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Entrepreneurship & Innovation

AI and the Future of Work

A Master's Thesis submitted for the degree of
“Master of Business Administration”

supervised by
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Vienna, 01.07.2019

Affidavit

I, **DI ADELA MEHIC-DZANIC**, hereby declare

1. that I am the sole author of the present Master's Thesis, "AI AND THE FUTURE OF WORK", 98 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted the topic of this Master's Thesis or parts of it in any form for assessment as an examination paper, either in Austria or abroad.

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Abstract

In January 2011, a supercomputer called IBM Watson played a game Jeopardy! and won against two of its best human players in the history of this game, Ken Jennings and Brad Rutter. “And winning at Jeopardy! requires mastering of pattern matching and complex communication, repeatedly, accurately, and almost simultaneously.” (Brynjolfsson and McAfee, 2016, p. 24-27) Ever since the discussion of human superiority versus machines is ongoing and it is one of the hottest topics of nowadays.

This research aims to understand the global implications of AI and advanced technologies on jobs across the industry and find practical solutions to support industry productivity growth and novel ideas. In the first part of the study, based on the literature review, the human plus machine collaboration is carefully elaborated and made as a recommendation for the organizations to win the race against competitors and attract and keep their top talent. We are witnessing the unprecedented level of disruption and we see companies that are capable of fundamentally changing the way they serve their customers by adopting the proper mindset, being open to experimentation and investing in their workforce. (Accenture, 2018b) found that 64 percent of workers recognize that the speed of change is advancing as a result of advanced technologies such as AI.

The second part of the study focuses on the five key management practices to support organizations’ leaders to be at the forefront of implementing advanced AI technologies. Findings from a combination of theoretical and practical research through literature review and case studies suggest that factors such as leadership, data-driven decision making as well fusion skills augmenting human capabilities, could be defined as thriving factors to succeed in the world of human plus machine collaboration. This research provides actionable recommendations for all three constituents – individuals, organizations and policy makers, to better prepare for the exciting new world of work where humans will work together with machines to successfully master worlds’ greatest challenges.

Keywords: Artificial intelligence, Future of work, Lifelong learning, Workforce transition, Digitization, Employment, Future of skills, Human plus Machine, Labor market.

Preface

U ime Allaha, Milostivog, Samilosnog!

The topic of this thesis stems from my current work in the field of IoT and BigData and interests in how its progress will affect our lives in general, and especially how it will affect our employment. The future of work and skills has been one of the hottest topics in last years for a good reason and it is here to stay to inspire our imagination of how close we will work with machines.

AI and advanced technologies should empower us to do good and make the world a better place, leaving this legacy to future generations. My advice to myself and to all business leaders and policymakers is, put the people in the heart of your digital transformation and you will soon experience an exponential growth and novel business ideas. I would welcome more Greta Thunberg and role models that will pave the way forward, communicate it effectively and bring the proposition of the future of work to the Top of the Agenda of each business leader, policymaker and every individual.

I would like to express my deepest gratitude to my supervisor Univ.Prof.Dr. Sabine Köszegi who was very patient and provided great support during writing this thesis. She is one of the professors that inspires me to stay humble and think of technology as a means to solve human needs. I would welcome the opportunity to work together on different projects in the near future.

This thesis marks the end of my enriching and insightful MBA program. I would like to thank the WU Executive Academy and my fellow colleagues for their support, encouragement and willingness and ability to share their knowledge and ideas. I am thankful to Tele2 IoT for their generous support and understanding along the way.

To my husband Zlatko and our families for their love and support.

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List of Abbreviations

AI	Artificial Intelligence
ATM	Automated Teller Machine
ATR	Audi Robotic Telepresence
CHRO	Chief Human Resources Officer
ESG	Environmental, Social and Governmental
FTE	Full-Time Employee
GAN	Global Apprenticeship Network
GDPR	General Data Protection Regulation
HBR	Harvard Business Review
HR	Human Resources
ICT	Information and Communications Technology
IoT	Internet of Things
LIME	Local Interpretable Model-Agnostic Explanations
MELDS Framework	Mindset, experimentation, leadership, data and skills.
STEM	Science, Technology, Engineering, and Mathematics
UK	United Kingdom
US	United States
vs.	versus

1. Introduction

"Logic will get you from A to B. Imagination will take you everywhere."

– Albert Einstein

In this chapter, an outline of the thesis is drawn and a brief description of artificial intelligences (AI) impact on the future of work provided. A context for understanding the current applications of AI and the automation affecting multiple sectors and occupations is created.

1.1 Context of the thesis

Automation technologies including artificial intelligence as well robotics will fundamentally change the way we work, and when, how and where we work. Will future developments and adoption of this technologies cause one of the highest unemployment rate in the history? What are the future human skills that will ensure employment and boost productivity growth and incentive economies to automate? What will be the impact of other key factors such as globalization, demographics, economic and social changes on the labor markets and employment? It is evident that the current discussion in media is mainly focused on labor substitution and winners and losers of the automation and AI.

Our state-of-the-art literature review gave us a sufficient number of case studies of companies globally deploying this technologies successfully and reaping the benefits. And it's not just digital companies such as Amazon, Google and Baidu that are already dominating this media discourse and investing heavily in AI across all departments (McKinsey, 2017a). This are companies such as Rio Tinto, a global mining company from Australia that has invested hundreds of millions of dollars to completely reinvent their mines using digital technologies and connecting all their vehicles using IoT. This enabled them to create the mine of the future and be one of the first movers and offering real value to their customers and shareholders.

Rio Tinto, as well many other traditional organizations, are gaining the competitive advantage by realizing that automation goes well-beyond labor substitution and in return offering their employees challenging job-opportunities and empowering them to take on challenges of the 21st century.

While it is hard to predict how this will play out, our research provides some insight into how labor markets will respond, and how can workforce prepare for the transition.

1.2 Aim and objectives

Automation technologies including artificial intelligence as well as robotics are one of the hottest topics of our times, and one of the main growth and productivity drivers over the next decade. However, the recent discourse in media was overwhelming occupied with news all over the world, where robots are coming and taking over our jobs and the future of work is depressing. Or there is another side to the story, where humans and machines will work closely together collaborating and by that offering new and innovative solutions to the world's "moonshot" challenges starting with the climate change and curing diseases.

One of the main objectives of this master thesis is to provide clarity and strategic planning with clear action steps towards answering these questions based on existing studies and papers. We have already seen proof of this becoming mainstream, which brings hope that it is not just a hype. Hope that there are organizations that have managed to reinvent themselves, retrain and reskill their workforce and offer them more exciting jobs where they will combine their technical skills with dominantly human skills such as empathy, creativity, management and critical thinking.

What is the future of work?

The phrase "future of work" has been used very frequently and the seemingly simple question, "What is the future of work?" is difficult to answer. This thesis provides a brief overview of possible definitions in terms of how the phrase has to be understood. The framework for understanding the future of work is elaborated in details and for this master thesis, we will focus mainly on the automation technologies as the forces of change. Further forces of change such as demographics, customer empowerment and the rise of global talent markets will be introduced briefly. The idea is to provide a high-level overview of the framework, which subsequently sets the stage for the comparison of publicly available reports.

What are the skills of the future?

The idea was to determine what are the skills of the future and how will they change moving forward as automation gets more adopted and developed. Our web research gave us plenty of surveys and reports to start with, as well use-cases and studies of global companies that have ensured smooth workforce transition. It gave us an understanding of how they enabled their workers to fully utilize human skills that will keep them employed over the next decades.

Furthermore, we explored the skill trends and developments and drawn recommendations for the future workforce, organizations and policymakers.

How do we transition smoothly into the future of work?

What could organizations and policymakers do to ensure a smooth transition of their workforce and equip them with the 21st century skills? While robots are getting smaller, faster, more flexible, cheaper and being deployed across all industries, it is time to starting asking ourselves, which jobs will be left for the human workforce. Will the robots be working and paying for our salaries, such as robot taxes? Furthermore, will there be a need for the universal base income? This master thesis should help answering this questions through reports, surveys, use-cases and success stories such as AT&T investing a billion $ to reskill its workforce and prepare it for the 21st century.

What are the main challenges and hurdles for workers as well organizations?

A basic question that should also be investigated concerns the hurdles in terms why more and more companies are not implementing automation technologies. Which challenges have been listed in the literature and reports? What are the major success factors for the human and machine collaboration? How can technology empower companies to come up with radical innovations and foster (intra) entrepreneurial spirit?

What role does education and lifelong learning play in this future?

How could companies and governments incentivize lifelong learning? Is it enough just to reform current educational system to meet future skills requirements? Or we need a comprehensive reskilling of the existing workforce throughout their lifecycle? Do we already have examples of successful collaboration between organizations and governments where it was ensured that individuals have time, motivations and instruments to pursue retraining opportunities? Our literature and reports have offered us many examples of successful collaborations and this leaves us optimistic about the future challenges and support for the workforce transition.

1.3 Course of Investigation

For this study, the state-of-the-art review was chosen. A qualitative approach served the purpose of revealing the key factors impacting the future of work and employment by collecting and analyzing reports from the international consulting firms such are McKinsey, Deloitte, KPMG, PwC and several others.

The state-of-the-art review provided an insight on what is currently done in the field of AI's impact on the future of jobs, skills transition and wages. Therefore, it is important to consider that the review is not closed once the thesis is finished. More and more AI advanced technologies are being deployed across the globe, and they will provide us with new findings and thoughtful insights. Furthermore, the purpose of this work is to convey to the reader which knowledges and ideas have been pioneered through the application of AI and the automation, and what are its strengths and weaknesses. It also collects and examines the state of current knowledge in the field of human plus machine augmentation by studying the work of scholars and researchers whose work has been recognized as valuable. The aim of this work is to provide a detailed insight on how AI and advanced technologies are boosting productivity and growth while transforming the business processes across all the industries (from manufacturing, to sales and marketing to customer service to product R&D), and what benefits are generated by integrating advanced technologies across all departments.

This research should serve as a reference on the newest developments in this field, and allow readers to fully understand the challenges and benefits of applying AI and automation into everyday processes by fostering human and machine collaboration.

The first step taken in the data collection process was to search academic databases and the World Wide Web to verify that enough articles are available to justify a literature review. The search revealed an acceptable amount of literature. As source academic databases, the Vienna University of Technology Libraries (https://www.ub.tuwien.ac.at/eng), Vienna University of Economics and Business (https://wu.ac.at/en/library/), SpringerLink (http://link.springer.com), Google Scholar (https://scholar.google.at) and Microsoft Academic (https://academic.microsoft.com).

Additionally, a review of online resources led to websites maintained by organizations that provide material with a high degree of relevance for this thesis, which helped frame the research problem. For the purpose of this study, resources made available through the websites of McKinsey, Accenture, Deloitte, KMPG, PwC, OECD (https://futureofwork.oecd.org/), and World Economic Forum (www.weforum.org).

1.4 Structure of the thesis

The thesis is structured as follows:

Chapter 1 highlights the importance of a holistic approach to the future of work. The chapter also includes the research questions and describes the structure of the thesis.

Chapter 2 reviews existing concepts, approaches and methods relating to the future of work with a special interest into human vs. machine compared to human plus machine collaboration.

Chapter 3 one important question for the future of work is what are the skills of the future. A single section is dedicated to summarizing the findings of the reports referencing the different types of data. Findings of several reports are combined and compared to provide a big picture of these aspects for the future of work.

Chapter 4 relates to implementing a fundamentally reimagining business process and human plus machine collaboration in the "missing middle". Success factors as well as challenges and hurdles for reimagining business processes are carved out of the available literature and are compared to findings of different reports. Out literature review has identified three roles humans will play in developing and deploying responsible AI, namely trainers, explainers and sustainers.

Chapter 5 is about to provide an overview of successfully reimagined business processes. All described case studies are focusing on new business models that are enabled by AI and advanced digital technologies such as the Internet of Things. It discusses also what these businesses had to consider regarding technology, knowledge, and skills that are necessary to deploy these newly developed business models in a successful way while solving their customer needs.

Chapter 6 summarizes the key findings of the research and contains conclusions and future recommendations.

2. Literature Review

"But they are useless. They can only give you answers."

– Pablo Picasso, on computers (as cited in Brynjolfsson and McAffe, 2018, p:187)

This chapter discusses two main narratives as follows: are robots and advanced AI algorithm causing job losses, technological unemployment, and wage inequality? Or, can humans and machines work closely, side by side, collaborating to deliver real value for organizations and society, as well and boost innovation (Daugherty and Wilson, 2018)?

2.1 AI's Impact on Employment: Job Redesign

As businesses continue deploying AI systems from machine learning to computer vision to deep learning, there are two extreme narratives about the technology industry that have prevailed in corporate and public debates over the past two decades. The first narrative is about "technology as a bubble" and the opposite narrative is worried about the impact that technology will have on jobs and society (Lauterbach and Bonime-Blanc, 2018, p.216). This section will give an answer to the question about the impact that digitization will have on jobs, employment and human plus machine collaboration.

Daugherty and Wilson (2018) in their book human plus machine have done an extensive research with over 1,500 organizations to answer the question how these companies are using AI to successfully transform their business and explore the full potential of AI. Through their research and own experience, they have discovered that these organizations are gaining competitive advantage compared to others, simply by fundamentally reimagining their business processes and understanding the true nature of AI's impact. These insights should help companies to get the real value from deploying these advanced technologies over a short period of time. They have identified three roles humans will play in developing and deploying responsible AI, such as trainer, explainers and sustainers.

Robots and new technologies powered by AI are taking over more and more jobs, not just from blue-collar workers but as well white-collar workers and highly skilled professionals. With the underlying AI technology, these smart machines are slowly impacting every aspect of every industry starting traditionally from manufacturing, to healthcare, transportation, education and

so forth. Nowadays supercomputers such as Watson IBM can diagnose cancer from X-rays and some authors go so far predicting that IBM Watson will ultimately be an excellent doctor (Bessen 2015; Brynjolfsson and McAffe, 2018).

It is evident that AI systems are impacting more and more daily businesses and the pressure on companies is growing as they will need to make some important choices about their use of AI, which Daugherty and Wilson (2018) define "as systems that extend human capability by sensing, comprehending, acting, and learning (ibid: p.3)".

How will this steep technology developments influence our jobs and wages? Is it justified to talk about technological unemployment due to automation (Bessen 2015; Brynjolfsson and McAffe 2018)?

A recent study (Frey and Osborne, 2013) analyzed an impact of computerization for over 702 occupations and estimated number of jobs that are at risk. According to their estimation, around 47 percent of total US employment it at risk and its jobs could be automated over the next decade or two (Figure 1).

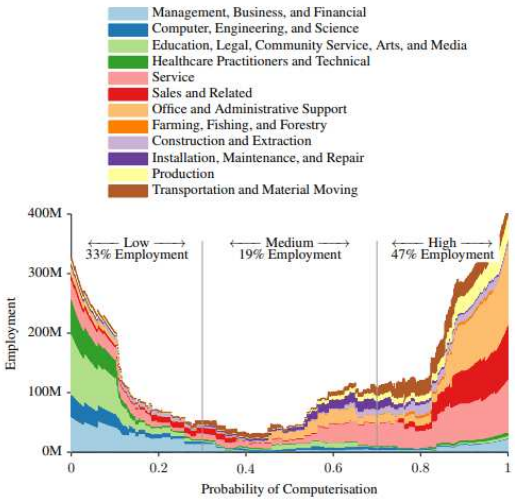

Figure 1. *Probability of computerization, along with the share in low, medium and high probability categories. Note that the total area under all curves is equal to total US employment. (Frey & Osborne, 2013)*

Does this mean that almost a half of our jobs are at the risk of automation and the US market is facing huge unemployment? Not necessarily. (Bessen, 2015) provided an excellent comparison between todays development and back in the days when ATMs were introduced in the United States in 1970 and was also seen as a threat factor to bank tellers' jobs and wages. Twenty years fast forward, the banks have rapidly installed over 400,000 ATMs across US alone and the number of employees did not decrease (Figure 2).

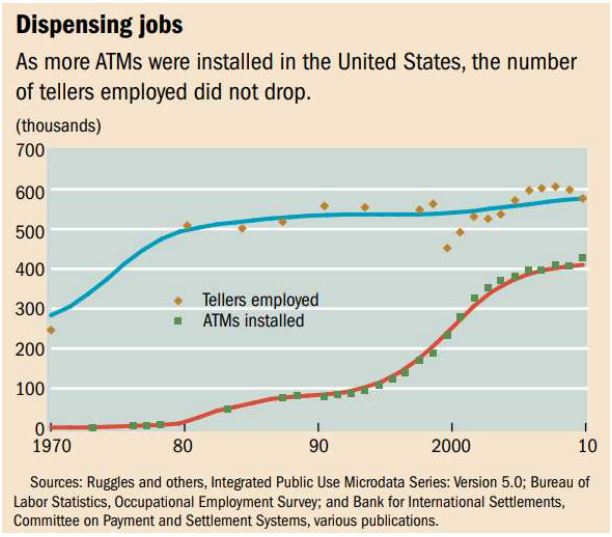

Figure 2. *Dispensing jobs by ATMs installed. (Bessen 2015, p.2)*

What was the reason that the number of employees did not drop? Bessen (2015) argues that the combination of these two following reasons is the key to answer the question above.

1. First, the demand for bank tellers was increased, as ATMs cut-down the costs for operating a bank branch. Between 1988 and 2004, the number of tellers in the urban areas decreased from 20 to 13. In order to compete for a larger market share, the banks continued opening more branches. At the end, fewer bank tellers were employed per branch, but more branches meant that teller jobs were not lost.
2. Second, as banks were increasing their market share, the tellers were becoming more important and they a part of the "relationship banking team (Bessen 2015)." This led to changing the nature of work for tellers, from handing out cash to the customers to building up a personal relationship with them and ensuring the greater market share. The skills changed as the ATMs were able to handle simple, repetitive tasks of handing out cash and more complex and interpersonal tasks stayed.

However, according to the Bureau of Labor Statistics, the number of branches is on decline and they predict the number of bank tellers will decline to 480,500 by 2024, down from 520,500 in 2014. This decline is due to the industry consolidation and technological changes as ATMs are becoming more sophisticated[1].

In an interview on June 14th, 2011, President Obama used ATMs as an example of where technology led to jobs losses for bank tellers[2].

"There are some structural issues with our economy where a lot of businesses have learned to become much more efficient with a lot fewer workers. You see it when you go to a bank and you use an ATM, you do not go to a bank teller, or you go to the airport and you are using a kiosk instead of checking in at the gate." – US President Barack Obama, in an interview with Today, June 14, 2011 – as cited by Timothy Taylor, Conversable Economist, March 2015[2].

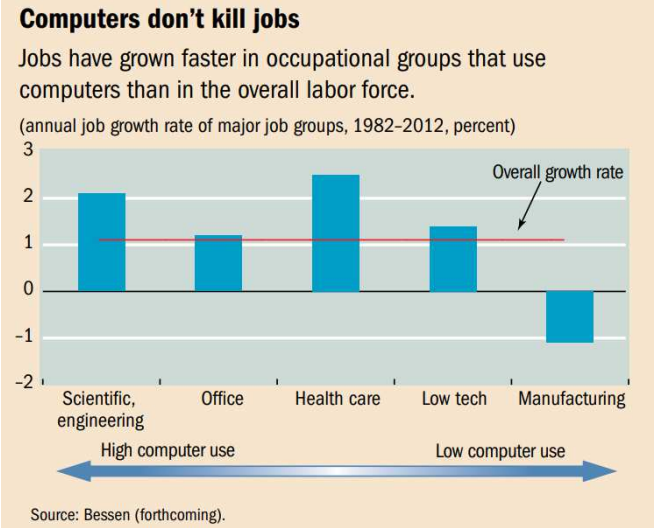

Figure 3. *Computers don't kill jobs. (Bessen 2015, p.3)*

Figure 3 presents an annual job growth of major job groups, 1982-2012 (in percent) where over half the workers in each of the first three groups used computers at work as of 2011. In all three computer-intensive groups, jobs grew rapidly than the overall workforce. To put it in another way, automation has caused job losses in a few industries, but the net effect on these broad professionals has not been technological unemployment (Bessen, 2015). However, manufacturing has experienced a net loss in employment – 5 million jobs over three decades. Moreover, growth in jobs in the overall economy offset these losses.

[1] Source: https://www.vox.com/2017/5/8/15584268/eric-schmidt-alphabet-automation-atm-bank-teller – retrieved on 22nd June 2019.
[2] Source: http://conversableeconomist.blogspot.com/2015/03/atms-and-rising-number-of-bank-tellers.html – retrieved on 22nd June 2019.

Generally, during the last three decade of automation starting with the personal computer, technology has not been the one replacing people and causing jobs to disappear (Bessen, 2015). However, this might change as the robots and algorithms are getting more sophisticated, smaller, more flexible, and becoming an integral part of our lives (Daugherty and Wilson, 2018, p:2).

(Beno, 2019) in his paper concluded that seeing automation as synonymous with job losses is not correct and that it is a mistake to believe that globalization and digitization lead to job losses.

As a result of the recent developments in AI systems, we are now witnessing a major transformation in business. In this new era, the fundamental rules by which we run our businesses are being reimagined daily. AI systems are not just making business processes more efficient; they are also enabling humans and machines to work collaboratively by changing the nature of work and calling for our business leaders to train their employees in novel ways (Daugherty and Wilson, 2018).

Furthermore, this is contrary to the traditional assembly lines and with the repetitive and standard tasks. Robots are nowadays enabled by machine-learning software and other related AI technologies as well smaller, more flexible and able to sense their environment, act and learn (Daugherty and Wilson, 2018, p.2).

With more innovation, we are about to see productivity growth and new jobs on horizon – many of those jobs we cannot even imagine today – just like we saw with previous example of ATMs (Lauterbach and Bonime-Blanc, 2018).

Despite the fact that historical data on employment development and job creation are reassuring, some experts worry that this time is different as AI systems will be more disruptive than they were in the past. Technology experts and economists are debating if it is the case that "this time things are different". What we can say this time, is that it depends on the time horizon taken in consideration (decades or centuries) and on the pace of technological development and adoption. There are for sure similarities between the scope and effects of automation today compared to earlier waves of disruptive innovations, going back to the industrial revolution (McKinsey 2017b, p.14-16) (see *Appendices 2 and 3*).

On the other hand, going forward, automation technologies may prove to be more disruptive than in the recent decades – and aligned with the recent progress – in two ways. First, if technological advancements and adoption go swiftly, job losses could be faster. Secondly, in

case of many industry embracing automation technologies at the same time, the percentage of the workforce in transition or displaced could be much higher. Figure 4 shows that the historical evidence on technology changes and employment is reassuring (McKinsey 2017b).

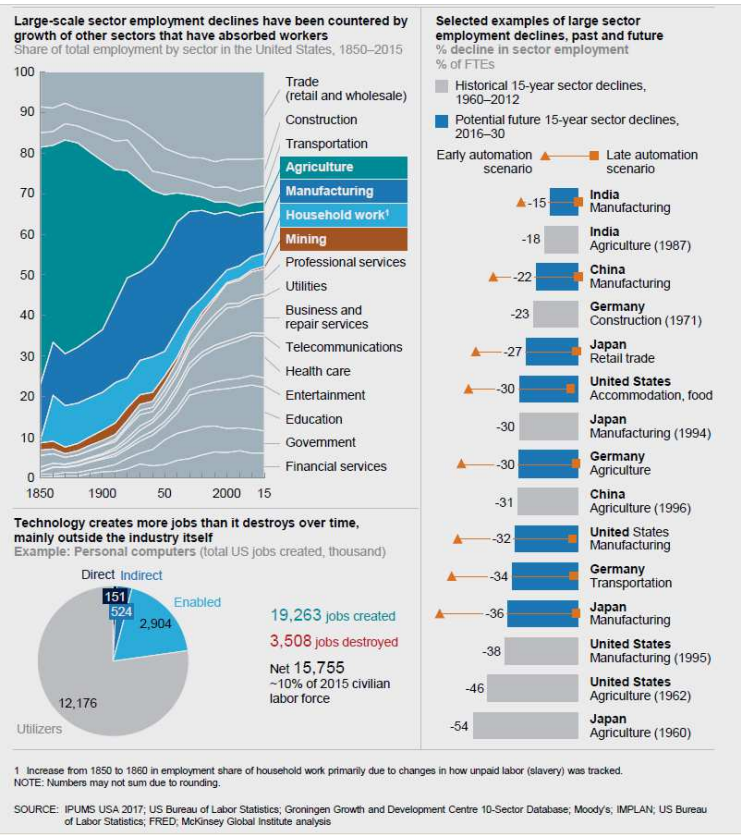

Figure 4. *History creates more jobs than it destroys over the time. (McKinsey 2017b)*

Technology visionary and investor Vinod Khosla believes that with AI, "the vast majority of today's jobs may be dislocated regardless of skill or educational level. …(E)motional labor will remain the last bastion of skills that machines cannot replicate at a human level (Lauterbach and Bonime-Blanc, 2018, p.215)".

In November, Stephen Hawking spoke at the 2017 Web Summit in Portugal. While he acknowledged that AI has tremendous positive potential, Hawking said that "we cannot know if we will be infinitely helped by AI, or ignored by it and side-lined, or conceivably destroyed by it (Lauterbach and Bonime-Blanc, 2018)". He advocated developing best practices and rules to regulate AI and robotics.

"It is not technology that eliminates jobs. It is the lack of a strategic vision and incentive plan for innovation that eliminates jobs when companies that are not prepared for technological

change and opportunity lose to their better-prepared competition (Lauterbach and Bonime-Blanc, 2018, p.217)."

2.2 AI will replace tasks, not jobs … for Now

Table 1 provides an overview of key AI Environmental, Social and Governance issues, because in the world where AI and ESG issues and opportunities are scaling rapidly and often interconnecting, it is of strategic importance to identify points of interconnection, and consider implications of AI/ESG both at the entity level as well at governmental and policy levels (Lauterbach and Bonime-Blanc, 2018).

Social	• AI is currently replacing tasks, will soon replace jobs. • But new jobs will emerge in which AI will be part of a team. • In the age of AI, societies need a paradigm shift to manage labor markets and employment. • Deploy lifelong learning with changes in educational/labor markets and public safety
Governance	• Need to deploy a different mix of social safety net policies at the governmental and business levels.

Table 1. *AI ESG Considerations: Labor, Employment, and Lifelong Learning. (Source: Lauterbach and Bonime-Blanc, 2018, p. 221)*

(Agrawal, et al., 2018) argued in their book Prediction Machines that AI tools may augment jobs, just as it happen with rise of the internet use and before that computer revolution. Furthermore, back in the days of the computer revolution, one of the first occupations that was affected was bookkeeping. Computers made it easy and cheap to do repetitive calculations and that is when the first killer app – VisiCalc was created. One of the main advantages of VisiCalc was that it reduced the time to make calculations dramatically, as well as it allowed business to analyze many more scenarios for different business cases. The creator of VisiCalc was himself an MBA student who did not see much value in repeating the calculations over again for the different scenarios in the Harvard Business school cases.

This success story of VisiCalc rapid adoption tells us how innovation can fully change the way we work and challenge the status quo and create new jobs. Just as the case of the introducing ATMs did not made bank tellers obsolete however, it did change their daily tasks and activities and made their jobs more human. At the time when VisiCalc was launched in 1970 there were more than 400,000 bookkeepers in the United States.

The question is why the bookkeepers did not see the spreadsheets as a threat to their jobs and there are no reported cases of people losing their jobs?

What we know from the case is that introducing spreadsheets enabled experienced bookkeeper to work on more intelligent and challenging tasks while creating more value for the company. This job transformation is nicely summarized as "from a bookkeeper to a spreadsheet wizard" (Agrawal, et al., 2018).

The authors argue that when we pair humans with machines (either hardware or software) we create superhumans with "superpowers". (Agrawal, et al., 2018)

Basically, the augmentation of human capabilities is one of the key research questions of this master thesis. We want to show that there will be jobs in the future and that tasks will be different, some of them automated - and that should not be the reason for the massive unemployment. We define jobs as a collection of tasks and once we break it down into individual tasks, some of this tasks may be augmented, some will be changed and reorganized, and new ones will be created as well. Therefore it is safe to say that the tasks that make up a job will change (Agrawal, et al., 2018).

According to Accenture (2018b) fewer jobs will be lost due to automation if workers are able to shift their skills to task that require more "human skills" such as complex analysis and social/emotional intelligence. If this recommendation is followed, their model indicates that UK would be able to reduce the share of jobs fully displaced due to automation to less than six percent by the year 2035. Furthermore, Germany to 10 percent and the United States to just 4 percent (Accenture, 2018b).

(McKinsey, 2017c) conducted analysis for the US market and, based on that template, estimated the automation potential for 45 other economies that represent around 80 percent of the global economy (see *Appendix 1*). This analysis of the US market provided the means to estimate the technical automation potential for more than 2,000 tasks in more than 800 professions across the industries. Each of these tasks requires some combination of 18 performance capabilities, which we have listed in Figure 5. This 18 performance capabilities are divided in five groups: sensory perception, cognitive capabilities, natural language processing, social and emotional capabilities and physical capabilities.

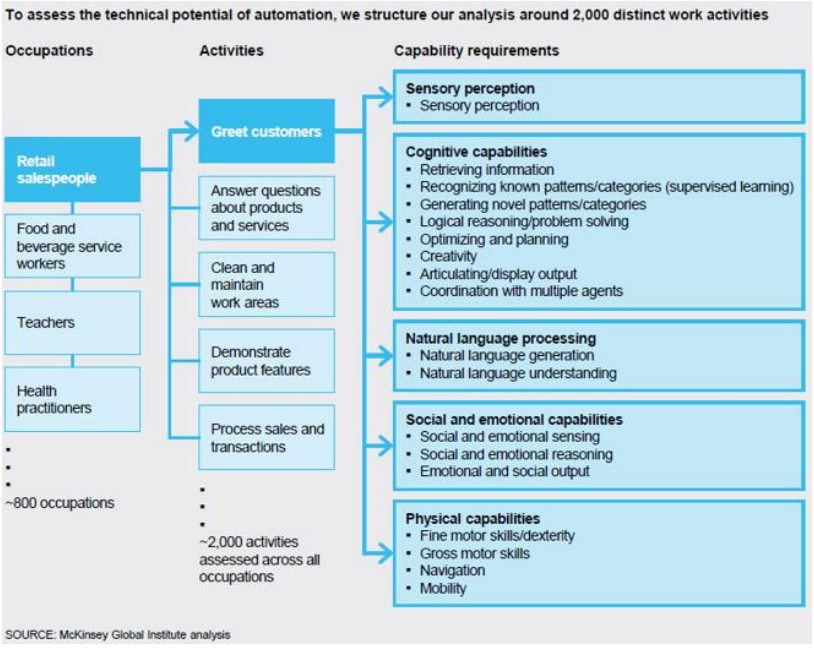

Figure 5. *How we established the technical automation potential of the global economy. (McKinsey 2017c)*

Furthermore, according to this analysis, we can draw the conclusion that very few occupations are fully automatable (less than 5 percent), 60 percent of all occupations have at least 30 percent technically automatable activities (Figure 6). We could conclude that most workforce will experience transition rather than job losses.

Most activities that will be affected by automation include physical activities in highly structured and predictable environments, as well as the collection and processing of data. These activities are common in industries such as manufacturing, housing and food services, and retail, and include a few of middle-skill jobs (McKinsey 2017c).

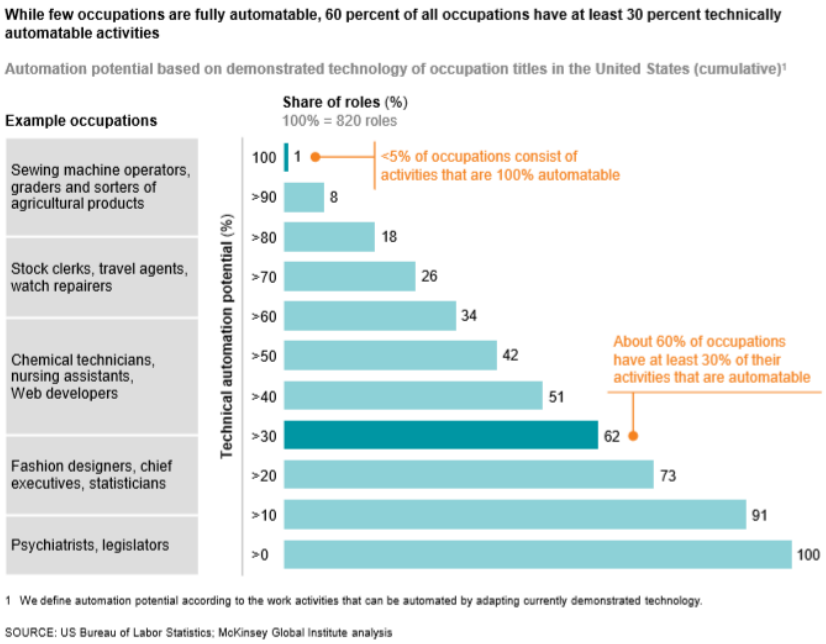

Figure 6. *Automation potential based on demonstrated technology of occupation titles in the US. (McKinsey, 2017c)*

The implementation of AI tools generates four implications for jobs (Agrawal, et al., 2018)

1. **AI tools may augment jobs**, as in the example of spreadsheets and bookkeepers (Job Redesign).
2. **AI tools may contract jobs**, as in the fulfillment centers (Missing link in Automation).

Robots have perfectly mastered assembling of a car or operating an aircraft. However, they have a difficulties of picking an object in an Amazon warehouse and putting it in a box?

As the cognitive scientist Steven Pinker explains it, “The main lesson of thirty-five years of AI research is that the hard problems are easy and the easy problems are hard. … The gardeners, receptionists, and cooks are secure in their jobs for decades to come.” (Brynjolfsson and McAfee, 2016, p. 29)

Robots are perfectly capable of assembling an automobile, as the components are highly regulated and the process is a set of predefined routines and procedures. However, an Amazon warehouse has an immense number of items that vary in shapes, sizes, weights and firmness, and these items are placed on the shelves with many possible positions and orientations for non-rectangular objects. In other words, the grasping problem – reaching out, picking something up, and placing it somewhere else, is still very challenging for robots and this is where humans play an important role (Agrawal, et al., 2018). As a result, alone

in Amazons' fulfillment center, there are 40,000 human pickers full-time and tens of thousands more part-time during the holiday season.

On the other hand, Amazon has been very successful identifying other important areas in the fulfillment center that would benefit from deploying AI tools such as machine-learning. By adopting machine-learning technologies they perfected their inventory management.

3. **AI tools may lead to the reconstitution of jobs**, with some tasks added and others taken away, as with radiologists (Should we stop training radiologists?).

As (Agrawal, et al., 2018) noted, two key aspects of a diagnostic radiologist's job are examining an image and returning an assessment to a primary care physician. Radiologists have been worried that machines might replace them since the early 1960s. What makes today's technology different than in the early 1960s? IBM Watson already commercialized AI tool in radiology as well many other startups have made commercially available their solutions in pattern recognition. This developments in pattern recognition to predict disease is what radiologist do.

Furthermore, as technology progresses radiologists will help train the machines such as Watson to interpret images from new imaging devices. Over time, a few superstar radiologists with their superior skills will assume this role, to train the machine to learn to diagnose. Their services will be highly valued and they will probably be compensated on the new techniques they learn AI or for every patient tested on the AI they trained.

For this reasons, five clear roles for humans in the use of medical images will remain over time, at least in the short and medium term: choosing the image, using real-time images in medical procedures, interpreting machine output (explainers), training machines on new technologies (trainers), and employing judgement that could lead to overriding the prediction machine's recommendation, as the case may be that the information is unavailable to the machine (sustainers). The question is if radiologists will assume this roles in the future as well. This will depend on their qualifications and skills to undertake these roles. It will also depend on whether, and if, some other specialist could take their role, or possibly if job classes will emerge that will combine more professions, such as radiologist/pathologist (i.e., a role that could be performed directly after imaging, where the radiologist also analyzes biopsies) (Agrawal, et al., 2018).

4. **AI tools may shift the emphasis on the specific skills** required for a particular job, as with school bus drivers (More than a driver).

With emergence of self-driving cars and automated driving, some jobs such as a school bus driver, will continue to exist but will require new skills, as the "driving" part has a great potential to be eliminated. Automating a particular task, such as "driving", may emphasize other tasks that have been underappreciated in the current job. If we take the example of a school bus driver, apart from simply "driving", he is also responsible for adult supervising as well in charge of the discipline inside the bus. In the future, drivers may act as teachers more than they do today. However, the point is that "automation that eliminates a human from a task does not necessarily eliminate them from a job" (Agrawal, et al., 2018, p. 149). On one side, the employer still needs someone to complete this task and on the other side, the question is if this will be a human or someone else.

We could apply the same logic to a job of the long-truck drivers where we would come to the conclusion that certain percentage of their activities could be automated, just as we've shown on the previous examples in Figure 6. Despite the fact that the future predicts that trucks will be more of containers on the wheels, humans will still be necessary, as these trucks' loads may be vulnerable to hijacking and theft. Such trucks will be needing a human on board to protect it, as well unload it and navigate any surprise along the way. As current truck drivers are the most qualified ones to fulfill this new roles, they will be the first ones to be employed in a new role augmented by machines (Agrawal, et al., 2018).

As a conclusion, AI tools may shift the relative returns to certain skills and, along those lines, change the types of people who are most qualified to do particular jobs. In the case of bookkeepers, the arrival of the spreadsheet tool – VisiCalc made obsolete the skill to perform many calculations quickly on a calculator. Furthermore, thanks to the technology advancements, it increased the returns to being good at asking the right questions in order to efficiently run scenarios analysis (Agrawal, et al., 2018).

(McKinsey, 2018a) did an extensive executive survey in March 2018 on 3,031 business leaders in Canada, France, Germany, Italy, Spain, the United Kingdom, and the United States. Only 6 percent of companies expect their workforce in the United States and Europe will decrease as a result of automation and AI (Figure 7).

Figure 7. *What impact do you think adopting automation and AI will have on the geographic location of your organization? (McKinsey 2018a)*

Technology will most likely complement rather than substitute humans completely. For example, if we look at mining industry, we have witnessed that the first generation of robotics demonstrated rather accelerated business without replacing humans. In other example of a collaborative approach, Swedish-Swiss multinational company ABB produces today so-called YuMi robots, that are designed to work with, rather than replace, humans in manufacturing (McKinsey 2017e, p.13).

Despite the fact that technology raises labor productivity growth and may displace workers within a sector, out data shows that overall workforce employment grows as well, especially when looking over longer periods of time and across the whole economy. Productivity growth and job growth go together hand in hand over the mid and long term because output growth speeds up. Prices go down, new novel goods and services are introducing, and markets are expanding (McKinsey 2017a).

As a conclusion to this chapter, we provide a Table 2 with summary of estimates of how automation will affect jobs and we can conclude that it varies widely, from 14 % to 47 % (see summary in Table 2 below). While most estimates appear to have a sound scientific basis (as we have presented through this chapter), there is significant disagreement among the results of the various studies, which diminishes their overall credibility (see *Appendix 5 f*or more details) (Servoz, 2019).

	Perspective 1	Perspective 2	Perspective 3	Perspective 4
	Bid your job farewell	**Keep calm and carry on (but do keep an eye on inequality)**	**Few occupations will be entirely automated, but all jobs will be affected**	**The rise of the industrial robots**
Scope & background	In their ground-breaking study, Frey and Osborne (2013)[29] were among the first to gauge the **probability of computerisation for 702 occupations in the US labour market** arguing that the potential scope of automation is vast.	The OECD (2018)[30] shifted **attention to the variation between jobs of the same name and assessed which tasks are difficult for computers to carry out**, even in jobs that are most susceptible to automation.	Focusing on the years 2016-2030, McKinsey Global Institute (2017)[31] **used data from 46 countries to break down 800 occupations into more than 2,000 activities.** Based on this breakdown, they determined the capabilities that would be needed by workers or machines for each activity.	Acemoglu and Restrepo (2017)[32] and Bruegel (2018)[33] respectively evaluate **the specific impact of industrial robots on the US economy and on 6 EU countries** that make up 85.5% of the EU industrial robots market.
Their assessment on the impact of automation	**47% of total US employment is at risk.** In the first wave, most workers in transportation and logistics occupations, together with the bulk of office and administrative support workers and production occupations are likely to be substituted.	**14% of jobs in OECD countries are highly automatable** – equating to around 66 million job losses. Occupations with the highest risk typically require basic or low levels of education, potentially furthering labour market polarisation and inequality.	**While less than 5% of occupations consist of activities that can be fully automated, up to 30% of hours worked globally could be automated by 2030.** Physical activities are most susceptible.	**One additional robot per thousand workers reduces the employment rate by 0.16-0.20 percentage points in Europe.** This notable displacement would most impact young cohorts, middle-education workers, and men.

***Table 2**. Everything you wanted to know about who predicts on the impact of automation. (European Political Strategy Centre, as cited in (Servoz, 2019, p. 41))*

3. The future of jobs and skills

"Work saves a man from three great evils: boredom, vice, and need."

– Voltare

In this chapter, we will determine what are the skills of the future and how will they change moving forward as automation gets more adopted and developed. Furthermore, we explored the skill trends and developments and drawn recommendations for the future workforce, organizations and policymakers.

3.1 A framework for understanding the future of work

Based on their experience and research, Deloitte (2017b) has identified three forces that are shaping the nature of future work and the future workforce (Figure 8). However, as we will discuss each of these forces in details through this master thesis, here we provide only a short overview and a new perspective (see *Appendix 4* as well).

- **Technology**. Technological advances – in the areas of robotics, AI, sensors and data – are rapidly changing the way we use our tools and how people are machines are collaborating and substituting for one another.
- **Demographics**. Demographic changes are altering the distribution of the global workforce. One of the future challenges in demographics is that younger generation will be predominantly concentrated in developing economies, while the developed economies (including China) will get ever older.
- **"The power of pull."** Organizations, as well as prospective workers, now have access to the global talent markets, provided by networks and platforms which will open new possibilities and change the ways they interact with one another.

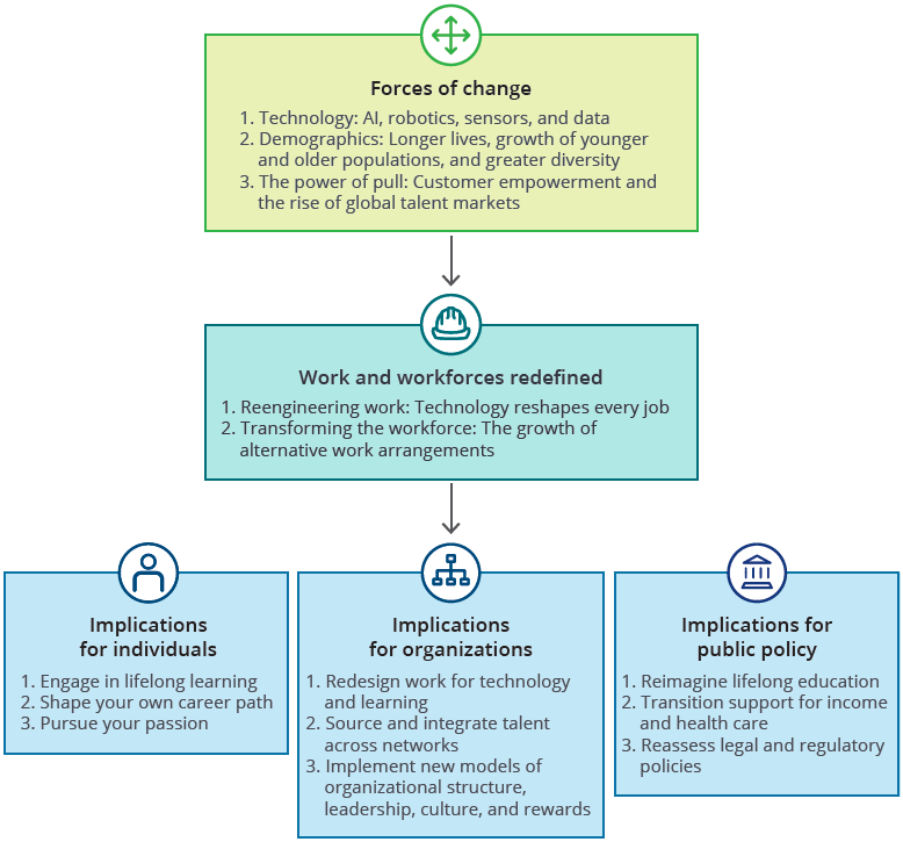

Figure 8. *A framework for understanding the future of work. (Deloitte, 2017b)*

- **Work and workforce redefined**. These three forces of change will have a significant influence on the nature of work. Routine task will be increasingly automated, while technology-aided creative work will expand and evolve in response to the unmet needs.
  - *Reengineering work: Technology reshapes every job.* We are in the early days of integrating industrial and software robots into work – and understanding their changing impacts and results. Therefore, the overall picture is fuzzy. For example, a Mercedes-Benz production facility in Germany announced plans to reduce the number of robots on its production line, and replace them with humans, as there is an increasing demand for customized car, and reprogramming and switching out robots was more expensive than shifting the line using human workers[3] (as cited in Deloitte 2017b).

[3] Source: https://jalopnik.com/mercedes-will-reduce-robots-on-production-line-employ-1761720298 - Accessed on June 29th.

- *Transforming the workforce: The growth of alternative work arrangements.* To come up with new novel ideas, solve problems, and design sophisticated systems, many global companies are currently using crowdsourcing. This will change the way individual jobs are done by changing the way companies are hiring new employees. The gig economy has already become a powerful source of labor in the US.

- Implications for individuals, organizations.
  - *Implications for individuals.* Employees will need to take action on their own to be successful while engaging in lifelong learning, shaping their own career path, and pursuing their passion.
  - *Implications for organizations.* Employers can help workers along this journey by shaping work and work environments and encouraging individuals to learn faster and accelerate performance improvement.
- Implications for public policy.
  - *Reimagine lifelong education.* To provide mass education and stable careers, the educational institutions have been established decades or even centuries ago. The question today is how we can create new educational models and funding that will support workers with three, four or even more opportunities to reskill and move on to new fields and new careers?
  - *Transition support for income and health care.* Governments around the world are considering and revisiting basic income guarantees in numerous options, as well recent proposals to tax robots as a way to provide funding for transition support programs.
  - *Reassess legal and regulatory policies.* As the future of work will likely engage a higher percentage of start-ups and small business, policymakers will find themselves under pressure to update regulations in order to support small businesses and make it easier for them (Deloitte 2017b).

(McKinsey 2017c) lists five factors that will affect the pace and extent of adoption new technologies.

- **Technical feasibility** – Technology has to be invented, integrated and adapted into solutions for specific case use. We will demonstrate this on the Rio Tinto's use-case with its strategy for building up the mine of the future.
- **Cost of developing and deploying solutions** – Hardware and software costs.

- **Labor market dynamics** – The supply, demand, and costs of labor will directly affect which activities will be automated.
- **Economic benefits** – Include greater turnout and increase quality, in parallel to workforce cost savings.
- **Regulatory and social acceptance** – Even when automation will likely lead to a good outcome, its adoption can take time.

3.2 The future of skills

(McKinsey, 2018b) concluded that there is work for everyone today and there will be work for everyone tomorrow, even in a future with automation and AI. However, we know that work in the future will be different, requiring new skills, and greater flexibility and adaptability of employees than we have seen before. With this in mind, we will look in details how disruption will shift the demands for certain skills and how human workforce can prepare to respond to it and be still relevant in the 21st century (Figure 9).

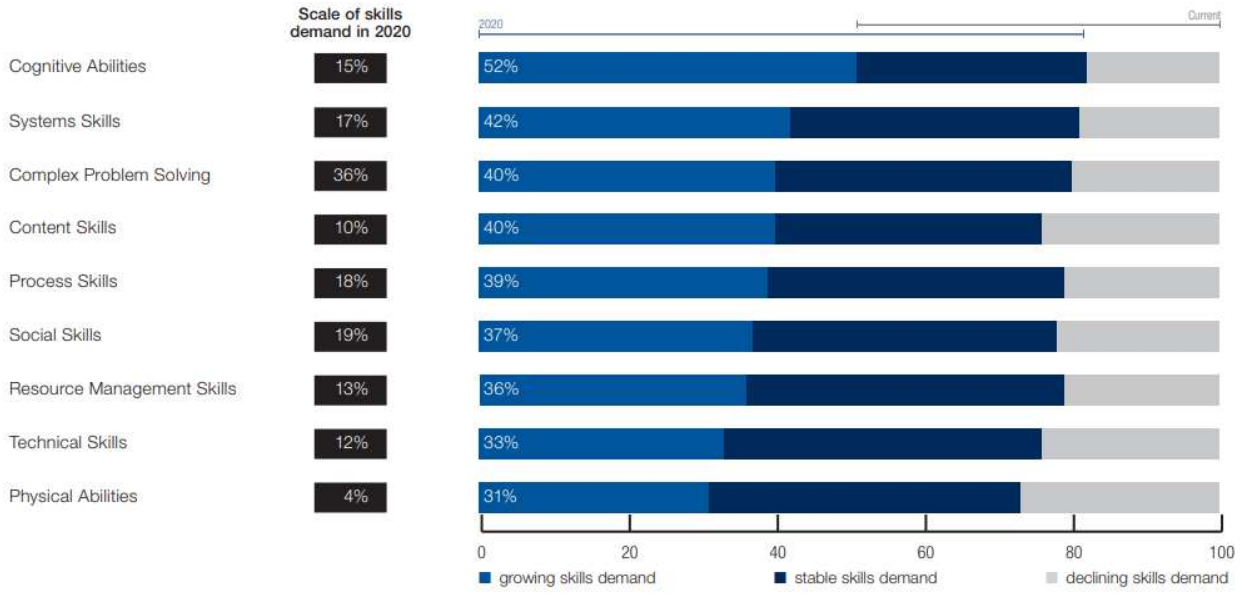

Figure 9. *Change in demand for core-work related skills, 2015-2020, all industries. (WEF, Forum, 2016)*

As skill demand is emerging swiftly at an aggregate industry level, the degree of changing skills requirements within individual job families and occupations is even more obvious (Figure 9). For example, all-presence of mobile internet combined with the coming age of the IoT promises to transform the daily routine of many customer-facing roles in the Sales and Related, Installation and Maintenance, as well Manufacturing and Production Job families across all industries, calling for a much higher level of technology literacy than in the past. Due to the

increased automation in these fields, employees are expected to take more responsibilities related to equipment control and maintenance and problem-solving skills, as well as a broader general understanding of the work processes of their company (WEF, Forum, 2016).

Many formerly purely technical occupations are expected to have a demand for creative and interpersonal skills. For example, for healthcare practitioners, technological innovations will enable automation of diagnosis and customization of treatments, reimagining many medical roles towards translating and communicating this data effectively to patients ("trainers" as defined by (Daugherty & Wilson, 2018)). Furthermore, Sales and Related jobs could witness an increased demand for creative skills and ideas for creating an enjoyable shopping experience, as conventional stores have to come up with new and innovative ideas to compete in the e-commerce arena (WEF, Forum, 2016).

(WEF, Forum, 2016) anticipates that a wide range of professions will demand a higher degree of cognitive abilities – such as creativity, logical reasoning and problem sensitivity – as part of their core skill set. More than half (52 percent, the bright blue part of the bar in Figure 9) of all jobs is anticipating to demand these cognitive abilities as part of their core skill set in 2020. Furthermore, in another 30 percent of jobs (the dark blue part of the bar in Figure 9), demand for these skills is currently already high and will persist over the 2015-2020 period. At the end, only 18 percent of jobs that demand high cognitive skills today are expected to do so less in the future (the grey part of the bar in Figure 9).

At the other end of the scale, among all jobs that are in need for physical abilities less than one third (31 percent) are expected to have a growing demand for these in the future. There are just about as many as the proportion of jobs in which physical abilities will presumably to decline in importance (27 percent). The skills family with the most stable demand across all jobs are technical skills: almost half (44 percent) of all jobs requiring these skills today will have a stable need for them in the coming years.

3.2.2 Understanding current skills supply

Today's job markets and in-demand skills are considerably different than the ones of 10 or even five years ago, and – as demonstrated in this report (WEF, Forum, 2016) – the pace of change is only set to propel. Governments, businesses and individuals are more and more concerned with identifying and forecasting skills that are relevant, not just today, but that will remain or become so in the future, to meet business demands for talent and enable those that possess them to take an advantage of emerging opportunities.

In light of technological trends, such as the ones outlined in Deloitte 2017b report, in previous years many countries have undertaken significant efforts to increase the amount of STEM (science, technology, engineering and mathematics) graduates produced by their national education systems (Table 3).

Share of degree holders, %

	ASEAN	AUS	BRA	FRA	GCC	DEU	ITA	JPN	MEX	TUR	UK	USA
Agriculture	4	1	2	1	0	2	2	3	2	3	1	1
Education	16	8	20	3	8	9	7	7	12	10	10	10
Engineering, Manufacturing, Construction	19	8	7	15	16	15	13	17	21	12	9	7
Health and Welfare	9	17	15	15	6	19	16	13	9	6	16	17
Humanities and Arts	6	10	2	10	18	16	15	15	4	8	16	12
Sciences	5	8	5	10	13	13	7	3	6	9	13	9
Services	5	3	3	4	2	3	3	8	1	5	2	8
Social Sciences, Business, Law	32	45	41	42	36	23	32	27	45	47	32	36
Unspecified	4	0	5	0	0	0	5	7	0	0	1	0

Source: World Economic Forum, *Human Capital Report 2015*, based on UNESCO Institute of Statistics, ISCED 2011.
Note: Most recent year available; data not available for China, India, South Africa.

Table 3. *Distribution of recent university graduates by degree subject and country. (WEF, Forum, 2016)*

What this report shows is that disruptive changes will have a significant impact on skills requirements in all job families, and that they are creating a range of opportunities and challenges in all industries, not just narrowly related to "hard knowledge", technical skills and technology. Furthermore, in order to manage these trends successfully, there is a need to potentially reskilling and upskilling talent from various academic backgrounds in all industries (Table 4) (WEF, Forum, 2016).

Share of degree holders, %

	BAS	CON	EN	FS	HE	ICT	MEI	MOB	PS
Agriculture	v	2	0	0	2	0	0	0	0
Education	1	4	1	2	5	1	18	2	1
Engineering, Manufacturing, Construction	47	3	51	2	3	25	4	27	3
Health and Welfare	2	5	1	3	29	1	6	2	5
Humanities and Arts	3	17	1	5	5	4	39	3	11
Sciences	16	9	15	11	31	50	11	11	11
Services	0	4	0	1	4	0	1	10	0
Social Sciences, Business, Law	29	50	29	74	18	18	19	39	67
Unspecified	2	5	2	2	2	2	2	4	1

Source: LinkedIn.
Note: Share of LinkedIn members with stated tertiary degrees across *Future of Jobs Report* focus countries; industry classification based on World Economic Forum taxonomy, education subject classification based on ISCED 2011.

Table 4. *Distribution of professionals by degree subject and industry. (WEF, Forum, 2016)*

(WEF, Forum, 2016) has focused on shifts and disruptions to skills requirements as perceived by CHROs. However, today in practice, there are large discrepancies between the actual supply and demand of crucial work-related skills (Table 5). According to Manpower Groups recent Talent shortage Survey, 38 percent of companies have had difficulties in filling jobs in 2015.

Share of skills family in industry total, %

Skills family	BAS	CON	EN	FS	HE	ICT	MEI	MOB	PS	OVERALL
Content Skills	4	4	3	5	11	3	14	3	8	**6**
Process Skills	6	4	7	6	11	3	9	3	11	**7**
Resource Management Skills	23	26	31	27	18	25	8	27	18	**23**
Complex Problem Solving Skills	8	5	7	6	7	4	3	5	5	**6**
Social Skills	40	55	33	47	47	30	50	47	48	**44**
Systems Skills	4	4	6	7	3	6	1	3	5	**4**
Technical Skills	15	2	13	2	3	29	15	12	5	**11**

Source: LinkedIn.
Note: Based on share of LinkedIn members with stated skills across *Future of Jobs Report* focus countries. LinkedIn currently has more than 400 million members in more than 200 countries and territories. Industry classification based on World Economic Forum taxonomy.

Table 5. *Distribution of skills supply, by industry (WEF, Forum, 2016)*

(Accenture, 2018a) points out that STEM skills are important for some people and professions, however every employee should get better at complex reasoning. Not everybody wants to be a mathematician or scientist, however each person should learn complex reasoning and high-order cognitive capabilities. The teaching of these skills should not be restricted only to STEM subjects (Figure 10).

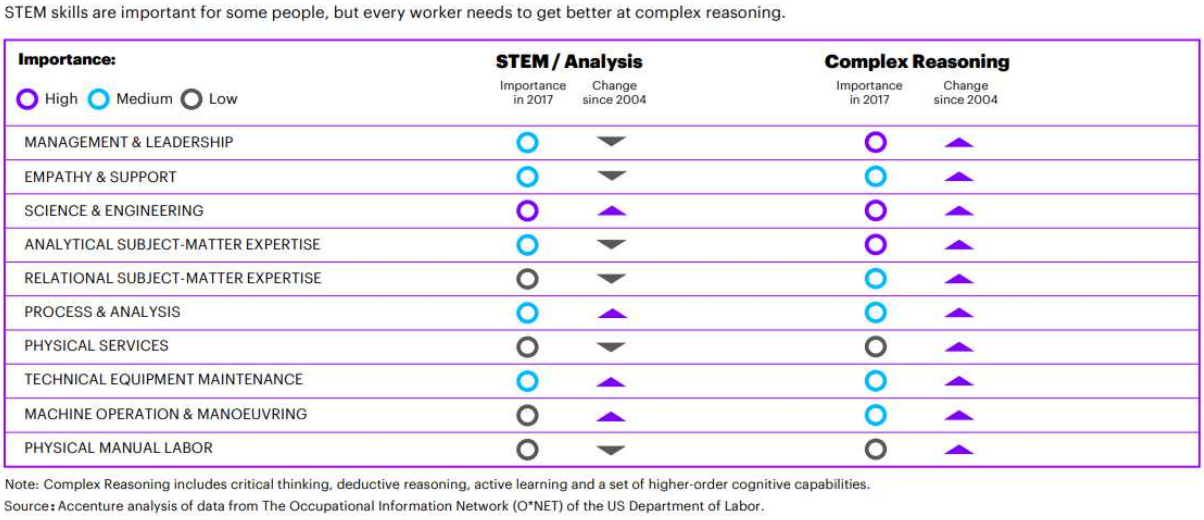

Figure 10. *The changing importance of STEM/A and complex reasoning skills. (Accenture 2018a, p. 24)*

Efforts aimed at closing the skills gap will need to be increasingly grounded in a solid understanding of a country's or industry's skills base today and of changing future skills requirements due to various forces of change, such are globalization, technological as well demographics movements (WEF, Forum, 2016).

3.2.3 Reskilling and retraining as a priority

Responses to the future of jobs survey indicates that companies are more than aware of emerging challenges, however, they have been slow to act with power and clarity. Across all industries, about two thirds of respondents (CHROs) also report efforts to invest in the reskilling of current employees, making it by far the highest ranked such strategy overall (Figure 11).

Furthermore, organizations that report recognizing future workforce planning as a priority are almost 50 percent more likely to plan to invest in reskilling than companies who do not (61 percent against 39 percent of respondents).

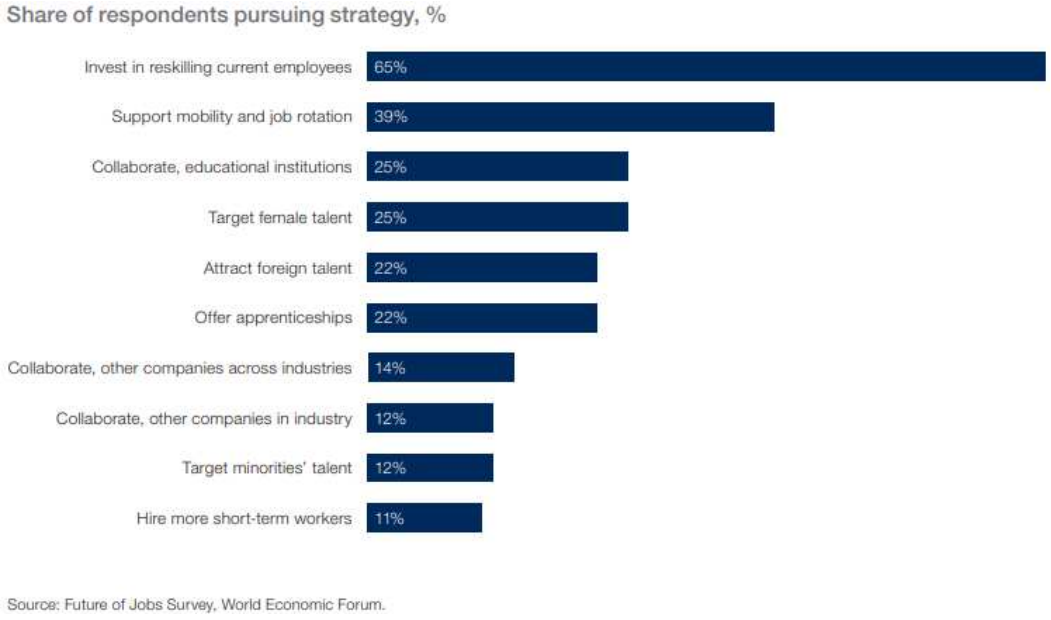

Figure 11. Future workforce strategies, industries overall. (WEF, Forum, 2016)

(WEF, Forum, 2016) report classifies work-relevant skills into abilities, basic skills and cross-functional skills (Figure 12), with particularly strong growth expected in cross-functional skills, cognitive abilities and basic skills, such as active learning and ICT literacy.

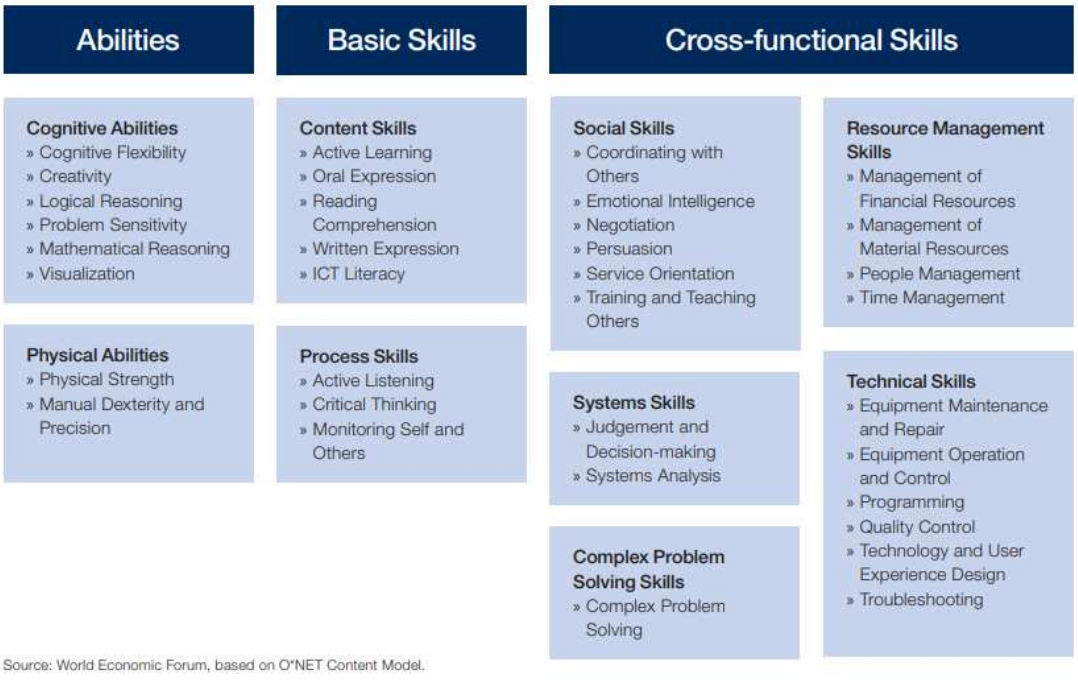

Figure 12. *Core work-related skills. (WEF, Forum, 2016)*

3.2.4 Barriers to managing change

(WEF, Forum, 2018a) reports that out of the 1.4 million jobs, which are projected by the US Bureau of Labor Statistics to become disrupted between now and 2026, the majority – 57% – belong to women. Female workers dominate secretarial and administrative assistant roles. In the US economy, 164,000 female workers in those roles are at risk. Some occupations such as assembly line workers predominantly employ male workers, and in the United States, over 90,000 workers employed are at risk. Without reskilling, on average, professions that are predominantly female and at risk of disruption have only 12 job transition options while at-risk male-dominated professions have 22 options. On the other hand, with reskilling, women have 49 options, while predominantly male professions at risk of disruptions have 80 options. In other words, reskilling can narrow the options gap between women and men. Furthermore, when considering pathways in an already disrupted future of jobs, an opportunity presents itself to close persistent gender wage gaps.

Figure 13 illustrates selected job transition pathway for a range of jobs at risk from technological disruption. Furthermore, for each job, four profiles are defined (or "archetypes"), to reflect the range of opportunities. The first archetype consists of a simple single transition with a rising wage. A second archetype consists of a single transition with a declining wage. A third consists of a steady rise in two steps. A forth consists of an initial decline in the first step followed by an increase (WEF, Forum, 2018a).

Secretaries and Administrative Assistants is an occupation for which the US will see a decline in demand corresponding to 165,000 workers by 2026 according to the Bureau of Labor Statistics. The range of opportunities available to those displaced workers is illustrated in Figure 13. However, despite those estimated losses, Secretaries and Administrative Assistants have 44 possible job transition opportunities to retain their current wage or even gain in wages, opportunities such as roles as Insurance Claims Clerks or Production, Planning and Expediting Clerks. In the long term, those transitions can serve as stepping stones to even more lucrative opportunities, such as roles in Logistics.

Figure 13. *Examples of pathways for secretaries and administrative assistants. (WEF, Forum, 2018a)*

(WEF, Forum, 2018b) summarizes key skills demand trending for 2018-2022 (Table 6). We see a continued decline in demand for manual skills and physical abilities and, on the other hand, as well as basic technology installation and maintenance skills.

Today, 2018	Trending, 2022	Declining, 2022
Analytical thinking and innovation	Analytical thinking and innovation	Manual dexterity, endurance and precision
Complex problem-solving	Active learning and learning strategies	Memory, verbal, auditory and spatial abilities
Critical thinking and analysis	Creativity, originality and initiative	Management of financial, material resources
Active learning and learning strategies	Technology design and programming	Technology installation and maintenance
Creativity, originality and initiative	Critical thinking and analysis	Reading, writing, math and active listening
Attention to detail, trustworthiness	Complex problem-solving	Management of personnel
Emotional intelligence	Leadership and social influence	Quality control and safety awareness
Reasoning, problem-solving and ideation	Emotional intelligence	Coordination and time management
Leadership and social influence	Reasoning, problem-solving and ideation	Visual, auditory and speech abilities
Coordination and time management	Systems analysis and evaluation	Technology use, monitoring and control

Table 6*. Comparing skills demand, 2018 vs. 2022, top ten. (WEF, Forum, 2018b)*

Furthermore, skills that will continue to grow by 2022 include analytical thinking and innovation as well as active learning and learning strategies. Proficiency in new technologies such as technology design and programming, is only one part of the 2022 skills demand. However, “human” skills such as creativity, originality and initiative, critical thinking, persuasion, and negotiation will be of greater importance, as will attention to details, resilience, flexibility and problem-solving. Likewise, emotional intelligence, leadership and social

influence will see a tremendous increase in demand compare to their current status (WEF, Forum, 2018b).

"The companies that do not associate AI with EI (emotional intelligence) are going to miss the mark."—Rachael Rekart, Director of Machine Assistance, Autodesk (as cited in Accenture 2018c, p.6)

3.3 Extending human + machine collaboration

Through their global survey Daugherty and Wilson, report that the work is changing profoundly in many ways. Their global survey done together with World Economic Forum, they found that 64 percent of workers recognize that the pace of change is gaining momentum as a result of new technologies such as AI. However, almost all (92 percent) believe that the next generation of workplace skills will be drastically different. Most of them (87 percent) believe that new AI technologies will improve their work experience within next five years. Furthermore, 85 percent of workers are willing to invest their free time over the next few years to acquire new skillset, while another 69 percent put an emphasis on finding on-the-job training opportunities to meet future digital needs of the organization (Daugherty & Wilson, 2018).

The real question now is what are those skills of the next generation, as future skills bear little relevance to the ones in the past? In our next subchapter, we will explore eight new novel fusion skills (the "S" in our MELDS framework) that workers will need. Furthermore, each of these fusion skills is emphasizing talents of humans and machines to create better outcomes that working independently.

3.3.1 Eight new fusion skills for an AI Workplace

We will now describe each of these eight fusion skills to guide managers and workers in designing and developing a workforce capable of succeeding in the missing middle (Figure 14). (Daugherty & Wilson, 2018) define "missing middle" as to where humans work with smart machines to benefit from what each party does best. They have decided for this name, because no one talks about it, and just a small number of companies is actively working on a strategy to fill this essential gap. Three of this skills allow humans to complement machines (the left side of the missing middle); another three enable humans to be augmented by machines (the right side of the missing middle), and the last ones support skillfully work across both sides of the missing middle.

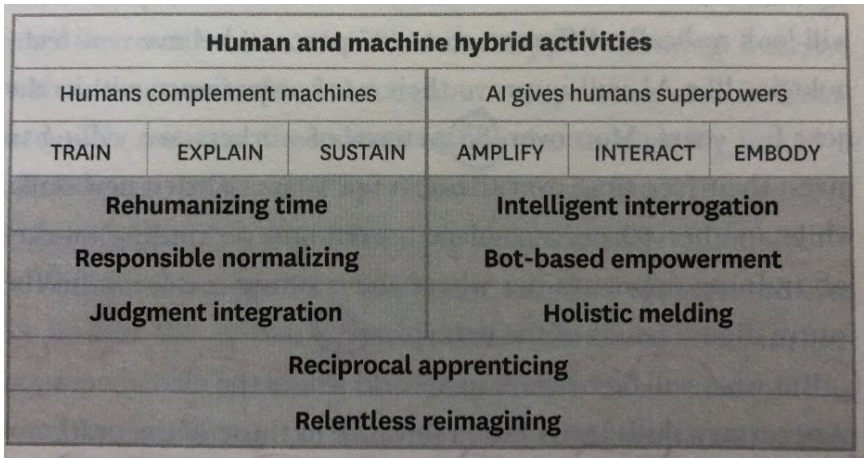

Figure 14. *Fusion skills for the missing middle. (Daugherty & Wilson, 2018, p. 186)*

These novel new skills do not require machine learning or programming, rather, they require thoughtful humans who are motivated to adapt these fundamental skills into specific business need.

Fusion Skill #1: Rehumanizing Time

Definition: The ability to increase the time available for distinctively human tasks like interpersonal interactions, creativity, and decision making in a reimagined business process (Daugherty and Wilson, 2018, p.186).

In practice, rehumanizing time allows humans to skillfully shift their time toward more human activities, such as increasing customer satisfaction, performing more sophisticated machine repairs and maintenance, or conducting research on new product ideas outside companies niche.

Fusion Skill #2: Responsible Normalizing

Definition: The act of responsibly shaping the purpose and perception of human-machine interaction as it relates to individuals, businesses, and society (Daugherty and Wilson, 2018, p.189).

In reality, normalizing is about responsibly shaping the way humans understand human-machine collaborations as well as having the big picture of how this collaboration is implemented. CEOs should foresee resistance towards AI and automation and they should be able to address the concerns and issues of their employees when introducing new AI to workers. As an example, if they are introducing new AI system they should be able to communicate openly to their employees, that this new system is about to make them more successful and not to dismiss them.

Fusion Skill #3: Judgement Integration

Definition: The judgement-based ability to decide a course of action when a machine is uncertain about what to do (Daugherty and Wilson, 2018, p.191).

In practice, human judgment will always be a key aspect to any reimagined business process. Despite all the remarkable advances of AI, it still does not know how to properly read situations and people.

Fusion Skill #4: Intelligent Interrogation

Definition: Knowing how best to ask questions of AI, across levels of abstraction, to get the insights you need (Daugherty and Wilson, 2018, p.193)

If we translate this in practice, workers should play on their strengths, and they should not mimic the machine's strength. In the process, the machine is training the human on how to operate it, and humans are training the machine as well. In the end, it is human business and operational competence, that will make a call for a certain action (e.g., fixing or replacing rotor of a machine).

"I think that we have got to cognizant that the machine is not all powerful." Bill Ruh, CEO of GE Digital, as cited in (Daugherty & Wilson, 2018, p. 195)

Fusion Skill #5: Bot-based Empowerment

Definition: Working well with AI agents to extend your capabilities, and create superpowers in business processes and professional careers (Daugherty and Wilson, 2018, p.195).

In practice, through bot-based empowerment and using intelligent tools at work, humans could get more productive and increase their efficiency. Marc Benioff, CEO of Salesforce is using their powerful AI tool Einstein Forecasting in regular meetings with his executive team. With Einstein and its capabilities of sophisticated forecasting and modelling, Benioff is now able to run the meetings with facts and figures and eliminate biases that could arise from the company politics.

Microsoft CEO, Satya Nadella, said that a bot "should augment human experiences, be trustworthy, and inclusive and respectful." [4]

[4] Source: https://www.businessinsider.de/microsoft-ceo-satya-nadella-on-tay-chatbot-2016-3?r=US&IR=T – Accessed on June 30th.

Fusion Skill #6: Holistic Melding

Definition: The ability to develop robust mental models of AI agents to improve process outcomes (Daugherty and Wilson, 2018, p.197).

In practice, robots are transforming the field of surgery by allowing surgeons to reach hard-to-access organs, perform precise cuts, and stitch up wounds with previously unimaginable skillfulness. However, the key to success is the ability of these surgeons to learn the skills needed to operate the robots – basically, it is about their ability to project their skills onto the body of a machine.

Fusion Skill #7: Reciprocal Apprenticing

Definition: (1) Performing tasks alongside AI agents so they can learn new skills; (2) on-the-job training for people so they can work well within AI-enhanced processes (Daugherty and Wilson, 2018, p.201).

For instance, if machine apprenticing is implemented in a devious way, where workers do not know exactly that some of their work is being used to train the machines, both machines and management can create lack of trust within the organization. In the best case scenario, apprenticing can help against anxiety, lack of enthusiasm for human-machine interaction, and sense of helplessness in human-machine collaboration. Basically this means, executives should give workers a bit of control, make them engaged in the future performance of a system or process, and this will create an environment where they will see AI as a colleague rather than an enemy.

Fusion Skill #8: Relentless Reimagining

Definition: The rigorous discipline of creating new processes and business models from scratch, rather than simply automating old processes (Daugherty and Wilson, 2018, p.203).

Basically, reimagining sets the foundation for the other skills such as intelligent interrogating and bot-bases empowerment. This will empower people to get used to the changes in their everyday world, where AI systems are fundamentally changing organizational processes, business models and industries.

As conclusion, fusion skills require a new way of thinking about human skills and, furthermore a very different approach to educating and retraining workforce (see *Appendix 6*) .

Accenture (2018c) proposes that the following 10 intelligences will be crucial in the AI workplace:

1) physical/sensory abilities
2) embodied or extended cognition
3) strategic intelligence
4) practical
5) analytical
6) creative
7) interpersonal
8) intrapersonal
9) moral intelligence, and
10) growth mindset (see Figure 14: Fusion Skills and Intelligences Matrix).

These 10 intelligences provide a broad guideline for business leaders directing training efforts and forming teams. In the age of human-machine collaboration, these core intelligences will be crucial to the future workforce (Figure 15).

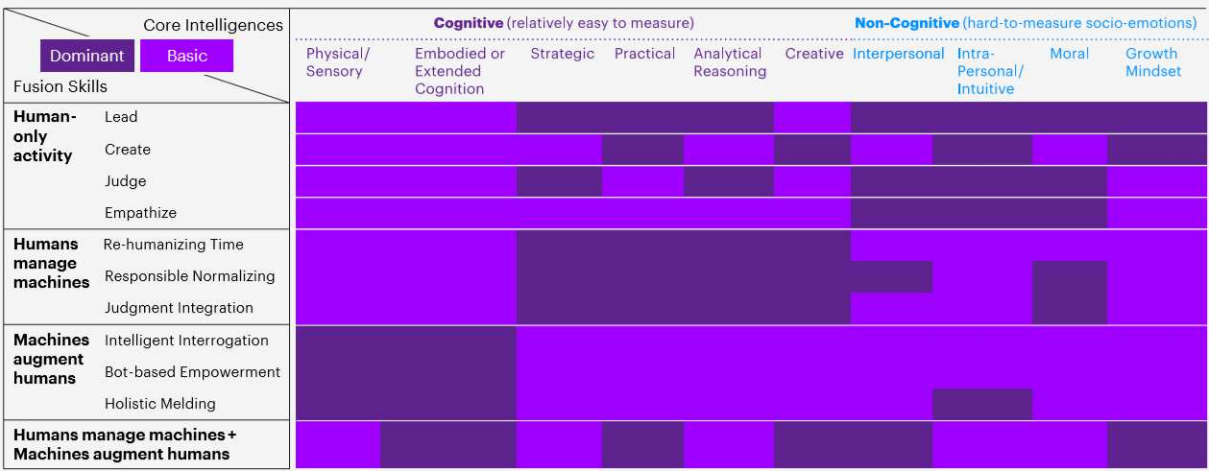

Figure 15. *Fusion skills and intelligence matrix. Core intelligence underlying human-only and missing middle roles. (Accenture 2018c, p. 9)*

3.4 Ironies of automation

We are living in a world where automation of production, logistics and many other complicated tasks is becoming an absolute necessity. Modern businesses are competing on an global level and there is a very thin line between a successful business and a failure (Bainbridge, 1983).

Furthermore, because of globalization, technological advances and intense competition, there are not many robust enough companies today that could easily overcome these challenges. To survive, we must innovate with new technologies and automate our production lines. However, automation is not an easy task, there are some inherent ironies in it (Bainbridge, 1983).

Every work or production process can be divided into many tasks/steps. These tasks can be treated separately, companies could write algorithms or develop new machines to perform these tasks easily and with low investments. The human worker was identified as a weak link in the chain and one of the main responsibilities of a system designer (who is also a human being) is to implement automation process, which means taking out humans out of the equation.

Therefore, this new automation process will be as good as its designer. In traditional production (pre-automation age), many years of training were needed for a good production operator; who would then supervise critical tasks, stop the processes when things went wrong and who was able to make necessary decisions.

The operator was given the opportunity to spend many hours during his/her training, learning from experienced, supervisors and benefiting from their valuable experience. He/she was able to work countless hours to solve real production problems. The training would take quite a time (years) to get a good operator. These professionals took great pride in their work.

Never ending pursue for optimization and cost reductions ushered the need for the automation. With automation, there was theoretically no more need for such experienced (expensive) workers, new operators should be there just to oversee the process and if needed to step in. Studies have shown, if the operator is a skilled one, the whole process will run smoothly, while the inexperienced operator will stop and will need to rerun the process many times, forcing it to oscillate and never achieving an optimal output (Edwards, Lees 1974, as cited in (Bainbridge, 1983)).

There are two ironies in it: the first one is that designer errors can be a major problem of the automated process (Bainbridge, 1983). The second one is that in a “perfectly automated system” there is still a need for an “old school” trained experienced operator. He/she will be now even

more loaded with work, while he/she must understand how the software and monitoring system operate.

It is easy to recognize that automation leads to deskilling. Automation per se takes the human out of the process, especially experienced, skilled and most importantly expensive. Of course, there is a transition period in which automated systems are still operated by experienced operators, utilizing their skillset. As time went by, they were substituted by new, cheap, inexperienced and poorly trained operators. Obviously, this led to the deterioration of skills.

In the ideal world of automation, an unskilled operator would monitor the automation system and call the supervisor if the process is not running smoothly. As already mentioned, the supervisor has to poses skills and experience which he/she loses by time if there is no practice. Consequently, it is very important to maintain manual skills (Bainbridge, 1983).

In the automated systems, many tasks are performed one after other in real time, monitoring operator cannot follow and critically analyze them fast enough. Therefore, he/she must rely on an automatic monitoring system. The operator can at its best say if system behavior is “logical” or “acceptable”. The actually irony is that we have a situation where the computer has to make decisions in real time because the human is not capable of doing so, but the human is the one who has to monitor system (Bainbridge, 1983).

Another issue that we have to address is task allocation between humans and machines. Some researchers suggested that tasks should be divided between humans and machines, assigning them tasks that they are best at. A human can solve complicated problems where there is no time pressure, and machines can support with time-consuming tasks. Tests were performed with autopilot and the use of human-machine interaction by the flying. Although a computer can reduce a big part of human work-load, there still has to be an option to overrule the computer and take over when a critical decision has to be made (Wiener and Curry,1980; Rouse 1981 as cited in (Bainbridge, 1983) .

The same reasoning can be applied to the autonomous driving. The computer can assist the human in many tasks, and even take own decisions (emergency braking in case of a possible accident), but the human still has to be able to take control and overrule the computer at any moment. On this example, it is obvious how critical is that human has appropriate skills and no matter how fast technology will advance, for some type of tasks full automation will never be possible.

(Etzioni & Etzioni, 2017) argues that with AI development, it is necessary to implement the same basic decision-making structure, just as we have for all non-digital-systems: a tiered-decision making system. Above all of that, there is a great variety of oversight systems that will ensure that the work is performed within predefined parameters. Oversight AI systems or AI Guardians will ensure that the decision made by autonomous vehicle or weapons, stays within a predetermined set of parameters. In an example of driverless cars, an oversight system would ensure that the speed limit is respected, even though other cars are going over the speed limit.

Inside Nokia's factory of the future in Oulu[5], robots are doing the final assembly of their products. By standardizing its components and equipment, Nokia is now able to give more and more tasks over to robots. In most of its factory, they are still using industrial robots, which are placed in enclosed cells and separated from humans. However, Nokia is also starting to introduce "cobots," which are safe to work alongside humans and have a greater degree of sensitivity. One of the main advantages of cobots is that they could be easily reprogrammed to take over repetitive, tedious tasks from humans (Daugherty & Wilson, 2018).

We conclude with that the state-of-the art of technology is currently not able to handle, e.g. flexible assignments of jobs between humans and machines, and cobots are not widely deployed in shops yet, but only in laboratories and factories of future.

[5] Source: https://venturebeat.com/2019/04/10/inside-nokias-factory-of-the-future-robots-data-automation-5g-and-even-some-humans/ - Accessed June 30th.

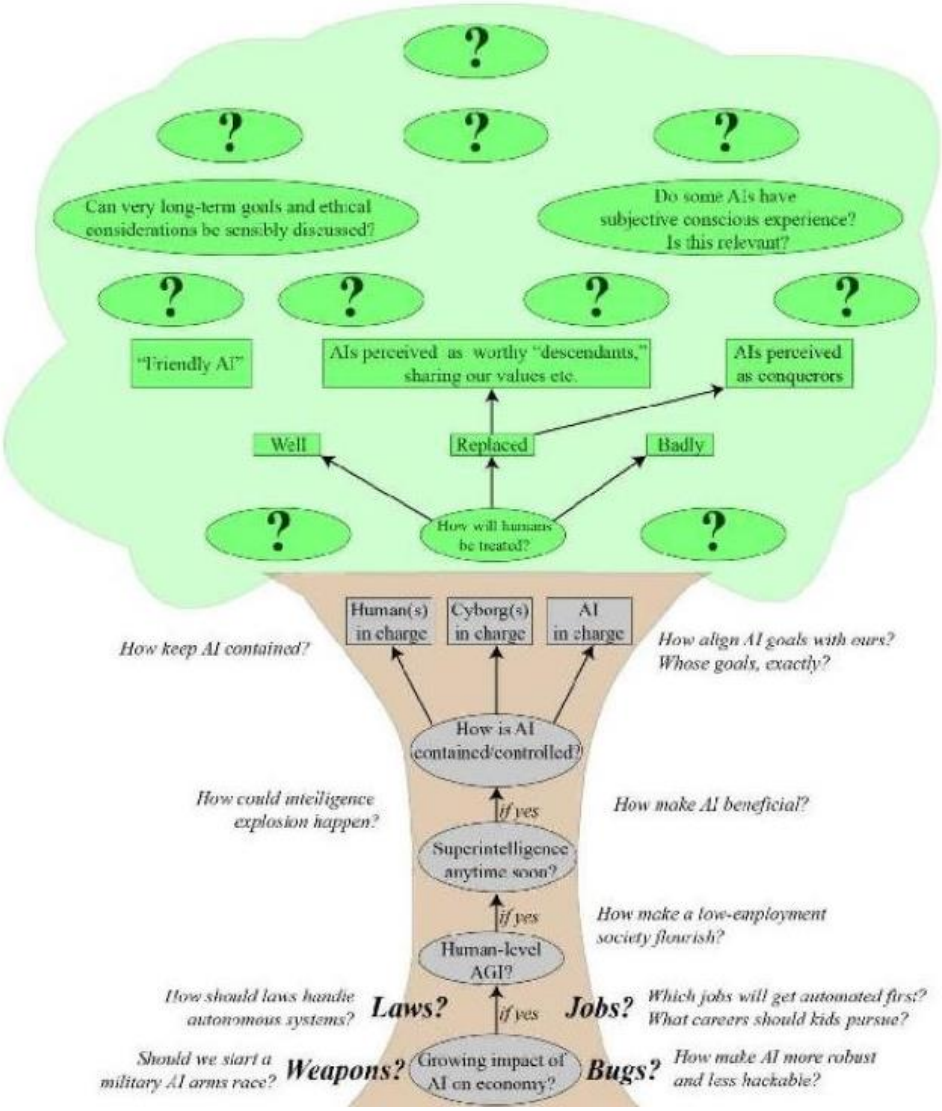

Figure 16. *Which AI questions are interesting depends on how advanced AI gets and which branch our future takes. (Tegmark, 2018)*

Figure 16 branches out many scenarios defined by answering to a specific set of key questions. Figure 16 summarizes key questions we will encounter as we march forward in time, to a potentially even more advanced AI.

3.5 Career advice for our kids

So what career advices should we give our kids (Tegmark, 2018)? Tegmarks' advice for his kids is to look for the professions that are not that easy to automate in the near future, or machines are currently bad at. Based on the discussion we had about various professions being taken over by machines, it is the right time to ask ourselves these question which can potentially help us make the right career choice decision by (Tegmark, 2018, p. 121):

- Does it require interacting with people and using social intelligence?
- Does it involve creativity and coming up with clever solutions?
- Does it require working in an unpredictable environment?

The more of these questions you can answer with a yes, the better your career choice is likely to be. This means that relatively safe professions include becoming a teacher, nurse, doctor, dentist, scientist, entrepreneur, programmer, engineer, lawyer, social worker, clergy member, artist, hairdresser or massage therapist.

4. The Missing Middle. Reimagining process with AI

"The future is already here—it's just not evenly distributed."

– William Gibson, science-fiction novelist

In this chapter, we will talk about three new human roles that are reimagining business processes and empowering organizations to transition smoothly its business and workforce. We will introduce three new roles, trainers, explainers and sustainers.

4.1 Three roles humans play in developing and deploying responsible AI

(Daugherty & Wilson, 2018) did an extensive global study with more than fifteen hundred companies that are using AI systems, and they found the emerging new category of jobs that will become increasingly important as technology advances.

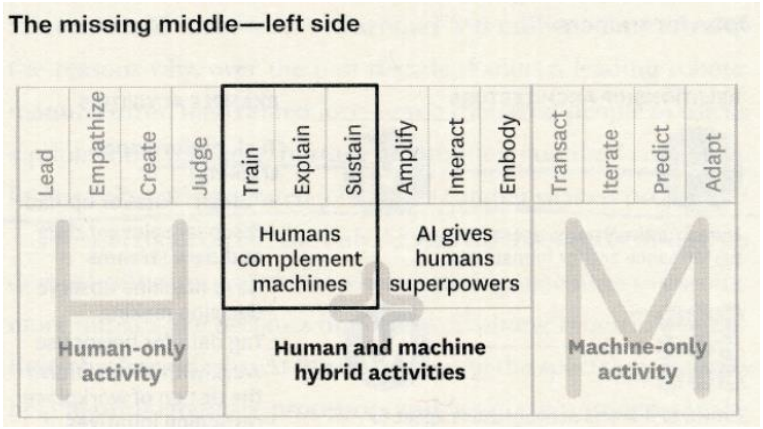

Figure 17. *The missing middle – humans complement machines (left side). (Daugherty & Wilson, 2018, p. 115)*

These new novel jobs will not just replace the old ones, they will require new skills and trainings that have never been performed before. Furthermore, this sophisticated AI systems will require new roles such as training, explaining, sustaining AI behavior, which fall on the left side of the human + machine hybrid activities in Figure 17. Where in your organization could you find these new jobs? How do these new roles fit into existing and reimagined processes? In this subchapter, we will answer these questions and provide examples for trainers, explainers, and sustainers.

4.1.1 Trainers – AI systems are learning to adapt to us humans.

One of the main activities of trainers is to make sure that AI systems are trained to act and perform certain tasks and activities like humans do. We tend to react more positively towards automation systems that can mimic human abilities and behavior such as empathy. One of the recommendations from the practice is to look for the initial trainers within your company to carry this responsibility. This job will require humans with the right skills. The best place to start looking for such individuals is the people who are already working closely with the physical and software automation systems, and those that have very good knowledge from an end-to-end backend system perspective. This training of AI systems should be performed in steps, starting with fundamentals and simple tasks, and moving forward to adding refined and nuanced training. These abilities will be demonstrated in the following examples.

Figure 18 gives an extensive list of types of jobs for trainers from task performance training to humanness attribute training.

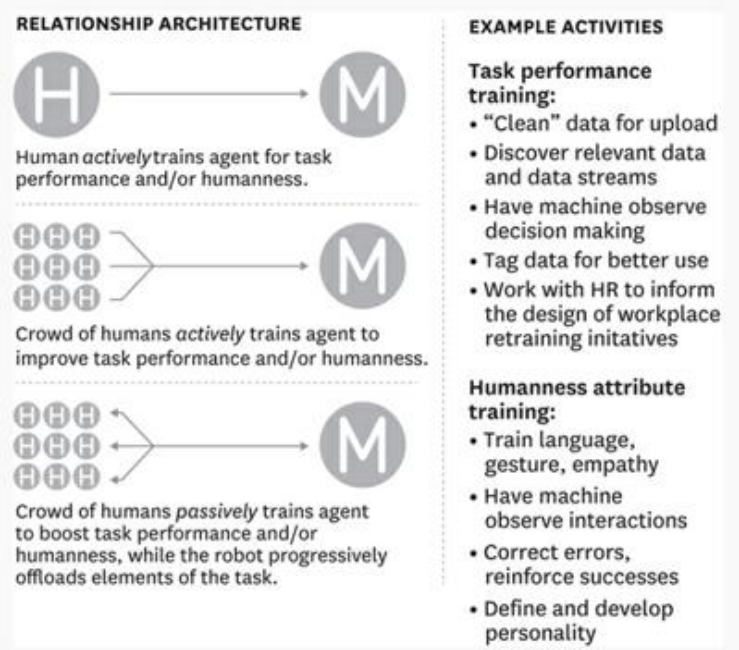

Figure 18. *Jobs for trainers. Example activities. (Daugherty & Wilson, 2018, p. 116)*

(Daugherty & Wilson, 2018) have identified following example activities for trainers.

- *An empathy trainer* – is an individual that has the task to teach AI systems to show compassion and empathy. The authors have brought an example of the startup Koko that is currently helping chatbots such as Amazon's Alexa and Apple's Siri to sympathize and show compassion while answering their customers' questions. These

companies are currently working intensively with Koko to train its machine-learning algorithm. At the moment, a human trainer is making sure to correct Koko if it responds inappropriately, and with time this algorithm should be able to run independently and answer people's questions or complaints with empathy, compassion, and even humor or sarcasm. The authors have brought a few examples showing the progress of Alexa where she would use sentences such as "I'm so sorry to hear that" or "Sometimes talking to a friend can help", in an appropriate context. Having such an empathetic bot implemented in their backend system could set such companies apart from their competitors and offer a great customer experience.

- *Personality trainers* – after developing compassion and empathy for AI systems such as chatbots in our previous example, next job opportunity for a trainer could be a personality development of an AI system. We could again take a chatbot as an example to illustrate the nuances and skills necessary to successfully execute this role. Daugherty & Wilson (2018: 119) gave an example of a technology such as Microsoft Cortana, which is a virtual assistant created by Microsoft Windows Phone 8.1 to deliver personalized recommendations over the Bing search engine. In essence, this means that, with the help from personality trainer, Cortana will be able to learn what a particular person is more interested in, and when that person would like to receive certain personalized suggestions. There is a whole team at Microsoft that consists of a poet, a novelist, and a writer that help develop Cortana's personality. This is important because these AI systems, such as chatbots, are representing a particular brand and they could deliver a two-way relationship (brand to consumer and vice versa).
- *Worldview and localization trainers* – so far our trainers have been focusing on developing AI systems, for example, chatbots to be able to mimic humans emotions and compassion. Then they have promoted and installed a personality to reflect the brand and its customers. Once we've accomplished these two valuable tasks, next on our list will be the responsibility of worldview and localization trainers. Just like with the employees who work globally and as such need to understand and value cultural nuances, the same principle needs to be applied to chatbots who should be understandable and accepting of the cultural differences across the globe. It is well-known that certain cultures have a very anxious and concerning view towards robots and automation. In this case, we can look into an example of Japan, the United States, and Western Europe. Worldview trainers should be aware of these differences and they

should be able to incorporate these global views into a variety of AI systems. Their main value to deliver will be a thoughtful AI system that consumers can trust globally.

- *Interaction modelers* – one of their main goal is to train a behavior of a particular AI system by using experts as their role models. The main idea behind it is to have an AI system that will watch the experts performing various tasks and once the training is complete, this AI system should be capable of performing these tasks independently.
- *Data hygienist* – naturally, the value of this job depends on the data inputs, and for that reason, the role of the data hygienist will become fundamental as companies start gathering data from a variety of sources such as social media, satellite images, IoT sensor data from the field and so on. This role will be of tremendous value as it will be able to identify valuable data that could support and thrive innovation within the company (Daugherty & Wilson, 2018).

4.1.2 Explainers – bridge the gap between humans and machines.

The second category of novel job positions are explainers, who will fundamentally change the future of work since they are the ones assisting our business leaders and executives to fully grasp the future potential of refined machine-learning algorithms. Furthermore, as the future AI systems are getting more sophisticated, the challenge will be to make it easily understandable to the business leaders and other stakeholders. Their job will be to explain and translate “the black-box" behind each of these algorithms to ensure its trustworthiness and applicability to their company. In a way, explainers can be described as the ones bringing clarity and transparency on the machine’s side, and building up the confidence to make the right decision with the help of data, on the human side.

One of the well-known examples, the European Union’s General Data Protection Regulation (GDPR), goes in line with the role of explainers. This regulation empowers consumers to challenge the corporations to explain and justify the decisions that affect those same consumers, based on their deployed algorithm.

Figure 19 gives a full overview of currently known explainer jobs with examples of their activities.

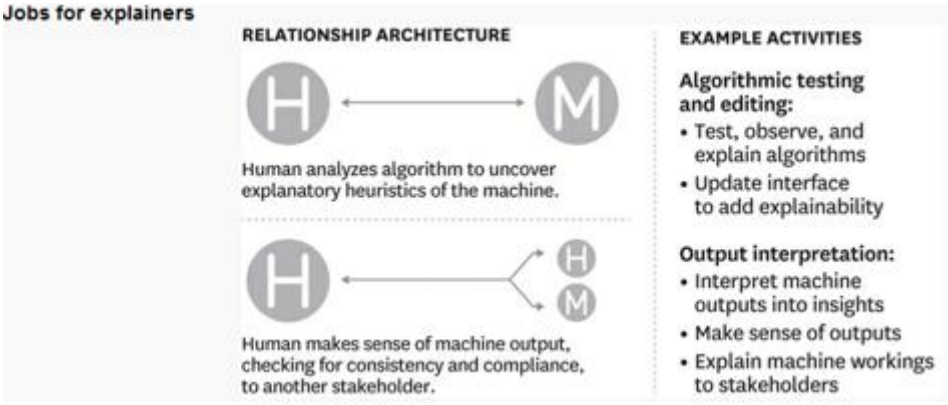

Figure 19. Jobs for explainers. Example of activities. (Daugherty & Wilson, 2018, p. 123)

With this in mind, we can deep dive into employee skills that will enable companies to explore the full potential of explainers.

- *Algorithm forensic analyst* – this person's job will be to make an AI system liable for its results. This is necessary as the machine-learning algorithms, such as deep-learning, are not that simple compared to the basic "if-then" rules. The forensic analyst will be able to investigate, explain and present the main results and decisions made by this algorithm. In order to perform such a sophisticated job, this person will need to have proper training and skills necessary to investigate all AI algorithms deployed within the company. One of the techniques that could be useful as a support mechanism, is LIME – Local Interpretable Model – Agnostic Explanations. Such a technique doesn't need to know all the details of the underlying algorithm. Its main goal is to enable the forensic analyst to make an educated decision while changing the input variable and observing the changes. For example, this can be useful in the HR department to support their hiring decision based on the positive match in criteria – such as education and experience, compared to the inexperience in working in the collaborative teams. This technique can ease our decision-making process and empower us with the right questions to ask. They can give us an explanation of why someone was hired, or why certain sales campaign was targeted towards this group of customers or channels.
- *Transparency analyst* – while introducing explainers, we have emphasized that one of the main reasons behind the need for this job is AI algorithms in all industries getting more and more sophisticated, to the extent that it becomes hard to keep up with the technology development, especially for our business leaders and executives. This brings us to our next job – transparency analyst. A transparency analyst is someone that will maintain a database of all algorithms and classify them by their transparency and

accessibility. For sure, we should consider that some algorithms will be deployed as "black-boxes", in order to uphold the intellectual property while others are black boxes due to the sophisticated nature of the code. The person doing this job will be working closely with the rest of explainers to provide transparency and user-friendliness of those deployed algorithms.

- *Explainability strategist* – this person will be responsible for deciding which AI technologies will be deployed and how will they affect the company's position on the market. We could say that for different fields and applications, different AI technologies will be considered and deployed. What we are trying to achieve in this case is to make sure that we are using proper technology (such as a deep-learning algorithm), which will help us deliver our business objectives. This implies that the explainability strategist, apart from being a technical wizard, will have to have a big picture of the whole company including financial, legal, ethical, and other key areas.

4.1.3 Sustainers – ensure desired legal and ethical use of AI systems.

Moving forward to the last category of new jobs – sustainers – whose primary responsibility is to secure the proper use of AI systems and to ensure that these AI tools are used with the intention of serving humans and making our lives and jobs easier. Employees in this sector have a vital role in the sustainable development of AI systems, and their role will be even more important as the system progresses. The AI systems and tools are in place to serve society and they should be developed in a way to support and stimulate human + machine collaboration only (Figure 20).

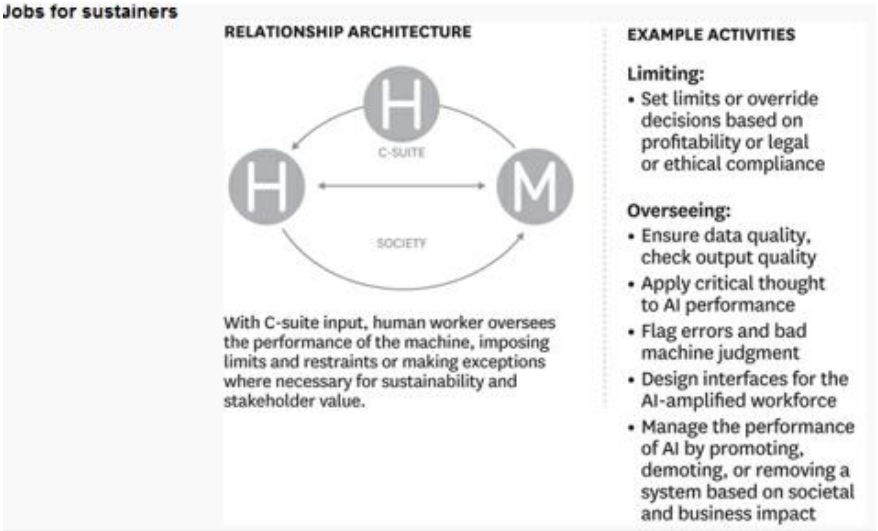

Figure 20. *Jobs for sustainers. Example of activities. (Daugherty & Wilson, 2018, p. 127)*

- *Experienced context designer* – the role of a context designer will be to ensure that robots and AI systems are functioning properly from the start. While developing a new system, these individuals will assume full responsibility, starting from the minor details such as the color of the robots' arm, to more sophisticated contextual ones such as the overall business processes, customers and the market, the end-users, cultural nuances, and so forth. As we have already introduced the term robots and human-machine collaboration, we could remind ourselves of the well-known science fiction author Isaac Asimov who popularized "Three Laws of Robotics" in 1942 in his short story "Runaround" (Isaac Asimov, as cited in Daugherty &Wilson, 2018:128):

1. *"A robot may not injure a human being or, through inaction, allow a human being to come to harm.*
2. *A robot must obey orders given it by human beings except where such orders would conflict with the First Law.*
3. *A robot must protect its own existence as long as such protection does not conflict with the First or Second Law." (Isaac Asimov, as cited in (Daugherty & Wilson, 2018, p. 128))*

- *AI safety engineer* – a person whose main responsibility is to foresee the impact of the designed and deployed AI systems within the company, keeping in mind the "Three Laws of Robotics". Certainly, one of the growing concerns around deployed AI systems is their safety, and what actions will be taken in order to prevent incidents that could harm humans. Safety has to come first if we want to move forward with new technologies and convince the society that robots and technology are here to serve them instead of harming them.
- *Ethics compliance manager* – We have to strive toward designing and deploying AI systems that will uphold our human values and morals. This is where the ethics compliance manager will be of fundamental importance. This person should ensure that the AI systems are clean from all different biases, such as discriminating against certain groups of people based on their geographical area, sex, gender, the color of their skin and so forth. It is vital for the ethics compliance managers to identify and repair these breaches. They could work closely with an algorithm forensic manager in finding those incidents and repairing them (Table 7).

Responsible and sustainable AI: Emerging considerations for sustainers	
Explainability	In necessary cases, use non-Blackbox models so intermediate steps are interpretable and outcomes are clear, providing transparency to the process.
Accountability	An explicit identification of which decisions are delegated to machines, which decisions require human interventions, and who is accountable in either case.
Fairness	Must assure AI solutions are balanced and not biased. Need to understand why decisions are made. Need protection against data bias.
Symmetry	Must make sure that our data is an asset to us as it is to others.

Table 7. *Responsible and sustainable AI: Emerging considerations for sustainers.*

(Daugherty and Wilson, 2018, p. 130)

Daugherty and Wilson (2018) shared an example of an AI prototype – Quixote that can learn about ethics, social protocols, commonly shared knowledge, exemplify proper and improper behavior and other human values by reading simple stories on how humans interact with each other. This AI prototype has been developed by two researchers from the Georgia Institute of Technology and through this simple story, he was able to learn that, for instance, striving efficiency is acceptable if it doesn't compete with other important applications. However, it is still important to acknowledge the importance of human ethics compliance managers as the gatekeepers, ensuring the proper functioning of the sophisticated AI systems.

- *Automation ethicists* – even though deployed AI systems could technically be well trained and function properly, they could be still harmful to society. The role of the automation ethicists will be to identify and manage all factors that could diminish and jeopardize the successful deployment of an AI system. They will play a key role in the overall compliance with the automation systems and provide a missing link in human and machine collaboration and acceptance. There must be a clear procedure where the automation systems are explained to the employees, in order to create synergy and reduce their fear of losing their job due to the automation.
- *Machine relations managers* – individuals who will have a very similar role to HR managers. The difference between them and actual HR managers is that they will supervise AI systems and robots, instead of human employees. They will be the ones making the decision when to promote a certain AI system, and when to retire an AI system that is not living up to the company's standards. These managers will work

within "machine relations department" and they will manage and conduct regular reviews of all deployed AI systems.

To summarize the new jobs and roles that will emerge as AI systems get more advanced and sophisticated, it's necessary to stress that this is just the starting point. Indeed, as AI systems evolve, we will see companies creating their own roles and responsibilities that will augment their capabilities and offer them a competitive advantage. What we have realized through describing these new roles of trainers, explainers and sustainers, is that they will require new education, training, reskilling and in-house training. In case of an empathy trainer, they could easily be individuals with high school education who are naturally compassionate and sensitive towards others and their environment. However, plenty of other new jobs that we have described, such as ethics compliance manager, will ask for higher education, relevant experience, and a specifically designed skillset. A majority of these new positions could lead to a rise of a "no-collar" workforce that will slowly evolve out of the blue-collar jobs in manufacturing (Daugherty & Wilson, 2018).

This goes hand in hand with what IBM CEO, Ginni Rometty said in an interview with CNBC News at World Economic Forum in Davos, Switzerland.

"It is a partnership between man and machine, if you want to put it that way. Think more about activities changing with the technologies. When you do your job, there will be things that take you a lot of time to research and do. Yes, they'll be done faster. Then you have the time to do what I think we humans do best. That's where I came up with this idea of 'new collar.' Not blue collar or white collar."[6] *– Ginni Rometty, IBM CEO in an interview with CNBC News at World Economic Forum in Davos, Switzerland.*

The bottom line is that the managers and business leaders will need to revise their talent and lifelong learning strategies in order to better attract, train, manage and retrain these talents. In order to keep going forward with the sophisticated AI systems, the organizations will need to reconstruct all of their business processes, end-to-end, and not just in IT. By doing this they should keep in mind that humans are in the center of this processes and that technology is merely an enabler in getting things done efficiently. Not the other way around. We will talk more about the mindset and leadership in one of our next chapters, where we present MELDS framework and reimaging the business processes (Daugherty & Wilson, 2018).

[6] Source: https://www.cnbc.com/2017/01/17/ibm-ceo-says-ai-will-be-a-partnership-between-man-and-machine.html – Accessed on June 19th.

"Ultimately, we will need to reskill existing employees as there will soon be a huge imbalance in supply and demand. We also have a moral obligation to train the future workforce in association with the broader education system."—Kees van der Vleuten, former Global Transformation Director, VEON (as cited in Accenture 2018c, p.21)

For business leaders, the opportunities are clear. Leaders should embrace the transformation and performance opportunities already available to them (and their competitors) from data, analytics, and digitization, as well as the rapidly evolving opportunities in AI, robotics, and automation. To harness these benefits, business leaders will not only have to invest in technology, but also in transforming their organizations. Specific approaches will vary business by business, however new mindsets will be critical (McKinsey 2017d):

- *Testing, experimenting, learning, and scaling fast.*
- *Reimagining business models and business processes.*
- *Digital assets and capabilities as the "new balance sheet".*
- *Staying calibrated and investing accordingly.*
- *A new focus on human capital, including integrating workers and machines.*

In our next subchapter, we will look into leader's guide to reimagining process – five steps to getting started by (Daugherty & Wilson, 2018).

4.2 A leader's guide to reimagining process – Five steps to getting started

Now that we have defined the jobs of the future, as well as the clear roles within the missing middle, we would like to continue by offering a framework that will support all business leaders and managers in taking their organization to the next level. This next level is where humans will be augmented by the underlying AI value that is to be explored and applied to the challenges and needs of the 21st century. Daugherty and Wilson (2018) have made it clear that this new era of AI technologies knows no limits and its power is yet to be seen and explored. This gives us hope that we are empowered by technology to face these challenges, from the climate change, food and water shortages, growing population, aging population and so forth. As we move forward and these AI technologies get more advanced, we, as future leaders, must ask ourselves how to face the new wave of digitalization and where should we start? In their book, Humans+Machine, Daugherty and Wilson (2018) have been very clear that this new wave of digitalization is creating a demand to fundamentally rethink (or recreate) business processes end-to-end, starting from the top leadership discussing ethical, cultural and trust concerns, and moving slowly towards IT and technology department. The MELDS framework is specifically

targeted to answer these challenges posed in front of our leaders and its main goal is to offer a clear path going forward. The aim here is to provide examples of leading companies that are mastering this AI-driven business transformation and these leading companies are utilizing AI technologies to enable long term growth and productivity.

4.2.1 Mindset: Imagine processes that might be.

What we should accomplish with adopting the proper mindset is to fundamentally rethink – recreate and innovate around business processes to achieve novel ways of deploying AI systems. It is important to be fully aware of which customer and employee needs and challenges we would like to solve, and based on that, we should look for smarter ways to do so. If we do it this way, then we increase our chances to have a successful deployment and we increase our return on investment. In order to get there, Daugherty and Wilson (2018, p. 155-160) suggest following the three-step method: discover and describe, co-create, and scale and sustain. Let us discover this three-step method in greater detail.

- *Discover and Describe* – in order to prepare and properly react to the changing environment around us, it is necessary for our leaders and executives to adapt to this new environment where the decisions are made based on the real-time data, and these data can be created from humans as well as machines. After all, to rethink business processes one must get away from the traditional approach and look for the new methods and tools such as design thinking. Where should one start the rethinking? The best starting point would be to identify the true customer needs and weak spots and work from there using design thinking or any similar method, in order to describe and deliver the true value that customers are searching for and are ready to pay for. These opportunities to rethink and fundamentally change the business processes could be internal (such as supporting HR department to hire new staff more efficiently) or external (such as supporting your customer in the field of agriculture in identifying his weak spots based on the real data from the soil, historic weather data, etc.). In Chapter 5, we will deep-dive in such transformational examples of real companies that have completely reinvented themselves and now they offer novel services and products to their customers all over the world. The major learning curve for our executives is finding a technique or a tool to identify, capture and deliver the real customer value based on real-time data from various sources. This will require a strong collaboration between humans and machines, where humans

will bring curiosity and patience, while machines will excel in finding the right patterns and opportunities in the data.

- *Co-create* – it is the next step in reimagining business processes and its main purpose is to envision how the work could be done and which resources, tools, techniques, and methodologies are necessary to achieve this. It comes as a natural extension of the Discover and Describe phase. One of the examples provided by Daugherty and Wilson (2018:159) is the Audi Robotic Telepresence (ATR) which represent the fleet of telepresence robots. This fleet of robots has been introduced as the answer to the urging need for more expert technicians that need to go directly to the Audi dealership across the country. This, of course, was challenging for Audi as they didn't have enough technicians to respond to the customer requests and this created a long waiting list of unsatisfied customers. The answer was the ATR system, where the mobile robot would be directly on the site in the dealership, and the expert technician would connect through him and help the technician on-site to resolve the issue. With this approach, the technician as well the expert technician could learn from each other and resolve the issues faster and improve the learning loop. This innovative solution was possible as a result of the advancement in the AI technology and most importantly through co-creation in the missing middle, where humans and machines collaborate.
- *Scale and Sustain* – now that we have discovered, described and co-created business processes, the next step would be to scale and sustain it with constant improvement. For example, Audi realized the overall great improvement with its pilot ATR program, and they continued to invest in it by deploying it throughout all their US dealerships in order to increase efficiency and effectiveness.

In place of siloed departments governed by hierarchies, organizations are shifting toward a more flexible system in which individuals move among teams and projects (McKinsey, 2018a) (Figure 21).

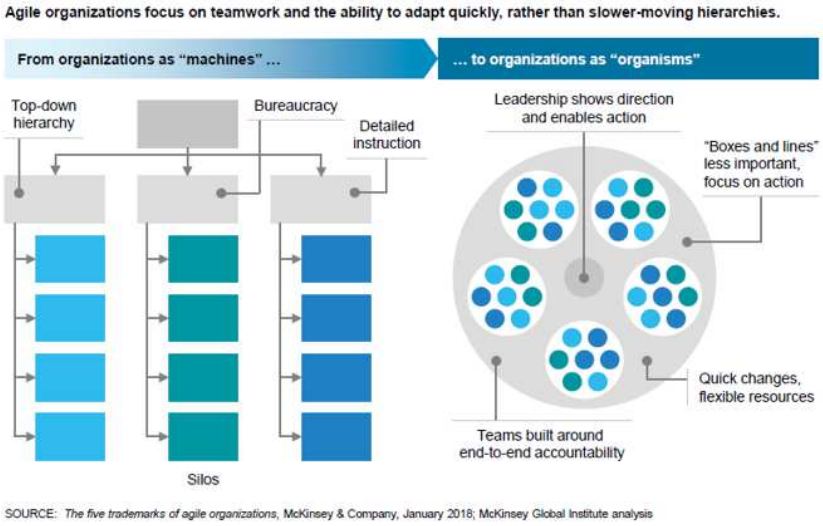

Figure 21. From organizations as "machines" to organizations as "organisms". (McKinsey 2018a)

4.2.2 Experimentation: Imagine an Experiment.

"I've made billions of dollars of failures at Amazon.com. Literately," Jeff Bezos, CEO, Amazon (as cited in Daugherty and Wilson, 2018, p. 161)

Amazon Go is definitely a great example of what a thoughtful and sincere experimentation can bring to the company and how it can make it a role model of what future holds for the retail industry[7].

- *Build-Measure-Learn* – as we have stated earlier, the age of standard business processes is over and the way forward in the age of AI is to embrace novel ways and experimentation. We brought a perfect example to convey this message. As Daugherty and Wilson (2018:165) thoroughly described in their book, Amazon Go started with small steps developing and deploying this concept within their campus, engaging its employees into this experiment and collecting their feedback in order to improve before launching to the market. We should be aware that, in order to provide its consumers with this amazing experience they are ready to pay for, Amazon had to deploy a sophisticated ecosystem of AI technologies from computer vision, sensor fusion, and deep learning. Some of these systems are still much under development and its full power is yet to be

[7] https://www.amazon.com/b?ie=UTF8&node=16008589011 – Accessed on June 19th.

explored and utilized. To compete in the future, it is of huge importance that business managers and leaders encourage their employees to experiment more. They should create an environment where mistakes and missteps are welcomed and use it as a means to inspire the rest of the organization. This will empower them to look for new ways to solve challenges and to realize which jobs are performed best by humans, which ones by machines and which ones in collaboration of these two. Start small, experiment, learn and then scale.

4.2.3 Leadership: Imagine a blended culture of people and machines.

For many companies, one of the main leadership challenges will be to establish a culture that promotes a responsible AI system. However, this might be a difficult task to achieve as many workers have an intrinsic lack of trust in technology, and those fears could get worse as people worry primarily about job displacement (Daugherty & Wilson, 2018). The skills of trainers, explainers and sustainer will be absolutely crucial, as well fostering a positive experience with AI augmentation. Business leaders need to make clear to employees that company is using AI tools to make their job easier and to reimagine processes. Furthermore, a healthy portion of resistance towards AI tools and its immediate acceptance is a good thing. (Daugherty & Wilson, 2018) research suggests that managers should promote a thoughtful balance of skepticism and acceptance, as a result of complex changes brought by AI systems. Of course, we are still learning what AI can and cannot do, and therefore it is not helpful to trust AI systems blindly. Clearly, human judgement remains a key to a successful implementation of AI.

- *Install Guardrails* – one approach towards a responsible AI system is to provide guardrails into an AI-based process. These guardrails will increase peoples confidence in AI. Typically, this is a sustainers task to build these guardrails and to keep the system on track. A good example that illustrates what happens in the absence of guardrails, is when Microsoft introduced a Twitter bot called – Tay[8]. Within hours, it was trained by other Twitter users and learned to tweet vulgar, racist and sexist language. Later on, its creators have removed it from the Internet. What we could learn from this example is that this could have been avoided, had they implemented content filters.
- *Use Human Checkpoints* – even automation technologists do not fully trust robots and AI. Party due to the fact, that they are not quite sure of what the machine is "thinking" or planning to do next – the machine is still a mystical black box. Here, the role of

[8] Source: https://www.theverge.com/2016/3/24/11297050/tay-microsoft-chatbot-racist - Accessed on June 30th.

explainers is crucial as they should keep humans in the loop. Furthermore, it is clear that the whole mind of an AI system cannot be known, however, some insights into its inner working processes should be known. One of the approaches for a better understanding of an AI system as well as building trust, is to implement dashboards and visualization tools that could be useful to share within human workers.

- *Minimize "Moral Crumple Zones"* – this term was coined by two ethnographers Madeleine Claire Elish and Tim Hwange. In their research, they discovered that control of certain services such as ridesharing, has become distributed among multiple human and nonhuman players, and yet social and legal perceptions of responsibility remain on the individual level. Let us consider an example of using a ride-sharing service, where the app instructs the driver which route to take and yet takes him and the passenger to a different location, not exactly where the passenger wanted to go. The question stays open, whose fault is that the app supplied an incorrect address, the driver did not know where he was going, and the passenger did not pay attention and did not correct the driver? One of the ways to move forward is to make sure that accountability is not there just for human workers. Secondly, give the opportunity to humans to overwrite the first decision made by AI. Workers should be able to provide valuable context as well as judgements and quality assurance for this service. Thirdly, rating algorithms should be in place for algorithms or machines, not just for humans. Fourthly, strive for continual improvements and look for misalignments. In order to get to this point, companies will need to spend tremendous efforts in aligning cultural values and norms.
- *Consider Legal, Psychological, and Other Issues* –in the end, to build trust in AI systems, leaders need to create an environment and envision its business processes to allow human workers to actively participate in the outcome, as well to have a clear understanding of how AI systems are operating. It would be excellent if AI systems would offer an explanation of their decisions and would allow people to keep some decision-making freedom. As a conclusion, we should say that developing processes that are fundamentally trust-based takes time, but case studies show that if all parties are engaged – then outcomes could become better for everyone (Daugherty & Wilson, 2018).

4.2.4 Data: Imagine a data supply chain.

To start with, good data is fundamental to AI and it is the fuel that powers AI. Furthermore, as data will be used by machine-learning, deep-learning, and other AI applications, it should be both rich (in terms of variety, quality, and usefulness) as well big (in terms of absolute volume). This implies, that the systems will only be good as the data that has been used to train them. As of that, organizations should ensure that they have workers in the missing middle, that help capture data and prepare it for analysis. These roles are essential as biases in the data could have serious implications and lead to altered results and inconsistent decisions. Here are the actions that could be performed (Daugherty & Wilson, 2018)

- *Think Dynamically* – firstly, start with a simple event to start with, one in which AI could support your organization in accomplishing its business goals. Focus on simple well-defined AI challenges, have it implemented successfully and then build it up from there.
- *Widen Access and Increase Variety* – secondly, as organizations make progress in their small-scale projects, they will continue growing and for that reason, they will need to ensure that their data supply chain consists of diverse, easily accessible sources of data. As companies continue to increase the variety of their data sources, they should be aware of any barriers to the consistent flow of their information. These barriers could be technical, where companies infrastructure is unable to manage huge volumes of data, as well as societal, since some firms could accumulate massive quantities of personal data and this could increase public distrust.
- *Increase Velocity* – we could say, that some data is fast, such as a news event of a sudden natural disaster, and this time-critical data should travel very fast throughout the supply chain. On the other hand, slow data could be of secondary interest and less useful.
- *Enable Discovery* – business leaders should ensure that anyone, especially less-technical users, has access to data and its insights. It should not be that only data analysts and data scientist profit from the data sources.
- *Fill the Missing Middle* – organizations should also make sure that they have a data supply-chain officer in their team. His main task as the top sustainer would be to manage all other sustainer roles in the organization. This role should be responsible for building up an integrated, end-to-end data supply chain, all the

issues that go along this, should be resolved by him. This should include questions such as, where are data silos or what data is being underutilized or how to simplify data access.

Figure 22. *Five keys to success in the age of AI. Summary. (Daugherty & Wilson, 2018)*

As a conclusion (Figure 22), we should underline that companies that have successfully reimagined their business processes, they adhere to the principles of MELDS framework. Specifically, to be successful at process imagination, business leaders must have the right mindset to offer new, fresh ways of operating in the missing middle. Furthermore, they should focus on experimentation, enable feedback loops and continue refining its vision. Further the line, managers should promote a responsible AI and create a culture of trust towards AI systems. On top, this will require good data, and companies will need to implement end-to-end data supply chains from various sources. In the end, fusion skills are the crucial part of MELDS framework and they are instrumental for success and empowering the future of work itself.

5. AI-driven changes in current jobs: three case studies

"Don't be a know-it-all; be a learn-it-all."

– Satya Nadella, Microsoft's CEO

In this chapter, we will provide three as best-practice-examples on how leading traditional companies and industries, are managing the transition and deploying the above five practices. Along the way, we will offer guidelines and recommendations to leaders aiming to implement AI while reimagining business processes. We have been specifically looking at this traditional organization to demonstrate the opportunity lies within transition, and it is not just applicable to digital native companies.

5.1 Rio Tinto: mining at the push of a button

Rio Tinto is a diversified global mining company and has been in business for over 145 years. The pace of change is accelerating right now across the industry and Rio Tinto continues to answer this challenges throughout the cross-functional working groups and divisions, such as Rio Tinto's Growth and Innovation division. This division, together in partnership with Rio Tinto's four Product Groups drives productivity improvements throughout whole organization. Rio Tinto's Growth and Innovation department includes following area of responsibility, such as management of global information technology, productivity, internal management consulting, automation and data science teams (McIntosh, 2018).

By applying artificial intelligence and automation company-wide, Rio Tinto has been recognized as one of the pioneers in this industry. AI technology is enabling the company to manage its large fleet of vehicles from a central operations center, that is hundred of miles away from the mines (Daugherty & Wilson, 2018).

Rio Tinto's key objectives over the past years and going forward are:

- *Ultimate goal of zero fatalities* – while intensifying focus on safety to deliver ever lower rates of injuries.
- *First mover within and beyond industry* – by partnering with the best of breed partners and remaking itself over and over again, to scale their operations and equipment and be one of the leaders within and outside the industry.

- *Established leader in automation* – by using their own automation technologies and tools they are making great progress and delivering novel solutions.
- *New disruptive solutions and competitive advantage* – by utilizing recent development in Cloud computing, data science, machine learning and artificial intelligence as well implementing open innovation.

By using a combination of technology, innovation and automation, Rio Tinto's key objective is to create the mine of the future. To move forward and maximize the return on investment, Rio Tinto is guided by their 4P framework: **Performance, Portfolio, Partners and People** (McIntosh, 2018).

Since they have been open and sharing about their transformational journey, we will now apply MELDS framework and identify key milestones that made this transition possible.

1 **Mindset: Imagine processes that might be by using three-step method: discover and describe, co-create, scale and sustain.**

Discover and Describe – Opportunities for reimagining processes might arise both inside as well outside of organization. Let's consider one of the recent examples from Rio Tinto's exploration team that will provide a useful insights into what has recently become possible in the area of data analytics. Its exploration team has managed to deliver a significant progress company-wide by utilizing latest capabilities in cloud computing and cloud at edge. The exploration team has been assigned to build up new algorithm that maps geology and certain styles of alteration and the superior data came from a recently deployed satellite. Their early tests showed that by using the traditional methods for processing this vast volume of data it would take them around 50 years to process this data. In their next iteration, they have decided to build computing clusters and managed to reduce this time to around 11 years and would cost them several millions of dollars. However, Rio Tinto's management imagined there needs to be a more cost effective, robust and agile way to process this data and that is how the co-creation among the stakeholders was born. In the next instance, the exploration team worked together with the data science team to process the data. They have realized that there must be a better way to minimize this time down from 11 years to weeks or possibly days (McIntosh, 2018).

Co-create – while working with one of their cloud providers, their data science team uploaded close to 1 Petabyte of data into the cloud and processed this data within 11 hours and for a compute cost of under $10,000 US dollars.

This was a significant progress where Rio Tinto managed to deliver upon their objectives and took their task from 50 years to 11 years to 11 hours and from millions of dollars to a few thousand of dollars.

Scale and Sustain – the final steps towards reimagining business processes is to scale their solution and sustain it with continual improvements. Rio Tinto, for example, decided to pursue with their new iron ore mine Koodaideri and has build one of the most advanced iron ore mine ever. They are planning to improve their operations significantly and sustain this new mine with help of technology such as use of digital design, advanced data analytics, machine learning and automation. In the long run, Koodaideri should be part of an integrated system, where the mine, process plant and rail system, will be connected and the operators will have the access to real-time data. By employing some of the latest technologies, such as digital twins, Rio Tinto is on its way to launch their first fully paperless mine and to offer completely novel solutions to the market.

2 Experimentation: Imagine an Experiment

Build-Measure-Learn – if we take again the use case of the iron ore mine Koodaideri, we could also recognize that Rio Tinto's mission is to create the future of mining and this is only possible by encouraging its employees to look for the innovative ideas within and outside their industry. And to foster the culture of experimentation, change management and looking for the future proof solutions that are possible with the power of underlying technologies and automation. Again, Rio Tinto is not using the technology just for the technology's sake – their mines of the future should improve safety, maximize performance and to attract the workforce of the future (McIntosh, 2018). Many might not see Rio Tinto as a digital-first company, however, it has restructured its workforce to work effectively side by side with AI systems. In other words, it has reimagined some of it processes to look more like a NASA's mission control in Houston (Figure 23), which is for sure unusual yet powerful indication for a mining company (Daugherty & Wilson, 2018).

Figure 23. Rio Tinto's Operations center in Perth, Australia. (Burke, 2016)

Rio Tinto's Pilbara location in Australia is called the "Mine of the Future" and has been designed as their testing ground for new advanced technologies (Burke, 2016).

The Operations center has been one of the main drivers behind the transformation of mining operations. It is an operational hub that brings people from various departments together to share their experience, such are experiences in mining, transport and supply chain. Furthermore, the operational hub embodies the perfect combination of high-tech environment and traditional know-how of mining industry. Rio Tinto's data analysts have a major in science and mathematics and only a superficial knowledge of mining. Along this idea, by building up such an environment, Rio Tinto provided an important link to exchange the knowledge and foster new, fresh ideas. A data scientist are the ones making the recommendations to operators in the Operations center, it is crucial that they work close together in cross-functional teams and that the operators have an opportunity to provide a feedback and have an influence towards new AI systems that will be tested and deployed. The operations center has already delivered positive results, from improving the reliability to increasing efficiency and boosting productivity (Kass, et al., 2014).

3 Leadership: Imagine a blended culture of people and machines

As we saw in the chapter 4, Leadership is all about building up a responsible AI and making sure that the employees have a full trust about new system and they are convinced that AI is not going to take their jobs, instead it will work together with them to deliver better results (Daugherty & Wilson, 2018). In this case, it is recommended to build an AI system that is easy to follow for people and where humans are able to making some decisions and have certain autonomy left. If we again take the example of the Operations center, we could say that these

center should be build-up around people and human workers should have the opportunity to question the results from the algorithm and not just have to blindly follow the results.

Figure 24 gives an idea of the Rio Tinto's fleet that includes, driverless trucks, smart autonomous excavators, smart autonomous drills and autonomous trains (Burke, 2016).

Figure 24. *Autonomous dump truck; Autonomous excavator; Autonomous drills; Autonomous train (from left to right). (Burke, 2016))*

Rio Tinto's CEO Sam Walsh, wrote for the HBR article in 2016, that their autonomous trucks "outperformed the manned trucks by an average of 12%, primarily by eliminating required breaks, absenteeism, and shift changes." [9] *(as cited in (Burke, 2016))*

However, its might seam that this 12 percent is not that big improvement, but we should keep in mind, this will grow over the time period, and will increase overall efficiency and safety along the way.

(Duffy, 2012) in his interview with the Australian Mining BAEconomics managing director Brian Fisher, talked about that there has been some miners have been hesitant towards automation. The mining unions claimed that Rio Tinto is using automation to cut labor costs. On the other side, managing director Fisher has made it clear, that it is not about cutting labor

[9] Source: https://hbr.org/2016/03/the-ceo-of-rio-tinto-on-managing-in-a-hypercyclical-industry - Accessed June 30th.

costs, it is more about staying competitive on the global market, which will require taking the advantage of new technologies (Duffy, 2012).

(WEF, Forum, 2015) says that deploying this connected machines will offer new level of flexibility for employees, as it will decouple the worksite and the machines in the field. This will revolutionize the way we work and transition "blue-collar workers" to the "knowledge-based workers". We have seen this on the example of the Operations center where skilled equipment operators are working now side-by-side with data analysts and engineers, to analyze real-time data of drills, excavators and other equipment across multiple mining sites.

As conclusion, one of the ways forwards to ensure smooth transition is an example of their Operations center where people from all departments are working closely together with machines to ensure productivity growth, less fatalities in the mines and saving millions of dollars (Kass, et al., 2014). Based on our experience, we could also recommend them to bring more explainers into their team, either through reskilling or hiring new employees. Explainers should have a holistic overview and offer greater access to data visualization and help its colleagues to trust AI systems. Rio Tinto's executive team, will need to ensure, that they communicate clearly to their employees the overall benefits that will bring AI and support its employees towards reskilling.

4 Data: Imagine a data supply chain

Rio Tinto has deployed AI technology to help them analyze the data from their sensors and equipment, and to come up with valuable insights to support strategic key initiatives.

As one example of the data challenge, every time that Rio Tinto connects another fully autonomous haul truck into their integrated system, this adds an additional 200 Megabytes of data per day to their data lake (McIntosh, 2018).

Rio Tinto is currently generating vast volumes of data every minute of every day, and as they continue adding new sensors, the data volume is going to grow exponentially. Rio Tinto is currently tracking over 4000 machines across multiple mining sites in real time 24/7. By connecting their assets, Rio Tinto is creating a tremendous added value and this will help them to drive their business towards a greater success. In order to build the mine of the future, Rio Tinto is committed in partnering with local communities around their operations to create tangible local benefits and to establish local promotors for their future operations (McIntosh, 2018).

(Daugherty & Wilson, 2018) would recommend to build up a team of explainers and sustainers to ensure the proper functioning of these systems. One of the roles they see as crucial is a data supply-chain officer that will be in charge of integrating data from various sources and ensuring an easy access to data.

5 Fusion skills: Extend human+machine collaboration

Rio Tinto's leadership team is committed to the open innovation and for the first time in their history they have ran a hackathon in Sydney organized by their Pioneer Lab. They have created this Lab to find, nurture and accelerate novel ideas, from small to huge – from incremental innovations to the groundbreaking ones. They know we live in the era of disruption and if they do not disrupt and reimagine their ways of thinking and operating, that will be done by their competitors. This simple exercise such as hackathon helped them to find new and innovative solutions to their current challenges in human+machine areas such as accuracy, predictions and efficiency. More importantly, the participants realized that the jobs in the mining industry could be fun, challenging and they could imagine themselves working in this industry (McIntosh, 2018). This young workforce could be the bridge and take on roles such as trainers, explainers or sustainers while supporting Rio Tinto business transformation and pioneering efforts.

Based on this extensive case, we could deduct following guidelines and recommendations for organizations managing their transition towards data-driven company.

- Firstly, we saw that Rio Tinto has seized the opportunity and responded to the challenging situation in a novel way by utilizing the latest technologies and fundamentally reimaging their processes work. This would not be possible without the full support from their management team that has realized that work might be realized in a collaboration between humans and machines.
- Secondly, Rio Tinto's management is fully supporting its team on the ongoing transformation and projects on small scale as well disruptive ones on a larger scale. Their open innovation approaches such as hackathon, engaging with the local community, pilot projects with connected machines and equipment, they are a sign of a good start and towards successful transformation.
- Thirdly, this transformation will ask for retraining and reskilling of their workforce which has been provided to its workforce, transitioning from "blue collar workers" to "knowledge based workers". In return, this will create new roles such as explainers and sustainers that will bridge the gap between humans and machines.

- Lastly, ensure clear and transparent communication within organization, from management to its employees, explaining what are the overall benefits of introducing AI systems.

5.2 AT&T's $1 billion gambit

AT&T has built a telegraph and telephone infrastructure in the last century in the US and is now facing a challenge where its legacy business is starting to become obsolete. With the recent industry movements towards the internet and cloud, AT&T rapidly realized it has to reinvent itself and to do that start with preparing its workforce for the future of work.

In year 2013, AT&T employed about 280,000 workers and as most of them received their educations and job trainings in a different era, it was obvious that this initiative will require enormous efforts from the HR department.

1 A Long View on Talent Management

AT&T approached this challenge in a rather positive manner and instead of hiring new talents, they have chosen immediately to start with retraining its current staff while stimulating a culture of lifelong learning. As Scott Smith, AT&T's senior vice president of human resources operations, explains it, *"You can go out to the street and hire for the skills, but we all know that the supply of technical talent is limited, and everybody is going after it. Or you can do your best to step up and reskill your existing workforce to fill the gap." (Donovan & Benko, 2016)*

The massive retraining initiative is ongoing since 2013, and AT&T has reported they spent on a yearly basis around $250 million on employee education and professional development programs and more than $30 million on tuition assistance annually. The results are more than encouraging and AT&T estimates that, around 140,000 employees have actively engaged in acquiring skills for new roles in the organization. They estimate that the employees will have to change their roles every four years again. Furthermore, in the period of January to May 2016 employees who have been retrained filled half of all technology management jobs (Donovan & Benko, 2016).

AT&T has redesigned its talent practices in three ways (Donovan & Benko, 2016):

1. **Performance metrics** were simplified and in return, this has improved the commercial benefits for individuals with skills in high demand, such as cybersecurity, data science, IT networking, and software-defined networking.
2. **Performance expectations** were increased for all of AT&Ts employees including their managers.
3. **Redesigned compensation plans** that gave weight to the in-demand skills.

Furthermore, basic principle of AT&T's program was to minimize number of people who leave or lose their jobs, by providing every employee a chance to change and acquire skills in-demand. Like with many large organizations, job displacements are inevitable, but AT&T believes that they could minimize its impact. There will be for sure people who are unwilling to take on new opportunities and AT&T is trying to reduce this as future options for this employees will be minimized.

AT&T employees were asked to invest some of their own time, and in some cases their own money, for their reskilling. It was possible to achieve this, as AT&T worked closely with the union and they together encourages its employees to actively participate in the ongoing trainings and development programs (Donovan & Benko, 2016).

"And when you have engaged employees, that leads to satisfied customers and increased profits for the company. Having a mantra of continuous learning is all part of that equation." - Bill Blase, senior executive vice president of human resources as cited in (Caminiti, 2018).

2 Tools for Change

In January 2014 AT&T's human resources department, launched an online self-service platform, to help employees with the transition. This platform provides tools and processes for performance management, career development, and talent planning and so far has gained good traction among employees. Furthermore, it offers workshops on the various topics, from virtualization and cloud computing, "technologies in motion," and "the communication transformation."

A career profile tools as well career intelligence tool are the most popular tools in the platform. A career profile tool supports its users in assessing competencies, business experience, and credentials. Second tool, a career intelligence tool is analyzing hiring trends within the

company and profiles of different jobs (including target salary range) and based on that is providing informed career decisions.

As soon as employees have identified skills gaps by using the tools provided by the platform and in conversations with their managers, it is up to them to sign up to online courses, certifications, and various degree programs that have been developed in a partnership between AT&T, Georgia Tech, and Udacity. The results show that most of employees spend five to 10 hours a week on retraining (Donovan & Benko, 2016).

3 A New Model for Agility

We could conclude that AT&T, as one of America's largest companies, is taking the right steps to become much more agile and to take advantage of how start-ups are organized. Furthermore, they are already developing people through techniques such as crowdsourcing, marathon process cycles, and small, temporary process teams. AT&T is an excellent example where the company is fostering a culture where employees can thrive in their career, and they are investing in people, rather than leaving them behind (Donovan & Benko, 2016). While the reskilling is an imperative for AT&T to achieve its business goals, they are recognizing that its employees are the key to their success and they want to give back to them as well (Schindelheim, 2018).

"Because the better, happier employees, the more productive, the more profitable companies can be. And that's just something really important to us, to give our employees the best place to work, and create a great place that works for them." - John Palmer, Chief Learning Officer at AT&T, as cited in (Schindelheim, 2018).

(Caminiti, 2018) tells a story of an AT&T employee Bick, who started retraining in Agile in 2014. She realized that the Agile project management tool has a future and it is more advanced than the traditional method – Waterfall that was used in AT&T project team. Since AT&T was offering courses in Agile, Bick was able to move to a new job as a senior scrum master, after completing more than 100 hours of online course work within 18 months.

As we discussed in the chapter 3, with increasing automation, effective systems for lifelong learning and workplace training will be essential.

McKinsey (2017b) (see *Appendix 7 f*or details) reports that, globally, between 60 million and up to 375 million professionals will need to switch their current occupations (Prigent, 2018).

(Prigent, 2018) in her article, wrote about OECD Forum 2018 and its recommendation on how to approach reskilling in a right way. She reported that, Ms. Gopaul, the Executive Director of

the Global Apprenticeship Network (GAN), identified AT&T's program to reskill people, as the best practice example.

Based on this AT&T case, we could deduct following guidelines and recommendations for organizations that have identified reskilling as one of their priorities in managing transition smoothly.

- Firstly, identify reskilling as one of the priorities and have a leadership team, including CEO, as one of the main change drivers and sponsors. This will set the wheels in motion and send a right signal to its employees, that the company is aware of the challenges, and it will create a proper mindset and culture of changes.
- Secondly, committing to reskilling, requires allocating a budget to it and tracking it progress, as well providing right opportunities for the employees within the organization. Align the performance system for all employees according to their skillset and career-plans
- Thirdly, employees will have to invest some time of their own, including weekends, and in some cases money as well. This should be rewarded with challenging opportunities within the company, just as the case of an employee Bick has demonstrated.
- Lastly, build partnerships across different learning platform and offer various opportunities to reskilling, from individual courses, on-the-job training, master degrees and so forth. This courses should support your team and certain level of flexibility is necessary.

5.3 "Vertical farms" – the farms that feed

Now we will consider the case of a large agricultural company that is developing an AI system to improve farmers operations. Through further research and observation the company learned that AI systems could address real farmers needs: what they really wanted are real-time recommendations. To deliver on this customer needs, the system will need to process vast amount of data from a various data sources, including historic weather data and information on soil properties. The farmers wanted concrete advice such as which crops to grow, where to grow them, how much nitrogen to place in the soil, and so on. Once they have identified real farmers needs, the company managed to deliver and test it in about a thousand fields. Furthermore, the data from the first tests was used to improve the algorithms (Daugherty & Wilson, 2018).

What we could learn from this case is that identifying opportunities for reimagining processes takes time and the executives must capture the real value, extract insight from various tests, and identify the potential value impact of the reimagined process. People that work in this roles will need to be extremely curious and patient, to absorb sufficient industry level of knowledge to be able to understand the available data (Daugherty & Wilson, 2018).

The good news is that new digital technologies are already reshaping the agriculture ecosystem, making it more data-driven and by that increasing its productivity and efficiency eventually (Accenture, 2017).

This is of greater importance not only for improving a farm's business performance, but also to meet the food needs of a growing human population. It is obvious that digital agriculture still has a huge potential to reinvent itself while deploying more digital technologies.

That is main reason why Accenture has decided to connect the dots with the digital technologies such as the Internet of Things (IoT) with its big data analytics, visualization capabilities, and industry knowledge to offer two major solutions in the market: Accenture Digital Agriculture Service and Accenture Connected Crop Solution. This two solutions will help farmers to achieve their objectives, such as, reducing the risk of crop failure, minimizing operating costs, and selling crops for the best bidding prices possible.

With help of a Digital Agriculture Service, a farmer can easily decide when to harvest. By setting a simple alert in the platform, a farmer can easily get notified, when it is time to harvest a particular plot. Or he can seamlessly integrate his farm management system with this solution from Accenture, and this will automate the decision-making as well execution.

Accenture Connected Crop Solution is, an end-to-end farm management solution, that can integrate and process data from different sources in a single hub. Furthermore, this data, along with data from the farmers' CRM systems, is then fueled into a cloud-based analytics engine that generates product recommendations based on a predefined set of rules, as shown in Figure 25 (Accenture, 2017).

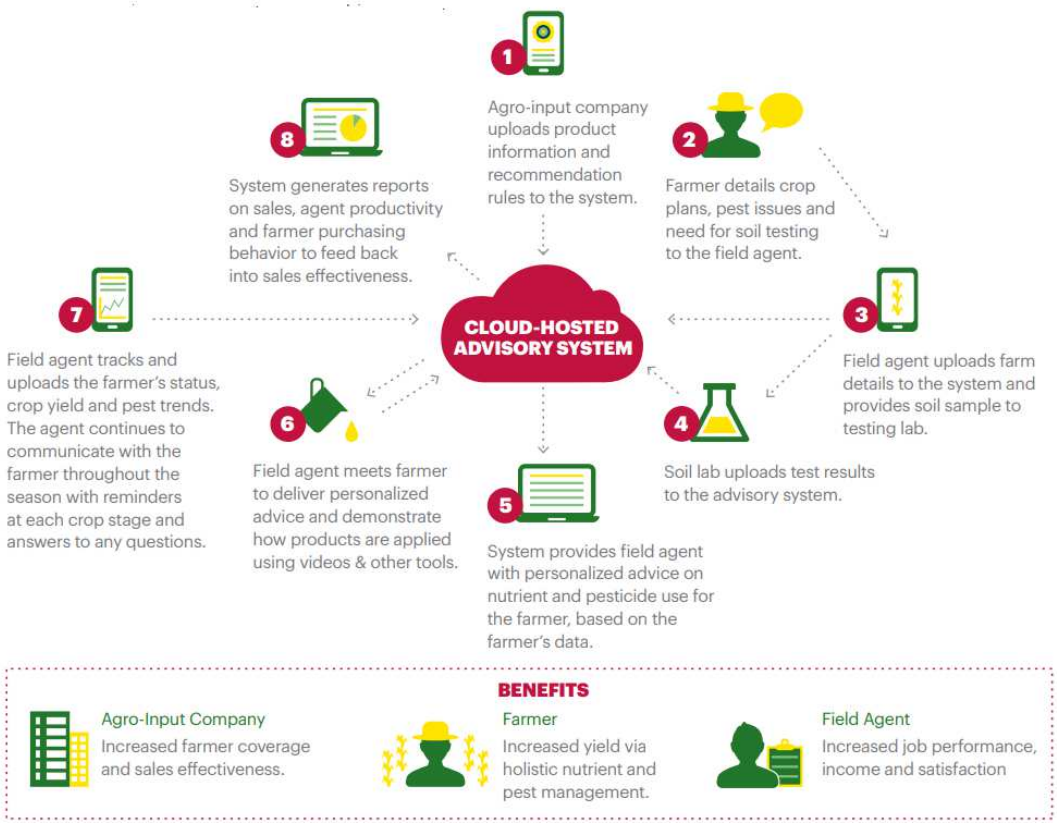

Figure 25. *Accenture Connected Crop Solution for Smallholder Farmers connects the stakeholders in rural agriculture. (Accenture, 2017)*

Our second case is a vertical farm – called AeroFarms, from Newark, New Jersey. Since 2004 AeroFarms has built nine vertical farms in Newark area. Furthermore the company is only growing greens at the moment, and later on they will start experimenting with other fruits and vegetables (Garfield, Leanna, 2016).

Moreover, to get to mass production and expand into new markets, AeroFarms are using real-time data to monitor and learn about the plants. They collect over 30,000 data points on things like humidity, temperature, CO2, and oxygen levels. Data scientists team analyze these real-time data by applying machine-learning algorithm. They want to predict how future crops will grow and they are continuously optimizing the algorithm.

"Cities have a lot of mouths to feed. We have population growth, urbanization, and we need better ways to feed humanity that are sensitive to the environment. Vertical farms could be one of the solutions." David Rosenberg, AeroFarms' CEO and founder, as cited in (Garfield, Leanna, 2016).

Based on these two agricultural cases, we could deduct following guidelines and recommendations for organizations and encourage them to explore the advantages of digital technologies.

- Firstly, reimagining business processes starts with identifying the customer need, and for that experimentation, curiosity, patience as well roles of the future, such as trainers, explainers and sustainers, will be essential.
- Secondly, start with a small experiment, learn from it, adapt the algorithm, and then scale towards new products and markets.
- Thirdly, have a dedicated team of data scientist and analysts that work cross-functional and have the right skills to translate those data insights to less-technical workers.
- Lastly, build trust between workers and AI system, and build partnerships across industries, to deliver the right value to all stakeholders.

6. Summary and Conclusions

As businesses continue deploying AI systems from machine learning, to computer vision, to deep learning, there are two extreme narratives about the technology industry that have prevailed in corporate and public debates over the past two decades. The first narrative is about "technology as a bubble" and the opposite narrative is worried about the impact that technology will have on jobs and society (Lauterbach and Bonime-Blanc, 2018:p.216).

A recent study (Frey and Osborne, 2013) analyzed an impact of computerization for over 702 occupations and estimated number of jobs that are at risk. According to their estimation, around 47 percent of total US employment it at risk and its jobs could be automated over the next decade or two (Figure 1). Does this mean that almost a half of our jobs are at the risk of automation and the US market is facing huge unemployment? Not necessarily. (Bessen, 2015) provided an excellent comparison between todays development and back in the days when ATMs were introduced in the United States in 1970 and was also seen as a threat factor to bank tellers' jobs and wages. Twenty years fast forward the banks have rapidly installed over 400,000 ATMs across US alone and the number of employees did not decrease (Figure 2).

To put it in another way, automation has caused job losses in a few industries, but the net effect on these broad professionals has not been technological unemployment (Bessen, 2015).

Generally, during the last three decade of automation starting with the personal computer, technology has not been the one replacing people and causing jobs to disappear (Bessen, 2015). However, this might change as the robots and algorithms are getting more sophisticated, smaller, more flexible, and becoming an integral part of our lives (Daugherty and Wilson, 2018, p:2). AI systems are not just making business processes more efficient; they are also enabling humans and machines to work collaboratively by changing the nature of work and calling for our business leaders to train their employees in novel ways (Daugherty and Wilson, 2018).

In November, Stephen Hawking spoke at the 2017 Web Summit in Portugal. While he acknowledged that AI has tremendous positive potential, Hawking said that "we cannot know if we will be infinitely helped by AI, or ignored by it and side-lined, or conceivably destroyed by it (Lauterbach and Bonime-Blanc, 2018)". He advocated developing best practices and rules to regulate AI and robotics.

"It is not technology that eliminates jobs. It is the lack of a strategic vision and incentive plan for innovation that eliminates jobs when companies that are not prepared for technological change and opportunity lose to their better-prepared competition (Lauterbach and Bonime-Blanc, 2018, p.217)."

(Agrawal, et al., 2018) argued in their book Prediction Machines that AI tools may augment jobs, just as it happen with rise of the internet use and before that computer revolution. Just as the case of the introducing ATMs did not made bank tellers obsolete however, it did change their daily tasks and activities and made their jobs more human. At the time when VisiCalc was launched in 1970 there were more than 400,000 bookkeepers in the United States. The authors argue that when we pair humans with machines (either hardware or software) we create superhumans with "superpowers". (Agrawal, et al., 2018)

Basically, the augmentation of human capabilities is one of the key research questions of this master thesis. We wanted to show that there will be jobs in the future and that tasks will be different, some of them automated – and that should not be the reason for the massive unemployment. We define jobs as a collection of tasks and once we break it down into individual tasks, some of this tasks may be augmented, some will be changed and reorganized, and new ones will be created as well. Therefore it is safe to say that the tasks that make up a job will change (Agrawal, et al., 2018).

According to Accenture (2018b) fewer jobs will be lost due to automation if workers are able to shift their skills to task that require more "human skills" such as complex analysis and social/emotional intelligence. If this recommendation is followed, their model indicates that UK would be able to reduce the share of jobs fully displaced due to automation to less than six percent by the year 2035. Furthermore, Germany to 10 percent and the United States to just 4 percent (Accenture, 2018b). Most activities that will be affected by automation include physical activities in highly structured and predictable environments, as well as the collection and processing of data. These activities are common in industries such as manufacturing, housing and food services, and retail, and include a few of middle-skill jobs (McKinsey 2017c).

Robots have perfectly mastered assembling of a car or operating an aircraft. However, they have a difficulties of picking an object in an Amazon warehouse and putting it in a box?

As the cognitive scientist Steven Pinker explains it, "The main lesson of thirty-five years of AI research is that the hard problems are easy and the easy problems are hard. … The gardeners,

receptionists, and cooks are secure in their jobs for decades to come." (Brynjolfsson and McAfee, 2016, p. 29)

Robots are perfectly capable of assembling an automobile, as the components are highly regulated and the process is a set of predefined routines and procedures. However, an Amazon warehouse has an immense number of items that vary in shapes, sizes, weights and firmness, and these items are placed on the shelves with many possible positions and orientations for non-rectangular objects.

On the other hand, Amazon has been very successful identifying other important areas in the fulfillment center that would benefit from deploying AI tools such as machine-learning.

With emergence of self-driving cars and automated driving, some jobs such as a school bus driver, will continue to exist but will require new skills, as the "driving" part has a great potential to be eliminated. Automating a particular task, such as "driving", may emphasize other tasks that have been underappreciated in the current job.

(McKinsey, 2018a) did an extensive executive survey in March 2018 on 3,031 business leaders in Canada, France, Germany, Italy, Spain, the United Kingdom, and the United States. Only 6 percent of companies expect their workforce in the United States and Europe will decrease as a result of automation and AI (Figure 7).

(McKinsey 2017c) listed five factors that will affect the pace and extent of adoption new technologies.

- **Technical feasibility** – Technology has to be invented, integrated and adapted into solutions for specific case use. We will demonstrate this on the Rio Tinto's use-case with its strategy for building up the mine of the future.
- **Cost of developing and deploying solutions** – Hardware and software costs.
- **Labor market dynamics** – The supply, demand, and costs of labor will directly affect which activities will be automated.
- **Economic benefits** – Include greater turnout and increase quality, in parallel to workforce cost savings.
- **Regulatory and social acceptance** – Even when automation will likely lead to a good outcome, its adoption can take time.

As skill demand is emerging swiftly at an aggregate industry level, the degree of changing skills requirements within individual job families and occupations is even more obvious (Figure 9).

For example, all-presence of mobile internet combined with the coming age of the IoT promises to transform the daily routine of many customer-facing roles in the Sales and Related, Installation and Maintenance, as well Manufacturing and Production Job families across all industries, calling for a much higher level of technology literacy than in the past. Many formerly purely technical occupations are expected to have a demand for creative and interpersonal skills. For example, for healthcare practitioners, technological innovations will enable automation of diagnosis and customization of treatments, reimagining many medical roles towards translating and communicating this data effectively to patients ("trainers" as defined by (Daugherty & Wilson, 2018)).

(WEF, Forum, 2016) anticipates that a wide range of professions will demand a higher degree of cognitive abilities – such as creativity, logical reasoning and problem sensitivity – as part of their core skill set. More than half (52 percent, the bright blue part of the bar in Figure 9) of all jobs is anticipating to demand these cognitive abilities as part of their core skill set in 2020.

In light of technological trends, such as the ones outlined in Deloitte (2017b) report, in previous years many countries have undertaken significant efforts to increase the amount of STEM (science, technology, engineering and mathematics) graduates produced by their national education systems (Table 3). Furthermore, in order to manage these trends successfully, there is a need to potentially reskilling and upskilling talent from various academic backgrounds in all industries (Table 4) (WEF, Forum, 2016).

(Accenture, 2018a) points out that STEM skills are important for some people and professions, however every employee should get better at complex reasoning. Not everybody wants to be a mathematician or scientist, however each person should learn complex reasoning and high-order cognitive capabilities. The teaching of these skills should not be restricted only to STEM subjects (Figure 10).

(WEF, Forum, 2018a) reports that out of the 1.4 million jobs, which are projected by the US Bureau of Labor Statistics to become disrupted between now and 2026, the majority – 57% – belong to women. Furthermore, when considering pathways in an already disrupted future of jobs, an opportunity presents itself to close persistent gender wage gaps. Furthermore, skills that will continue to grow by 2022 include analytical thinking and innovation as well as active learning and learning strategies.

"The companies that do not associate AI with EI (emotional intelligence) are going to miss the mark."—Rachael Rekart, Director of Machine Assistance, Autodesk (as cited in Accenture 2018c, p.6)

Through their global survey Daugherty and Wilson, report that the work is changing profoundly in many ways. Three of this skills allow humans to complement machines (the left side of the missing middle); another three enable humans to be augmented by machines (the right side of the missing middle), and the last ones support skillfully work across both sides of the missing middle. These novel new skills do not require machine learning or programming, rather, they require thoughtful humans who are motivated to adapt these fundamental skills into specific business need.

Accenture (2018c) proposes that the following 10 intelligences will be crucial in the AI workplace:

7) physical/sensory abilities
8) embodied or extended cognition
9) strategic intelligence
10) practical

11) analytical
12) creative

7) interpersonal
8) intrapersonal
9) moral intelligence, and
10) growth mindset (see Figure 14: Fusion Skills and Intelligences Matrix).

The human worker was identified as a weak link in the chain and one of the main responsibilities of a system designer (who is also a human being) is to implement automation process, which means taking out humans out of the equation.

There are two ironies in it: the first one is that designer errors can be a major problem of the automated process (Bainbridge, 1983). The second one is that in a "perfectly automated system" there is still a need for an "old school" trained experienced operator. The actually irony is that we have a situation where the computer has to make decisions in real time because the human is not capable of doing so, but the human is the one who has to monitor system (Bainbridge, 1983).

Another issue that we have to address is task allocation between humans and machines. Some researchers suggested that tasks should be divided between humans and machines, assigning them tasks that they are best at. A human can solve complicated problems where there is no time pressure, and machines can support with time-consuming tasks (Bainbridge, 1983).

So what career advices should we give our kids (Tegmark, 2018)?

Here is the list of question, which could potentially help us make the right career choice decision by (Tegmark, 2018, p. 121):

- Does it require interacting with people and using social intelligence?
- Does it involve creativity and coming up with clever solutions?
- Does it require working in an unpredictable environment?

The more of these questions you can answer with a yes, the better your career choice is likely to be.

These new novel jobs will not just replace the old ones, they will require new skills and trainings that have never been performed before. Furthermore, this sophisticated AI systems will require new roles such as training, explaining, sustaining AI behavior, which fall on the left side of the human + machine hybrid activities in Figure 17. One of the main activities of trainers is to make sure that AI systems are trained to act and perform certain tasks and activities like humans do. We tend to react more positively towards automation systems that can mimic human abilities and behavior such as empathy. The second category of novel job positions are explainers, who will fundamentally change the future of work since they are the ones assisting our business leaders and executives to fully grasp the future potential of refined machine-learning algorithms. Moving forward to the last category of new jobs – sustainers – whose primary responsibility is to secure the proper use of AI systems and to ensure that these AI tools are used with the intention of serving humans and making our lives and jobs easier.

To summarize the new jobs and roles that will emerge as AI systems get more advanced and sophisticated, it's necessary to stress that this is just the starting point. Indeed, as AI systems evolve, we will see companies creating their own roles and responsibilities that will augment their capabilities and offer them a competitive advantage.

The bottom line is that the managers and business leaders will need to revise their talent and lifelong learning strategies in order to better attract, train, manage and retrain these talents

Now that we have defined the jobs of the future, as well as the clear roles within the missing middle, we would like to continue by offering a framework that will support all business leaders and managers in taking their organization to the next level.

In the chapter 5, we have provided three best-practice-examples on how leading traditional companies and industries are managing the transition and deploying the above five practices.

Based on this extensive case, we could deduct following guidelines and recommendations for organizations managing their transition towards data-driven company.

- Firstly, we saw that Rio Tinto has seized the opportunity and responded to the challenging situation in a novel way by utilizing the latest technologies and fundamentally reimaging their processes work. This would not be possible without the full support from their management team that has realized that work might be realized in a collaboration between humans and machines.
- Secondly, Rio Tinto's management is fully supporting its team on the ongoing transformation and projects on small scale as well disruptive ones on a larger scale. Their open innovation approaches such as hackathon, engaging with the local community, pilot projects with connected machines and equipment, they are a sign of a good start and towards successful transformation.
- Thirdly, this transformation will ask for retraining and reskilling of their workforce which has been provided to its workforce, transitioning from "blue collar workers" to "knowledge based workers". In return, this will create new roles such as explainers and sustainers that will bridge the gap between humans and machines.
- Lastly, ensure clear and transparent communication within organization, from management to its employees, explaining what are the overall benefits of introducing AI systems.

"AI will transform everything we do. We must press forward ambitiously in the one area robots cannot compete with humans: in dreaming big dreams. Our machines will help us achieve them. Instead of worrying about what machines can do, we should worry more about what they still cannot do." – Garry Kasparov, Chess Grandmaster, WeAreDevelopers Congress in Berlin, 2019[10].

[10] Source: https://read.wearedevelopers.com/the-human-in-man-vs-machine/ - Accessed on July 1st

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Appendices

Appendix 1

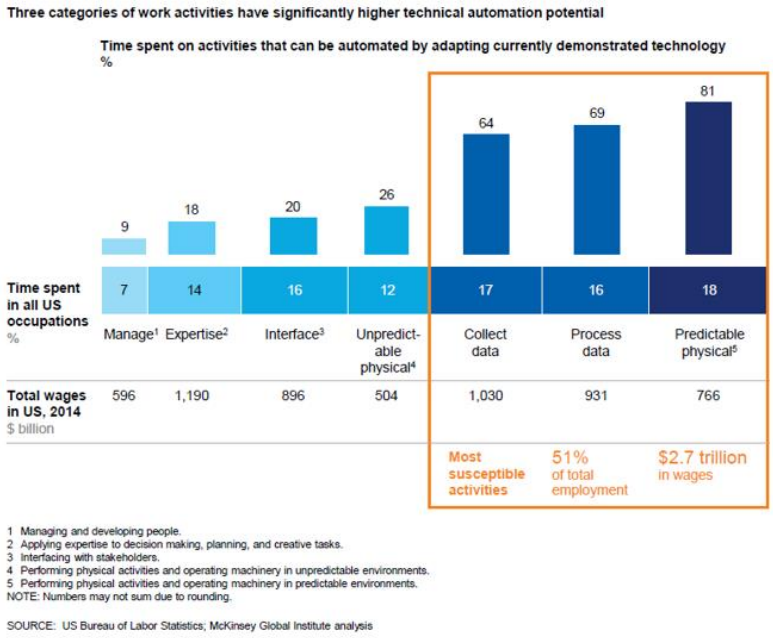

Figure 26. *Three categories of work activities have significantly higher technical automation potential. (McKinsey 2017c)*

Appendix 2

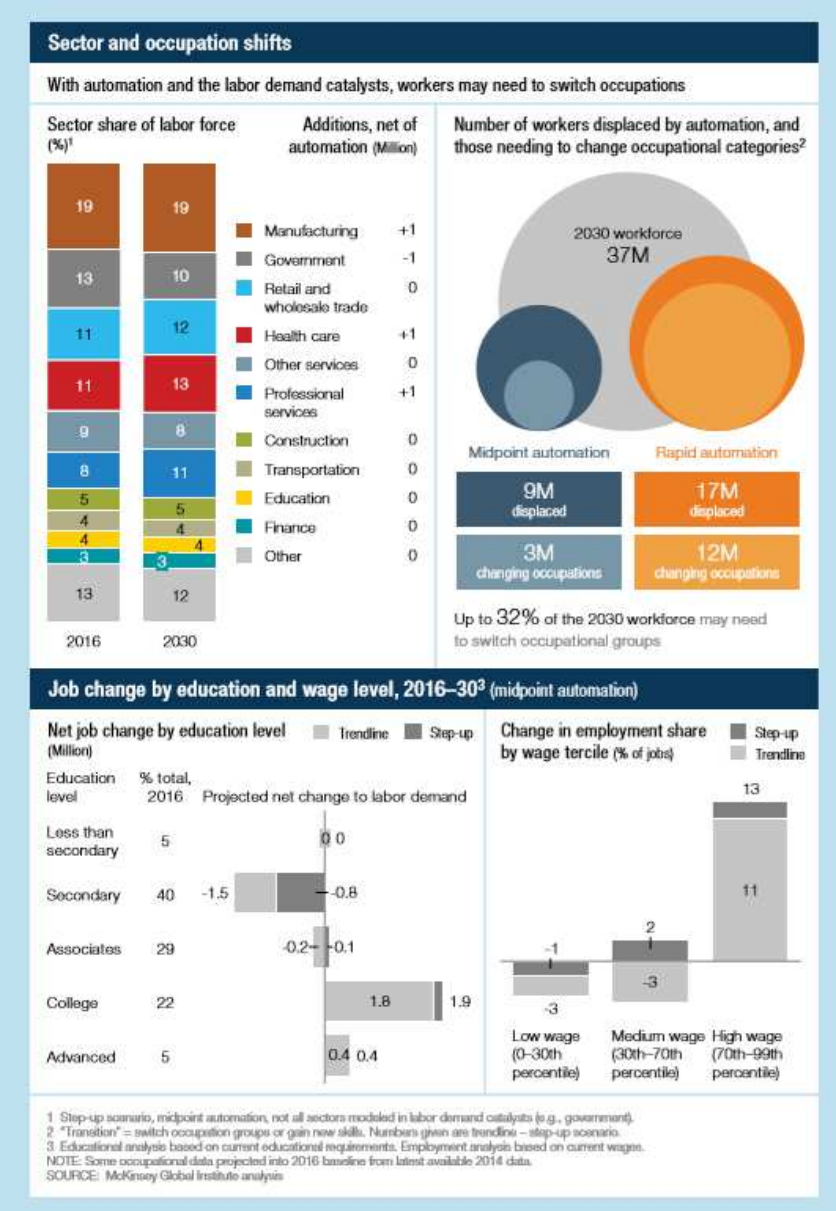

Figure 27. *The future of work in Germany. Sector and occupation shifts. (McKinsey 2017b, p. 94)*

Appendix 3

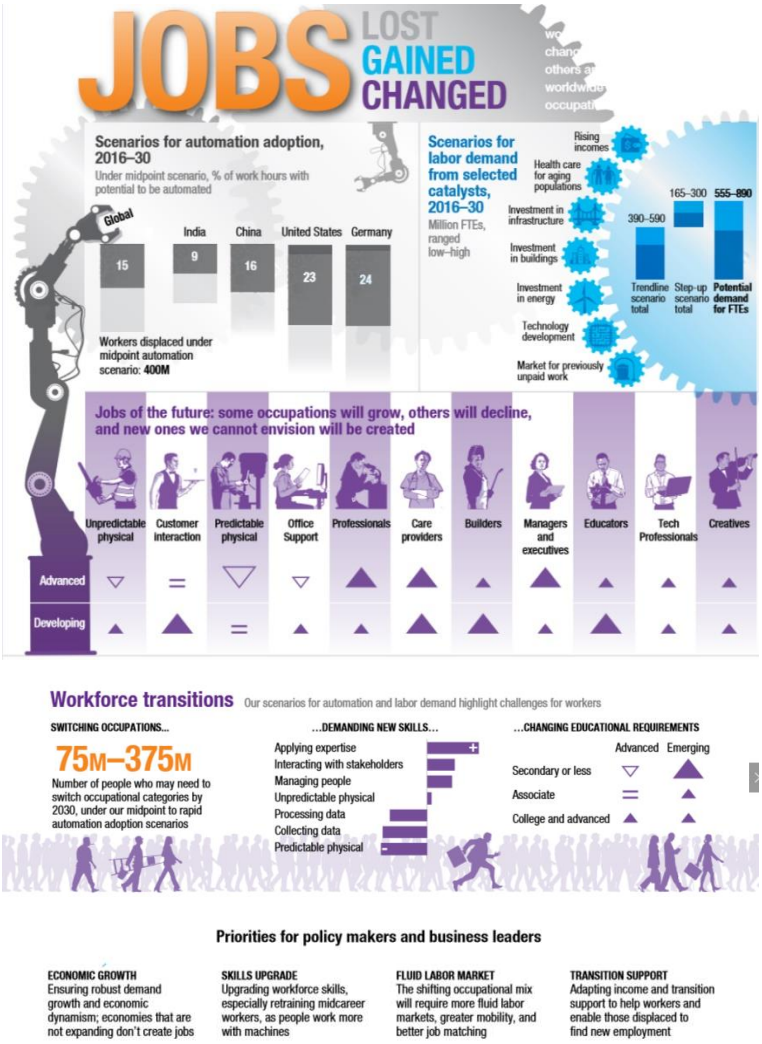

Figure 28. *Jobs lost, gained and changed. (McKinsey 2017b)*

Appendix 4

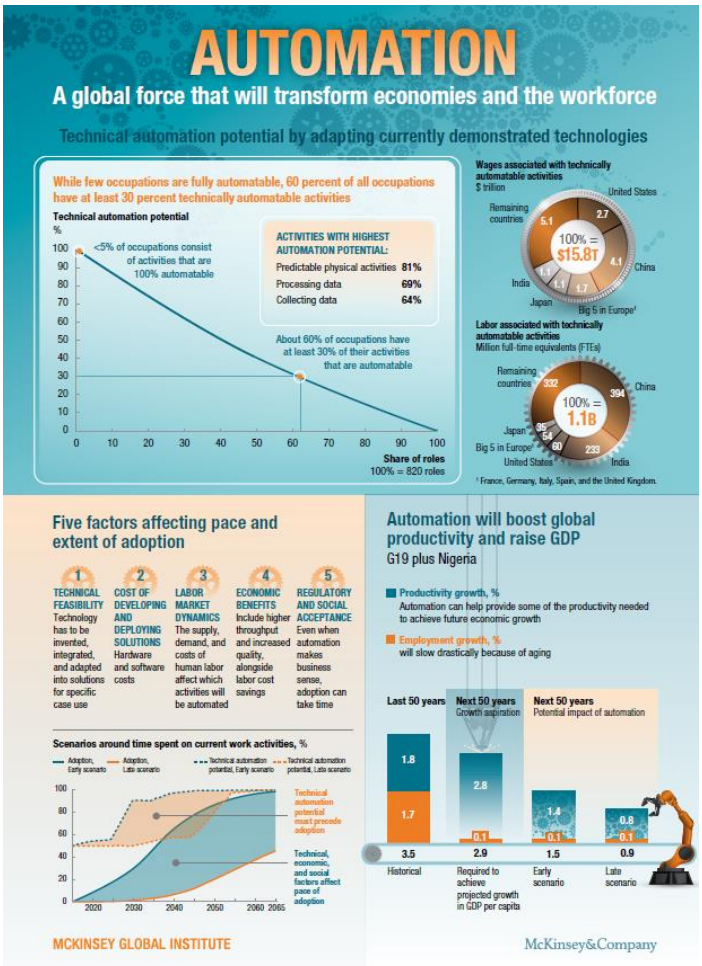

Figure 29. *Automation – a global force that will transform economies and the workforce.*

(McKinsey 2017c)

Appendix 5

Figure 30. *Executive Summary from AI Report.*

Appendix 6

STEP 1 Deconstruction of Fusion Skills in the Missing Middle

Missing middle	Fusion skill	Definition	Aptitudes identified
Humans manage machines	**Re-humanizing time**	The ability to increase the time available for distinctly human tasks, like interpersonal interactions, creativity and decision-making in a reimagined business process	• Interpersonal • Creative • Analytical, Practical
	Responsible normalizing	The act of responsibily shaping the purpose and perception of human-machine interaction as it relates to individuals, businesses and society	• Ethical • Contextual awareness, Analytical, Strategic • Enterprising, Gritty
	Judgment integration	The judgment-based ability to decide a course of action when a machine is uncertain about what to do	• Analytical, Perceptive • Intuition • Ethical
Humans manage machines	**Intelligent interrogation**	Knowing how best to ask question of AI, across levels of abstraction, to get the insights you need	• Business-savvy, Curiosity • Strategic, Imaginative
	Bot-based empowerment	Working well with AI agents to extend your capabilties and create superpowers in business processes & professional careers	• Tech-savvy • Practical
	Holistic melding	The ability to develop robust mental models of AI agents to improve process outcomes	• Intuition • Perception
Humans manage machines + machines augment humans	**Reciprocal apprenticing**	Performing tasks alongside AI agents so they can learn new skills; and on-the-job training for people so they can work well within AI-enhanced processes	• Practical • Inspiring • Trustworthy, Ethical
	Relentless reimagining	The rigorous discipline of creating new processes and business models from scratch, rather than simply automating old processes	• Imaginative, Creative • Enterprising

Figure 31. *Deconstruction of Fusion skills in the missing middle. (Accenture 2018c, p.25)*

Appendix 7

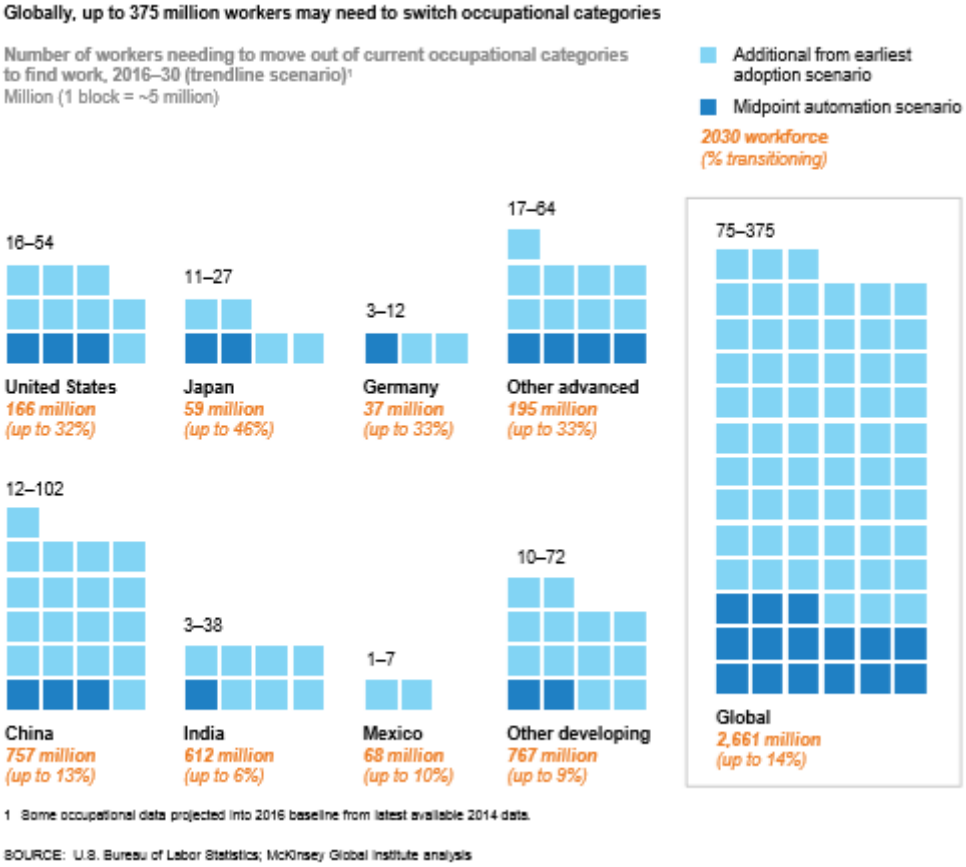

Figure 32. *Globally, up to 375 million workers may need to switch occupational categories (2016-2030). McKinsey (2017b)*