INDUSTRY 4.0 AND ITS IMPACT ON EDUCATION, WORKFORCE AND SKILL REQUIREMENTS FOCUS ON LOGISTICS SECTOR IN GERMANY

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TORINO

Declaration / Attestation

I understand the nature of plagiarism, and I am aware of the University's policy on this I certify that this dissertation report is my original work which is produced during my University project except for the following:

- The model of the future workforce based on Pwc study [54].
- The future model of the distribution centre, sorting centre and the last mile delivery based on DHL study [80]
- The Curriculum of the training and study courses in Germany are based on information supplied by telephone and emails [links are provided at each section]

Signature: **Date**:

18/03/2019

Abstract

“One machine can do the work of fifty ordinary men, no machine can do the work of one extraordinary man”

– Elbert Hubbard

Throughout the history of the industrial revolution and the technological impact on the workforce over the last decades to the dilemma and the opportunities of the manufacturers, the employees, the industry and the governments, this report highlights the real risk of automation on job redundancy. Moreover, studying the global megatrends and how Germany perceives them and act towards them in the context of workforce in the logistic sector taking into consideration the driving forces of the German digital economy. This report focuses on the dualism between the technology and the workforce providing an answer to a set of questions, Where is the logistics sector? and Where is the workforce? Here it comes the challenges for education and the vocational training to deliver the digital talent for the logistics 4.0.

Acknowledgement

First of all, I want to say thanks for the four most important people of my life: my mom, my dad, my sister and my brother, without them and their countless help in all the senses I never could accomplish my studies and my thesis. I want to say thanks to Prof. Marco Cantamessa for all the trust that he showed by giving me the magnificent possibility to work with him in Politecnico Di Torino not only during the thesis work but through the innovation management course as well, and for all the patience demonstrated during the past year for the paper works etc... Also I want to thank Prof. Holger Köhl for his guidance and mental support during the mobility program in Technical University in Berlin. Thanks to my colleague Esraa khafagy who offered continuous help during the literature review.

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Nomenclature

Business Units	(BU)
Cyber-Physical Systems	(CPS)
Internet of Things	(IoT)
Enterprise Resource Planning	(ERP)
Product-Lifecycle-Management	(PLM)
Manufacturing Execution Systems	(MES)
Augmented Reality	(AR)
The Federal Ministry of Education and Research	(BMBF)
The Federal Ministry for Economic Affairs and Energy	(BMWI)
Internet of Things and Services	(IoTS)
Computer-Aided Design	(CAD)
Computer Numerical Control	(CNC)
Direct Numerical Control	(DNC)
Gross Domestic Product	(GDP)
Centre for European Economic Research	(ZEW)
Chief Digital Officers	(CDOs)
Artificial Intelligence	(AI)
Institute for Leadership Culture in The Digital Age	(IFIDZ)
Institute for Management, Market and Media Information	(FAZ)
Universal Mobile Telecommunications Service	(UMTS)
Association of The German Internet Industry	(ECO)
Logistics Performance Indicator	(LPI)
Global Positioning System	(GPS)
Graphics Processing Units	(GPUs)
Stock Keeping Units	(SKUs)
Warehouse Management Systems	(WMS)
Intelligent Tutoring Systems	(ITS)
The Baden-Wuerttemberg Cooperative State University	(DHBW)

1 Introduction

1.1 Background

Technology is the outcome of implementing a scientific research into a real life physical product or process. Production technology is a set of sub-systems connected together in a way or another to develop the methods and the criteria of creating a tangible physical product. Technology drove manufacturing of goods to what is known as automated mass production where standard goods are being produced continuously on production or assembly lines.

Mass production was initially born in the eighteenth century and later refined by Henry Ford in the twentieth century when he brought MP techniques to scale in T-model which faced a sales growth from 10,607 cars at price $850 in 1908 to 730,041cars for $360 each in 1916; two years after introducing the concept of assembly line. [1]

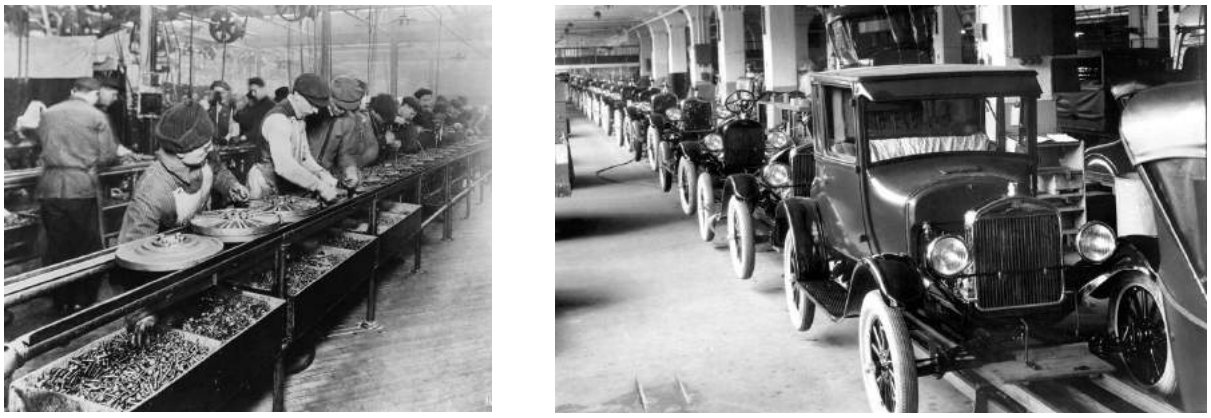

Figure 1-1 Ford's Assembly line [1]

Nowadays production and processing are being optimized by a universal competition and necessity of fast technology adaptation to global trends and dynamic markets. To coup up with these challenges, governments and companies started introducing Industry 4.0 which is known as the forth Industrial revolution by connecting all business units (BU) together and the integration of the activities of company's value chain. Achieving this requires application of Cyber-Physical Systems (CPS) along with Internet of things (IoT) to the infrastructure of the production system.

Moreover, Companies are in deep need to software support to distinguish the numerous amount of data based on Enterprise Resource Planning (ERP), Product-Lifecycle-Management (PLM) and

Manufacturing Execution Systems (MES) which are essential for continuous integration of the manufacturing systems with the back office functions. Basically the data is stored in cloud storage then it need intensive and wide analysis (eg. R or Python) to transform the raw data to useful information to perform specific actions. [2]

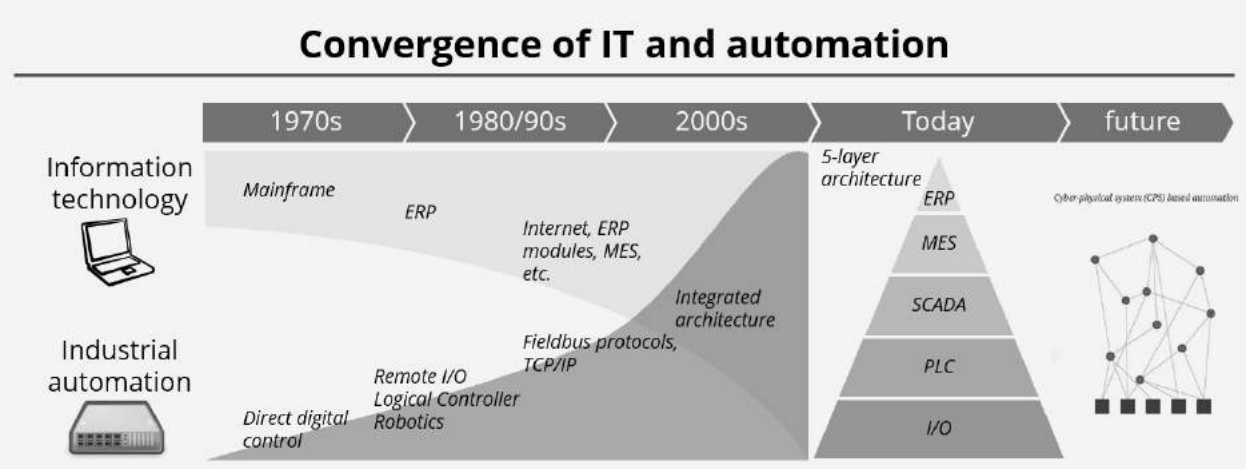

Figure 1-2 Convergence of IT and Automation [3]

In 1981 Bill Gates and Paul Allen started licensing MS-DOS to IBM. Two years later, Microsoft Windows has released, before the end of the decade It was crowned as the dominant operation system disrupting other systems. Later in 2000s a small start-up called Android came with an operating system for cell-phones that later dominated the operating system space with Microsoft. Now Microsoft and Android dominate approximately 75% of market shares of the operating systems. IT industry has followed massive disruptions during the last few years. [3] [4] On the Contrary the production and manufacturing industry has progressed and definitely improved over the last decades. High degree of Automation, Wide adoption of lean manufacturing, Integration of manufacturing and IT systems are considered as the main transformation of the Industrial environment these days. (Figure 1.2) shows the interaction between two different worlds aiming to introduce the industrial revolution and building the scheme of the smart factories by the convergence between IT and industrial automation over the last few decades. [3]

1.2 History of Industry

1.1.1 Industry 1.0 | From Mines to Miles

In 1698 in The UK when Thomas Savery first used the steam power pump which he named it "Miner's friend" and it was mainly used to pump water from mines. [5] Later in the eighteenth century when Watt steam engine was introduced and it was successfully able to produce and manufacture a large number of different goods in textile industry and later after the introduction of high pressure engine transportation application became even possible and steam engines initiated their own way into transport systems as seen on railway trains speed boats and commercial vehicles being able to move humans and good for distances in such few hours. [6] Fuel resources such as stream and coal made the wide commercial use of machines more possible and feasible, the concept of machine aid in production and manufacturing widely spread and contributing on higher standard of living.

1.1.2 Industry 2.0 | Electricity and Assembly lines

In the beginning of the twentieth century, Electricity turned out to be the main source of power and it is more efficient and feasible in the manufacturing sector than the steam and water systems. Machines became more portable by including their own built-in power source. Meanwhile the management and production techniques have witnessed vast development by introducing division of labor, mass production and assembly lines. Thanks to the studies carried out by Frederick Taylor on workers and work techniques and later to "Toyota Production System; Just in Time" and "Lean Manufacturing and Six Sigma", Firms could significantly develop and enhance their output at better quality and lower cost. [7]

Workers moved from their rural places to urban side and factory standardized jobs. 40% of US population used to live in cities, besides this period has witnessed several inventions like electric bulb, telephone and radio which radically changed the way the people communicate.

1.1.3 Industry 3.0 | Digitalization and Automation

Starting from 1970s the introduction of mainframe computing, programmable control, partial automation and later the Internet access have contributed in what we are living now "The Digital Revolution". Everything has gone from analog to digital form, these technologies have radically transformed the production process leading to less human power and assistance. Today firms become able to automate the entire manufacturing process and measure factors of business that were unmeasurable in the past besides large data analytics leading to superior decision making.
Digitalization went far from allowing us to read this document now on the mobile phone to online banks and paying your bills by finger print touch ID. Due to the exponential rate of technology, Industry 3.0 is being followed very quickly by Augmented Reality (AR) cyber physical systems and internet of things to shape the future smart factories.

1.1.4 Industry 4.0 | Cyber physical system

In 2011, German government has initiated the term "Industrie 4.0" as part of its High Tech Strategy 2020, the strategy was set for 10 to 15 years through The Federal Ministry of Education and Research (BMBF) and the Ministry for Economic Affairs and Energy (BMWI). The main aim is to enhance the industry to fit for the future and to coup up with the integration between CPS and Internet of things and Services (IoTS).
Germany has set the objective of Industry 4.0 platform to lock and improve the country's leading position in the industrial manufacturing and to endorse the digital transformation. Moreover, It has a purpose of developing consistent overall comprehension of industry 4.0 by discussion with stakeholders in order to come up with recommendations to be performed/done and to explain how digitization of industrial manufacturing can be done.
As stated by *The German Chancellor*, Angela Merkel: "We must deal quickly with the fusion of the online world and the world of industrial production. In Germany, we call it Industrie 4.0". [8]

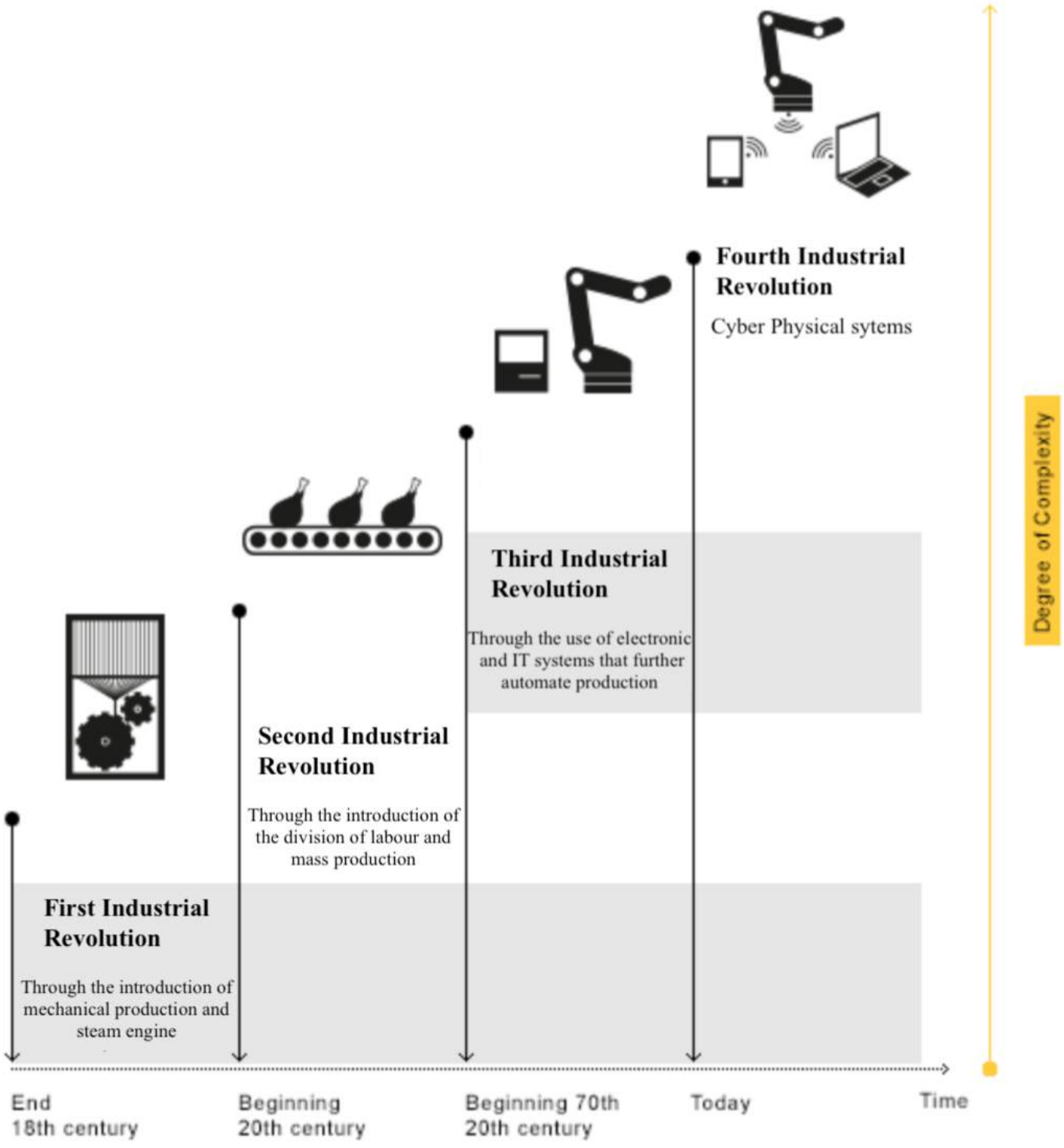

Figure 1-3 The history of the industry 1770 – present [9]

1.2 Evolution versus Revolution

1.2.1 Computer Integrated manufacturing CIM

An integrated system in which computer is being used to control the manufacturing process. It was first developed with the inception of the third industrial revolution and evolved by time by integration between CAD and CAM from being partially aided manufacturing process as till now the computer is taking over the entire production process.

There are several technologies, techniques are listed under CIM

- Computer-Aided Design (CAD)
- Computer Numerical Control (CNC)
- Direct Numerical Control (DNC)
- Computer-Aided Quality Assurance
- Automated Inspection Methods
- Industrial Robots

Clearly the full potential of CIM is obtained by the integration between these different systems mention above with allowing data transfer among different systems and functions. However, achieving this requires continuous development in both hardware and software.

CIM keeps reducing the human factor in the manufacturing process while at the same time it can definitely help in reshoring the manufacturing process if companies invested in the above mentioned technologies which would allow them to go into the global competition. [10] [11]

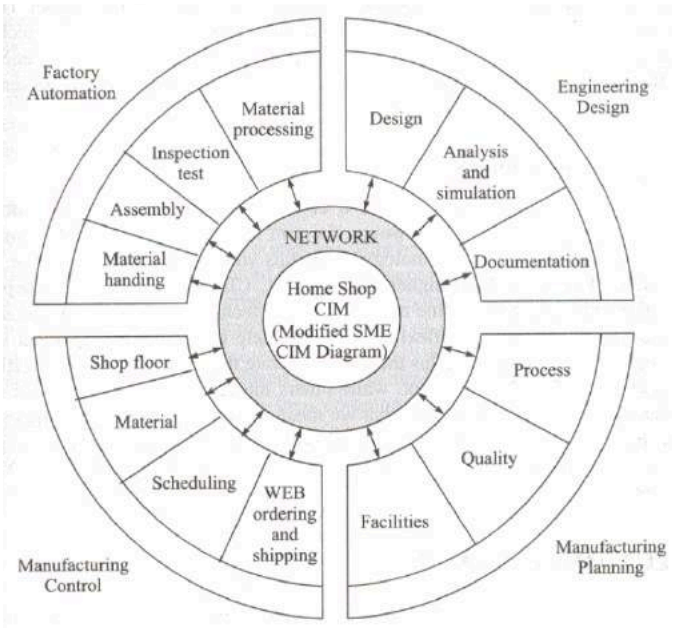

Figure 1-4 Computer Integrated Manufacturing [11]

Basically the current wave of innovation is based on IoTS which eases the interaction and communication between objects on real-time basis [12] the main factor behind all these innovations is the continuous improvement of electronics and computing. This exponential growth is rather following economy of scale and confirms Moore's law related to transistors in and integrated circuits which means that the power of computers is being doubled every 18 to 24

months. [12] [13] IoTS doesn't only comprise such improvements, even though convergence of different technologies like IT and automation was a key success factor in delivering these technologies to the industrial sector as cost efficient innovations. (figure 1-2)

1.2.2 Exponential rate of technology

However, CIM and Embedded systems have impacted society, culture, daily communications and the entire economy and transferred the world linearly. These technologies are accelerating at an exponential rate. (Eg. It took more than 100 years to use the spindles in the textile manufacturing in Europe on the other hand it took only 10 years for the internet to cover the whole world.) [14] [15]

Against this background, In a long time span these systems may have a vast impact on not only labor fulfillment but work organisation as well and definitely changes the role of the human factor in the whole process and adds value to the most industrial value chains. [16] This will not only have consequences for employees in the blue-collar jobs , but for board of management and high-skilled people in the white collar positions. Moreover, particularly in Germany, with its relatively huge industrial base, entitling 22% of the Gross Domestic Product (GDP), Technology might put the local workforce under outstanding pressure in order to keep themselves employed. [16]

New technologies will fulfil simple and repetitive activities. While advancements can help to create more various types of job positions; Mckinsey & Co researched that automation has the potential to eliminate more jobs than it would generate as they came out with a conclusion that digitization is expected to add around $2 trillion to US GDP while eliminate up to 12 million middle-skill workers. [17]

Moreover, the introduction of cyber-physical technologies has been discussed in logistics since the turn of the millennium. Logistics and the Internet of Things are considered to be the outstanding application domain of the fourth industrial revolution. Such a fundamental change is expected in the near future. This is due to the rapid technological development, on the other hand, many of the major technical and social challenges are directly or indirectly connected with logistics, distribution and efficient supply chain management.

As Distribution Centers (DC) evolve into an increasingly crucial element of the supply chain, they need to adapt to new expectations for quickly handling an ever-more diverse set of goods all while performing additional value-added tasks not traditionally associated with warehouses. Current and emerging Industry 4.0 technologies can enable greater operational flexibility, reduce operational costs, drive more modular and adaptable automation, and promote business growth. The transition toward Industry 4.0 technologies in distribution centers will drive changes throughout the DC, from reconfiguring the workforce to managing, analyzing, securing, and acting upon data. [18]

In view of this situation, this research firstly provides an overview of the future world including the opportunities, threats of Industry 4.0 in general and the future and secondly contributes further research to this context, the discussion of the evolution of human machine interface, and what action to be done regarding the future workforce in the logistic in particular.

2 Dilemma VS Opportunities

The attractive debate of the Industry 4.0 is not only about the competitiveness issue, but about the question of impact and the adjustment of the arising consequences of the digitalization on the social and economic aspects. Hence, the main digitalization debate in Germany is mainly focusing on:

- Productivity development and effectiveness
- Employment and organization
- Qualifications and skills requirements
- The range of big data and cyber security

Approximately half of organizations in Germany are already implementing technologies and operating under the term Industry 4.0 which puts together traditional production systems with innovative digital techniques. A study obtained by Centre for European Economic Research (ZEW) shows that digital technologies are currently playing an increasingly significant role in German industries, even though these technologies are involved in only 5% of manufacturing processes and around 8% of office work. [19]

Human resources leaders think that Industry 4.0 is changing the employment schemes concluding that the question of "where do you see yourself in five years?" no longer applies. Both individuals and enterprises are in essential need to foresee where their skills and capabilities would endure for the upcoming years. Organization and people readiness are no longer slogans but realities, employees must consider and perceive upskilling and adopt these actions to coup the revolution. Global workforce is considered as one of the most critical disruptions in era of Industry 4.0. The megatrends of the digitalization are bringing new challenges in the labor market, to better understand these issues we need to estimate the possible opportunities and threats followed by the impact of the digitalization of the workplace on the main three core group - manufacturers, employees, and the industry and how the employees and the board of management adapt to these challenges and transformation.

2.1 The Manufacturers

2.1.1 Dilemma

Manufacturers are worried about the growing talent gap between employees and new vacancies challenges. Mainly the risk of lack of experience and knowledge arises by the retiring of the current employee base. According to a Census report, by 2029, the majority of baby boomers are expected to be retired, this contrasts an expected significant drop in number of active workers and employees in the economy generally, and in the manufacturing sector particularly. [20]
The young generation considers the manufacturing sector as "blue collar" jobs and not willing to work there. Moreover, the rapid introduction and contribution of new technologies in the production process led to what is known as the skill gap that most of workers do not have the proper knowledge and training to coup up with the new technology trends. First Research predicts that 2 million jobs in the manufacturing sector are going to be unfilled. [21] Firms are in need to build new teams and hire tech-savvy employees with hybrid skills and comfortable with innovation.

2.1.2 Opportunity

The more the enterprises be able to gain the digital competencies and capabilities, the quicker that adaption to market changes, even determining them and could be a catalyst for innovative products and services. Definitely, there are clear rewards and gains. According to a strategy study conducted by Keystone "organizations that take these steps to embrace digital transformation generate an average of $100 million more operating income each year than those who lag behind" [22]

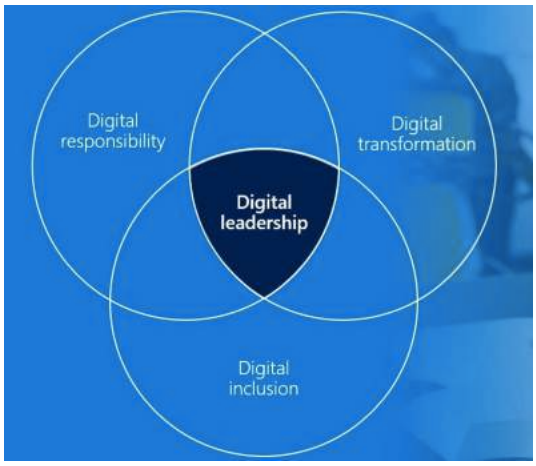

Figure 2-1 The emergence of digitization

Nowadays, Manufacturers have chance to invest in new state of art technologies like 3D printing and additive manufacturing in general which enables them to further develop and automate the whole manufacturing process. Manufacturing systems witness a paradigm shift from MP techniques to a **mass-customization paradigm** recalling the statement of Microsoft's Worldwide Manufacturing Genral Manager Arkan "**one size fits one**". [23]

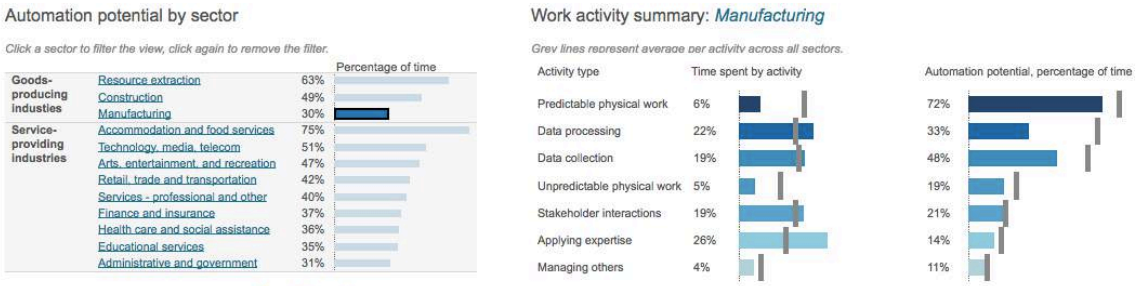

Figure 2-2 the detailed work activities for more than 800 jobs to evaluate the technical potential for automation [24]

An action-packed study made by McKinsey & Co. two years ago concluded that workers who are performing specific physical work activities embrace 6% of total workforce in manufacturing and production sector, while 72% of the manual activities have the potential to be automated. [25]. By 2026 service robots are expected to an annual growth by 24% to reach 264.3 million active unites worldwide. [26] This increase of the robots is meant to take over all the repetitive, sensitive and sophisticated tasks leading to less human involvement.

On the other hand, New technologies and the high degree of automation are helping in filling the talent gap by hiring back the retired experienced workers. Using video conference technologies, those workers can offer their knowledge, intelligence and experience to share it with any entity around the globe verbally and visually, these innovations would ease keeping older workers in their jobs for longer with less physical effort.

Pushing up economies by reshoring the outsourced jobs and bringing back these jobs to their home countries as labor cost is no longer the main factor in terms of production cost. "China makes all sorts of things we do not anymore, from circuit boards to textiles. In Germany and Switzerland, 60% of young people go into an industrial apprenticeship. America needs a 10

to 20 year skills push before it can lure manufacturers back". Said by Reshoring Initiative founder Harry Moser [25]

2.2 The Employee

2.2.1 Dilemma

The other side of the skills gap the workforce is concerned about the unemployment. Workers in the US are worried that that manufacturing sector jobs are sifting to other countries as happened in the last few decades. Manufacturing sector is the leading the outsourcing schemes as 50% of the companies are outsourcing tasks in 2015. [26]

Referring to the world economic forum 2018 reporting, *the future of jobs*, 313 unique responses by global companies in 20 developed and emerging economies, collectively that represents around 15 million employees worldwide. Employers estimated that in four years , more than 54% of the workforce will require significant upskilling (figure2-3). Approximately, 35% of these reskilled workers are expected to require vocational training which stays for up to six months, apparently 9% will need trainings that last from six to 12 months, while 10% need to acquire additional skills which requires trainings for more than a year. [27]

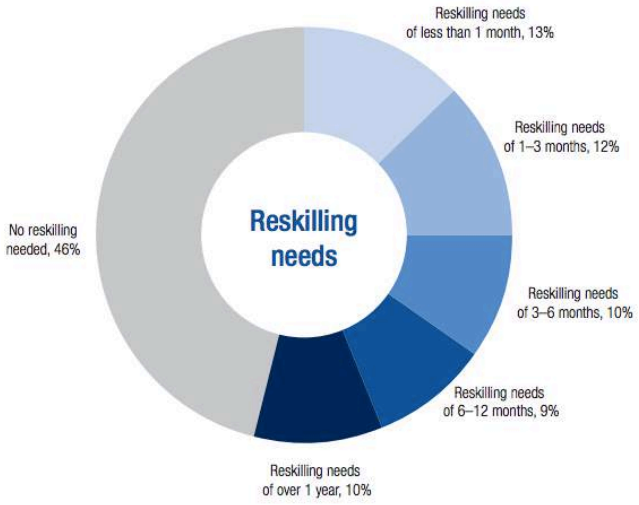

Figure 2-3 Expected average reskilling needs across companies, by share of employees, 2018 – 2022 [27]

Workforce is worried about the way they will access and afford the required trainings they would be in need to in order to obtain the right skill to coup with our rapidly evolving technology job functions. Many of them might need to be upskilled different cycles during their career span. Usually fresh graduates find out that the education they had didn't prepare them properly for the skills and the roles needed for over-changing businesses like manufacturing, production and

logistics. On the top of that, the rapid and vast transformation in the workforce profile as we can realize that long gone is the era of being in the same job along the career life. Nowadays, millennials are used to working multiple jobs, even while being enrolled in the school. They are Uber drivers, babysitters, restaurant waiters; they are also exploring internships and summer schools and doing volunteering and extra-curricular activities. The world is constantly and rapidly changing and the upcoming generations are coming to the working life with different set of expectations than previous ones. According to MIT's research conducted on employees between 22 and 60 and came out with a conclusion that the majority prefer to get hired in digitally-enabled organizations [28]

2.2.2 Opportunity

There was never better time join the manufacturing workforce for the future of the industry. The transformation in the workplace to be a highly technological environment. However, Employees still in a deep need to understand what the new roles are and seek out those tasks by upskilling by attending online courses or post graduate degrees. They can create the opportunity to focus their intentions around digitalization, intelligence and technology. Definitely people who would invest their time to learn these new skills would adapt faster with technology and would be employed in the technological revolution era. As stated by Caglayan Arkan in Thoughts on global workforce transformation in the Industry 4.0 era "After all, we already established that every enterprise will become enterprise software companies and that means the world will need more software and more developers to write them - many, many more". [23] big entities still don't neglect the work-life balance and they do respect millennials' preferences. Markets in the economy are moving towards highly flexibility in work arrangements as like job-sharing schemes and work-from-home arrangements.

2.3 Industry

1.2.1 Dilemma

While advancements can help to create more various types of job positions; **Mckinsey & Co researched that automation has the potential to eliminate more jobs than it would generate as they came out with a conclusion that digitization is expected to add around $2 trillion to**

US GDP while eliminate up to 12 million middle-skill workers. [29] Within Germany, four out of five companies already believe that their value chain would be noted by a high degree of digitalization by 2020. Each one in four companies still consider themselves as a highly digitalized environment. A brand new PwC study shows that the levels of value chain digitalization will reach 80%, with an overall increase in efficiency by 18%. 20% of firms in the automotive sector already operate their self-controlling production facilities. [30]A recent study by Deutsche Bank finds that technologies would destroy more positions than it would create which is against all the predictions. *the head economist at ING-DiBa*, Carsten Brzeski, concluded that **only in Germany, 18 million jobs even professions that require high qualifications are potentially threatened by the risk of automation and digitalization.** [31]

It is a warning apart from all the benefits brought by Industry 4.0, it also suggests the evolution of a main socio-economic structural transformation in our new world of employment. From the industry's perspective, the dilemma goes around how to keep everyone, even high-skilled workers, employed; besides how to coup with the social consequences and social security issues.

Apparently, Robotics and Artificial Intelligence (AI) are re-defining the workplace which we deal with now. we are about to face an overhaul in terms of planning the social security system and managing the unemployment

In terms of dealing with fact that technology and automation are related to the basic preparation of the future workforce, today's schools and vocational education institutes are simply not keeping up with the megatrends of the new digital world. We still need diverse types and sources of education and training plans. It is not only about governments and educational institutes; but already few forward thinking firms are doing the much they can do to help in the upskilling of the next generations.

2.3.1 Opportunity

Back in 1870, around half of the US population were employed in the agriculture sector; ending by 2008, less than 2% of the people in the US are still employed directly in the sector. Basically people have adapted with using the new technologies in the past and when the economy has gone

from agriculture to industry, they could obtain new jobs and developing their skills; along this time new skill-sets were identified; new jobs were created; and new challenges were noted for innovation and progress. The fact that world is in a state of radical digital transformation and ever changing innovation. In the year of 2015, roughly, 20 billion devices and systems were connected online expected with exponential growth to be around half a trillion worldwide. According to McKinsey, the IoTS will generate up to USD 11 trillion only in value added in the next six years. [32]

In a McKinsey Global Institute paper, *Driving German competitiveness in the digital future*, we estimate that by quickly adopting automation technology, the country could add up to 2.4[1] extra percentage points of annual per-capita GDP growth to 2030[2] (figure 2-4) This could help compensate for a 0.6[3] percentage point annual drags on per capita GDP growth from aging and help Germany to sustain its historical per capita GDP growth. [33]

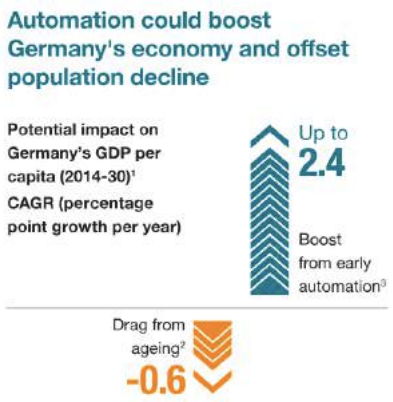

Figure 2-4 The Automation in the German economy [33]

With evolving industries and changing technologies, it is clear that there would be great countless opportunities for the Information Technology leaders to drive the upcoming workforce issues with the next generations like we are dealing with these days to keep in advancing the economies of the future. The unanswered question is still: "***Are we able to support these new professions and new expectations with our existing training, education, and government systems?"***

To support the new millennial workforce, as well as their needs to remain relevant, we are in deep need to rethink high schools, colleges, vocational education, industry training, and to make sure that the upcoming generations are ready for the future of work equipped by the new skills and

1 Calculated change to GDP per capita assuming a constant 2014 productivity rate and a declining working population.

2 Assumes the total population will decline from 82.6 million in 2014 to 79.6 million in 2030. Assumes the working population will fall from 40.1 million in 2014 to 34.9 million in 2030.

3 Considers the benefits of labor substitution only, and assumes that all FTE hours displaced by automation will be reallocated to equally productive work. Shows the difference in per capita income growth under a scenario with automation and one without.

scientific mindsets for instance, software engineering and data science. These new skills would support the agility that would be the DNA of every single workplace if the future. A report by Frost & Sullivan which highlights the developing role of the chief digital officers (CDOs), concluding that "they will be instrumental in enabling digital enterprises **to move from product-centric businesses to service-centric models** with data and digital at the center. These roles will also help to 'digitalize' business processes that go from the supply chain, to manufacturing, to innovation, to engineering and design, to the development and deployment of smarter products, and beyond" [34]

2.4 Governments

2.4.1 Dilemma

Robotics would definitely help businesses to make the best use of their existing capital resources leading to increasing profit margins. In turn, that could generate further demand for classical forms of investing like warehouses and machinery. The price of goods and services could fall down or rise more slowly if businesses lower their profit margin and offer their consumers lower prices in order to capture the market along the dynamic competition. [35] If we expand it to countries, Germany comes on the top as the government is also considering the using of these new automation enabled wealth systems be able to to offer subsidies for their citizens with basic unemployment insurance in other words the unconditional basic monthly income, no matter what is their employment status. [36] Apparently not all countries are ready to make this happen. In June 2016, three in four citizens in Switzerland voted against introducing an unconditional basic income claiming that disconnecting the link between work done and money earned would have negative effect on the society. [31] [37]

2.4.2 Opportunity

The fact is that the technological advancements and industrial automation would ultimately threaten almost all business models involved in the mass market industries, as there would basically be very few viable consumers to purchase their products, leading to a new social and tax system which is designed to enforce higher taxes on capital to be able to nurture a notably larger class of the unemployed as explained by Ford in 2009. [38] In order to balance off job

redundancies and associated tax revenue losses, governments need to reform the tax rules and guidelines and transform it to make it more independent from the income. Recently, this topic has been further examined in the context of the discussion on the outline of the unconditional basic income as a possible consequence of the growing move towards income from capital gains and not income from human labor. [39] [40]

2.5 The real risk of Automation

Simply understanding the problem is a challenge. Experts still disagree on exactly which groups and regions are losing jobs primarily to automation, how quickly such impacts will spread and what interventions might help. To build sound, long-term policy on something this important, we cannot rely on anecdotes. Government, foundation and corporate leaders need to invest in better data - today.

As reported by L. Rafael Reif, President of Massachusetts Institute of Technology, to the World Economic Forum "CEOs across many sectors describe one existing quandary is that **they have to lay off hundreds of people because their jobs have disappeared and they do not need their skills anymore while they have hundreds of job openings cannot bet filled because they cannot find people with the right training and skills**. This mismatch is bad for everyone: Lives are derailed, families and communities damaged, business opportunities lost." [41]

However, In Pwc's 20th CEO survey[4], Interviewees were asked which skills were important and which were hard to find. **Soft skills were in high demand**: **problem-solving, creativity and innovation, leadership and adaptability** were identified as today's skills battleground. CEOs should be encouraged to find that these high demand skills as long as both CEOs and workers are on the same level of competence. [42]

4 PwC's 20th CEO survey, January 2017 (1,379 CEOs)

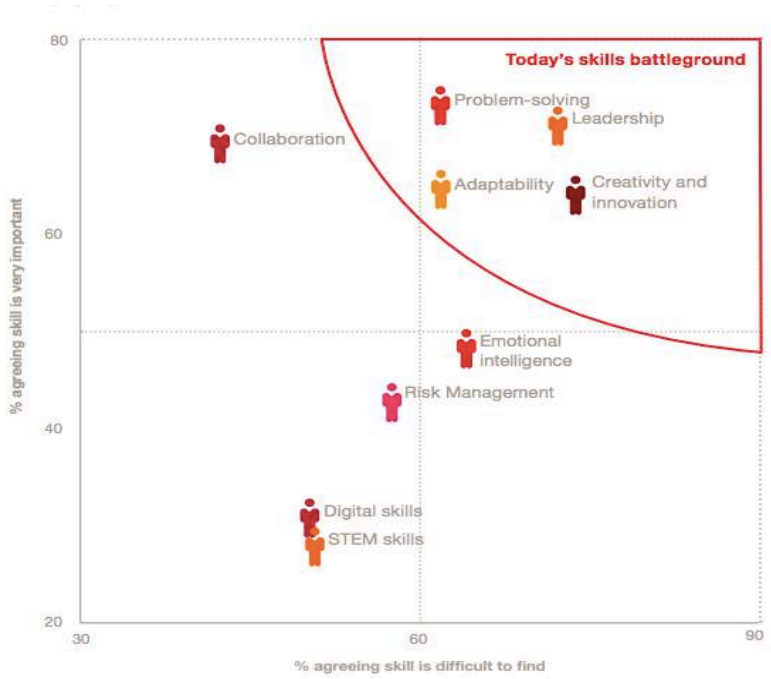

Figure 2-5 Soft skills are in demand – and CEOs say they're hard to find [42]

From Erik Brynjolfsson and Andrew McAfee point view, The competition for jobs are being fed by the race between technological and educational progress; technological advancements would not only tend to take away routine jobs, but high-skilled jobs as well giving a definition by pattern identification and cognitive non-routine tasks. [43] [44] they mainly came up with a set of measures in order to avoid negative implications of cyber physical systems and to overcome for job redundancies phenomenon arising from the ever growing computer and software disruptive innovations, concurrent examples of the keys they suggested are better education, further focus on entrepreneurship and startups, paying more attention for academic research or the introduction of "Pigovian and negative income taxes" [44] Those measures emerge to go in the same direction with the others which Ford proposed earlier in the government's opportunity.

Moreover, Osborne and Frey conducted a case study, they focused on the issue of how computerization affects our daily jobs and routines. they estimated the probability of computerization for 702 detailed occupations in the US labor market in order to analyze the potential jobs at risk and to assess potential correlations between computerization probability, wages and educational attainment. [45] Computerization risks range from 99 % for telemarketers to 0.28 % for recreational

therapists. They presented the result of this study as almost half of the jobs in US are expected to disappear as a result of automation. the remaining human jobs becoming more complex and comprehensive as technology is taking away all the simple repitive jobs. On the other hand, Bowles -in an attempt to apply a similar study approach to the European marketplace- pointed out that Northern European countries like France, Germany and Sweden have similar results as the US and theoretically would not be highly affected by the risk of computerization as per Southern Europe, in which a high percentage of their domestic workforce could be affected by the risk of automation ranging between 45% and 60%. [45] [46]

Generally speaking, complex tasks once considered too difficult to automate would be done by machines; In the medical sector, diagnoses and treatment plans are reported by fully automated systems; algorithms would create detailed, responsive exercise plans; and already artificially intelligent therapists offer their patients low-cost programs to overcome social anxiety issues. [47]
Human labor are still going to be required for much manual and low-income work. For instance, goods are going to be delivered to local hubs by automated vehicles. However, years are needed until affordable robots that are smart enough for the last mile navigation between unexpected entrances, into small corroded litter boxes and upstairs. [47]

The greatest risk is for people in low-income manual work and medium-income work, in which the majority of the tasks are clearly defined and repetitive. More roles will become supervisory, with the increase level of decentralization of planning and scheduling and the lack of the skills and the training the work may become less controllable and the worker may get lost and doesn't know what is exactly his liabilities.

That concludes the reason why The Science Year 2018[5] is devoted to the topic of "Working Environment of the Future" *under the authority of BMB*F which aims to exploring both the opportunities and the challenges that lie ahead. Around 440 partners from politics, science,

[5] **Science Year 2018: "Working Worlds of the Future"** is the topic of the Science Year 2018. It deals with questions of how work will change in the future and what role research and science play in coping with these changes.

society and industry participated in more than 700 events all over Germany to discover and help shape the working worlds of the day after tomorrow. [48]

3 Germany X.0

3.1 The Megatrends

When so many complex forces are contributing in shaping our upcoming working world, linear predictions are too simplistic. Enterprises, governments and individuals need to be prepared for a massive number of possible outcomes.

These driving forces are the megatrends which reshape the society leading to the economic shifts in which power, wealth, competition and opportunity are redistributed around the world; the progressive thinking, uncontrollable innovations, scarceness of resources and new business models which are affecting all the sectors. Businesses necessitate a purpose that is clear, has a value and meaning and criteria to attract and retain employees, customers and partners in the decade ahead. [49]

Pwc analysed the megatrends as the five global shifts changing the way we live and do business: [49]

3.1.1 Technological breakthrough: Rapid advances in technological innovation

AI, robotics and automation are quickly promoting, drastically altering the available jobs' number and nature. Technology has the ability to enhance our lives, life span average and standards of living, productivity raise and free people to concentrate on their personal fulfilment. However, it brings social unrest threat and disruption in terms of politics in case of inequitable sharing of economic benefits.

3.1.2 Demographic shifts: The changing size, distribution and age profile of the world's population

The population of the world is aging, with a few regional exceptions, adding up stress on economies, business and social institutions. Our longer life span will affect business models, talent ambitions and pension costs. Older workers will need to learn new skills and work for longer. 're-tooling' will become the norm. The shortage of a human workforce in a number of rapidly-ageing economies will drive the need for automation and productivity enhancements.

3.1.3 Rapid urbanisation: Significant increase in the world's population moving to live in cities

By 2030, the UN projects that 4.9 billion people will be urban dwellers and, by 2050, the world's urban population will have increased by the same 72% already, many of the largest cities have GDPs larger than mid-size countries. In this new world, cities will become important agents for job creation. [50]

3.1.4 Shifts in global economic power: Power shifting between developed and developing countries "The Next Game Changers"

The rapidly developing nations, particularly those with a large working age population, that embrace a business culture, attract investment and improve their education system will gain the most. N11 The Next Game Changers: The next big emerging markets coined as the Next 11, will be the future economic engines of growth signalling a shift in economic power in 2020 from BRIC countries to nations of Bangladesh, Egypt, Indonesia, Iran, Mexico, Nigeria, Pakistan, Philippines, South Korea, Turkey, Vietnam. [51]

3.1.5 Resource scarcity and climate change: Depleted fossil fuels, extreme weather, rising sea levels and water shortages

Water and energy demand is expected to grow by as much as 40% and 50% by 2030; respectively. New sorts of jobs in reuse, waste management, product design, new engineering processes and alternative energy are going to be created in order to be able to cope with these requirements. [52] Traditional energy industries, and the millions of people employed by them, will see a rapid restructuring.

In a study by Pwc on how AI is pushing man and machine closer together, they thought of AI as three levels [53]

Assisted intelligence	Augmented intelligence	Autonomous intelligence
widely available today, improves what people and organisations are already doing. A simple example, prevalent in cars today, is the GPS navigation programme that offers directions to drivers and adjusts to road conditions.	emerging today, helps people and organisations to do things they could not otherwise do. For example, car ride sharing businesses could not exist with the combination of programmes that organise the service, being developed for the future, establishes machines that act on their own. An exampleof this will be self-driving vehicles, when they come into widespread use.	Some optimists believe AI could create a world where human abilities are amplified as machines help mankind process, analyse, and evaluate the abundance of data that creates today's world, allowing humans to spend more time engaged in high level thinking, creativity, and decision making.

To better understand Pwc's model the future of workforce, we need to study the human dynamics in their Scenario analysis; the push and pull effect of **collectivism versus individualism,** and **integration versus fragmentation**. [54]

Is "me first" going to first win, or are societies going to work with each other through a collective responsibility sense? Is the digital technology going to certainly symbolize the end for large companies?

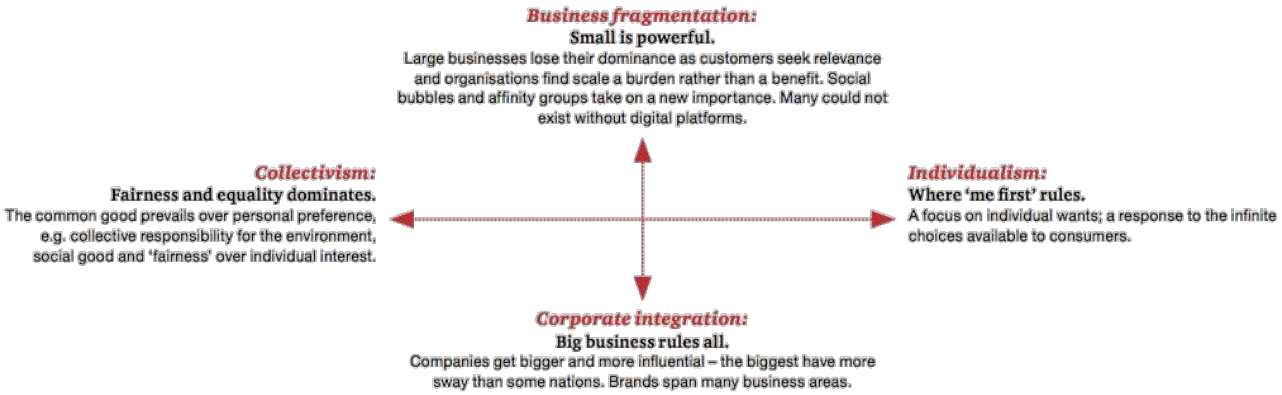

Figure 3-1 The Scheme of the Business world in the future [54]

Figure 3-2 predictions of the future business entity [54]

3.2 How does the workforce look like? – based on Pwc report [54]

THE YELLOW WORLD: HUMANS COME FIRST	THE RED WORLD INNOVATION RULES	THE GREEN WORLD COMPANIES CARE	THE BLUE WORLD CORPORATE IS KING
Like-minded workers gravitate towards each other, aided by technology platforms. Individuals come together for collaboration on delivering on an idea and on projects; no matter how long it takes. Guilds help workers remaining current, building trust in their services and for creating scale when required. Guilds provide members with a strong senseof identity – individuals see themselves as members of their profession, identifying with each other because of their particular skills set, interests and goals. Non-financial rewards are assessed fairly in a trade-off for less pay. Work is often a fluid concept and a regimented 9 to 5, Monday to Friday working week is rare; the borders between home and workare blurred.	Specialism is highly prized and workers seek to develop the most sought-after skills to command the biggest reward package. Organisations are typically stripped-down and nimble, supplemented by talent attracted by the next promising opportunity. A small number of 'pivotal people' with outstanding management skills commandhigh rewards. Like-minded workers gravitate towards each other, aided by technology, sparking bubblesof innovation. Projects quickly flourish, evolve and resolve and specialists move rapidly from one to the next.	Workers are attracted to Green World companies by the opportunity to work for an organisation they admire, whose values match their own. Even so, competition remains intense for the best talent; financial reward is still important. The incentives package is an essential tool retaining workers and has become increasingly inventive.' Three weeks' paid leave a year to work on charity and social projects is standard practice. It is expected that workers would reflect their employer's valued both at home and at work via "organizational pledges" There is tight control and monitoring of travel and there are motivation for efficient and inventive resources usage. The "job for life" concept comes back to the lexicon of the workplace.	Aside from a core group of high-performers, talent is bought in where and when it's needed. 'Retainer and call-up' contracts are frequently used for rare skills. Top talent is fiercely fought over – the bestengage an agent to negotiate and manage their career. Employers begin their search for exceptional talent early, forming links with schools and engaging promising youngsters. Employees of all levels actively participate in the development of their own career, improving and refining their skills however and whenever they can; human enhancements included. Society splits into the ones who do not have access to the same level of financial rewards, healthcare and benefits and the ones with a corporate career.

Figure 3-3 Jobs at risk of automation [55]

3.3 Workforce in Germany

In may 2018, the 12th edition of re:publica conference, which is the largest and most exciting conference about digital culture in Europe, was held in Berlin and brought together more than 20,000 visitors to share their knowledge and discuss the future of the information society about the digital world. [56] A workshop named "Work fiction: New Working Hours in 2030+" consists of 80 participants aimed to design future scenarios for our working environment, the result shows that the future of work and is addressed under current trends of the digital world. [57]
Participants discussed the probable and speculative effects of the three main megatrends:

- increasing interconnectedness
- demographic change
- technological advances

3.3.1 Likely effects on the workplace: the workplace is facing many changes

Everyone agrees: **working hours are changing**. However, some participants suspect an extension of working hours, others expect a reduction in working hours because automation takes over certain tasks and leaves more time for knowledge which may not just change working hours, but also transform job profiles and the classic understanding of career: lifelong learning and qualification is becoming increasingly important.

Increasing **technology-based work** leads to individual relief. Rest periods, project outlays and burdens as well as individual needs in the workplace can be automatically recognized by technologies and corresponding follow-up actions implemented.

Workforce in the future are way more **self-determined, independent and self-responsible than before**. Agile networked environment is increasing and leading to revoking of conventional structures. Common goals and problems are pushing towards the co-operation.

The outcomes:

- borders blur more and more
- more misunderstandings arise through virtual communication
- informal and independent working relationships increase
- people disappear in the mass and no longer receive individual recognition

3.3.2 Speculative effects on the working world: work is completely redesigned

Virtual technologies and more agile forms of organization make it possible to work anywhere. Due to increasing virtually and globally networked cooperation. **AR becomes the common communication system**. As a result, there will be less traffic and office space.

New forms of cooperation emerge: Biodata[6] are used, tasks are assigned automatically on a daily basis depending on the work done so far, the physical condition and current performance, remote leadership is spreading, companies are more dependent on co-operations, individuals are allying. In Parallel with these developments, **legal forms as well as employment contracts are reconsidered** and social benefits reformed. [57] [58]

Roda Muller-Wieland clarified "At the Center for Responsible Research and Innovation of the Fraunhofer IAO, we already assume responsibility by identifying wishes and demands of social stakeholders for new working and living environments in our corporate foresights and developing successful, accepted and sustainable solutions for the future. We equip companies and organizations with the knowledge and the right methods to actively shape transformation according to new societal needs as well as to prepare their employees and executives for the requirements of the working world 4.0." [57]

6 Biodata is factual kinds of questions about life and work experiences, as well as items involving opinions, values, beliefs, and attitudes that reflect a historical perspective [60]

3.4 Economy 4.0

In 2014, Fraunhofer IAO has carried out a survey where 518 industrial companies' representatives have been asked about their point of view on Industry 4.0 effects. 50% of the respondents had expectations about less activities that were carried out manually and 54% expected increased planning and control activities. 77% of the respondents anticipated a greater significance of interdisciplinary cooperation, 76% awaited IT competence higher standards and 86% anticipated an increased significance of lifelong learning. Viewing these findings, scientists in Fraunhofer forecast shrinkage in workforces because of cyber physical systems, however, they believe that factories will not operate totally with no human beings intervention [59]. The Institute for Management, Market and Media Information (FAZ) and the Institute for Leadership Culture in the Digital Age (IFIDZ) carried out a further study among the managers of first and second levels in 100 companies in Germany, where 8 out of 10 responded with an agreement on the same alterations in the work model [60].The researchers have investigated the way that digitalization would alter the contents and procedures of work and concluded the following [61]

- A stronger role would be played by ideas of customers regarding product development
- Increased stress on managers would be a result of digitalization
- More flexibility of work life
- More importance would be gained by partner networks
- More attention would be paid by employees on risks of social media
- Increased importance of teamwork

Managers confirmed that they are preparing their employees to coup with the new digital paradigm and learn how to think digitally in order to be able to stay in the market with the un predictable competitors who are invading the markets with new technologies.

3.4.1 The digital competition

Technology has swept away common market's barriers to entry such as high economies of scale, control over distribution channels and a strong brand and reputation even in formerly protected industries such as **Automotive industry**, which hasn't witnessed any new entrants for the decades but it was full mergers and acquisitions. Nevertheless, industry boundaries blur and new competitors emerge with lower production costs and thus higher profits but they rarely distribute

back their shareholders, but invest more in even more risky future projects. The chain had begun as the difference in the productivity between young technology companies and established companies are vast and obvious: *Google employee generates about six times more revenues than one employee of the German software group SAP while it is three times between Amazon and Otto*. [62] It is important for companies who wants to adapt with digital paradigm and to offer an ecosystem in the digital market to learn from the past and to pay attention now for the next step of their competitors.

3.4.2 Learning from the past

Everything could have been good in 1999, when The Hamburg publishing house Gruner + Jahr took over Fireball, "*originally called Flipper and started in 1996 as the faculty of computer science project in the Technical University of Berlin";* quickly, it had increased popularity and turned out as one of Germany's largest search engines before even Google exists [63] It could be the birth of one of the internet champions in Germany, but it happened differently when three years later, when the Gruner + Jahr parent company Bertelsmann launched the initial public offering (IPO) for the Internet portal Lycos Europe. [64] Under the ownership of Lycos, Fireball development decelerated. The fireball massively lost market share within a short time as a result of Google rising and being introduced to the German market as well as Lycos takeover. By mid-2000, Fireball's market share had dropped to 22% and possible historic opportunity is just gone. [65]

In the area of mobile application, and the way people are connected with each other daily through mobile apps since the triumphal march of iPhone from Apple since 2007 to find virtually in every pocket. Surprisingly, The first application of this kind arose much earlier; At the time Kieler Woche in 2004[7], the first mobile application was already based on Universal Mobile Telecommunications Service (UMTS) and based in Germany. [66] It was developed by T-Mobile, Motorola and beLocal and co-operations of researchers at the University of Kiel for the Kieler Woche where 200 of UMTS phones are used daily by the visitors, with the help of data-

7 Kieler Woche is an annual sailing event in Kiel, the capital of Schleswig-Holstein, Germany. It is the largest sailing event in the world, and also one of the largest Volksfeste in Germany, attracting millions of people every year from all over Germany and neighboring countries

provided updates, the visitors could be updated by one touch screen about the announcements, stage programs, finish runs of sailing regattas and explanations of sights with textual, pictorial or video elements also the location of the user by a map-based route guidance. Despite this successful trial, neither T-Mobile or Motorola hit the ball that made only by Apple three years later. [62]

Lack of risk appetite, and lack of courage to think big could have changed the German digital economy. Nevertheless, German companies have great, successful and competitive existence in the internet industry with great outcomes. United Internet is such an example; **Rocket Internet, Zalando, Delivery Hero and Check24** are also in this category. But they are exceptions, because most of founders prefer to sell their companies for a lot of money to the American sector. mobile.de, the **Scout Group, Trivago, Brands4Friends, BigPoint, Teamviewer, Sociomatic, the 6Wunderkinder and Pay.On** went into the hands of American companies for three to four digit millions. These were probably good business trade for the founders and investors, but bad for building their own digital economy in Germany.

3.4.3 Digital Economy markets in Germany

The products and services of the new digital economy give rise to delivery models (Ad Tech and FinTech) that rely on innovative web-based data management solutions such as Big Data and Cloud Computing which are capable of successfully analyzing huge quantities of data during navigating successfully increased threats and risks online (Cybersecurity). The sensors systems, applications and data analytics implementation in order to have the conventional value chain models is probably represented best by “Industry 4.0” term.

3.4.3.1 Ad Tech

The modern life growing digitalisation had a remarkable transformative result on the used media platforms and advertising delivery models. About 81% of the population of Germany use internet on regular basis, spending about 149 minutes online per day in 2017. [67] Smartphones users represent 64%, reviewing the change of internet from stationary mode to mobile mode. The print media and broadcast models of the analogue world are gradually being replaced by the emphasis

of the digital world on mobile and online delivery platforms, with the growing market. In 2016, the net investment in advertising in digital (search engine and display marketing) pulled ahead spending of television advertising, resulting in the internet being the most powerful medium for the first time. In accordance to Statista, the volume of mobile and online advertising is forecasted to be 7.8 billion Euros in year 2019 and increasing up to 13.6 billion euros in 2023 [68] in which almost half, precisely 45%, of that amount is spent through programmatic advertising. The platform of demand side and sell side, allied to targeting options, multi-screen concepts and new formats support the digital campaigns in reaching a target audience that are hard to be reached. [32]

3.4.3.2 FinTech

In parallel, Germany is a significant market of FinTech in Europe and is ranked the fourth largest worldwide. In accordance to statista, in this sector, there are 700 companies, 50% of which were formed during the past 3 years alone. Berlin and Frankfurt are home to one hub of Fintech respectively and Cologne and Munich have hub of InsurTech each. Majority of the German FinTech companies are located in Berlin (228 companies as of September 2017), followed by Frankfurt and Munich (84 respectively), Hamburg (67), and major cities in North Rhine-Westphalia (53). [69] Banks, insurance companies and other players launch corporate programs for startups and establish offices for incubators and accelerators so that new FinTech companies can be set up in the market. Also, some builders of the company are centering their activities in FinTech. Based on EY, more than 50% of the population of Germany are open to utilizing digital financial solutions that are offered by third parties rather than their own house bank. In 2017, FinTech startups in Germany received financing investment that reached 541 million Euros, which results in FinTech being second to the sector of e-commerce startup. [70]

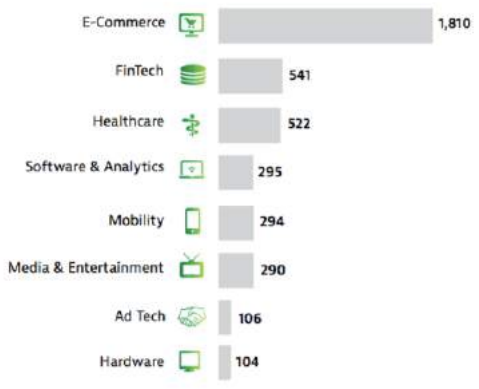

Figure 3-4 Investment in German Start-ups 2017 [30]

3.4.4 E-Commerce

Germany is responsible for approximately one quarter of the whole European B2C e-commerce revenues; It is classified as Europe's second largest online market after the UK but with nearly three times the current growth potential of UK, according to A.T. Karney. [71] As a matter of fact, the Association of the German Internet Industry (ECO) had expected the turnover to exceed 100 billion euros by 2020. [72] Together with a highly developed extensive infrastructure for logistics, Germany is clearly this area's continental leader and provides a huge number of opportunities for international online service providers and retailers.

3.4.5 Logistics

The rise of e-commerce has led to demand for more sophisticated logistics. Yet the degree of automation in most warehouses is quite low as it is still too expensive and structurally unreasonable to upgrade existing infrastructure with the best available robotics. [73]
In today's e-commerce world, where shipment time is crucial for customers, setting up a warehouse or a logistical facility in Germany is beneficial. Indeed, Germany is the global logistics leader for three times in a row according to World Bank's Logistics Performance Index (LPI). [74] Global logistics has changed in big ways in the last 10 years, fast growing international trade puts pressure on traditional actors; the new players and new business models, such as e-commerce, have emerged. Technology and new concerns about supply chain resilience drive industry changes and reshape the classic policies. [75]

The world bank identified eight megatrends likely to drive the future of logistics: [76]

- Logistics skill shortages
- Supply risk and recovery (resilience)
- Sustainability of supply chains
- Logistics property and infrastructure
- Restructuring global value chains
- Digital transformation of supply chain
- E-commerce driving demand chains
- Collaborative business models

We can conclude that the advancements in technology can lead to higher productivity and even create value added services, but also less human needed. Technology is already replacing human in logistics. You can see automated warehouse by e-commerce giants like Amazon, Alibaba.

Automated vehicle, robotic delivery, etc, are also being developed, tested. However, technology is always changing. In a few years, those automations may become the norm in this industry, giving way for new trends to rise. Therefore, **it is important for the workforce to be dynamic in the same way. Management should proactively approach supply chain management by always seek out new trends**, new technology to maximize productivity, while lower-level workforce should follow up with the trend to make sure that their jobs are not in the risk of being replaced by technology.

3.5 Logistics 4.0

Logistics 4.0 operates under the same principles of industry 4.0, but with a different components set. Particularly, it utilizes vehicles, pallets, smart containers and transport systems to form a supply stream that is fully networked that offers freight forwarders, supply chain managers, shippers and others the essential visibility to direct transport and carry out other logistics tasks optimally resulting in the creation of a digital, networked value chain that has a high level of supply network visibility, it results in having the possibility of seeing potential breakdowns and bottlenecks well prior to occuring and developing back up plans or countermeasures in time in order to maintain smooth operations. [77]

3.5.1 Enabling robots in the logistics

At FedEx's large distribution center in the North Carolina Piedmont reigion, **Jefe** has become part of the team. Jefe is a robot not a person and is involved in an expanding robots group at the facility of FedEx which transports package all over the massive complex, starting from the arrival point to another place for being further sorted. As robots pull a "tugger" for packages transportation, each of the robots in FedEx have sensors and navigators to show

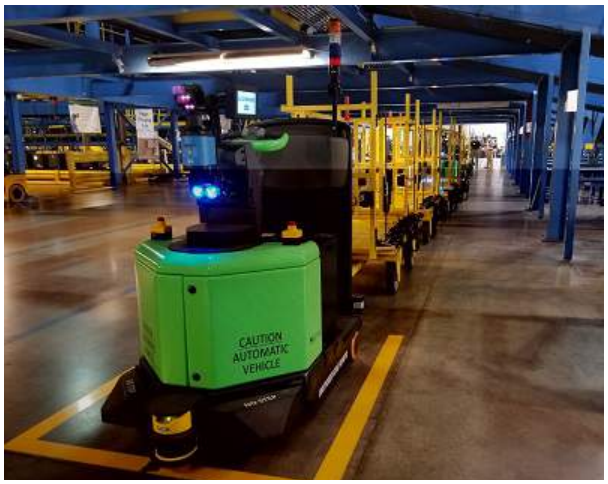

Figure 3-5 Jefe, The robot in Feed-ex DC in North Carolina [78]

its path (figure 3-10) [78] - staying away from objects and workers along the path. Even some robots have the cognitive tools for future journeys optimization based on previous experience [79]

In June 2018, JD.com, the logistics major from China, has unveiled a warehouse that is able to handle 200 000 orders per day but recruits only 4 employees [80] that have their jobs focused around the servicing of the robots that handle and operate the place. The fulfillment center, which was built at Kunshan, on Shanghai outskirts, marks the start in a new future to the Chinese e-commerce industry with JD.com ensuring delivery on the same day even to the farthest destinations across China, on a condition of having the order coming in earlier than 11 A.M. for the day. [82]

Figure 3-6 JD.com fully automated warehouse [81]

A study by DHL on Robotics in Logistics obtained the ultimate low-cost robot to support logistics will need to have some form of "Eyes, Hands, Feet, and Brains". It will need eyes to see an object, hands to pick it up, feet so that it can move the object to another place, and brains capable of coordinating all these tasks. [81] In this section we will discuss the technological advances that are currently underway that would finally be able to provide robots some sort of "Brains, Feet, Eyes and Hands".

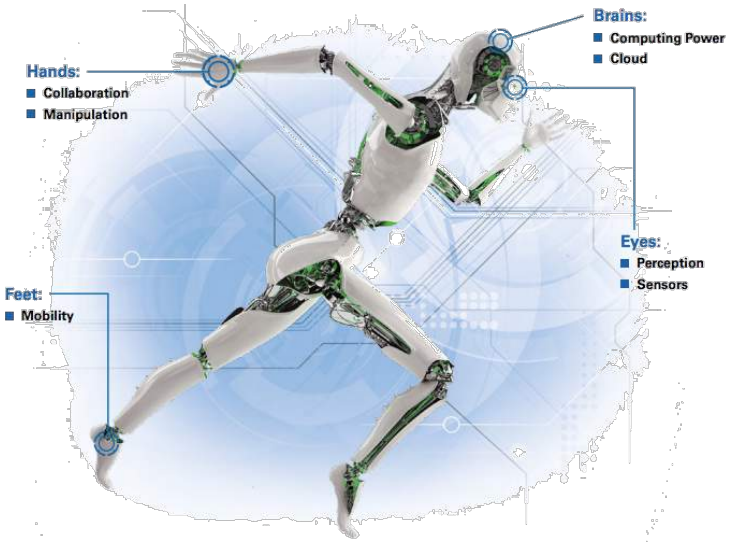

Figure 3-7 model of a robot by DHL *[80]*

3.5.1.1 Eyes

A certain product had a very strong effect on the development of robotics and it arises from the video game world. Kinect video game controller has been brought to market by Microsoft in 2011. The kinect is basically an affordable system of 3D camera that may be connected to the TVs at home. Players of video game can be watched and their live motion can be tracked by the camera. Similar technology are being developed by many companies as a result of the Kinect success. One company, Leap Motion, has developed a comparable sensor for use with laptops that is 100x more accurate and retails for just $70. [82] Like all consumer electronics, this type of technology will clearly continue to increase in capability and decrease in cost over time. The robotics world is poised to benefit greatly from this trend. However, Cameras alone are not enough to act as 'Eyes' to robots. Also, sophisticated softwares are essential for interpreting data that are received from cameras. This results in requiring the robot to use a camera for the identification and picking up a part out of a bunch of similar parts in the same box. As soon as the computer receives the image from the camera, programming with an advanced level is needed for a single part identification even if part of it is covered. After the part is found, its orientation needs to be understood by the computer in order to make sure that the part is reachable and then the computer plans a certain path that the arm can follow, at the same time it calculates the robotic hand's suitable orientation that allows it pick the part. This whole process should be done at a speed that the industry would find interesting.

Figure 3-8 Microsoft Kinect

3.5.1.2 Hands

In order to explain the hands in robotics, we should first understand what is so called "the cobot" which in other words is the collaborative robot that is mainly designed and are being used to assist and work with the operator and it is placed close to them in the common workplace. For instance, the first part of the task is being performed by the human operator while the cobot takes the responsibility of the rest. In the logistics sector, this could be seen in several applications as robots

handles heavy parcels under human direction or takes on long distance transfers to decrease human effort in walking. Indeed, the collaborative robotics sector is expected to reach $1 billion in the next year. [83] Nowadays, distributions centers are equipped by operated robots working alongside traditional warehouse operators. Moreover, sorting robotics are working alongside with truck drivers in parcel hubs. It is it expected in the future delivery robots would become the norm hence they would have direct interaction with human customers. Apparently, collaborative robots in the logistics sector are going to be more widespread and efficient than non-collaborative ones. No surprise that robot arms are getting less expensive as the timespan between 1990 and 2005 has witnessed a great drop in their prices by 80% and the low-cost collaborative robotics have been introduced to the market. ABB has the second leading installation base of industrial robotics in the world. [84] Yumi is the new collaborative robot introduced by the company in 2015; Yumi stands for "You and Me working together". As showen in the figure 3.9, It is a two-armed robot is aimed at the electronics and small parts assembly market which their arms are roughly in the same size of a small human body and have a lightweight but rigid magnesium skeleton with a plastic cover. Yumi costs approximately $40,000.

Figure 3-9 Yumi robot by ABB

3.5.1.3 Feet

There are already massive improvements in the area of mobile robotics comprising enhanced mapping of environments, improved path planning, efficient electric motors, longer lasting batteries, ultimate-speed wireless connections and other innovations. Currently there are undergoing innovations in the wheels in addition to the development of omnidirectional wheels which enables the robots to move a robot in any direction freely and without turning which helps a lot in introducing the "feet" to the logistics sector.

Knightscope is a California based startup where they were able to develop a mobile security robot that can drive and move all around a workshop, warehouse, factory, parking space, or even a shopping center. This robot is mainly designed to identify and detect abnormal behavior or an unexpected act, like someone moving in a building at night or after planned working hours then it reports back to a central security center. K5, the American made robot equipped by four high-definition cameras, two laser sensors, Global positioning system (GPS), microphones, a medium sized computer, electric motors and 24 hours self-recharging batteries, is now taking over the security men jobs. [85] K5 guards its environment while avoiding objects moreover it creates a map as it moves around. It will stop suddenly once a person comes to its way and accordingly sends a warning if someone stabs to switch it off. It has the ability to work both indoors and out outdoors. It is not far to find this application implemented in warehouses if its restructured and coupled with a robot arm as it could help in packing or developed to the last mile delivery.

Figure 3-10 K5 the guard robot

At the moment, delivery robots are delivering daily mails and items around the offices and homes. "Relay" is another example of this; a hotel robot which is being sold by Savioke that can go from the reception desk to the rooms in oreder to deliver snacks, towels and any other items. Simply when it arrives by the door, it sends a message on the guest's phone number notifying them that the requested item is arrived by the door, with a personal code the guest can get his item. This state of art robot got hugh positive rating regarding to the user experience in the last 3 years. During the year of 2015 Relay has traveled around 1,000 miles in five hotels delivering around 5,000 items. [86]

3.5.1.4 Brain

Robot makers are putting all the effort they can do in order to increase the computational power as the computing speed is the one of the main pillars to build a smart robot. Thanks to the consumer electronics industry which opened the door to the development of special computer chips called graphics processing units (GPUs) which have the ability to calculate and form the high-speed game images that we deal with. Engineers are continuously improving these GPUs as

today they can use it image processing cameras mounted on the robot arms. GPUs are ten times faster than the traditional Central processing units (CPUs) and using several units in parallel leads to high computing power.

Figure 3-11 Pepper

Definitely, the robots in the logistics would not need this high level of computing power to be efficient. But it is better to better to follow the concept of cloud robotics. Matthias Heutger, *Senior Vice President Strategy, Marketing & Innovation; Deutsche Post DHL Group,* stated "If many dumb robots could share one large smart computer, each taking turns at thinking only when needed, we could lower the cost of each robot while greatly increasing its capability." The concept of cloud robotics is emerged from the development of cloud computing. over the Internet, cloud computing enables bulk users to exchange and share a common public internet resource that might be existed miles away. The clearest application of cloud robotics is currently out to the public use, A robot called "Pepper"; a robot which is engaged in social activities; a human friendly, voice communicating, sensible touching and simulated emotions. The first 1000 units listed for sale were sold out in one minute, the following 6,000 items have been sold worldwide for $1000 in 2015. [87]

Throughout this section, we have discussed many important and vast improvements in robotics technology and examples in real life applications, along with clear evidence that robots are now invading the logistics industry. Following in this chapter we would consider that these technologies mature and became eco-system and commonly used in the industry. The next approach is one possible scenario of our future of the distribution centers, sorting centers and last mile delivery brought to us by DHL research center.

3.5.2 The Future of distribution center

Comparing to nowadays' distribution centers, the automated warehouses of the future are likely to be improved in almost everything. These incredibly scalable facilities are about to relocate with high speed and flexibility to reach the highest possible rate of productivity and quality. New operations are introduced thanks to different types of robots able to perform repetitive tasks like

unloading trucks, picking orders, controlling inventory, co-packing or delivering shipments. Well-developed warehouse management systems are being utilized for coordination of those mobile robots to track inventory movements and process orders with a high degree of accuracy. In the future model, each robot acts separately and performs little task so there will be less “single points of failure” in the system so when the robot breaks down we would be able to replace it leading to a higher degree of reliability and increasing the overall efficiency. What makes really interconnected that the new robot is going to be connected to the cloud so it will automatically continue the required task with the same knowledge. Warehouse staff need to act on a high degree of accuracy and responsibility to perform more complicated tasks including operation management, flows coordination, robots monitoring and handling challenging situations. They are equipped by “exoskeletons” to assist them in lifting heavy goods with less strain, fatigue, and chance of injury. Moreover goods are brought into a co-packing space where robots are working alongside with human workers when needed with the aid of Human Machine Interface (HMI) employees could train the robots to perform these easy tasks while they take care of the complicated tasks. Unsurprisingly, both small and huge warehouses will enjoy high productivity as we add as much as possible of smart robots which helps in supporting the current employees. Relocation and rebalancing strategies that aims to move the robots according to the scale of demand and where they are really needed. By time, planning strategies will be evolved and robot leasing market will emerge allowing logistics firms to cut off their cost of capital while further increasing operational flexibility.

Figure 3-12 Distribution Center of the future

3.5.3 The future of Sorting Center

When it comes to the sorting center we have to accept the fact that they will be running continuously 24 hours 7 days a week and they would be working in full capacity in order to fulfill the needs. Working in waves as the new supply chain system will enable multiple shipments to be delivered to end customers on the same day. By fully utilizing equipment across shifts resulting in cutting off the logistics costs. self-driving trucks are moving the goods to sorting center according to a specific schedule by using GPS and yard management systems to control van movements into and around the center.

Simply, once a truck arrives by the door, robots will unload the parcels and sort them accordingly to next stage "the last mile delivery". There are several possible scenarios to achieve this. For instance, using a swarm of mobile robots to deliver the shipments from inbound dock doors to a specific loading area. Each robot is loaded with the goods using a robot arm then each robot aligning with the other robots in the **swarm of robots** transport the shipments efficiently around the center. In case of dangerous goods, this process will be handled and secured separately using human intervention. In both case, all tasks will be supervised by employees working in a **robot-control room**; their task is to communicate any issues and manage the workflows. Employees who are based in the sorting center are supposed to handle any exception cases like parcels that need repacking or a customs check.

At the end, normal parcels will be loaded using robot arms onto **line haul trucks** which take them to the next stage. some parcels will be loaded into **drones** for air delivery to difficult-to-reach addresses. While local delivery parcels would be loaded onto **mobile parcel robots** which take them to the homes in the neighborhood. In parallel, high priority customer are able to get their parcels by sending their self-driving cars which is in a way or another compatible with the technology adopted in the sorting center. It is clear to say that he sorting center in the future will be flexible, fast, productive which is translated to a better service to the end customers.

Figure 3-13 Sorting center of the future

3.5.4 The Future of Last mile delivery

In the near future the interface between robots and humans will become a daily routine. The connection with the robots will be so natural that people will never have to fear for their physical safety. Robots will have the ability to avoid anything on their way thanks to using advanced sensors such as cameras, laser scanners and proximity sensing skin to avoid bumping into people. The robots will provide high-quality customer service using cloud computing techniques. What is more they will communicate with us in our language, react accordingly to our emotions and access appropriate account information to ensure that the interaction is successful. Our local parcel service centers are the places where we are likely to encounter the first robots. In this kind of a place a robot can assist us to help with shipping a present to an old friend. Another example of the everyday occurrence could be an information that there is a package waiting for us to collect at a mobile parcel locker, which is located outside a shop close to us. How do we get the information? Each early morning these lockers will be swapped out by self-driving trucks for lockers holding new parcels which have been preloaded the night before by the robots at the local sorting center.

What about large shipments? Human workers will be delivering them by the doors and by the assistance of exoskeletons, they would be able to lift heavy weights safely. And shipments that must be delivered in multiple apartments block, here it comes the robots similar to “Relay”, the hotel assistant robot we mentioned before, they would be able to take the elevator and come by the door then send you a text and then you enter a code to get your shipment. What about far destinations? Drones might message the customer and require a similar access code procedure. In this case, they would be able to preschedule the delivery time to organize their daily plan since this single parcel delivery option would be set individually according to people’s schedule. What if no one is at home? The home assistant robot can receive the shipment on their behalf as explained, fully smart homes, self-driven cars, and personal robots will definitely work all together in the future to ensure that we always receive our deliveries safely and on time!

Figure 3-14 the last mile delivery in the future

4 - work 4.0

After studying in details the megatrends that shaping our future and how people perceive them worldwide in general and in Germany to be specific, here we would analyze how these trends affected the workforce under the Work 4.0 as it is defined in Germany "Arbeit 4.0", A German born term was first initiated in November 2015 by Federal Ministry of Labor and Social Affairs (BMAS) that aims to conclude all future of work in Germany and basically extended to the European Union, the initiative focuses on studying and analyzing the world of work and its transformation during the digital revolution and until 2030; the term work 4.0 is growing up under the umbrella of Industry 4.0 [88] Work 4.0 comprises two main topics, the green paper in June 2015 and the white paper in march 2017.

In the white paper of work 4.0 the ministry addressed these challenges:

- Employment effects
- Big Data
- Digital platforms
- Flexible working time and location
- Industry 4.0 and the human-machine interaction
- Organizational structures in transformation

Here we discuss in details two main challenges related to the workforce in the logistics sector.

4.1 Employment Effects: transformation of sectors and activities

Generally speaking, German labor market has been positively growing in the recent years. The country could totally overcome successfully the global financial and economic crisis. Opening the door to skilled migration enables them to offset the negative impacts of demographic changes. Several years of inertia in the German economy in late 1990s and it reached its highest record at the beginning of the year 2005 as a consequence of the emergence of unemployment and social assistance. Apart from the financial crisis in 2008, the unemployment rate has declined steadily and is currently at its lowest level since reunification

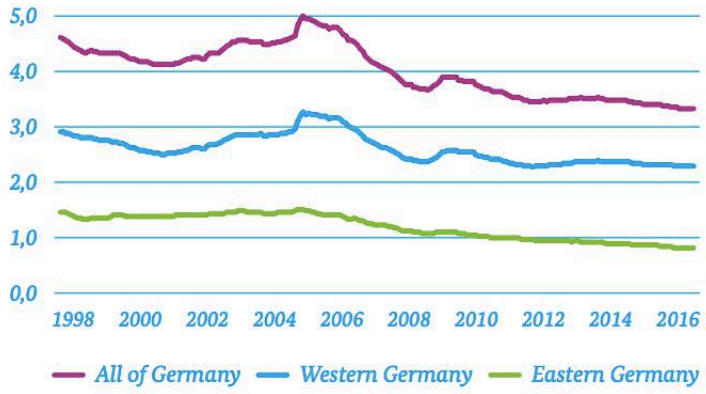

Figure 4-1 observation of the unemployment in Germany over the last 20 years

of East and west Germany, at around 2.6 million according to the federal employment agency in September 2016. Figure (4-1) Since then, multiple long-term researches have been conducted by the Federal Ministry of Labor and Social Affairs to forecast relative the development of the labor market by 2030. The current study aims to estimate and assesses the possible scenarios in order to figure out to what extent the digital transformation can be shaped. [89] The study is based on two states "baseline scenario" in which digitalization is growing steadily and slowly without any given priorities alternatively, "accelerated digitalization" in which policy-makers along with business communities undertake the role of pioneering technology and consequently align education and infrastructure policies systematically with the digital transformation.

The outcome is as follows, in "the baseline scenario", the number of workers in 2030 will be approximately the same as in 2014, while in the "accelerated digitalization scenario" the employment rate is growing significantly due to the increasing level of productivity.

In the German labor market, accelerated digitalization reflects the continuation of structural change. For instance, an additional 750,000 jobs in total are expected to be lost in

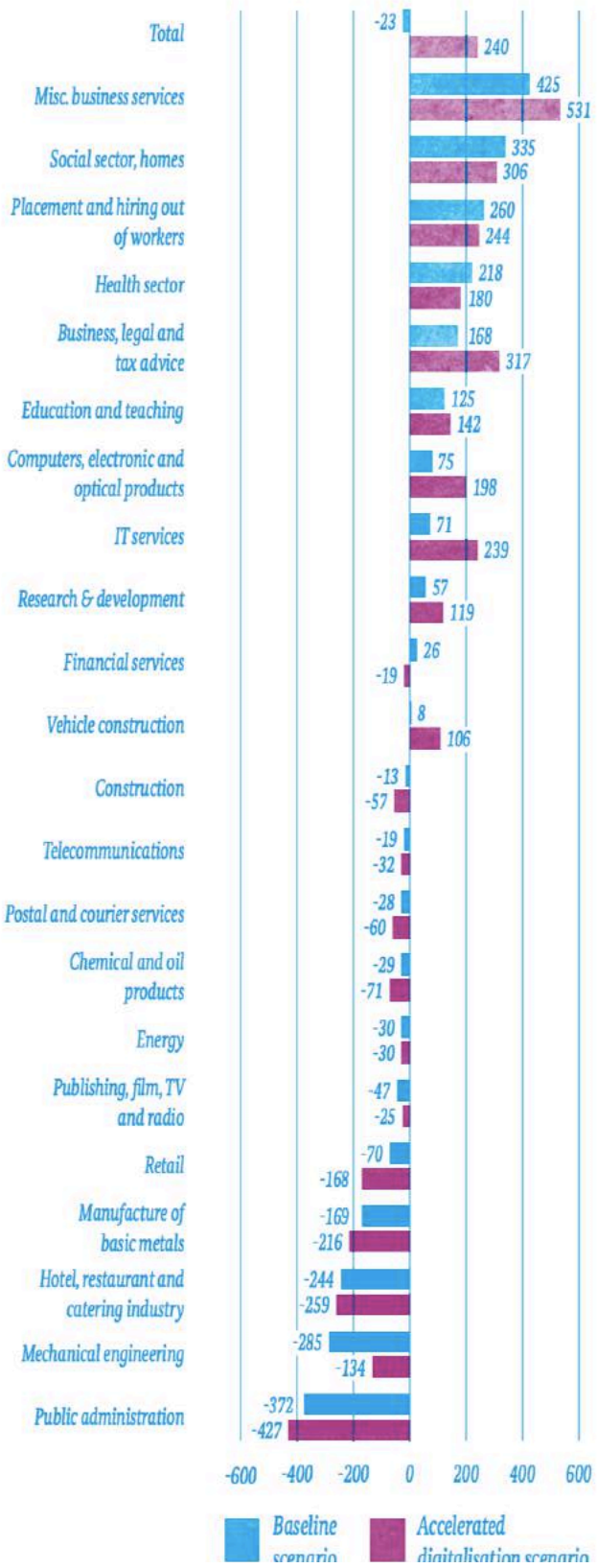

Figure 4-2 Forecast for 2030: changes in employment in selected sectors, 2014– 2030 (in 1,000s)

27 sectors (e.g. Mechanical engineering, courier services and public administration), in the other hand, the employment growth in 13 other sectors offset by one million jobs in total (e.g. IT services, legal and tax services, research and development). In general, the workforce could grow by around a 250,000 people by 2030, with a corresponding fall in unemployment.

As in figure 4-2, The labor market forecast expects a significant increase in employment in business services followed by social sector, and a clear drop in employment among other sectors like public administration, the hospitality sector, and retail. And what is interesting is that "the accelerated digitalization" intensifies "the baseline approach" in most of the sectors as we can see that it is clear especially when mentioning sectors like IT and business services as they are responsible for delivering Industry 4.0.

4.2 Industry 4.0 and the human-machine interaction

The continuous developments in AI is taking to the human machine interface to the next level. Thanks to machine learning and big data, AI applications can now be adopted by humans allow them to carry out multiple complex tasks by understanding human need then by collaboration with them. Though they are not implemented in everyday use application but it is clear that there are a potential to transform our daily routine and how jobs look like, not only in industrial but in service sector as well, where knowledge-intensive jobs will be particularly affected.

On the point between people and technology, "functions will be assigned in new ways on the basis of situational and specific strengths" while "hierarchically separated sub-processes which have previously taken place in sequence will be replaced by integrated decentralized planning and scheduling" between process and technology and at the connection of people and process, "the question of how tasks are outlined and roles assigned arises anew". The transformation of HMI consequently offers new opportunities to shape and define the traditional work and production processes, relieving

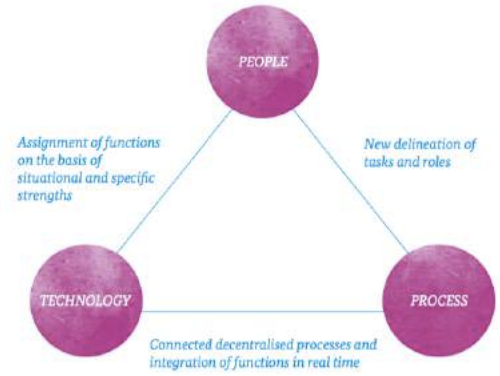

Figure 4-3 Transformation of the socio-technical system as a consequence of digitalisation [90]

workers of routine activities, developing workers' skills and rebalancing their work-life relations. [90]

Utilizing the human-machine interaction is the way for older workers who now can make an important contribution to secure Germany's supply of skilled labour. Jobs which are non-ergonomic can be replaced and the situation of the people will change as well - they can be relieved of the burden of accomplishing physically demanding tasks, or those which involve difficult motor activities or can be found as psychologically stressful. Thanks to this, workers can be prevented from unhealthy physical and psychological strain.

This also changes participation in work as new possibilities are open, as assistance systems which can help with compensation for physical or sensory impairments. That means older workers can work for longer and are provided with a healthier work environment. What's more, people with disabilities also can take a job when it is secured in this way. This improvement of capacity also applies in the cognitive field as intelligent assistance systems can create greater scope for decision while making sure that the information which is found useful and suited will be available at all times.

Looking ahead to the future, intelligent tutoring systems (ITS) offer advanced level of learning during the working process. Such systems have their role in mentally and physically supporting the workers who are involved in the direct interaction with autonomous systems by designing tasks and allocating them to each other. Meanwhile, the increasing degree of decentralization leads to declining in the work which is tied to machine cycles and introducing work flexibility and process integration.

Work 4.0 white paper also discussed the challenges and the areas of tension due to the increase involvement in and with complex autonomous systems. Firstly, there is a clear conflict between the necessity of **upskilling and deskilling**. HMI is designed to enrich activities for workers on one hand it increases the degree of complexity and introduces a greater level of responsibility. On the other hand, it might lead deskilling once complex activities being simplified and entirely standardized and become the norm in the process, they would require lower level of expertise and knowledge. For instance, the machines send signals to the human workers and they ask for

involvement and the workers act for it with set of instructions with many skills un-used. There are two scenarios, fully automated environment with few leftover tasks to be carried out by the human-worker or working along with collaborative robots in complex. In both cases there might be non-desired psychological and physical strain.

The other face of the coin is related to the **experience and know-how**. The automation has the potential to relegate the human worker to the involvement in the manufacturing process, consequently the workers have little contribution in the process without gaining any experience during their work. The “Irony of automation” is that workers who are involved in the automated process become less capable of dealing with accidents and they are somehow losing their problem solving skills. The challenge behind Work 4.0 is to make sure that AI based systems do not devalue the necessity of skilled workers in the process.

4.3 The four level of logistics employment

A study by the World bank classified the jobs in logistics into four different categories as a simplified organization model of supply chain management comprising, Operative logistics, Administrative logistics staff, Logistics supervisors, Logistics managers. [91]

4.3.1 Operative logistics "blue-collar staff"

This group includes employees who are responsible for basic operational tasks which does not require extensive skills while they do not have any liabilities. This category includes

- Truck drivers
- Forklift drivers
- Warehouse pickers

4.3.2 Administrative logistics staff

Staff of this level have limited managerial responsibility as they are responsible for information processing. There are several types of jobs in this category like

- Traffic planners
- Expediters warehouse clerks
- customs clearance officers
- customer service employees

4.3.3 Logistics supervisors

Mainly supervisors who have frontier responsibility like controlling and mentoring on ground operations rather than in the office. Jobs in this category comprises:

- Shift leaders in warehouses
- team leaders in a traffic department

4.3.4 Logistics managers "white-collar"

Employees in this category have high degree of responsibilities for logistics and supply chain strategy and decision making. This category extends from junior through middle management roles to senior managers and board of directors:

- Managerial staff
- State and regional managers

The above mentioned positions are already fulfilled due to the focus of the education system in Germany on vocational trainings “Ausbildung” offered by private sector companies, Dual study programs offered by partnership of companies and universities of applied science “Fachochschule” and continuing education courses offered by Universities.

4.4 The current state of training

4.4.1 Vocational training by companies

4.4.1.1 The Rudolph Logistics Group

The Rudolph Logistics Group offers training for a total duration of one year as Warehouse specialist. Each week during the course, there are two visits in block sessions where the trainee gains theoretical background in storing and transporting goods during operation and shipping goods. Also the program consists of training rounds across different locations and departments to make sure that the trainee has insight into different processes of the logistics. The outcome of the training is to prepare the warehousemen to perform tasks of accepting storing goods properly specifically,

- controlling the incoming and outgoing goods
- loading and unloading the trucks with the help of a forklift truck
- packing goods for loading

More information about the training here on:
https://www.rudolphlog.com/karriere/stellenportal/?jid=567&jp=Ausbildung_Fachlageristzur_Fachlageristin_2019

4.4.1.2 The Hornbach Building Materials Union

The Hornbach Building Materials Union offers two-year training focus on loading and unloading trucks and driving skills, During the apprenticeship the trainee contributes in the following processes:

- Receiving goods
- Inventory control and maintenance
- order picking
- inspection and storage
- quality assurance
- loading and planning routes

More information about the training here on:
https://www.azubiyo.de/stellenanzeigen/fachlagerist-fachkraft-fuer-lagerlogistik-m-w_hornbach-baustoff-union_ed98b795/

4.4.1.3 PV automotive GmbH

PV automotive GmbH provides the trainee with a practical three-year training as a warehouse logistics specialist. The program is a combination between theoretical knowledge and practical elements in the logistics daily operations. The main outcomes of the training program are:

- accepting goods and checking their quantity and condition.
- organizing the unloading of the goods
- sorting and storing goods under optimal conditions
- maintaining quality standards during the storing process.
- sorting the orders for the delivery
- observation and optimization of the material flow from procurement to sales

More information about the training here on:
https://www.pvautomotive.de/karriere/#Ausbildung-Fachkraft-f%C3%BCr-Lagerlogistik--m-w-d-

4.4.2 Dual studies (University of Applied Science & Companies)

4.4.2.1 Deutsche Post DPDHL

DHL offers dual study program in 5 different cities around Germany. Graduates obtain bachelor degree of arts after studying courses in several areas like business, leadership, transport and logistics supervised by DHL and The Baden-Wuerttemberg Cooperative State University (DHBW). During the study, the student gains intensive insights into the areas of responsibilities

of the various departments of a branch and work there from the start, optimization of work processes or planning and coordination of the fleet management.

4.4.2.2 German Railways DB

A three-year dual study program which spitted in two main chapters, business administration bachelor degree carried out by DHBW and Training in transport and logistics at DB Cargo AG the theory and practice phases alternate every 3 months.

In your theory phases
Explaining business basics with focus on topics like international land transport, procurement and production logistics, rail, sea and air freight as well as dangerous goods.

In the practice phases
Completing assignments in the departments sales, order processing, product management, planning, insurance, controlling, loading management and human resources.

4.4.3 Continuing education (Educational Institutions)

4.4.3.1 Ostfalia University of applied Science

The institute offers Bachelor degree in transport and Logistics structured in eight semesters with the following courses outline.

1- Mathematics and Statistic	2- Foundations of Computer Science	3- Economics
4- Foundations of Business Administration	5- Accounting and Balancing	6- Cost accounting
7- Procurement, Production, Marketing	8- Transportation	9- Commercial Law
10- Financing, Investment and Taxation	11- Traffic Management	12- Transport technology
13- commodity science, packaging techniques	14- Soft Skills and Conflict Management	15- Risk Management and Controlling
16- External Logistics	17- Passenger traffic	18- Internal Logistics
19- Methods of logistics	20- Marketing Management	21- Corporate Management
22- Inventory Management	23- Transport Law and Project Management	24- Elective modules

In addition to two supervised practices during the 5th and the 8th semesters. More information about the training here on:

https://www.ostfalia.de/cms/de/k/.content/documents/curricula/Curriculum_LIP.pdf

4.4.3.2 IUBH University of applied science

The institute offers master degree in Logistics and transportation structured in three semesters in addition to one semester for the thesis with the following courses outline.

1- Advanced research methods
2- Applied statistics
3- Service operation management
4- International business ethics
5- Corporate governance
6- International economic policy
7- International organizational behaviour
8- Advanced HR management
9- Strategic aspects of the service industry
10- International marketing
11- leadership
12- Negotiation skills
13- Financial management
14- Transport business models
15- Infrastructure management
16- Transport policies
17- Sustainable transportation
18- Foreign language

More information about the training here on:
https://www.iubh.de/master/studienprogramme/international-management-logistics-and-transport/inhalte/

4.4.3.3 Technical University of Berlin

TU Berlin offers two teaching schemes "Logistic qualification modules" and "Logistics Management Workshops" through university courses, workshops and seminars. The purpose is to prepare the participants for current projects in the company and to jointly develop ideas and solutions and to keep the awareness to keep up with the trends in the logistics.
The Continuing education topics:

- Trends & Best Practices in Logistics
- Global Logistics
- Finance & SC Controlling
- production logistics
- Sustainable Logistics
- Supply Chain Collaboration
- IT in logistics
- Supply Management & Inbound Logistics
- Demand Management & Outbound Logistics
- Change Management & Implementation
- Strategy and customer management for logistics service providers

More information about the training here on:
https://www.logistik.tu-berlin.de/menue/weiterbildung/seminare_workshops/

4.5 The evolution of logistics employment

4.5.1 Skill shortage

A recent study published by the German Confederation of Logistics under the name of "Skill Shortage in the Logistics Sector" opened the eye on the concurrent lack of skills and young talent in the logistics as of IT 47% of IT activities, 46% of drivers, 41% in disposition and 38% warehouse staff are already in state of skills shortage. Definitely on the long run this shortage in the skills along with the technology adoption strategies set by the giant companies like (DHL, BASF, Mondelez, Cisco, Intel, Johnson & Johnson and BMW) leads to extremely negative effects on their company's success.

4.5.2 Evolving skills

The higher the degree of automation, the more reliance on data accuracy. Apparently, there a continuous increasing need for logistics professionals who can understand and manipulate complicated data with a strong operational grounding to assure the maximum utilization of these data. Logistic and supply chain management and operations are seeking kind of master key skills that can take the sector to the new level and help moving from the transition phase from centralized planning to decentralized planning and scheduling.

4.5.3 Recruiting for the future

Here are some existing examples of the new evolved career paths during the transition phase and the introduction of "Intra-logistics"

1- The role of demand planner has evolved to be "commercial trouble-shooter" who is expected to enjoy his familiarity with cloud-based planning systems, learning algorithms and transactions processing. In the future, the commercial trouble shooter is responsible for business creation by setting the priorities, business analysis, solving supply-demand balancing issues. Quality is defined by the commercial impact rather than forecasting the accuracy.

2- The call for the roles of "Logistics analysts" and "Solutions designers" is already increasing in the transition phase as they focus on extracting data to better identify optimization opportunities.

3- The role of production planner has evolved to be "customization master" who is constantly working in parallel with "Cobots" which can be reprogrammed in couple of minutes running simulations to digitally test a large number of work paths in few seconds. Basically the customization maser is a craftsman who enables the business to profitably manage inventory with infinite Stock Keeping Units (SKUs) resulting in pleasing the customer, and increasing profits.

4- Warehouse systems manager who is responsible for managing and handling the warehouse management systems (WMS) which would be mainly linked to robotics and automation equipment.

5- The role of Logistics manager has evolved to be "customer satisfaction director": Data analytics and automation in fulfilment centers will deepen the range of options available to build a load, plan a route, and confirm the customer's readiness to receive a shipment. Extended backward with late-stage custom packaging and forward with Omni-channel delivery options like self-driven cars and drones, logistics could become the most attractive occupation in supply chain management. Customer contact at the point of delivery may be your best chance to make a great impression and renew the business.

6- The role of Sustainability leader has evolved to "Reserved instance Czar" as "Sustainability in supply chain has been around for a while, but precision in operations, coupled with machine learning on optimal resource consumption, could create a career that has more financial impact even than sourcing. Resource utilization could define a career of the highest prestige by 2025."

4.6 Delivering the intra-logistics talents

While the current status of training and education is coping with the management skills needed for the future, there is a huge gap in the vocational training systems which mainly is responsible for preparing the operative logistics worker "blue-collar workers" whose jobs are potentially threatened to be replaced by the high level of automation. The case now is open and it is clearer than before as the introduction of Industry 4.0 and exponential rate of adopting technology in the logistics environment would definitely transform how low skilled workers need to operate. They are in need to be aware of how these technologies affect not only their positions but the whole work environment as well. For instance, there are dramatic changes in role of picking goods to be packaged together, Voice picking is taking over all paper lists and the shift to fully AR environment is already in its way [92]. Workers who use wearable AR to simply pick goods are in need to not only know how technology works but also to understand how such technologies are shaping the warehouse space for the future so they do not lose their perspective at some point. New set of skills are needed to maintain the back-end servers, programming applications and troubleshooting issues. Companies with long term strategies to adopt with technologies should modify their training programs to fill the technological gap within the new environment.

4.6.1 The culture of Intralogistics

Logistics and distribution companies are challenging for acquiring the skills set of the IT giants, to be able to do that, companies' management need to have their eyes open on above and beyond their usual talent pipeline. Already happening, in a panel discussion in may 2017 during the Transport Logistics show in Munich, Bernd Schwenger, *director of Amazon Logistics and general manager of Amazon Deutschland Transport*, said "70% of our team are operational researchers and mathematicians, while the remaining 30% have experience in logistics. In fact, I am the only employee in the company that holds an HGV license". [93]

Psb intralogistics[8] offers set of vocational trainings for three years in “application development”, “automation technology” and “applied computer science”. Managers in logistics companies need to act fast and follow the model of the intralogistics training systems to bring the vocation trainings up to date so workers would be able to understand what kind of technology they are dealing with.

4.6.2 An upgrade to Vocational Training 4.0

While the processes are on their way to be fully automated, vocational trainings and apprenticeships should be structured by different criteria that the learning should be held in independent places equipped by virtual learning techniques. There is still great opportunity to focus on the outlined learning to be borne in mind as technology equipped trainings are better to be organized during the early stage of designing the facility or DC consequently, the trainee becomes aware of the new environment and he can adapt easily while he has already developed skills able to meet the technological demand. As shown in this document, the current state of trainings in logistics are concluded in dual study and degree programs through collaboration between companies and educational institutes which is really effective on the management scale. However, the vocational training system must not leave it the educational institutions alone, while there are no uniform standards exist yet. The technical concept of the vocational training need to be developed to by collaborating with “intralogistics leaders” and hybrid entities in the context of introducing **Vocational Training 4.0**

8 Psb intralogistics plans and implements integrated systems for the storage and flow of materials within the company in both production and distribution

5 Conclusion

Overall, having a look through the history of industry and the evolution of the technology, including the dilemma and the opportunities in the context of the industry, the employee, the manufacturers and the governments while matching the today's skills gap and How Germany perceives and acts towards the global megatrends shows that German tech leaders should to learn from the past and start now utilizing workforce preparations and training techniques so the workforce understand what is expected from them, As the journey towards the fully automated warehouses is just started and It is the best time to create new opportunities who would lead the companies for tomorrow.

The future is agile and lean; companies are looking for candidates who have good understanding of Kaizen, lean and agile methodologies as this would be the norm in the environment. Furthermore, most of companies in the logistics sector are putting a greater emphasis on soft skills like different management techniques which makes it difficult to find the right candidate who is equipped by both technical and soft skills in the same time. Taking into consideration that supply chain is comparatively new as a business career choice. While the cement is still wet and digitalization is expanding to all business areas. It is time for the leader companies to imagine the job they need and here comes the role of courses offered by technical schools, apprenticeships and vocational trainings to shape the workforce to be compatible with the future needs.

> "It is supposed to be automatic, but actually you have to push this button."
>
> - John Brunner

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