now and they're getting better and better and even better than human beings in some fields but they need lots of more energy if you compare it with jewel than a human being and so that would be the next thing that we have to coup if there is a process already if there's the hardware ready or what calculating power we need. That's another example. I don't know if you know the game Starcraft 2? It's a 10-year-old game and it's still played in worldwide competitions. Millions of players around the world wide. And I think three months back or something the computer was able to play the game and it was trained about two weeks long and played as many games as a human playable game in 200 years. And the interesting part was that it got new ideas how to play it now and all the million players around the last 10 years didn't coup this game play. And so there is lots of potential within the automatic and the implementation of I would say automatic games and machine learning in this field but we're beginning right now.

I: If we now switch to the workplace or to the future of work in general which kind of skills do you think are important?

5#19: I think something like that you can cope new task something like that you are flexible that you still want to learn something new that you have some skills but that you are able to combine it with new skills that you want to improve yourself.

I: Are there some other skills or do you think these are the core skills?

5#19: There are lots of people discussing this the people should learn how to program a computer for example. But I'm not a fan of it because you have always something like habits and you have always fields like as human being. Also it's important to use the human intelligence and not always trust the machine. And I had the discussion with my wife for example, she's a researcher too, is doing a postdoc and did a PhD in economics, but she says hey the repair of the back of my iPhone is your task. Same with a lots of people have the driving licence but why should they know how to repair the

car? And they don't exactly know how the car works but that's fair and that's OK because you can't be expert in everything. I don't think that everyone should be able to program the computer but you should be aware, how things are working and you'll need digital literacy.

I: Which kind of strategy should universities have to train the next generation of students in those kinds of skills?

5#19: There are different levels or layers or pillars I would say on the one hand you have the curriculum, that needs to get updated. You don't need everything in your head. But perhaps you need some more of the way of critical thinking of the mind-set that you can cope with new ideas, new concepts and new organisms. So we have to update on a regular basis- we have to update our curricula we have to think on more on a societal level so how does technology affect the society. We have special programs out here. We have some unique Center for Technology Societies for example discussing options how to get more social sciences into the technical studies. Harvard has it, MIT and other US universities. And we have to work on that too. And for sure we have to build extra courses for digital understanding and digital literacy. Not every information in the printed newspaper was correct. And why should it be correct on Wikipedia or other platforms? And if you compare the content here it's a very diverse level of quality. Now our students have to cope with all this immersive information.

I: Do you have examples how to update the curriculum and how important for example soft skills are for engineers?

5#19: We have a Manifest for teaching on our website and we want to integrate online teaching. Because the students have to try out the technology, they have to get used to get used on working on digital teams or online teams. We want to support our students in the best efficient and possible way. But it should be possible to meet the professor in personal, face-to-face. That's where the real learning takes place, from my point of view. But you have to use the digital, too.

I: How can we rethink education?

5#19: In Germany I would say that the public appreciation, meaning that you're really proud that you are studying, that you are getting a really high level of education. Because right now in Germany public education is for free now, but the people are more proud that they're doing their Zumba courses, instead of a MOCC or that they are good in maths etc. On a worldwide level its different, but we have to work more on that we appreciate the education that we get in Germany. In Germany we really have to cope with that and then we have to discuss which kind of teaching level we want to have because we have a federal system in Germany we have 16 states and each state is self responsible for the quality of the grammar schools, the so-called Abitur. And there are big differences around and even for the higher education institution for the university so different levels and some federal state said each university has to be on an equal level but there is only a limited number of resources: you need someone who is more into teaching and other ones who are more in the top research and they need different resources now.

I: Thanks for your time and your insights!
I: We have to tackle a lot of challenges right now. Which challenge do you think is the most critical and how can we solve it?

5#19: Yes and no- I think we have always been on a very high level of standards and the question is where you are looking at, what's your initial system, is it something like Germany, in Europe or worldwide? If we look at Germany then we have to look that we get a little bit more hungry again for new topics that we get that we discuss technology as a chance because we can use it and we can shape it somehow. But lots of people are fearing and fearing it. Right now the people don't see the positive aspects of it. Now in the field of medicine there are lots of potentials around. But we are coping with our data protection laws and I think we have to get both sides with it and we have to get a fair use somehow of the information. And for example we have to enhance these that you know in a German rights system that we still are coping something like the media and the freedom of information and data and that everyone can decide what's this is state or it is done. But on the other hand that we can use it to learn something out of it because as I pointed out in the first question there is a potential right now with artificial intelligence. And the challenge right now is to define the "human-digital" world. We are human beings and not everything digital will help us. So for example drinking a beer over skype doesn't make as much fun as meeting in person. But the other hand right now we're doing the interview: You're in Cambridge and I'm in Germany. Our politicians right now think at least a Germany that the debate is also about ethical aspects. Relating to work we have very strict working hours. Sunday is a free day and you are not allowed to open your grocery store for example. But there is lots of stuff coming up like Amazon Prime. I can if I want order something after eight o'clock online and it's delivered to midnight now. No job has to be closed so that doesn't fit. And it's the same with the working right something like this our employees and I'm sure you reading e-mails on the weekend. We both right now are talking over the Internet on a Saturday, so we're both working. We need a new and more flexible working model. It does make sense that we have something like a limit of 40 hours to work but perhaps we need something like to stretch that you have project times have a little bit more and that's a little bit less than that flexibility work at night or day. Because if you're working together with someone from the U.S. or from Asia you have different working hours anyhow. There are lots of challenges but I think I'm very positive. I think it's like we can shape the future. As university, we know we are educating the young people, the next young leaders of tomorrow, so we have to be prepared for this challenges.

I: You've already mentioned China or the US. Which changes does Europe have to develop to be a global player and what can we learn from Asian or U.S.? What's the European status quo right now?

5#19: I would say it's a tough one because they're always challenges and you don't compare apples with bananas. But there are positive examples where we are quite good in Europe. In Germany, there are always some examples where people say no we are in the last places of the ladder and stuff like that, but I think in school it's important that our kids should first learn in school how to write and how to read and how to do calculate. This is a requirement if you don't know your mother language for example then it doesn't make much sense that you try to write on a notepad or on a template or whatever. And for sure we have to work on the ability that you still focus and concentrate on topics.

I: Last question: if you could give an advice to future students or to students right now which advice would you give on which skills they should concentrate or which studies should they concentrate on?

5#19: On the business level, perhaps to stay noisy to stay hungry to be someone who tries new topics out. And then you get creative then you have your own point of view don't just look in the newspaper or online channels or whatever and copy what others saying just do it on your own thing and then you can say okay that's good working for me or not. And then you can get a feeling about technology and your stay on track somehow.

Interview 20

I: The first question would be what do you think are human abilities?

5#20: I think this is a really good question. I think the introduction of artificial intelligence pushes us these days to think much harder of what makes us human and the boundary between human abilities and artificial facilities will change. I think that's very important. But I do think today that human agency artificial intelligence is very good in extrapolating from the past and learning from the past and making decisions that are future oriented. I think it's something that is human. I think also the whole range of social and emotional skills, resilience, curiosity, courage, leadership. Certainly, those are also human today when it comes to cognitive skills, like, you know complex problem-solving that's where the boundaries are probably little bit more fluid.

I: What are non-human abilities?

5#20: First of all routine and cognitive skills the kind of things that are easy to teach and test they are very quickly taken over by technology or AI in some non-routine skills, when you think about translation for example. On the cognitive part I see a fluid boundary like artificial intelligence is taking over an increasing range of cognitive functions starting from the routine cognitive skills, but also in sort of now getting involved in some of the normal cognitive skills.

I: And when we now I going into more like an educational setting as into schools, maybe also kindergarten and universities. How do we have to rethink education in general?

5#20: I mean in education you want to develop first class classroom and it's not second class robots. So I think we should take serious what technology can do and spend less time on things that have no value today. For example in school, if you think about a subject like science spend less time on accumulating scientific content, spent more time and learning how to think like a scientist. In history, spend less time on learning about you know names and places and spent more time on thinking like a historian. I think that is very very important that we focus more on epistemic understanding and less on the accumulation of subject matter content, but I also think that education and the learning environments need to be more conducive to the 21st century skills. Learning in school is traditionally a passive process, you know, students listen, teacher talks. The kind of active learning agency based on collaborative learning will or should have more room in schools. And to teach those kind of skills. So to be more creative and to be more collaborative.

I: How can we motivate teachers, schools and universities to integrate the mentioned skills into curriculum?

5#20: You know, the curriculum design is one aspect, but I think even more important is to get ways in education. You can put many things into a curriculum, but at the end of the school year or school time, we only access a very limited range of cognitive skills. The curriculum is unlikely to change tracks of paradigms. And if you for example say, well, you know, we should all be learning to work collaboratively and then at the end of the school year you ask students to be better than the neighbours in an individual test, then the test will win. So I think it's also a matter of adopting learning environments. The education examined assessment system has to be a good match between ideas aspirations and the criteria for success.

I: How can we use technology in educational environment?

5#20: Well, you know, I think, technology can play a very powerful role in facilitating learning. It can personalize learning it can give learners a much greater control over how they learn, where they learn, when they learn and what they learn. I think that's very important also on the field of assessment. Now it's not just whether you get an answer right or wrong. But also how you got to the answer. So I think technology can play many different roles in the learning and assessment process complementing teachers in many different ways.

I: So when we go now to Europe how are they preparing the education system for those kind of new environment and for the new modern world of work? Who are the 'big players'?

5#20: It's very difficult to sort of assess. Finland has gone very far and walking towards the kind of integrated curriculum, that is cross-disciplinary. I think Singapore is gone very far in terms of developing its kind of sort of focusing on teacher development. And I think that are many interesting examples in the world in adopting learning but whether these efforts are successful, it's always going to take time to find out.

I: Which kind of skills and abilities are important for the next generation to adapt and to learn?

5#20: to know your capacity, to think for yourself but also your capacity to navigate ambiguity, manage complexity, resolve tensions and dilemmas, I think to be resilient, to try something new and stay intellectually curious. I think those tasks are very important.

I: Which advise would you give students on which field of studies should the concentrate on?

5#20: I think that's a really good question. As a young person today, you have to find out what your real passion is and where you believe you can become really good at. I think that's very important. And I also think to look at the world through different lenses and perspectives is important. And I think maybe everybody should study two things one you really like to do that makes a big difference to you and another subject that has a more instrumental value and then you'll find probably in life always the combination that will help you.

I: Thanks for your time and your interesting insights!

Interview 21

I: Thank you so much for your time- let's start and I'm looking forward to your insights.

1#21: It is well known that we manufacture cars and therefore also deal with robotics and artificial intelligence, whereby this must be considered from different sides - on the one hand the topic of new developments, innovations, where robotics, AI can be used for future vehicle generations and future production concepts, etc.. There is a certain task force here, which deals with it, the colleagues think 3-4 years ahead. Any innovation that we bring into production must be robust, reproducible and highly available, that's important. Of course, the innovations also have a strong influence on the employees, on the one hand, there is the qualification aspect, so we have to make sure in advance that the employees know the technology and train them accordingly, so that they understand the complex interrelationships in robotics. And you can rely on your own training and further education to help integrate content and be adapted to further training measures and age, which is not possible overnight, but is done on leave. For all topics, it is important that the systems are highly available and that the process runs smoothly.

I: Thanks for these insights. First question what are human abilities?

1#21: Creativity is one thing, the other is dealing with complex situations and also the subject of assessing situations this is also a basic topic of autonomous driving. The child runs out onto the street, does the car evade? Basic knowledge and assessment of complex situations, speed of reaction, we are still ahead and how do I assess something, AI systems are not yet able to take environmental influences into account.

I: What are non-human abilities?

1#21: Clearly, in the repeatability and execution of standards and quality control, robotics is already included, the human eye is simply not so good. The subject of speed and, for example, in painting and body construction, robotics is much better and can last 24 hours a day and people don't have to burden themselves with it.

I: What are potentials for human-machine interaction? And how to best train this interaction?

1#21: There are some collaborating robots that have sensors and where I can support humans. And so there are already areas where the robot works next to the human. Especially in car assembly, collaboration is indispensable, there are so many different processes that cannot be fully automated but still need humans. For larger tasks the machines are usable, but for tinkering and precision work the people are needed. In our assembly department, 80% are still human.

I: Did I understand right, 80% human tasks?

1#21: Yes

I: Okay, wow would have never thought of that.

1#21: Well you have to differentiate. In the assembly- In the bodywork, there is the other way around and also in the painting 80% can be automated. But there are many things that cannot be detected by the robot. One possibility is collapsing systems, which do not cause any damage and the human being then has to work in parallel.

I: Where are the most challenges for your industry?

1#21: The subject of occupational safety, the subject of defining interfaces What does the machine do, what does man do? Where are the deficits that I mentioned earlier with regard to the assessment of complex decision-making processes?

I: What are you asking people that have fear of job loss?

1#21: At that time the robots came into the body shop in the 80s. But this is not a paradigm shift. Automation is also viewed positively where man has made mistakes before, the machine will replace it. I have ergometric improvements, facilitations for the employee, concerning repetitive activities, which are also error-prone. This is not a change of work form from one day to the next, it is rather a creeping change, it is rather accepted as a support than a threat. Young people also bring digital knowledge with them, so it does not inhibit contact with the machine.

I: What skills do the next generation need?

1#21: Car production is still very much influenced by standards and teamwork. And about processes, that requires strong process discipline and that is where robotic can help with the standardized work. Of course, the younger generation is open to new technologies, which could be even better. If you look at China, where I was 4 years old, these are completely different standards, and we have to make sure that we don't lose the connection. Then, of course, the corresponding training is also important. In addition to the normal curriculum, digital know-how has to be introduced in the company, but also in the university curriculum.

I: How does the teaching has to look like? Where do we have to rethink education?

1#21: We have already made quite good progress in the training, e.g. in terms of learning programming languages and collaborative approaches - where we still have to look in the assembly there is still need for action.

I: And in regards to universities?

1#21: It is important to reflect that new technologies support value creation in terms of quality and efficiency. And why I do something and how I do it. The know-how and the decision, that is still a human task. And it's still the job of managers to weigh that up and put it to good use.
To reflect that and combine it with research and practice.

I: That was my last question, do you have something to add to this topic?

1#21: Of course I am interesting in the results of your work. Robotics is essential for our work, because we have the basis to get better faster. But even in an international comparison, if we don't really step on the gas, we will soon have no reason

to exist here in Europe. Other continents are really putting the pedal to the metal, especially China, which is already better at manufacturing than we are in Europe. We must therefore invest in creativity and innovation.

I: Thanks for your time and your insights.

Interview 22

I: The first question would be what do you think are human abilities?

1#22: The human body can react very fast on different situations and different tasks. It is the most flexible tool and machine in the environment. Humans have the possibility to think fast and flexible and over limited boundaries above, so the human brain is capable to expand over learned algorithm. And that is the biggest advantage of human beings. If you compare it with the robot, the physical flexibility is very far. It's very easy for the human body to adapt to different situations.

I: And when we now switch to the opposite part, what do you think are non-human abilities?

1#22: They are more sustainable. So, they have higher strength. They are independent from tiredness. They are reliable. You can repair them after break down. That's a little bit of a problem of human beings if they break really down, because of the physical and psychological effort, it's very difficult to maintain them.

I: And when we now go to the workplace, what do you think which skills are particularly important for the future?

1#22: If we go to the workplace we have different scenarios, so we have repetitive work and I think repetitive work is quite good from machines. As longer the repetition lasts the more important machines become. If we go to a flexible environment where decisions have to be made, human beings are more important. And that is I think the limitation between artificial intelligence and human intelligence. Artificial intelligence can calculate very fast and has a big advantage in this, but to develop a broader picture artificial intelligence is limited. The biggest problem with intelligence is behind the artificial intelligence so it's all based on algorithms. And it all depends on who has programmed this algorithm and that's something we shouldn't forget.

I: Just going back humans are better in decision-making and can you think about more examples in which humans are better in than machines?

1#22: I think machines will develop in decision-making and they are progressing very fast. The important thing is above all about the learning algorithm. How does the machine learn? I know a little bit about the different concepts about machine learning, therefore the machines will learn, but in a defined environment. So, a machine will always have its learning in a defined environment and a human being can learn outside this box. So, outside the box thinking and problem solving the biggest assets we still have.

I: Alright, so now we're going like more into human machines interaction. And what are you answering people that are maybe afraid of losing their job?

1#22: Good question. I don't know. But the thing is this answer is quite complex. Do you ask in general? What about losing jobs because we implement machines or is it a specific job that will be taken over by a machine? So, when we talk about machines we talk about jobs that can be taking over and give a benefit to the people in general. That was the problem that since we talked about automate the system. When we look at Henry Ford and how they build cars at that time, it was very people intensive. Okay, the people earned money but it was very expensive to buy a car. If you look on the whole progress in the economy, what a camera costs what a computer costs that was only possible with automotive processes. And that is the balance. So, we always ask the question: “does automation kill our jobs?” Yes, but it also creates new jobs and it

makes our life cheaper and with less effort. It is the balance. It's much more a question of the ethics. When do we overdo the whole system but we all understand that competition is the drive of the economics. So, if we don't do it, somebody else will do it. If we are cheaper and using artificial intelligence, we will do it. So, there's no chance to stand against it and there will be kind of people that will be highly successful and get a lot of more jobs now like IT-specialists. And other people with less skilled jobs will have a problem to find new jobs. So, that is the downside of the whole thing. It's more a question of the skills level of people have than about the question who will lose their jobs. That is the danger in the whole game that the people, the less skilled people will lose their jobs. And what do we do with them?

I: Is there some kind of re-training at your company? And where do you see the most kind of challenges with within learning and re-training new tasks?

1#22: I think you have two levels: first level is that you as a person have to be open to face new challenges. And if you want to go into this new challenges you have to use possibilities to develop yourself. So, that you come away from the jobs that will be taken over to the machines and be a part of those who designed this environment. It's easy to say that when you are on the sunny side of this game. If you are on the dark side of this game, it will become very difficult and that can become a social problem.

I: Which kind of advice would you give people that are afraid losing their job?

1#22: Difficult, I think we are not anymore in the discussion about artificial intelligence or not. We are already in the discussion about human development and life perspective and that is exactly the problem. Sometimes we try to mix up. We say artificial intelligence kills our jobs or kills the possibility for the people. But we shouldn't mix that up. So people have to develop themselves in a direction where they can contribute and where machines cannot contribute and they have to be open in that direction, but be flexible over the lifetime.

I: How can we best train this kind of human-machine interaction?

1#22: How can we best train it? We have to give people a kind of safety. So, I can only compare it if I'm in a company. If I am in a classical workplace: suddenly they get a new colleague that is a robot. So what we have to give the human people is kind of security about what will be their perspectives. And if we give them a kind of security and develop them and be a part of a development in their environment, they will take it. We still use that expression, especially in the environment when we talk about data generation and dealing with shop floor information. It was always hard to bring people to a point where they had to track performances of machines manually with a pencil in the hand. Everybody told it's a big effort and it's a waste of time and why do we do that? Now where we implemented tablets and they had to fill in the information in tablets, nobody complained. Everybody was happy because they had a tablet It was still the same information. It was still the same input, but it was fancy to have such a toy. Artificial intelligence and IT solutions can also be fancy, can be interesting for people and I think it's important that we create an environment where it's a positive thing to be a part of it. Not only negative thing.

I: This is more or less the last question which kind of advice would you give to young students or the younger generation on which kind of skills should they concentrate on?

1#22: What I see at the moment is that we more and more forget about the classical skills.

I: What are classical skills for you?

1#22: IT Solutions, algorithm programming parts. If I go nowadays down on the shop floor and I observe what's going on there, that is not intelligent. That is very basic, very unstructured. The problem nowadays is that people are very much focused on IT. On computers and on apps and all that stuff, - we have to bring young people back into a physical reality. How does the shop floor work? How does the material flow? What is wrong there? We lose the capability to live in a real physical environment. A lot of young people are not any more interested in there and we will generate an enormous gap with because we live in a virtual reality that does not fit into the physical reality in the real world and we have to be careful that we still have enough people that are capable to generate hardware, not only algorithm. You cannot eat algorithm.

I: Cool, so that was like my last question. But if you have something to add to the topic, feel free.

1#22: Yeah that is for me the most important message. We generate with hardware material. And we have to focus that we understand the processes that we manage the processes and we have to see the artificial intelligence as something that will support us. And we have to understand what is happening there. I want a perspective where we as human beings need not to control any more artificial intelligence because artificial intelligence can develop itself. There I see the biggest risk at the moment that we don't understand what's going on anymore. And there are several areas in the world already where we lost control but clear understanding what's happening more and more. It's internet what's going on there? We have effects there that we cannot understand because they are based on algorithm, we don't understand anymore. And if we continue in this direction it is the biggest danger for me. I'm not against artificial intelligence, but we still have to understand what's happening there.

Interview 23

I: What do you think are human abilities?

1#23: In general, I would say everything with emotions and empathic behaviour. I think in some cases there is some decision necessary, but the last decision should always be taken by human beings. Intuition and gut feeling- two points we have to consider when talking about decision-making, because that is something that technology will never be able to put into algorithms.

I: What do you think are non-human abilities? In which kind of abilities are robotics or Technologies better in?

1#23: All the tasks where people are getting bored, heavy-weight tasks, machines can act as support here and humans can spend the time, knowledge and capabilities of human intelligence for example for creative tasks. In sum, all the tasks which are repetitive, non-creative, boring, time intensive and heavy-weighted can be taken out by machines.

I: When we now look at the workplace, which kind of skills do you think are really important to have in future?

1#23: To be open-minded, to be willing to learn, to have intellectual knowledge, because your knowledge what you know is kind of a rich advantage, to have sustainable behaviour, more heart and care-taking related skills, the whole tasks about CSR. Relationship-building will be much more important in future.

I: Okay, and when we now go to the human machine interaction. What do you think are potentials for human machine interactions?

1#23: In manufacturing, there is a lot of potential, where you have repeatable tests and procedures you can already digitalize and optimize.

I: What are you answering people that are afraid of losing their jobs because of automation?

1#23: You have to find a spot where you feel comfortable in, a combination between opportunity for digitalization but also opportunity for personal development. There is the fear between intellectual elite versus everybody gets the same access to content. So, life-long learning and learning systems have to be very innovative. Starting in kindergarten, you get the benefit of just learning, and learning does not stop after universities, it is lifetime learning. The virtualization and free access to universities all over the world allows to get trained and educated in areas where you want to learn more.

I: Okay, so you already talked a little bit about education and maybe how education has to reshape for the future. Could you maybe elaborate a little bit more on that and maybe also how politics has to react to this kind of challenges?

1#23: Starting with politics, the German system is really federal and there is an individualized educational system. The other thing is that we have to integrate technology in a very early stage and already have to educate kids, that technology will be part of their life forever. I think what we see at the moment at the democratic systems especially in Europe where the young generation and people are fighting for environment protection with an ability for changing the system, whatever

this means. There is much more traction and impact also how decision makers will act in the future. It is a very historic moment in both politics and technology.

I: Yes, I totally agree to that. This is the last question: which kind of advice would you give young students right now on which kind of skills should they concentrate on?

1#23: Be open, go for the ideal, use the experience of mentors around you and try to co-work.

I: Cool, so that was my last question. But if you have something to add to the discussion, feel free.

1#23: I'd like to add maybe just some comments on what I think are human capabilities and that's the creativity. Sometimes, we can't explain ourselves and I think whatever we are going to teach a machine or how perfect we are going to design it, it won't be able to copy a human mind, including emotions and spontaneous decisions. I think especially this is going to be a chance. Since the last year's there's so much focus on technology. This might be a new chance for people to make money from art and music and from things machine can't copy. Machines can give us the opportunity to enrich our lives, to explore more ourselves, the arts and our mind-set.

Interview 24

I: What are human abilities?

1#24: To my mind it is the ability to think. The second thing is being creative. A third area might be things that we can do with our hands and where we can show empathy. These may be some of the most important things that come to mind spontaneously.

I: What do you think are non-human abilities?

1#24: Non-human abilities among those are certainly the digestion of huge amounts of data in a short time. Everything is related now to doing things in a short time. I think it's partly solving complex problems in a time frame that is reasonable in terms of when a solution is needed. That doesn't mean that humans cannot solve complex problems, but sometimes you need a solution pretty quickly and that's where humans probably have challenges because of the capacity of our brain. But I think that the foremost thing is probably the digestion of huge amounts of data and doing routine tasks for a very long time period without losing concentration. That's the second thing.

I: Alright and when we now think about the workplace, what do you think are important skills that we will need in future?

1#24: I think, creativity is some of the things that we will need, the ability to innovate, ready to think, to have a forward-looking perspective, and continuously learning would be another thing. Still and that may sound contradictory to what I've said before but being able to maybe cut a complex problem in smaller pieces so that it can be solved either by many humans or by a machine. I would say something that I paraphrase as common sense or critical thinking. I think that's an important skill. Empathy or emotional intelligence, are certainly also among those and that will probably also impact the way we lead. So leadership is something that's needed today and that is something that will be needed tomorrow or in the future: Leadership in the workplace so that we can substitute the work, coach people, develop them, develop the company or the workplace further. All that requires leadership. Maybe the type of leadership is probably something new.

I: Okay, could you maybe just say two more sentences about the leadership. How will it change?

1#24: So I think if you look at what we learned from the agility paradigm and agile and self-directed teams, which can act more independently now, I think a leader for example needs an open mind-set to learn new things and also motivates the team and helps the team to develop an open mind-set. It will all be a much more coaching relationship than giving directions and guidance, but also having a very open feedback culture.

I: Now we look more into the part of human-machine interaction. What do you think are potentials for human machine interaction?

1#24: I think the potential lies in every industry. We have seen a lot of human-machine interaction already for example in manufacturing. So everywhere where things are getting produced in the future. And also today we will see some human-machine interactions in insurance, banking and health care. Maybe we should differentiate between just a machine interacts with a customer or the machine interacts with an employee within the enterprise. But still I think you will see it in all industries. So machines interacting with customers, for example, if you think of a chatbot, kind of a virtual machine or

human-like robots that can also serve as a concierge in hotel or at the airport or in hospital. That's the one thing. The other thing is if you think of enterprises or companies you could imagine that machines help employees take better decisions or help develop new insights from large amounts of data or they can help judges and lawyers to digest of legal text for example to come to better decision because they can include more information and more data. So I think it will be in every industry with 2 differentiations: interaction with customers and interactions with employees.

I: What do you answer people that are maybe afraid of losing their job because of like more machines?

1#24: Well, I think you know, we should first of all look at the opportunities. First discussion is going on regarding 'do machines replace humans or do machines support humans or augment their intelligence and their work'? So I think the objective should be that machines support human that they can make their job better. Because they take over the routine activities that typically are no fun anyway, and people would like to focus on the more creative aspect or the more innovative aspects of their job because it's more interesting. However, there are simply jobs where you can say, this is something that can be automated completely that's a kind of a contradiction to what I just said. But the overall goal for me would be that in general especially for knowledge workers, the machine should augment the work and support humans who would more interact with machines than a machine replaces a human. In the case of the routine jobs, I would say, you know, let's focus on what is your job and what are the options and what is the potential for you within the company to develop yourself further, can you evolve into a new area? Because typically there is of course an efficiency aspect with that. Companies think of what can be automated in terms of what can machines do versus humans. But typically, there are a lot of tasks that where there's a lack of resources. So the question is, how can we retrain people? And how can we make them fit for different kinds of jobs? I know that this is a more general statement and that there will always be individuals who still suffer from loss of jobs. But that's the usual transformation and we have had that more or less all the time. I mean that doesn't make these people happy but if they have an open mind, if they are open to be retrained and do something else. If you look at the job market, there must be something for everyone.

I: And what do you think are challenges for your industry?

1#24: I think this discussion is about especially the acceptance of new technologies and how they are introduced into the workplace. So I think that's something that we have to deal with constantly and continuously and as our CEO once said if you introduce new technologies into the market, then you have a certain responsibility that they are used in reasonable way. And I think that's the challenge- that the technology industry must make sure and also ensure people that this is not meant to do them harm, this is meant to create progress in the world and to solve some of the most challenging problems that we have in our world and that we all have certain principles which we work for. That means for example, we don't do harm to anyone. The objective is to augment the work and not replace the work for example. I think this is the discussion and one of the challenges that the technology industry faces. On the other this is also a challenge and probably a lot of industries have because also there will be products that have nothing to do with technology. So it's not only technology but I think it's several industries that may face similar challenges.

I: What do you think should be the direction of politics?

1#24: That's again a really interesting question that we just discussed in the past couple of weeks. How do we actually submit that in the context that we're living in, in the environment that we're living in? So I think overall and that's a constant responsibility of politics is to see what is changing, how the world is evolving what's coming and starting in continuing the debate of how do we actually implement these values that we share. With that I mean that we decide when we want to use

technology where we don't want to use technology. But that is a pretty complex question because you cannot just say you can't use technology in this or in this area because we will lose that many jobs. Because that might be a very short-sighted decision. You have to consider the overall context, the overall context of society, of economy, the overall context for a globalized world that we live in. So it's a lot of different aspects that need to be considered but it may result in the end that you see couple of regulations. For example, you say how can I use personal data in a healthcare context? That's different to how can we use data in a manufacturing context where you don't have these personal data. I think it's important for politics to set everything in the context and don't put out regulations that are too general but that it fits the purpose. There needs to be a constant debate about that and that should not be started too late. And maybe a second thing to think about the areas where the Government wants to invest in so that they make sure our nation can stay competitive. That's the other aspect that needs to be taken into account. What does it help if I maybe short term secure 20,000 jobs in Industry XYZ but that means that in three years, we have no idea how to compete in the World Market because that industry is going everywhere else and no one wants the product.

I: Which advice would you give young students, which skills should they concentrate on?

1#24: Again, a tough question and I just had similar discussion with one of our friends children who just started university. It's not too easy to answer because I think if you look at today's university degrees that you can get especially on the master's degree from my perspective, some of them are pretty narrow. To a certain extent this is good because for example, if you for example take technology and focus on artificial intelligence or machine learning you can focus on data science. This is good because that's needed right away. If you're a specialist in this or an expert in this area you will definitely find a job. On the other hand, I think as we all know that we have to learn continuously in our life. Being too narrow and focusing too much on one topic can make it, doesn't have to, but can make it difficult later on to retrain and to move into a different area. So I think it should be a good combination of specialization and generalization and that you can move into a different area. However, a certain amount of technology skills, are important to have as well. Just focusing on business administration may not be enough in future. But I can't tell, I don't know what’s right, it's just a gut feeling, because a little bit of technology will be everywhere. The second area I think is the so-called soft skills. Here I think about project leadership: How do I lead teams, how to train communication skills, how to exercise creativity as an individual or in a team. All these different soft skills and knowing how to get a certain structure in your mind and how you can apply methods on a certain problem, I think that's some general skills that you should also acquire. I know it's a lot and I wonder if I did the same when I went to University probably not but the one crucial thing is to develop an open mind-set. At the end, what you have learnt at University will help you for the first couple of years. Then you need to always learn new things. Jumping back and saying I have my degree now and now life is beautiful is not enough. Life may be beautiful, but you know, you will not get away without learning. Life-long learning will be essential.

I: Perfect, thanks for your time and sharing your insights.

Interview 25

I: Thank you for your quick responding answering my E-Mail and for your time! Then the first question would be what do you think are human abilities?

1#25: I will ask in regards to manipulation and capabilities to handle things in the physical world. That's where I'm looking at. If I think about robots on the one hand humans on the other hand I mean very generally speaking I would say that what is the main distinguishing factor between robots and humans is that humans have a big brain and the brain allows them to intelligently understand and analyse the world and then also make very clever decisions on that. And then because of all the actuators we have built in our body to act on that world all in a very intelligent way much beyond what robotic systems can do today. So I mean I hope it's ok that I do this kind of comparison that is easier for me than to just to look at generally what human abilities are.

I: The second question would actually be what are non-human abilities, so you can combine these two sights.

1#25: Ah yes, that makes it easier for me. Human intelligence is an important factor in that and far beyond what artificial intelligence can do at the moment. And that goes across many areas. Obviously, there are certain fields where computers and computer programs already are ahead of what a human can do. So for example playing chess and playing Go are very specialized areas and the AI that has been developed there is very different from the human intelligence because it has a lot of emphasis on trying things out so that you just run at very high speed. My hypothesis on what your next move should be if you have the opportunity in very short time to try all possible avenues now then obviously, you will have an advantage they are compared to the human will and can run only at a given speed. So, the ability there is the whole one that we can make use of this fantastic interaction between all the neurons that we have. Many synapses in our brain can do a very effective pilot process. That has not been achieved through robotics yet. That is the most important difference and definitely it is part of the overall equation. For example, intuition is something we have not been able to program yet. It's difficult to capture the processes and understand where it comes from. Emotion are other aspects that have not been programmed properly yet. The brain with all its aspects is very important and complex. One might argue emotions are not so important but if we think about human-robot interaction or also about human-human interaction then emotions can be very important and if we wanted to develop all these robots that can somehow communicate or handle humans in one way or another the emotions might be very important. The brain is a grey matter. One says well actually it's a very dark matter because we cannot really see what's happening there. So it is very opaque. It can only make some guesses through observing each other. I mean obviously people try to do brain scans as well but very limited results. There have been of course a lot of attempts now to emulate that and you have heard of neural networks and deep neural networks, deep learning and all the rest of it which is very good and it proves to be very successful at least for some applications. The main issue I can see here is that again we cannot really see what's happening. Again, it's a black box. We train it, I mean we make it learn, we make its doing the connections between inputs and output, but what is really happening inside, is not clear and I see that as a big problem. Because I mean from an engineering point of view it's very good, you know it solves the problem. But from a scientific research point of view it's not so good because we don't learn anything. It doesn't bring us forward. I mean there are efforts now to understand what's happening in these networks but we are very much at the beginning there and I'm not too sure whether it will lead to a good result at the end or a good understanding of these neural networks and a good understanding of our brain we don't know. Anyway, I've spoken a lot about the brain and one can also of course speak about the sensors that are built into the humans and into the actuators and the mechanisms that we have on the central front. Lots of stuff has been done again in the robotic world or generally in the engineering world but sensors are still very limited in their capabilities and they compare that to the huge human counterpart. In particular, I think

about tactile and fore-sensing. So, we have in our hands many thousands of nerve endings and tactile receptors and I haven't seen a robot finger with a similar number of tactile sensors built in. From that perspective, very primitive to what is still out there. I mean if you look at vision- it has been improving in machines and robotics. Well let's say the capability to receive images has meant we have now high definition and ultra high definition cameras with lots of pixels on them. So the images we can read in are brilliant. They have a highly developed optics we can zoom in better than humans can. But then on the other hand that is only the image itself. What we humans are very good at is actually interpreting these images. So I can see you very clearly on that screen now and even though it's only a very cheap 2D representation of you I can very easily distinguish between you and the background. That is still to a certain extent a challenge for these artificial systems. Although a lot of progress has been made especially as using new networks and deep networks being implemented on hardware. GPU, meaning Graphic processing units can operate at very high speeds. They effectively have also parallel processing mechanisms, but the improvements staggered in the last five years or so. Systems have been developed that can maybe not match yet the human way of vision but getting closer and closer encapsulated that is quite impressive. Again, difficult to understand how it is actually happening and the other thing what I find quite interesting for the interpretational interception are similar the humans are processing images in the brain with numbers of layers that do different perception tasks. When create artificial muscles that are comparable to human muscles are still far away-but we are still far away from creating something that is in a very local area, by just doing electric stimulation and carry out some movement- so movement is a great human ability.

I: In regards to the time, one last question: What are potentials in human-machine interaction?

1#25: Maybe I come with a very specific answer here: I have interest in human-robot collaboration, in particular in the manufacturing environment- I can see there some potential. I can say that, because technology is not yet there, to fully automate manufacturing processes, some areas are virtually automated, e.g. car manufacturing industry, but there are other industries, where there’s a wider range of complexity. There will be in the foreseeable future, tasks where humans will still be involved. Now to bring the human together with the robot: I think humans are better in precise movements and collaborations. This could be a very good way forward, before the technology gets fully automated. For example, Ocado, food product distributor, is an online food supermarket and they don’t have any shops, you can only order it online and then it will be delivered to you. They recognize that it’s very difficult to pick up different objects with robotics hand, so that’s where you need the humans. There is scope for replacing humans, but also scope for collaborations and for certain tasks. There are repetitive tasks at certain points, not the best working environment and to release the humans in this kind of sense would be useful. There are also of course other areas where human-machine interaction is useful: The care of the elderly & disabled surgery and where robotics can help and lots of interaction between robots and humans. Further, there is GPS, where we have already AI applications, we don’t see them as an AI anymore, but it is marvellous, I would be lost without AI.

Interview 26

I: What is uniquely human?

1#26: These are two questions, so what is typically human and what other abilities can only be performed by humans. If we look at ourselves, the typically human is the multidimensional intelligence and differ different dimensions such as sensor-motoric, cognitive emotional and social possibly even collective. And in these dimensions the human being has a self-confidence and he lives in his action in confrontation with the environment in the context of what he wants to achieve. He is driven by his desires, hopes, dreams. Then it's about power, vanity and a desire for prestige, about gratitude and helpfulness and so on. All this belongs to the typical human and it is something of which we know that it motivates people to perform actions in a certain way. There is also jealousy when you think about it that is typically human. And then you would say that could lead us over to the phenomenon of empathy. We need empathy to find out how the environment is doing or to simulate how our reactions might provoke mine against my actions. In the original understanding you can't explain this algorithmically but you have to include the dimensions of credibility because our needs are not imaginary needs they are all signals from the body and it's very hard to code. Fear, for example, is something that is difficult to represent in machines. It is something completely different to feel. Contrary to what you could implement as a kind of point system so that a machine tries to optimize a state. This is all relatively simple. But the feeling is always something completely different. People and machines are very different. We just have to start thinking about the human being and his personality and structure. Then we realize that as soon as you build systems that have these competences somehow have competence in these dimensions. In order to be successful or to be reliable we have no idea how to achieve these goals because we simply don't want to be people's knowledge about their thinking, about their life. We know far too little. These are the basics and a lot of abilities are derived from them. And you have to look an ability should now also be a trait and should serve to achieve a goal.

I: What are non-human abilities?

1#26: Let's just say flying is not a human ability. Hearing is a human ability but only the range is very small. Of course, we do not hear in the high frequency range. Seeing is only possible in a very small spectrum. So, there are even obvious natural limits. You need concentration to think. You have to be able to focus and maintain concentration over time. That seems to be something that human cannot do very well. In some cases, very many different aspects but in a temporal proximity should work on. The human being says ‘switchen’ from one topic to the other one speaks frivolously way of the fact that some could process parallel which is not naturally. You know it from the processor, where a task is assigned to a processor and the processor works briefly on it and then it moves to the next task. And it's not an emotional burden for a processor. For humans, this is a tremendous emotional burden. It leads to the fact that sometimes it depends a bit on the hierarchical structure that you don't want to be disturbed. That's very different from processors that just stop and take over the calculations exactly where I was before. Of course, everything that has to do with a certain monotony is something that people can't do well. Humans + AI are unbeatable.

I: Where do you see potentials in human-machine interaction?

1#26: I would say that wherever you use tools, you will continue to use tools. These tools will help us a lot. If we accept that we are the solution and the tools help us to put something into action, then it is all in a very good relationship. If we believe that the tool itself is active, then we are not in a good relationship. And now mankind has been thinking about it for a long time. Aristotle has thought about it. He also thought about what it would do to society. I like to describe the fast

machine translation. 1955/56 in the Cold War era, the motivation to translate Russian texts into English was high. Meanwhile the systems are really good. If one tests this system one will determine which problem, it solves and will then also see which problem it does not solve. It doesn't solve the problem of induced communication with a language I don't understand at all, so it means translating a written text in my native language correctly for other languages. This problem does not solve it completely.

I: What are the challenges with critical discussions about AI?

1#26: That is correct negative reporting on AI is in the headlines. I have to say that I often have the impression that journalists are fictionally driven and that they benefit from the fact that it is so easy to skip some requirements and ask questions that we would say are not so easy to answer and then to decorate with terms that are then clicked extraordinarily often. Otherwise, this only leads to too much social nervousness, to a decisive emotionality that can no longer be controlled, and to a scepticism of innovative power. Something else that has just occurred to me, we do not know what human self-confidence is. We know that our own self-confidence is. We don't know how it comes about. We do not know when it will arise. We suspect that it has so obviously to do with the brain. But we have to see that this confusion does not become a social confusion. I believe that you simply have to start socially, but you also have to do some educational work: what is it about all these terms, because many people only hear the buzzwords?

I: What are potentials for humans at the future workplace compared to machines?

1#26: The human being has endless abilities that are much better than what machines can do. If you look at the study of Osborn and Frei. 2013, Oxford Martin School, at the beginning there's a list of 700 professions that are weighted with the probability that these professions can be automated or not. And it's just when you look at the 20 professions that can hardly be computerized and the 20 professions that you think can be computerized extraordinarily far, then you have some professions to deal with, I think that's not bad. Humans need as humans as counterparts. Obviously, the machine is not in the right place for the working ability to engage in dialogue. AI can achieve a lot in the whole area of health and in analysis, so that it supports diagnosis or anamnesis. But then, for example, things happen in the doctor's office that cannot be explained anyway, it may have to do with the right formulation, the right emphasis or the aura of the doctor that can sometimes ignite the self-healing powers. Furthermore, I think it will be the case that people will continue to enjoy eating and I think they want to be welcomed and served by a person. There shouldn't be a robot. They want to sit at the table, they don't want to type in an electronic menu. I think they would rather have a conversation with a person. When it comes to bedridden patients having to be touched and transferred. You need high emotional intelligence to do it in a way that makes the people feel good. Here the robot can relieve the caregivers.

I: I know your schedule, so that was my last question, if you have anything to add to the discussion, feel free:

1#26: I am quite concerned about the technological disinterest in society, but also that too much data can lead to manipulation, such as health data. I believe that total surveillance may superficially lead to more security in the public space, but it leads to an absence of society.

Interview 27

I: What are uniquely human abilities?

4#27: Mhh, which abilities are typically human – probably the others have said the same: empathic reaction, so exactly what children learn from the beginning, connecting with emotions, that is typically human for me. Even in an environment with others, even if it is virtual – but nevertheless what I lack in a concern is that it's hard communicating with my colleagues. So that's why I need network events. I need other people around me. I have to be able to touch them, to see them, to smell them, to feel them. Then we can much better work together We simply notice that despite all these great new digital tools, people are missing exactly one room to be in and to come together. And what's real is to react empathetically in any case, which means to respond to others. But also. Be flexible and to feel such a loyalty at all. Ethical and responsible thinking. And a sense of responsibility towards others and responsible leadership. That is in any case, also very human for me.

I: Are there any other abilities next to what you've already said, like empathy, flexibility, loyalty and responsibility?

4#27: What I meant a moment ago was to awaken all these emotions, to inspire, to speak of charismatic leadership, to inspire others, but to create an environment of trust, to feel comfortable. That's what it is for me to trust this supportive action and then try something new. That's something I think machines can't take over. Sophie, for example, this humanoid robot and therefore I believe humans should also remain humans with trusting interaction and emotional action, because facial expressions and gestures are often intuitive connections that a robot cannot really learn.

I: What are non-human abilities?

4#27: Typical routine assembly line work. There are many studies to suggest that this work really makes you sick. That is definitely not human. In all kinds of industries, where routine work is involved, where heavy loads are involved, everything that can physically affect me. Robotic can be very supportive in nursing and old people's homes, not in an emotional sense, because this should be the task of the people.

I: What are future skills for the future workplace?

4#27: We also deal a lot with future competences and abilities and we notice that professional competences are extremely diminishing. On the one hand, we need to work together virtually so that we remain capable of learning - that is, we need constant motivation to learn, the ability to learn and the flexibility mentioned. Learning from scratch every time. Teamwork is becoming more important than ever. Projects and team members are divided worldwide. Show this topic also humanity. Bringing this trust with you and giving trust, giving feedback, sharing knowledge and, of course, a great ability to communicate with others to teach this. But on the other hand also expressing one's own needs and promoting good cooperation which becomes more important than ever when we work together virtually and the topic of self-leadership, in the sense of I also have to take responsibility myself, because we learn that quickly at school. Always someone prescribes that we both learn that we have prescribed everything for ourselves. And that's exactly what we have to learn to take responsibility for ourselves as well as for the company in terms of entrepreneurship. To think along on our own responsibility and to want to constantly develop the organization further. I think, if we already had these competencies for everyone, we would be quite far.

I: What about digital or technical skills?

4#27: It depends on the time horizon. In the medium term, I would definitely say that it is important but basic training in computational thinking is important. How does digitisation in general work? And there are of course those who are more familiar with technology but the operation of programming. Nevertheless, I think that this human level is very important because if we can all work well together, I can bring trust, commitment and future fields to the table. The worst thing is when you see this as a threat but not as a good addition. There is this concept of human creativity and machine intelligence, it's called "humachine" and I think that the human abilities are simply important and should not be neglected.

I: Do you have a training concept for adapting those future skills?

4#27: That this not going to happen by itself is clear. We have already devised various concepts for this. This falls under mind-set shift and culture.

I: Where do you see potentials in human-machine interaction?

4#27: Of course, a great deal is involved in manufacturing. Much has already been automated in production. I see great potential especially in the health sector. And analysis of X-ray images and so on. There we can do much more and minimize human errors. The decisive factor here is the interaction between man and machine.

I: What are uniquely human abilities?

5#28: That's a difficult question. To this question there is the standard answer or the realistic answer: The standard answer is everything that is human, cannot be replaced. Personal approach, creativity, communication, understanding of subtexts in human communication and face-to-face communication, complex activities. It is generally said that these topics in particular can never be covered by robots or machines. I have my doubts about this standard answer. Why do I have doubts? Because the last few years have shown that areas that we described ten years ago as typically human can now almost be covered as well by computers or rather by deep learning mechanisms. For example, assessing the marketability of creative designs. This happened in Japan 3 years ago when a CEO was replaced by an AI because it was said that AI could better assess marketability. This is an intrusion into human competence. Although AI can be creative, it is of course imitated creativity and not comparable to human creativity. In my opinion, and I'm probably in the minority, it's about co-working, pro-actively and preventively focusing on AI and we have to be prepared to learn new skills that come from interacting with the machine, both of which together is the real potential from my point of view. There will be no area absolutely none, in my opinion, in the human or professional field that is excluded from AI. Therefore, co-working with machines is the future.

I: What are non-human abilities?

5#28: To the previous question, emotional-psychological abilities are clearly still human abilities. It is also often said that AI will replace low qualifications. I believe that AI will penetrate these areas regardless of the level of qualification of the human being. Already four years ago in a finance agency in Hong Kong, a human finance director was replaced by an AI decision-maker finance director. Normally one calls executive board positions, whether this is true or not, however as highly-qualified jobs. On the other hand, warehouse workers from other companies are equipped with VR glasses in order to do more highly qualified work. So, different fields of activity and industries are exposed to this change.

I: Where do you see potentials in human-machine interaction?

5#28: Well, I could only give a general answer because basically every process, be it environmental protection or in the care sector, has enormous potential. Especially in the care sector. But if in 5 years people in Germany say that they no longer want AI at all in the care sector, then technology is not beneficial. An awareness change in society has to take place here. This is difficult to predict.

I: Which skills are important at the future workplace?

5#28: It depends naturally completely strongly on in which area one is active. First of all you can't get any further with the classic job classification. But nevertheless it is clearly social skills, so-called soft skills but also an open approach to human-machine interaction.

I: How do we have to rethink education?

5#28: That of course depends strongly on the country. In Germany, we are below average and honestly it is a fiasco. When I look at the work situation, mobile working becomes more and more important. If this form of work is offered, wouldn't we have to offer it for education as well? Open provocative question: Why do we still need the school or university as a building? Why? We are going in the direction of virtual teams and cooperation, and that doesn't happen in the field of education. The digital infrastructure in Germany is miserable in schools, no WLAN, no hardware, no software, and always discussions about data protection. In Scandinavia, they are already much further along. The third construction site is the integration of digitalisation into curricula, both in the presentation of content and as a topic in itself. Example: in geography application of the world map could be integrated as an interactive learning tool. It would be an immense gain not to carry around anymore schoolbooks and also to save paper. In the area of politics & society, digital topics could be adapted to the social security systems & legal bases. Or in mathematics with applied computer science As you can see, there is so much potential and the curricula urgently needs to be revised!

I: Do you have something to add to the discussion?

5#28: Yes, some more thoughts about company culture. It is important not only to distribute tablets as a technology measure, but also to build digitalization in the corporate culture. Technology and culture must always be thought together. They often have the problem that decision-makers who are older do not have any digital expertise at all. Here we must clearly offer lifelong training for all levels.

Interview 29

I: What do you think are human abilities?

1#29: Right now, it is changing quite dramatically. What was uniquely human 10 years ago is I think much smaller or much less now than it was 10 years ago. Right now, I'd say what's uniquely human is of course the kind of person to person interactions. Developing collaborations and having cross-functional teams to achieve change. This is quite uniquely human. I think humans like to be managed by people as well. So I think management skills are quite uniquely human. Also, complex problem solving is uniquely human. The problem-solving space has been used to be quite uniquely human but I think that's changed quite a lot. Machines taking over that space quite a lot. The manual labour and repetitive tasks is not a debate of uniquely human.

I: How do you think will this kind of manual labour change?

1#29: I think a lot of manual labour will be replaced and the performance of automated systems to perform tasks will increase. I think it will also be replaced because the type of work people want to do: they want to be involved more in their creative side of production and design. They want to be more involved in management of systems and maintenance of systems and so forth. So, I think that's the way of changing.

I: And when we now go a little bit into the opposite what do you think are non- human abilities? So, in which kind of sense are machines or robots better than humans.

1#29: In a lot of which can be phrased human efficiency machines do better than us. Humans have limited computational power I think machines by far exceed us on those processing capability. I think it provides a prime space for machines to work. I think also kind of a traceability of decision making. If you set an algorithm with a particular light making decision on to a problem, it's traceable. I think that the flexibility of decision rules is not as good as for machines yet but we'll getting there. But at the moment algorithms tend to make a decision and defined by the rules which they'll predict where humans can often change their decision-making patterns quite quickly. In terms of tasks, I think uniquely machine tasks or things like precision work and repetition. And the ability to kind of understand large amounts of data or extract meaning from large amounts data will make systems increasing.

I: OK. And if we now talk about humans and machines: what do you think are potentials in this the human-machine interaction?

1#29: If you think about some of the cutting-edge applications of human machine interactions I think I mean there's the obvious ones. Machines can because they can comprehend vast amounts. There's the opportunities for interaction between machines doing a lot of that computational work and then humans being kind of the check that works like an ultimate decision point. I think the human is important for kind of defining those rules: beginning to define the problem and also checking the output and implementation or putting at least kicking off the process of computation like this. That's been demonstrated in things like manufacturing related.

I: Yeah I totally agree. And if you have to think about skills for the future- which kind of skills would that be for the future workforce?

1#29: I think the creative kind of design is a huge space but we seem to need more and more people in particular these kinds of tasks. Machines take up more as I mentioned before of the manual repetitive tasks. The creative gene has not yet been duplicated in machines as well. They say they can to a certain extent. But I think at some stage with humans because we'll find a lot of self-actualization and they want to work in a very inspiring and very rewarding space to work. I think there is partly needs from companies to set this up, because people want to work in that sort of creative work. I think we're always going to need maintenance personnel machines that do the work on production. I mean humans are always going to be quite integral for R&D and innovation. So, I think the major process innovations is going to be massive place for humans and human skills to be able to kind of design and implement new processes on the shop floor and new practices that I think to a certain extent when you've got large customers. I think the kind of human sales factors will be big simply big deal. I don't see that machines will completely replace it. But if you're a company that has a great broad customer base and not very high value products then that will be easily replaced by machines. I mentioned before management skills I think people have a much higher expectation of manage capabilities now. So, any people who are working in design or process or new product development or anything like that they will have a higher expectation of management. So, I think management skills and processes will have to improve. And often that's where a lot of a lot of innovation will come. A difficult question to answer. Maybe something else is coming to my mind in the next minutes.

I: What kind of challenges do you have in the manufacturing industry?

1#29: Right now, a major challenge is the unknown procedure of Brexit. That's gonna be the number one major challenge short manufacturers approaching an unknown relationship with Europe. Unknown ability to export and import raw materials or different materials and export products. That's going to be the major theme I think over time where we still do need more manual labour. I think the UK will struggle there's a cultural respect to providing the UK where the people who work in manufacturing to people to grow companies. So companies in the UK if they're created are often sold quite early because that's not the cultural recognition that they can pay for growing a company or you're recognized for being an entrepreneur and then sells it makes millions and retires whereas in many other countries particularly in East Asia there's more respect for growing a company even there is just starting one. I would say that under the major managerial challenges technically, is also the scaling up topic. One of the major challenges we've always come across people is that we just don't have the technical skills now and yet we are turning people all the time from universities who have very good engineering degrees and very good science degrees but they don't seem to be right for the companies. The problem rests partly in what we're teaching in universities but it also rests quite significantly with how much less companies are investing in there and start to tighten them up. And that's partly a result of this declining company funded training for the staff, but also staff members circle around much more than they used to and as a consequence that deters companies from wanting to invest too much in this stuff because they leave. And this is this kind of dilemma: we have to train them because what if we don't train them and they stay. And I think that's a very good argument for getting people to upskilling. Manufacturing companies often have trouble making places or significant new developments in the UK.

I: So you've already talked a little bit about education and also universities -what do you think are answers of politics and maybe how do they have to rethink education for the upcoming challenges?

1#29: There are unique challenges that face government and politicians in particular about: life learning so people now will work much longer. They will need to be retrained throughout their life potential flooding in different careers. And it's not something that we haven't cracked yet. We're still in a very linear model of going to education, work and retire. We haven't found a structure for people's lifestyles where the education, work, education, work, education, work and then retire model fits throughout their lives. So, I think that kind of retraining is perhaps the biggest on a very large challenge. But the

government has been thinking about this for some time now and it is a pretty tricky problem to crack. I think the government does a pretty good job at publicising manufacturing and trying to kind of break that culture. But if you work in the manufacturing sector that's unglamorous as if you're a doctor or a lawyer or a banker. And I think they actually do a pretty good job of saying know we've got some very big firms we're very proud of them and they created a lot of value to the UK economy. But I think government could certainly do more than that.

I: What kind of advise would you give university students? Which kind of skills should they concentrate on?

1#29: So, this may be completely jaded by my own experience because I was trained as an engineer but I still think engineering is very very good. I would strongly recommend it to go for engineering. There's a couple of reasons: One is fairly broad based it still gives you gives you complex solving skills. It could be skills in programming and then it gives you kind of an understanding of solving real world problems. Working in teams to do so and I think that kind of selection of skills and it gives you there is much older than most of learning so I also did a commerce degree I get a business degree outside of great time and the other one was in international business management and yeah I learnt a lot about international business and management but I didn't learn the problem-solving skills. I didn't learn much about how working in teams I learned material that was so much the application of it whereas engineering is kind of hands on very practical and I think that's very very important. So, I'd go for engineering. Many had science degrees are very good as well. But I would always push people towards the more practical end of science degrees or so. Many of my friends who have gone into kind of very basic science degrees have trouble kind of finding their own career path after that not knowing that they've got such a general skill base, a too general skill base to be able to apply it to jobs and positions so that they often have trouble.

I: This was it from my side- it's your time now feel free to add some thoughts maybe I missed out or that you think are important in this kind of discussion.

1#29: I think there is actually one more thing that I didn't mention before so I think one place for government forgot that is in coordinating national resources so particularly in countries like the UK where we're big but not the biggest. And we can't rely on the sheer scale of some of the research and industry that we have to come in the country to be much more strategic about what we pursue. We pursue a very particular area of research that links us to other dominating an industry. I think it's much more niche and emergent than that where you coordinate people and you kind of gather stop convening skills and capabilities of people you haven't a country to that then to then select the areas we should be pursuing. So that's all very vague. A particular example. I think the efforts that the UK has made in trying to forge a base in synthetic biology is very intelligent and very enlightened. I think that the government has played a role in convening some people in synthetic biology to get picked in areas Guinea sharing synthetic biology. The UK is very good at and then that we can pursue new opportunities that come in some other areas that just said we want to be good at all but not contain most people and as a consequence it's been very little support vertical focus for the UK and I think the UK has suffered a little bit because of the Brexit.

I: Perfect then thank you so much for your time and your insights.

1#29: Thanks for the opportunity, of course I'll be interested in the research results.

Interview 30

4#30: I'm working right in the middle of education and government, like a triple unit. Every project we start is in between. We are working on five challenges, education, smart mobility, jobs of the future, health and data. I think you're interested in future of work right?

I: Yes.

I: So how does future of work change?

4#30: We have to define our own values. What trends do we see? We see that job descriptions are changing, meaning that new jobs arise, that we need digital skills, but more or less leadership skills. The second is the future of education. So what do we need to teach and how can we best prepare our kids? And how do we have to teach? But also how do we manage the huge amount of learning and how do we re-and up-skilling the people, who maybe not lose their jobs, but maybe need other competencies? The third one includes technology- how is technology shaping work and education, how can we use technology, also in regards of inclusion and diversity?

I: When we talk about skills, what skills do we need?

4#30: The main skills- learn-to learn, be adaptable, how to re- and upskill yourself. There is a discussion about soft skills and form the basics, but besides that, when we have ambitions in circular economy or digital environment we need hard skills, like digital skills to make sure kids can be part of the digital society and circular economy. What is important besides digital skills is creativity and this should be taught already really early. You can't really start young enough with preparations for the future.

I: When you think about what specific skills or human abilities do we need for the future workforce- what human abilities?

4#30: Human abilities can be anything. I mean the adaptability and learning is important. I don't think robots are taking over our jobs. I don't believe in that. Digitalization and automation is a chance for us and our leaders, because all in all in the end it creates more and more jobs. And humans can concentrate on creativity, authenticity and solving problems. Leadership requires human tasks.

I: What are non-human abilities?

4#30: Everything that has to do with data or AI or logical thinking, computer and technology is better in than us. It is already now but it will be more and more in the near future. A lot of tasks, that are repetitive, we'll be automated and then I'll really think that's nothing to be afraid of because in those jobs or tasks not many people find themselves really intrinsic motivated.

I: Thanks for your time and your insights.