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## Smart work: The transformation of the labour market due to the fourth industrial revolution (I4.0)

Birgit Eberhard<sup>1</sup>, Mickael Podio<sup>2</sup>, Azucena Pérez Alonso<sup>3</sup>, Evita Radovica<sup>4</sup>, Lidija Avotina<sup>5</sup>, Liga Peiseniece<sup>6</sup>, Maria Caamaño Sendon<sup>7</sup>, Alison Gonzales Lozano<sup>8</sup>, Joan Solé-Pla<sup>9</sup>

<sup>1</sup> FH Joanneum, Austria, Werk-VI-Straße 46. 8605, Kapfenberg, Austria

<sup>2</sup> FH Joanneum, Austria, Werk-VI-Straße 46. 8605, Kapfenberg, Austria

<sup>3</sup> FH Joanneum, Austria, Werk-VI-Straße 46. 8605, Kapfenberg, Austria

<sup>4</sup> BA School of Business and Finance, Kr. Valdemara 161, LV-1013, Riga, Latvia

<sup>5</sup> BA School of Business and Finance, Kr. Valdemara 161, LV-1013, Riga, Latvia

<sup>6</sup> BA School of Business and Finance, Kr. Valdemara 161, LV-1013, Riga, Latvia

<sup>7</sup> Universitat de Girona, Campus Montilivi -- C/ Universitat núm. 10, 17003 Girona, Spain

<sup>8</sup> Universitat de Girona, Campus Montilivi -- C/ Universitat núm. 10, 17003 Girona, Spain

<sup>9</sup> Universitat de Girona, Campus Montilivi -- C/ Universitat núm. 10, 17003 Girona, Spain

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### ABSTRACT

#### Purpose

This article explores how the fourth industrial revolution is transforming the labour market by demanding new professional skills and by digitalizing jobs done by the human resources of companies. A further aim is to postulate on new professions which will, in the future, be in high demand and the skills that will be required to fulfill those job non-robotized profiles.

#### Design/methodology/approach:

The proposed methodology is, firstly, an analysis of the impact of digitalization on the labor market in those economies experiencing the digital revolution. Secondly, an expert survey of university professors is conducted and curricula of universities are evaluated in order to analyze if higher education institutions are aware of future digital trends and what measures and teaching methods professors use to prepare their students to encounter these trends. .

#### Findings:

Based on the results, future jobs of highly demand will be described, as will the skill sets needed to fulfill those jobs. Furthermore, a call of action to the higher education sector will be made to encourage universities to prepare future graduates for a new labor market reality.

#### Research limitations/implications:

The results of the research are expected to serve as a reflection on how the digital revolution is transforming the labor market and how universities can support students in order to enhance their employability. Conversely, an analysis of jobs that are expected to be in demand in the near future – new occupations will appear and some will slowly disappear as they become automated – will encourage students to better prepare themselves for their professional careers and give them a clearer perspective about the labor market they will work in, upon completion of their education.

#### Originality/value:

The skills portfolio, introduced by the authors of the present article, shall support universities and professors with future adaptations..

#### Keywords:

Smart Work, Digitalization, Employment Market, Job Skills, Workforce Strategy, Industry 4.0..

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### 1. Introduction

Technological innovations in the fields of digitalization, nanotechnology, 3D printing, genetics and robotics, just to mention a few, are radically altering the labor market

landscape. The study “The future of employment: how susceptible are jobs to computerization?” has concluded that by the year 2033, 47% of the jobs in advanced economies are at “high risk” of being automated (Frey and Osborne, 2013). In 2014, 88% of the companies participating in a study conducted by Altimeter Group

+Corresponding Author: Liga Peiseniece

E: [liga.peiseniece@ba.lv](mailto:liga.peiseniece@ba.lv)

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(Digital Transformation Survey) claimed to be undertaking a digital transformation effort (Solis and Szymanski, 2014). Big data analysis, digitalization and robotization are enforcing the automation and substitution of human workforce in areas such as logistics, paralegal contract law, patent law tasks, accountancy, transport, manufacturing work, housekeeping, healthcare, as well as some highly skilled medical tasks; just to name a few (Pérez Alonso and Frutos Rodríguez, 2017). In contrast, tasks with a high demand in creativity (e.g. industrial design), social intelligence (e.g. negotiations), perception and manipulation (e.g. surgery) will low-risk of being automated. However, many jobs as we know them today will disappear or change dramatically.

Educational institutions must react to these trends and adapt their formation in order to provide their students with the adequate skills for future jobs. Upcoming job profiles and the required skills have also to be identified. Hence, the impact of technological innovations on the employment market has to be analyzed.

The present article explores the role of the fourth industrial revolution in transforming the labor market, leading to demand in new professional skills and the digitalizing of jobs done traditionally by the workforce. A further aim is to analyze professions that will be in the future in high demand, and which skills will be required to fulfill those roles that are not automated. Additionally, the article attempts to offer a thought-provoking impulse to reflect on how universities can prepare students for employment in companies, including for possible functions that do not exist yet, using technology that has not been yet been invented and to solve problems which, up to now, we did not face.

The proposed methodology is firstly an analysis of literature on the impact of digitalization on the labor market of a handful of selected industries experiencing the digital revolution. Secondly, a survey of university professors is conducted and curricula of universities is evaluated in order to analyze how the universities are facing the digital trends and how professors are reacting in order to prepare their students for these trends. Based on the results, a skill portfolio to fulfill the requirements of the labor market in 2020 was created. Furthermore, a call of action to the higher education sector was made, to encourage universities to prepare future graduates for the new labor market reality.

The article consists of three parts; the first part the literature review on mega trends and technological changes and their impact on work in different industries, the second part describes the methodology of the research, the analysis of interviews and the content of curricula of universities. The article ends with a discussion and conclusions.

## **1 Literature review**

### **2.1. Mega Trends and Technological Changes**

Megatrends are defined to be transformative and global forces that shape our future world with their impact on business operations, societies, economies, cultures and personal lives (Frost & Sullivan Consulting, 2015). According to McKinsey, our world today is undergoing a dramatic transition due to the influence of four

fundamental disruptive forces: urbanization, accelerating technological changes, challenges of an aging world and greater global connections.

The first trend is that the main economic activities have shifted to emerging markets like China and their economic centers. McKinsey forecasts that by 2025, more companies will set up subsidiaries in China than have headquarters in the US or Europe. The second force involves the increasing technological impact on using information and communication technology.

The third disruptive force highlights that the human population is getting older and the fertility rate especially in developed countries is decreasing. According to the European Commission, Germany's population, for instance, will decrease by one-fifth in 2060 and the number of inhabitants that at a working age will fall from 54 million in 2010, to 36 million in 2060. The fourth disruptive force indicates that the world is much more connected through trade and movements in capital, people and information due to the development of ICTs (Dobbs et al., 2015).

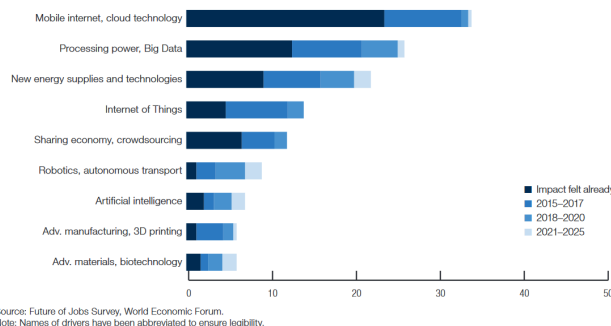
In general, social and demographical trends have a significant impact on the labor market. The nature of work will change as people demand more flexible work times. The middle class in emerging markets will increase, providing more and more well-educated young people (World Economic Forum, 2016). However, developed countries are facing an increasingly aging society (Dunne, 2016). In developed countries five generations on the labor market can be identified: Traditionalist (born mid 1920 - 1945), Baby Boomers (born 1946 - early 1960s), generation X (born early 1960s - early 1980s), generation Y (born early 1980s - mid 1990s) and generation Z (born mid 1990x - present) (Lulu, 2015). By 2020 however, 50% of the workforce will be generation Y (also referred as millennials) and generation Z that already grew up with new technologies (Morgan, 2014). According to surveys conducted by respected organizations, such as Cisco, Pew Research, Time, Bentley University and Deloitte, millennials are assumed to have different attitudes and expectations on their future work.

The majority believes that office attendance is unnecessary on a regular basis, only 20% think that they can trust their leaders and 40% say that they should be promoted at least every second year. Furthermore, 84% of millennials say that making a difference in the world is very important for them and 92% think that businesses should be measured by more than profits (Apfelthaler, 2016). Besides, millennials will more likely change their employers several times and engage in a lifelong learning in order to fulfill future job requirements. Most millennials are presumed to embrace an intrapreneurial style of work. Intrapreneurs prefer a workplace supporting creativity and autonomy. Additionally, intrapreneurs are usually highly self-motivated, proactive and action-oriented people who are comfortable with taking the initiative, even within the boundaries of an organization. Intrapreneurs are presumed to play a major role in the future success of companies` (Investopia, 2016). Hence, in the future there will be also an increasing war of talented people that supply entrepreneurial thinking as well as other skills that contribute highly to the success of future business

operations (McKinsey, 2011).

McKinsey has said that we are facing an accelerating technological impact on our social life using information and communication technology (Dobbs et al., 2015). Besides, Frost & Sullivan think that this impact results in a connected living containing a connected home, a connected work and a connected city. A world in which ICT services provide access and ubiquitous connectivity anytime and anywhere (Frost & Sullivan Consulting, 2015). Consequently, digital transformation effects almost every area of our lives. We are nearly permanently connected with new technologies through our smartphone, tablets, computers and other mobile devices.

On the one hand, these new technologies allow us to have access to a broad range of services like chats, online shopping, online banking, flight and holiday bookings and e-tickets that make our private shopping more comfortable. On the other hand, new technological opportunities and innovations provide new possibilities for companies to support their business operations in human-to-human, machine-to-machine and machine-to-human communication and interaction (Roth and Armin, 2016). The digitalization offers opportunities for new business operations, however it also brings along many challenges for current businesses to ensure their future competitive ability. Consequently, companies must adapt their strategic orientation to this trend and to prepare their processes and employees for upcoming technologies.



**Figure 1:** Technological impacts on the labor market  
Source: World Economic Forum, 2016

Among demographic and socio-economic trends, technological innovations transform industries and business models, change required skills and shorten the shelf-life of employees' existing skill sets. Figure 1 shows technological innovations which will be drivers for the transformation of the labor over the next decade. Mobile internet and cloud technologies already have a significant impact on the labor market. In 2015 Internet of Things, for example, had a minor impact in comparison to the other trends, however, it is assumed that soon the Internet of Things will greatly affect the labor market, especially in industrial countries (World Economic Forum, 2016).

Out of twelve trends that will shape our near future Frost & Sullivan, among others, highlight "Connectivity and "Convergence" that, will also have a significant impact on the European economy. The study especially claims that future markets, as well as factories, become

more connected due to the technological development and improvement in the internet-related communication speed. Following this trend several initiatives have been established in Germany as the fourth industrial revolution takes place, to create an approach on specifically how German companies can prepare themselves for a connected world. Therefore, we are convinced that also educational institutions have to react to this trend and prepare their students for the new industrial revolution (I4.0) in order to ensure Europeans' competitiveness on global markets (Frost & Sullivan Consulting, 2015).

After the invention of steam power units (first revolution), introduction of mass production using electrical energy (second revolution) and employment of electronics and information technology for automation (third revolution), today the world is facing the fourth industrial revolution - the digitalization of the world. The fourth industrial revolution involves the connectivity of all human and mechanical actors over the complete value chain as well as the digitalization and real-time analysis of all relevant information for this purpose. The idea is to create processes that are more efficient and transparent and to optimize the customer value by using intelligent products and services (Roth, Armin, 2016).

The term "Industrie 4.0 (I4.0)" was established in 2013 by the German government as an initiative to ensure Germany's future competitiveness as a production location for high-tech products. China as well as India has registered many patents in basic technologies for industry 4.0. The Chinese are aiming to become the global technological leader. Additionally, the US invests a huge amount of money in its re-industrialization project "advanced manufacturing". Consequently, the Forschungsunion stated in 2013 that production facilities in Europe especially in Germany can only be protected by developing intelligent production systems using cyber physical products (Kagermann et al., 2013).

The usage and analysis of large amounts of data, the employment of sensors, robots and new technologies like the 3D-printing offer new opportunities to increase the overall productivity of a production system. Therefore, new working approaches are required over three central components of production systems: techniques and methods (processes and resources), management (organizations and performance measurement) and human beings (skills, mindset and behavior) (Behrendt and Andreas, 2017).

Furthermore, industry 4.0 intends to improve the productivity and efficiency over the overall value chain. The intention of the initiative is to create more demographical and socially sensible work places. I4.0 is not projected to only reduce manual workplaces, but to create new jobs that are more flexible and less physically-exhausting. The tasks and competence profiles of employees that will work in so called "smart factories" will change strongly (Kagermann et al., 2013). During previous industrial revolutions, changes in the education methods have often taken decades in order to provide workers and students with new major skillsets.

However, the fourth industrial revolution involves disruptive changes and require a fast adaption. It is

expected that by 2020, on average a third of the currently desired core skills sets of most occupations will be comprised of skills not yet considered crucial to the job today (World Economic Forum, 2016). Therefore, adequate qualification strategies and learning working organizations are required to provide their employees with on the job trainings.

**2. Transformation of the Labour Market**

A study conducted in 2013 by Frey C. B and Osborne M. A. shows that 47% of the jobs then were in advanced economies were at high risk of being automated in the coming decades. New technological trends like big data analysis, digitalization and robotization are accountable for automating an increasing number of jobs, replacing human workforces in many areas. The computerization on labour markets will cause a decline of employment in routine and intensive tasks.

In the past, computerization has been just supporting routine tasks involving explicit rule-based activities, however new algorithms for big data are now rapidly entering domains reliant upon pattern recognition and will substitute human labour within a great range of non-routine tasks. Advanced robots, for instance, can perform a broader scope of tasks that leads to radical changes of jobs across industries and occupations. According to the Frey and Osborne study, most workers in the transportation and logistics sector, as well as office and administrative support worker and labour in production jobs are at risk (Frey and Osborne, 2013). Controversially, business and financial operations supported by computer and mathematical functions are predicted to rise (Dunne, 2016).

According to the World Economic Forum the highest level of skills stability over 2015-2020 is found in the media, entertainment and information sector, whereas a large amount of skills disruption is expected to happen in the banking sector, industry, infrastructure and mobility (World Economic Forum, 2016). Based on that, it is assumed that low-skill workers in these industries have to retrain and relocate to tasks that are non-susceptible to computerization. It is argued that with the declining prices in computing, problem-solving skills are becoming more important. This indicates that a future workforce must deal with more cognitive tasks (Frey and Osborne, 2013).

The World Economic Forum pointed out that 65% of children entering primary schools today will work in occupations that do not exist yet. Besides, due to connectivity and convergence, our future work places are predicted not to be only in real offices; interconnected workplaces involving virtual conferencing, complete and constant connection and portability will be established. A survey conducted by the World Economic Forum shows that new technologies enabling remote working, co-working space and teleconferencing are the main drivers of future work places (Dunne, 2016).

Besides, in 2013 Frey and Osborne investigated 702 detailed occupations and their probability to be substituted by computerization (Frey and Osborne, 2013). Based on this study and further findings, Table 1

highlights the main jobs that are of high risk of substitution, as well as future jobs that offer great opportunities in several industries.

**Table 1: Jobs at high risk vs. future jobs**

<b>Jobs at high risk</b>	<b>Future jobs</b>
<ul style="list-style-type: none"> <li>• Cargo and Freight Agents</li> <li>• Bookkeeping, Accounting, Auditing Clerks</li> <li>• Administrative occupations (e. g. Order and Procurement Clerks)</li> <li>• Office Clerks (e.g. Telephone Operators, Postal Service)</li> <li>• Paralegals and Legal Assistants</li> </ul>	<ul style="list-style-type: none"> <li>• Human Resource Managers</li> <li>• Marketing and International Sales Managers</li> <li>• Database Administrators</li> <li>• Computer and Information Systems Manager/Administrators</li> <li>• International Consultants</li> <li>• Training and Development Managers</li> <li>• Computer System Analysts</li> <li>• Industrial-Organizational Psychologists</li> <li>• Data Scientists/Analysts</li> <li>• Social Media Managers</li> <li>• Network and Computer Systems Administrators</li> </ul>

Source: Frey and Osborne, 2013

Due to the computerization and other trends, the employment market is facing drastic changes; jobs will become obsolete and new work places that require new skill sets will be established. Higher education is intended to prepare students to be able to work not just in one industry, but to give students a knowledge about the processes in different industries. Hence, in the following chapters the impact of digitalization on selected business sectors is described shortly.

According to a survey conducted by A. T. Kearney, advanced robots, for instance, will be able to perform a broader scope of manual tasks and jeopardize many professional groups. Within the next two decades 42% of all jobs in manufacturing in Germany are in danger. However, smart factories provide greater opportunities for production controllers and planners (Lakner et al., 2015). The study also shows that manufacturing businesses are engaging more into research and development collaborations with suppliers as well as competitors, to create new innovations (Lakner et al., 2015).

This will entail the establishment of international work offices, where people from many different countries and cultures are speaking different languages, having different working behaviours and interests work together.

Additionally, by using modern ICT and by developing the speed of the internet, manufacturing companies will be able to create real-time communication and connectivity with worldwide subsidiaries. All the mentioned facts result in totally new workforce requirements. Jobs at high risk and future jobs related to the industry sector are summarized in appendix A1. Equipment assemblers, all kind of production workers, as well as automotive repairers and car dealers are assumed to be at high risk of substitution, whereas there is a great need for production supervisors, controllers and planners, as well as all kind of engineers

in the future (Frey and Osborne, 2013).

### **2.2.1. Banking and Financing**

Accenture Consulting claims that the organizational philosophy in the banking and financing sector will shift from product-oriented to customer-oriented strategies.

Therefore, banks and other institutions will have to integrate and adopt new technologies in order to develop the ability to engage with customers anywhere and anytime. Even though the majority of banks still have many branches, the digitalization of the industry has already begun. Today the banking sector uses different digital and mobile technologies to diversify their distribution channels and to increase the customer's satisfaction (Accenture Consulting, 2017).

The future human work will possess a broad knowledge in technologies combined with the ability to sense and understand the customers (Ian, 2014). Moreover, another study from The Economist shows that financial institutions have to redefine their business models and strategies to keep up with the exponential pace of technological development in the banking industry (The Economist, 2016). Jobs at high risk and future jobs related to the banking and financing industry are summarized in appendix A1.

Loan officers, receptionists and information clerks, as well as personal financial advisors are assumed to be at high risk of substitution, whereas there is a great future need for user experience designers, behavioural psychologists and telematic specialists (Frey and Osborne, 2013).

### **2.2.2. Insurance**

Demographical trends indicate that people are now living much longer. Consequently, the amount of pensions being paid out is increasing as well. Therefore, the next generations will struggle to pay these pensions adequately. Besides, our population is facing a social trend that nowadays people are interacting much less face-to-face with each other and communication is mostly done via modern technologies.

These trends are also shaping the global insurance industry. Businesses have to integrate social media platforms like Facebook and other innovative technologies in their communication strategies, as most of Gen Y and Gen Z are present on these platforms. In addition, it is presumed that future jobs will require the ability to navigate in these virtual environments that social media platforms provide (PWC, 2017). Telematics specialists are believed to come on the market. It is believed that by 2020, 10% and by 2030, half of world's vehicles will be equipped with telematics policies (Ralph, 2016).

Moreover, a study from the Insurance Information Institute shows the trend of a "Sharing economy" becomes popular. There are several risks associated when people share things such as cars or rent a flat or a room to strangers. Things can break down, accidents can occur or something can get stolen. It can be difficult to define who can be held responsible for such causes. The need for insurances that are specifically designed to cover the damages of such unforeseen events will increase. Consequently, insurers will need workers that have good problem-solving skills to find profitable

insurance solutions for such events (Insurance Information Institute, 2016). Jobs at high risk and future jobs related to the insurance industry are summarized in the appendix. Personnel, for instance, insurance advisors are assumed to be at high risk of substitution, whereas there is a great need for risk analysts, reputation builders and cyber insurance providers (Frey and Osborne, 2013).

### **2.2.3. Commerce**

The fourth industrial revolution is not only influencing classic industrial sectors (e.g. the automobile industry), but also other industries that are a part of our daily lives.

The retail sector is today one of the most dynamic and changing sectors. New trends and technologies have already resulted in major changes in the business. For several years, the e-commerce and m-commerce (use of mobile devices) have become increasingly important in retail companies' business model. Additionally, other factors, such as big data, apps and intelligent products are influencing business (Hamburgisches WeltWirtschaftsinstitut gemeinnützige GmbH, 2015). Existing retail stores are modernized, upgraded with new information and communication systems and connected with the virtual world.

Additionally, in the last few years, we observe that retail companies establish multiple channels to communicate and interact with their customers. This trend, the integration of the physical and the virtual world is expected to continue. Retail companies' business models need to be adapted to these dynamic changes. Furthermore, this change and integration of new technologies and systems are also a challenge for the human work force of the affected companies. The work force must adapt their skill sets to new requirements directed by the commercial sector's use of new technologies and new business models (Hamburgisches WeltWirtschaftsinstitut gemeinnützige GmbH, 2015). Jobs at high risk and future jobs related to the commerce industry are summarized in appendix A1. Retail salespeople, telemarketers as well as library technicians are assumed to be at high risk of substitution, whereas there will be a great need for user experience specialists and virtual shopping advisors (Frey and Osborne, 2013).

### **2.2.4. Transport and Traffic**

Today the transport and traffic sector, including the logistic branch is already highly competitive. The intense competition can be explained by huge overcapacities and many different actors on the market. Due to new regulations, e.g. concerning emissions and the introduction of new, innovative technologies like 3D-printing, mobile devices and autonomous driving, amongst others, the branch will change significantly (Deutsche Post AG, 2012). Amazon, for example, is already a game changer in the market as it tries to cover the whole transport chain.

This new business model is sustained by investing in means of transport (e.g. ships, planes, drones) and in transport infrastructure (such as logistic centres and airports) (Spiegel Online, 2017). The changes in regulations, use of technologies and business models especially affect the employees in this branch. The field of operations will change as well. Thanks to increased

automation and digitalization, the tasks of the employees will change and therefore, the necessary skill set will also change (Dalziel, 2013). Jobs at high risk and future jobs related to transport and traffic industry are summarized in appendix A1. Packaging and filling machine operators, shipping, receiving and traffic clerks, bus drivers, train drivers and various other jobs are assumed to be at high risk of substitution, whereas there will be a great need for air traffic controllers and all kind of engineers that develop systems for autonomous driving (Frey and Osborne, 2013).

### **2.2.5. Information and Consulting**

Today the information and consulting business is becoming more and more important, new consultancies are founded and the specialization of companies is increasing. Particularly, the market for IT-consultancies is increasing (cf. the other industries described in this article). Digitalization is moving into traditional and new, innovative consultancy businesses. Due to this trend, the business models of the consultancy's customers are changing.

This means also that the information and consulting industry has to change to become more flexible and adaptable. The customers' views on services have also changed in the last number of years, and are still changing. Today it is not sufficient to have (nearly) standardized tools and/ or solutions. The consultancies must deliver more individualized results for smaller projects (Braun, 2015).

The "new" virtual world is having a great impact; it is becoming normal to work in globally spread (project) teams and to work together in a virtual world. In some industries, especially consultancy that is built on trust and personal contact with the client, this trend means a big change in thinking and attitudes (Cecere, 2016). Future jobs related to information and consulting industry are summarized in appendix A1. It is assumed that there will be a great need for software and system developers, commercial and industrial engineers, statisticians, survey researchers, management, business and financial analysts (Frey and Osborne, 2013).

### **2.2.6. Tourism, Hospitality and Healthcare**

Following the technological changes and demographic developments, a series of new skills in the tourism, hospital and healthcare industry will emerge, whereas some jobs are in danger of becoming obsolete within the next decades. Not only will new jobs be established, but in most cases the job profiles of current jobs in these industries will change drastically. New profiles related to the application of the latest ICT will be established.

This does not mean that certain professions will disappear, but many of them will be transformed. Administrative tasks, for instance, will be more and more automated. In exchange, consultancy, excellence in treatment, customer adaptation and other interpersonal tasks will be stressed. The change will have to take place at all positions and professions in tourism, hospitality and healthcare.

In general, specific characteristics like productivity, empathy, efficiency, languages, teamwork, adaptation to continuous change, orientation to results, and

technology as a basis of day to day tasks and services are going to gain importance in these business sectors (Canalis, 2012). Jobs at high risk and expected future jobs in tourism, hospitality and health industry are summarized in appendix A1. Telephone operators, travel agents, receptionists are assumed to be at high risk to be substituted, whereas there is a great need for recreational therapists, mental health and healthcare workers, social workers, psychologists and many other jobs in the future (Frey and Osborne, 2013).

### **2.2.7. Entrepreneurship and Green Jobs**

Digitalization offers great opportunities for entrepreneurs. Since new technologies offer great opportunities for innovations and ideas, new jobs in entrepreneurship are assumed to be established. There will be a call for green entrepreneurs that deal with environmental issues and work to keep our planet healthy and sustainable.

Furthermore, within the last number of years, a new business model called "social entrepreneurship" emerged globally, which involves businesses with governmental and social organizations. Social entrepreneurs are especially focused on environmental and social issues (Gore, 2017). Besides, the demand for jobs dealing with topics like innovation to zero, green innovation and economy will increase. Innovation to zero is a mega vision driven by companies and governments that should enable zero carbon emissions and carbon-neutral cities (Frost and Sullivan, 2012). In order to reach such a mega vision, the demand for jobs like environmental scientists and consultants, agricultural engineers, climatologists, bioinformatics and archaeologists, just to name a few, will increase steadily (Profita, (2016).

## **2.2. Skill Portfolio for University Trainings**

Institutions in higher education must adapt their curricula and their teaching methods to react particularly to the demographic, social and technological changes presented in the previous chapters. Some jobs will become obsolete, additionally; present jobs as well as new jobs will require new skills sets. Consequently, this chapter examines how universities are supposed to react to these changes and what future skill portfolios university trainings should cover.

### **2.2.1. Education**

Education is vital for businesses because it concerns concrete goals, such as to maintain economic growth. Today, for many universities it is a huge challenge to not only offer a qualitatively high level of education, but even enhance it steadily, as in the past decade the developments are becoming more dynamic and numerous.

To emerge, the higher educational institutions will have interactive learning which means textbooks will be supported using databases and other online tools. The integration of new technologies and pedagogies needs to be placed at the heart of institutions' teaching and learning strategies, and they should become an integral component of everyday institutional business. Institutional leaders need to consistently communicate the expectation that all staff - while recognising the scope for doing so will differ across disciplines - must

become more active, skilled and experienced in using new, innovative pedagogical tools and provide the support they need to meet that expectation.

Institutional strategies should set out a coherent framework for the development of new modes of delivery as part of an institution’s offering, the embedding of innovative technologies and pedagogies in curricula, and the provision of appropriate training for academic staff and students (European Commission, 2014).

Economic growth is strongly affected by the skills of workers. To ensure that the future labour force will be knowledgeable it is essential that universities consider the emerging trends presented in the previous chapters when they update their teaching methods and contents (Daggett, Bill (2014).

Education is a key priority under the European strategy “Horizon 2020” formed in 2010 that comprises a budget of 3% of EUs GDP (FFG, 2017). All EU member states must ensure the quantity and quality of foreign language as a vital instrument for the future labour markets as the command of different languages can ensure competitiveness. Besides, students have to be trained in the usage of different information and communications technologies.

Therefore, programs are created that should support universities and students to gain the skills that the dynamic labour markets of the future requires (Eurostat, 2016). Programs like Erasmus plus, EuroSkills, INTERREG EUROPE, SaveComp, GLOBE Cosme and FFG in Austria are financed within the Horizon 2020 strategy.

**2.2.2. Skill Portfolios**

Niclas Schaper stated in his study on the German educational system, that the aim of higher education is to provide students with an “able to act professional education”. All learning processes should be targeted to typical phases of actions like informing, planning, decision making, controlling, evaluating and reflecting. The Bologna-process itself defined four different types of competences that students should gain during their education (Schaper et al.,N., 2012):

- **Professional competence:** includes specific skills and abilities that are required to do a certain job (understanding procedures, application of knowledge, analytical skills)
- **Methodological competence:** comprises cognitive and metacognitive skills (problem solving, decision making or self-organized learning) that are necessary to solve complex problems
- **Social competence:** involves knowledge and abilities to realize aims and plans in social interactions, featured by communicative and cooperative behaviours towards other people
- **Personal and Self-competence:** includes personal disposals like attitude, values and motives that influence the working behaviour as well as skills for self-perception (reflection of own skills) and self-organization (time management)

**Table 2:** Competence portfolios based on the four basic competences

Group of	Competence	Group of	Competence
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Competences	s	Competences	s
<b>Professional Competences</b>	<ul style="list-style-type: none"> <li>• Language Skills</li> <li>• ICT Literacy</li> <li>• New technologies (e. g. electronics, IT)</li> <li>• Governance, Risk Management, Compliance</li> <li>• Entrepreneurial skills</li> <li>• Analytical skills (e.g. statistics)</li> </ul>	<b>Methodological Competences</b>	<ul style="list-style-type: none"> <li>• Complex problem solving</li> <li>• Cognitive skills</li> <li>• Savvy in technologies</li> <li>• Creativity</li> <li>• Interdisciplinary skills</li> <li>• Critical thinking</li> <li>• Change management and adaption skills</li> </ul>
<b>Personal and Self-Competences</b>	<ul style="list-style-type: none"> <li>• Time management</li> <li>• Knowledge in psychology and body language</li> <li>• Dealing with persistent and pressure</li> <li>• Emotional Intelligence</li> <li>• Judgment and decision making</li> <li>• Intrapreneurial skills.</li> </ul>	<b>Social Competences</b>	<ul style="list-style-type: none"> <li>• Interpersonal skills (empathy)</li> <li>• Communication skills</li> <li>• Intercultural skills</li> <li>• Virtual collaboration</li> <li>• Coordinating with others</li> <li>• Open-mindedness</li> <li>• Negotiation Skills</li> <li>• People management skills</li> <li>• Ethics and social responsibility</li> <li>• Service orientation</li> </ul>

Source: Schaper et al.,N., 2012

In general, training at educational institutions should ensure students acquire these four competences which are valid for every type of study. Consequently, the competence portfolio that is presented in Table 2 is based on these competence areas that comprise all the analyzed skills demanded by future labour markets shaped by an increasing digitalization.

Additionally, the World Economic Forum created a broader skills portfolio called “core work-related skills” that is based on the O\*NET Content model and shown in appendix A1. In general, the model that was created by the World Economic Forum differentiates between abilities, basic skills and cross-functional skills (World Economic Forum, 2016). Based on the skills mentioned in the competence portfolio developed by Sharper and



the core-work related skills from the World Economic Forum, the authors have created a new skill portfolio that comprises the other theoretical findings of required skills and the defined skills from the World Economic Forum.

The new skill portfolio is shown in figure 2 and focusses on the skills that graduates from each type of study should have in the year 2020 in order to supply the demands of the labour market in 2020. The presented skill portfolio also serves for the curricula comparison in the following chapter.

Abilities are defined as enduring attributes of the individuals that influence performance. Cognitive skills comprise cognitive flexibility, creativity, logical reasoning, complex problem solving, mathematical reasoning, visualization, and troubleshooting as well as analytical skills like statistics (World Economic Forum, 2016). Personal and mental abilities are a new skillset

that was added by the authors. A basic knowledge in psychology, the control of body language, resilience and entrepreneurial skills are defined by the authors to be essential skills that university students should acquire during their education.

Besides, basic skills are developed capacities that facilitate learning or the more rapid acquisition of knowledge: content skills like active learning, oral expressions, reading comprehension, written expression as well as ICT literacy. ICT literacy means that students should be trained to use and apply different information and communications technologies. ICT literacy is also a main goal under the EU Horizon 2020 (Eurostat, 2016). Process skills including active listening, critical thinking, self monitoring, as well as interdisciplinary skills are very important basic skills students have to learn (World Economic Forum, 2016).

Abilities	Basic skills	Cross-functional Skills	
<b>Cognitive skills</b> Cognitive flexibility Creativity Logical reasoning Complex problem solving Mathematical reasoning Visualization Troubleshooting Analytical Skills (statistics,...)	<b>Content skills</b> Active learning Oral expression Reading comprehension Written expression ICT literacy  <b>Process Skills</b> Active listening Critical thinking Monitoring self and others <b>Interdisciplinary skills</b>	<b>Social/Interpersonal skills</b> Coordinating with others Emotional Intelligence Negotiation Persuasion Service orientation Training and teaching others Ethics and social responsibility Virtual collaboration Communication skills  <b>System skills</b> Judgement and decision making System analysis Change management and adaption Governance, risk management Compliance Entrepreneurial skills	<b>Resource management skills</b> Managem. of financial resources Managem. of material resources People management Time management  <b>Technical skills</b> Equipment maintenance and repair Equipment operation and control Programming Quality control Techn. and user experience design New technologies (ICT, etc.)  <b>Intercultural skills*</b> Language skills Open mind-set
<b>Personal/mental abilities*</b> Knowledge in psychology Body language Resilience Intrapreneurial skills			
Legend Added skills *added skill sets			

Figure 2: Skill portfolio for university trainings, Source: World Economic Forum, 2016

The cross-functional skills are defined as entry requirements for developed capacities that facilitate performance of activities that occur across jobs. That is why social skills like coordinating with others, emotional intelligence, negotiation and persuasion skills, service orientation, training and teaching others belong to cross-functional skills. Social skills were also expanded by the authors by adding ethics and social responsibility, virtual collaboration as well as communication skills. System skills like judgement and decision making, system analysis as well as change management and adaption, governance, risk management, compliance and entrepreneurial skills are defined by the authors to be important cross-functional skills.

In addition, the management of financial and material resources and time management are summarized under the term resource management skills. Basic technical skills are further important cross-functional skills involving equipment maintenance and repair, equipment operation and control, programming, quality control,

technical user experience design as well as the knowledge of new technologies (Grey, 2016).

Following the trend of connectivity and convergence, global business interactions increase. Therefore, students at universities are advised to learn basic intercultural competences like an open-mindset as well as foreign languages. For example, the EU provides various programs like Erasmus+ to support European students to develop intercultural skills (European Commission, 2015).

Besides, listing a broad range of skills that graduates of universities should have in 2020, the World Economic Forum defined (based on surveys with chief human resources and strategy officer from leading global employers) the top ten skills in 2020 and how the importance ranking of these skills changed compared to the year 2015 (the information in the bracket is based on the comparison of the skills ranking between 2015 and 2020):

1. Complex problem solving (#1 no change)

2. Critical thinking (#4+)
3. Creativity (#10+)
4. Leadership skills (#3-)
5. Coordinating with others (#2-)
6. Emotional intelligence (new)
7. Judgment and decision making (#8+)
8. Service orientation (#7-)
9. Negotiation (#5-)
10. Cognitive flexibility (new). (World Economic Forum, 2016)

Creativity is assumed to become one of the top three skills. Future workers have to be more creative in order to develop new products, services, technologies and new ways of working. Complex problem solving is seen as the most important skill enabling future workers to deal with complex issues that future megatrends will bring up. Critical thinking, as well as judgment and decision making are seen to be much more important skills in 2020 than in 2015. Besides, emotional intelligence as well as cognitive flexibility is evaluated to be under the top ten skills in 2020, even though these skills were not seen to be that important in the past (Grey, 2016).

It is recommended that universities adapt their trainings to integrate all the skills mentioned in the skills portfolio. Furthermore, they should focus their trainings on the top-ten skills to prepare students with the best education for the job market in the future.

### 3. Methodology and analysis of results

#### 3.1. Explorative qualitative interviews

Based on theoretical findings, an expert survey was conducted in Austria, Latvia and Spain, with the intention to analyze how university professors train their students for future workplaces. Furthermore, the aim was to find out if the university professors are aware of the skill sets that students have to acquire in order to fulfil the requirements of the future job markets. Therefore, a semi structured interview guide was created. Each student group conducted four to five expert interviews with professors of their university in Austria, Latvia and Spain.

Besides the evaluation of the content of university curricula in the next chapter, the project team decided to conduct an expert interview of professors of their university. Professors are involved in the creation of the university curricula, and can give a deeper insight into the content and teaching methods of the courses. The semi structured interview guide was designed specifically for this project and is presented in the appendix A2. Since only 14 expert interviews are conducted from four different universities the survey cannot claim representatively and only gives an insight in the opinion of questioned professors. In order to get representative results, further investigations have to be done with a much higher sampling size.

**Table 3:** Survey design

Characteristics of Survey	Description
Interviewee Selection Criteria:	<ul style="list-style-type: none"> <li>• University professors from Austria (FH Joanneum), Latvia (Ba School of Business and</li> </ul>

	Finance) and Spain (University of Girona and Zaragoza) <ul style="list-style-type: none"> <li>• Professors of business related studies (e.g. Economics, Business Administration, Marketing, Psychology, QM, Entrepreneurship)</li> </ul>
<b>Questioning Techniques:</b>	Open, single and multiple choice questions
<b>Interview Duration:</b>	20 minutes

#### 3.2. Analysis of interviews

The results of the survey are structured into general information about the university, teaching methods, adaption of teaching methods, new skills/jobs in 2020 and personal trainings.

##### 3.1.1. General information about the university

Most universities adapt the curricula of the study programs every five to six years, whereas two Spanish professors stated that their universities change the curricula only every 15 years. New trends, student feedback, companies' feedback, new technologies, new laws and adaption to the European system (Bologna process) are named to be the main reasons for the adaption of the curricula. According to most professors, companies, head of departments and professors are highly involved in the adaption process, whereas students, student councils, the rector of the university as well as the head of department play a minor role in this process.

Benchmarking with other universities, EU/state requests, recommendation of the accreditation committee, interviews/feedback with companies, recommendation of own researches and professors as well as interviews with students are the main information sources for the adaption process. Besides, each university offers their students the possibility to conduct projects with companies. In three out of the four universities, it is obligatory to do an internship within the undergraduate programs and they also provide services like job portals, career centres, seminars to support the students to find an internship.

##### 3.1.2. Teaching methods

Case studies, group works and projects, basic lectures, guest lectures from companies, assignments, excursions and students' presentations are the main teaching methods the questioned professors use in their courses. Computers, videos, audios, podcasts, virtual platforms and computers are the main technologies professors use in their classes.

However, only some have also mentioned the use of virtual games and business simulations to train their students' analytical skills. Each professor uses books as supporting materials and the most part of the professors also use articles and papers. Some use flip charts, games, white boards and real product examples for their trainings. Eight out of fourteen professors assign more subject specific tasks to their students, three said that interdisciplinary tasks are more important and another three professors use subject specific as well as

interdisciplinary tasks in their classes. Furthermore, the most part of the questioned professors hold classes in English.

**3.1.3. Adaption of the teaching methods**

Ten out of fourteen professors update their teaching methods and content every year and the others between two to three years. Conferences and seminars, workshops, online publications, books, papers, companies' projects, other universities, other professors, professional journals, social media, own innovation institute (ICE) as well as webinars, are the main sources where professors look for new contents and methods for their trainings. Professors adjust their teaching methods and contents based on the outcome of these sources like new trends, new technologies, latest researches and publications as well as own experiences, feedback of the professors, students and companies.

**3.1.4. New skills/jobs in 2020**

Most professors stated that jobs where social, technical and ICT skills are greatly needed will be highly-demanded in 2020. Some mentioned that those jobs will have a greater international focus and will deal with

more interdisciplinary topics than they do today. Specific jobs like data scientists, financial and business analysts, all kind of engineers, psychologists are mentioned.

Whereas, jobs that do not require specific trainings, jobs that can be substituted by computers and robots, too specific jobs, routine jobs, basic manual assembling jobs in manufacturing and administrative jobs like bookkeeping are stated to be at high risk of substitution in 2020. By asking the professor an open question about the most important skills that their graduates should acquire by 2020, a ranking of top ten skills could be made that is shown in table 4. Analytical skills were mentioned by the professor to be the most important skill that should be acquired during training at the University, followed by cognitive skills, social skills, emotional intelligence, technical skills, creativity, ICT literacy, intercultural skills, critical thinking and interdisciplinary skills. Some professors said that there will be no change in the required skills from today to 2020. Others however said that self-evaluation and -development, flexibility and adaptation, critical thinking, creativity, and especially analytical skills will become more important in 2020 than they are today.

**Table 4:** Top ten skills ranking in 2020 (open questions)

Ranking	Skill	Ranking	Skills	Others skills	
1	Analytical skills	6	Creativity	Self-evaluation	Active learning
2	Cognitive skills	7	ICT literacy	Business ethics	IT collaboration
3	Social skills	8	Intercultural skills	Flexibility, adaptation	Proficiency in English
4	Emotional intelligence	9	Critical thinking	Language skills	Communication skills
5	Technical skills	10	Interdisciplinary skills	Negotiation skills	Market knowledge

Professors were asked to rank a broader range of skills based on the skill portfolio presented in chapter 4 according to their importance. Thereby social skills are evaluated by the professors to be the most important

skill, followed by cognitive skills, personal/mental abilities, process skills, system skills, technical skills, content skills, intercultural skills and resource management skills. The ranking is shown in table 5.

**Table 5:** Skills ranking based on the skill portfolio

Ranking	Skills	Ranking	Skills
1	<b>Social skills</b> (e. g. negotiations, emotional intelligence)	6	<b>Technical skills</b> (e. g. new technologies, programming)
2	<b>Cognitive skills</b> (e. g. creativity, analytical skills)	6	<b>Content skills</b> (e. g. ICT literacy, active learning)
3	<b>Personal/Mental abilities</b> (e. g. dealing with pressure and persistence)	8	<b>Intercultural skills</b>
4	<b>Process skills</b> (e. g. critical thinking)	9	<b>Resource management skills</b> (e. g. time management)
5	<b>System skills</b> (e. g. decision making, entrepreneurial skills)		

Active and self-directed learning methods, case studies, assignments, student's self-reflections, discussion about current issues, teaching psychologic aspects and problems, application of specific analytical software and topics, group works, English classes, students'

presentations are methods used by the interviewed professors to support their students to acquire the demanded skill portfolio by 2020.

**3.1.5. Personal trainings**

Professors attend educational seminars, conferences,

webinars, read books, articles, papers, maintain a broad social network to other professors, use social media platforms like LinkedIn and conduct own researches to educate themselves to provide the students with the latest knowledge. Most professors attend trainings and seminars at least twice a year and mostly to topics like

ICT, leadership, change management, language trainings, new teaching methods and skills evaluation. Half of the professor also gives talks at other universities about interdisciplinary skills, leadership, emotional intelligence, international human resource management, marketing and market research and entrepreneurship.

**3.2. Curricula Content Evaluation**

Using the skill portfolio deduced from the theoretical findings, ten university curricula from bachelor studies were evaluated to analyze if the universities offer trainings that help students to acquire the necessary skillset. The aim was to analyze gaps between the trainings provided and the skill portfolio demanded by the companies. Every year The QS World University Rankings ranks the best university worldwide involving over 900 universities in 80 states. The rankings are intended to help prospective students to make informed comparison of leading universities around the world based on rankings compiled using four sources (academic reputation, employer reputation, research citations per paper, H-index). According to the ranking, the top five universities in Europe are University of Cambridge, University of Oxford, UCL (University College London), ETH Zurich (Swiss Federal Institute of Technology) and the Imperial College of London (QS World University Rankings 2016/17). Consequently, the curricula from the University of Cambridge serves as a benchmark for the evaluation.

Furthermore, three curricula from bachelor degree programs were taken from Austrian universities, three from Latvian and three from Spanish universities. Austrian and Spanish degree programs last three years and Latvia and the Cambridge ones four years. However, the different length was not considered in the comparison. Additionally, no focus was laid on a special subject of studies, mainly business and technical related study programs were evaluated. The evaluation of the university curricula was based on information on the website, university brochures and the questioning of students that have attended the specific study program. Each student group could evaluate the content of the curricula based on the extent the required skills defined in the skills portfolio have transferred - *Social Skills, Technical Skills, Personal/Mental abilities, Cognitive Skills, Content Skills, Process Skills, System Skills, Resource Management Skills, and Intercultural Skills.*

Therefore, grades from 1 (very poor) to 5 (very good) could be assigned. Based on the evaluation, an average rating was analysed on how all university curricula transfer the required skills to the students. Firstly, the curricula of study “Business management” in the University of Cambridge was analysed to determine the transfer level of the required skills to the students. Subsequently, each university curricula was analysed, based on the information on the website, university brochures and the questioning of students and compared

with the curricula of the study program “Business management” in the University of Cambridge, thereby obtaining the transfer level of the required skills. The average fulfilment for each skill was calculated after the evaluation of nine programs.

**3.2.1. Analysis of the content of the curricula**

Based on the analysis of the content of the curricula, a ranking of the transfer of required skills was created and is shown in table 6. Content skills with an average grade of 4,6 is assumed to be the best transferred skills within the analyzed curricula, followed by process skills (4,3), social skills (4,2), intercultural skills (4,1), cognitive skills (4), system skills (3,8), resource management skills (3,8) and personal and mental abilities (3,6). Technical skills however, are evaluated to be not very well transferred within the content of the curricula with an average grade of 3,3. The content of three university curricula (one from Austria and two from Latvia) were evaluated to only poorly transfer technical skills to students.

**Table 6:** Results of curricula content evaluation

Ranking	Skills	Average fulfilment	Ranking	Skills	Ranking
1	Content skills	4,6	6	System skills	3,8
2	Process skills	4,3	6	Resource management skills	3,8
3	Social skills	4,2	8	Personal/Mental abilities	3,6
4	Intercultural skills	4,1	9	Technical skills	3,3
5	Cognitive skills				

**4. Discussion and Conclusions**

Taking all the above-mentioned information into consideration it can be stated that the increasing connectivity and convergence shaped by the fourth industrial revolution as well as other mega trends (social, environmental, etc.) have a great impact on the future labour market. The application of new ICT will change the labour market immensely by digitalizing jobs and demanding new professional skills. New ICT, as well as big data analysis and robotization will be accountable for jobs being done automatically and human workforces being substituted in many business sectors.

Basic administrative jobs like bookkeeping, accounting and office clerks as well as a wide range of manual tasks like equipment assemblers and repairs are at high risk of substitution in a couple of years. Additionally, due to the implementation of modern ICT, new jobs in different industries will appear, which will

need completely new skillsets. For instance, new jobs like data scientist and analysts, training and development managers will be highly demanded in the future. On the other hand, jobs like financial and business analysts, behavioural psychologist in the banking industry, cyber insurance providers and engineers developing autonomous driving are assessed to become even more crucial. Above that, a broad new range of consultants like software developers, survey researchers and all kind of engineers will be needed to consult companies with issues that they will have to face when implementing and using new ICTs.

New jobs will appear that require new skills. However, the skill sets of present jobs will change as well. Especially higher educational institutions should react to the transformation of the labour market and update their trainings on a regular basis. Beyond that, it is not just recommended that universities change their trainings based on upcoming trends, but they even have to shape those trends. That means that universities should not just follow the trend of connectivity and convergence by teaching their students how to use modern ICT. They should also think critically about the use of ICT and analyze diverse ways that processes can be increased or even automated.

Furthermore, universities should not only focus on transferring some basic skills to their students. Rather it

is recommended that the study content of each type of study should sufficiently fulfil the presented skill portfolio in order to increase the employability of the graduates of a university.

The authors defined nine basic skill sets (presented in table 7) that together define the skill portfolio which students should acquire during their education at a university to fulfil the requirements of the future labour market shaped by the implementation of modern ICT. Social skills like negotiation, communication skills and emotional intelligence are rated by the professor to be the most important skill set in 2020. With an average grade of 4,2, social skills are already integrated in the training of universities, however a special focus on the transfer of this skill set should be laid. Cognitive skills like creativity, analytic skills and personal and mental abilities are evaluated to be the second and third most important skill sets.

Furthermore, personal and mental abilities are insufficiently covered in current curricula, consequently a call to action can be made to universities to integrate trainings that better transfer this skillset to their students. Technical skills, such as the use of new technologies and programming are evaluated to be the sixth most important skillset. However, the evaluated curricula only transfer technical skills with an average grade of 3,3. Thus, universities have to update their trainings in order to better transfer those skills.

**Table 7:** Skill portfolio ranking

Ranking	Skills	Average
1	<b>Social skills</b> (e.g. negotiations, emotional intelligence)	<b>4,2</b>
2	<b>Cognitive skills</b> (e.g., creativity, analytics)	<b>4</b>
3	<b>Personal/Mental abilities</b> (e.g. dealing with pressure and persistence)	<b>3,6</b>
4	<b>Process skills</b> (e.g. critical thinking)	<b>4,3</b>
5	<b>System skills</b> (e.g. decision making, entrepreneurial skills)	<b>3,8</b>
6	<b>Technical skills</b> (e.g. new technologies, programming)	<b>3,3</b>
6	<b>Content skills</b> (e.g. ICT literacy, active learning)	<b>4,6</b>
8	<b>Intercultural skills</b>	<b>4,1</b>
9	<b>Resource management skills</b> (e.g. time management)	<b>3,8</b>

In general, universities are recommended to update their curricula at least every five years to react to the dynamic requirements of the labour market. In addition, it is recommended that professors regularly review their teaching contents and methods. Thereby, they are able to identify potential for improvement. This article encourages the professors to include new trends and new technologies.

Moreover, the conducted interviews with several professors showed that the usage of multiple sources (e.g. latest research, seminars, conferences, university benchmarks) increased the quality of this change process. Universities need to encourage professors to participate regularly in educational training, conferences, webinars and research projects. Adapting the curricula and training contents, respectively, methods, increase the existing educational quality. Apart from that, regular changes in the education system ensure the competitive advantages of the students in the labour market.

Consequently, on the one hand the universities

increase their influence on the economy and the labour market, and on the other hand, the competitive advantages of the national economies can also be ensured (through highly qualified, young academics). Nevertheless, it is essential to remember that, especially, a change in the professor's training methods is resource-intensive and difficult to achieve as there are many influences to consider (e.g. personality of lecturer and students, course subject, number of students, group dynamic). This complexity could be simplified by creating and implementing a modular toolset of different training contents and methods. However, further research is necessary to define such modular toolsets. The presented article demonstrates that the education

system and the economy are facing the same challenges and megatrends. Universities are constantly monitoring these trends in order to properly react and adapt their curricula. The conducted interviews and analysis of the curricula highlights that most universities already deal with those trends. Nonetheless, it is necessary to enforce this change and adaption process. The article encourages

the university to not only react to current trends, but to also go ahead and establish them.

The skills portfolio, introduced by the authors of the present article supports universities and professors with future adaptations. Different methods and tools are necessary to transmit the different skills to the students. Interactive courses, for example, support students in expanding their social skills by working with colleagues in a team as well as train students in cognitive skills, like finding creative solutions for different, and interdisciplinary cases.

Case studies also support the acquisition of active learning skills and system skills like decision making and entrepreneurial skills. Interdisciplinary tasks provide the possibility to train analytical skills and process skills like critical thinking. By giving presentations, the students can train their personal and mental abilities together with their social skills like emotional intelligence when receiving feedback from their colleagues. Technical skills can be trained by the integration of new technologies on tablets, computers, as well as the use of new specific software for a certain subject.

Furthermore, it is not enough to know about new technologies, but it is essential to use them correctly and meaningfully. Consequently, is important to train

content skills like the use of modern ICT. Companies' projects do not just support the acquirement of professional experiences; they also train resource management skills such as time management and social skills. Additionally, classes in foreign languages, as well as, an exchange semester abroad support the acquirement of intercultural, social skills and personal and mental abilities.

All in all, the aims of the article could be achieved by giving insight in future jobs and by creating a skill portfolio that should be integrated in each type of study at higher educational institutions. In addition, a call to action is made by recommending teaching methods and other measures that universities can use to update their curricula accordingly to the demands of the future labour markets. Even though, the article cannot claim representativity, it can serve as a basis for further investigation and shall provoke discussions within the educational institutions.

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Appendix I

Table A1 –Future Jobs

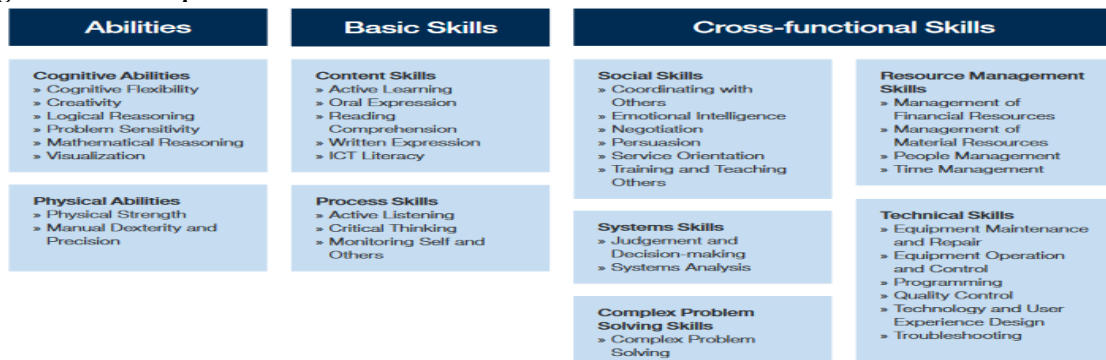
	Jobs at high risk	Future jobs	
<b>General</b>	<ul style="list-style-type: none"> <li>• Cargo and Freight Agents</li> <li>• Bookkeeping, Accounting, Auditing Clerks</li> <li>• Administrative occupations (Order and Procurement clerks, ...)</li> <li>• Office Clerks (Telephone operators, postal service, ...)</li> <li>• Paralegals and Legal Assistants</li> </ul>	<ul style="list-style-type: none"> <li>• Human Resource Managers</li> <li>• Marketing and International Sales Managers</li> <li>• Database Administrators</li> <li>• Computer and Information Systems Manager/Administrators</li> <li>• International Consultants</li> <li>• Training and Development Managers</li> <li>• Computer System Analysts</li> <li>• Industrial-Organizational Psychologists</li> <li>• Data scientist/analyst</li> <li>• Social Media Managers</li> <li>• Network and Computer Systems Administrators</li> </ul>	
<b>Business Sector specific</b>	<b>Industrial sector</b>	<ul style="list-style-type: none"> <li>• Equipment Assemblers</li> <li>• Operating Engineers and other construction equipment operators</li> <li>• All kind of production workers</li> <li>• Automotive Body and Related Repairers / Car dealerships</li> </ul>	<ul style="list-style-type: none"> <li>• Production Supervisors, Controller, Planners</li> <li>• Mechanical/Industrial Engineers</li> <li>• Material Scientist/Engineers</li> <li>• Electronical and Electrical Engineers</li> </ul>
	<b>Banking and finance</b>	<ul style="list-style-type: none"> <li>• Loan Officers</li> <li>• Receptionists and Information clerks</li> <li>• Personal Financial Advisors</li> </ul>	<ul style="list-style-type: none"> <li>• User experience designer</li> <li>• Behavioral psychologist</li> <li>• Algorithmic risk specialist</li> <li>• Community builder</li> <li>• Telematic specialists</li> </ul>
	<b>Insurance</b>	<ul style="list-style-type: none"> <li>• Personal Insurance Advisors</li> </ul>	<ul style="list-style-type: none"> <li>• Risk Analysts (for investments )</li> <li>• Reputation builders/ Image improvers</li> <li>• Cyber insurance provider</li> </ul>
	<b>Commerce</b>	<ul style="list-style-type: none"> <li>• Retail Salespeople</li> <li>• Telemarketers</li> <li>• Library Technicians</li> </ul>	<ul style="list-style-type: none"> <li>• User experience specialists</li> <li>• Virtual shopping advisors</li> </ul>
	<b>Transport and traffic</b>	<ul style="list-style-type: none"> <li>• Cargo and freight Agents/Postal service Mail sorters</li> <li>• Packaging and Filling Machine Operators and Tenders</li> <li>• Shipping, Receiving and Traffic Clerks</li> <li>• Procurement Clerks, Billing and Posting Clerks</li> <li>• Counter and Rental Clerks</li> <li>• Couriers and Messengers</li> <li>• Traffic Technicians</li> <li>• Taxi Drivers and Chauffeurs</li> <li>• Bus Drivers, Train Drivers.</li> </ul>	<ul style="list-style-type: none"> <li>• Air traffic controllers</li> </ul>



	<b>Information and Consulting</b>		<ul style="list-style-type: none"> <li>• Software, System Developers</li> <li>• Commercial and Industrial Designers</li> <li>• Statisticians</li> <li>• Survey researchers</li> <li>• Management/ Business Analysts</li> <li>• Training and Development Managers</li> <li>• Financial Analysts</li> </ul>
		<b>Jobs at high risk</b>	<b>Future jobs</b>
<b>Business Sector -specific</b>	<b>Tourism, Health and Hospitality</b>	<ul style="list-style-type: none"> <li>• Hosts and Hostesses, Restaurant, Lounge and Coffee Shop</li> <li>• Telephone Operators</li> <li>• Chefs, Cooks, Restaurants</li> <li>• Postal Service Clerks</li> <li>• Hotel, Motel and Resort Desk Clerks</li> <li>• Waiters and Waitresses</li> <li>• Bartenders</li> <li>• Travel Agents</li> <li>• Receptionist</li> </ul>	<ul style="list-style-type: none"> <li>• Recreational Therapists</li> <li>• Mental Health and Healthcare Workers</li> <li>• Social Workers</li> <li>• Dietitians and Nutritionists</li> <li>• Physicians and Surgeons</li> <li>• Psychologists (all kinds)</li> <li>• Nurses</li> <li>• Marketing and sales operator/ PR manager/ Branding</li> <li>• Tourism destination planner</li> <li>• Strategic sales and channel manager</li> <li>• Community manager</li> <li>• Cultural manager</li> <li>• Innovation manager</li> </ul>
	<b>Entrepreneurship a. green job</b>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Green Entrepreneurs</li> <li>• Social Entrepreneurs</li> <li>• Environmental scientists and consultants</li> <li>• Agricultural engineers</li> <li>• Climatologist,</li> <li>• Bioinformatics</li> <li>• Archeologist</li> </ul>
	<b>Others</b>	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Teachers all kind</li> <li>• Medical Scientists</li> <li>• Clinical, Counseling and School Psychologists</li> <li>• Educational, Guidance, School and Vocational Counselors</li> <li>• Career/Technical Education Teachers</li> <li>• Marriage and Family Therapists</li> </ul>

Source: Frey and Osborne, 2013

Figure A2: Skills portfolio



Source: World Economic Forum, based on O\*NET Content Model.

### **A3 Interview Guide - Expert Survey**

#### **Expert Survey**

#### **Adaption of university trainings reacting to digitalization**

We are a team of 6 international students from Austria, Latvia and Spain. Together we want to analyse what future skill portfolios are required from university graduates by the labour market in 2020 due to the digitalization and how universities should adapt their trainings in order to prepare their students for requirements of the labour market in 2020.

For us it is important to collect as many expert opinions to this topic as possible. Therefore, we really appreciate if you have 20 minutes to answer the following questions. Your answers will be treated strictly confidential and remain anonymous.

<b>Demographic Data</b>
Nationality:
University:
Taught subjects:
Education:

<b>General information about the university</b>
1. How often are curricula of the study programs at your university changed?
2. What are the main criteria/factors to update the curricula?
3. Who is involved in the change process of the curricula? (Multiple choice possible)
<input type="checkbox"/> Companies <input type="checkbox"/> Head of department <input type="checkbox"/> Professors <input type="checkbox"/> Rector of the university <input type="checkbox"/> Students (general) <input type="checkbox"/> Student council <input type="checkbox"/> Others: _____
4. Which information sources does your study program use for the adaption of the curricula?(Multiple choice possible)
<input type="checkbox"/> Benchmarking with other universities <input type="checkbox"/> EU/state requests <input type="checkbox"/> External researches/reports/articles

<b>Subject specific questions</b>
<b>Teaching methods</b>
5. Which teaching methods do you use in your courses/ lessons? (Multiple choice possible)
<input type="checkbox"/> Case studies
<input type="checkbox"/> Excursions
<input type="checkbox"/> Group works/projects
<input type="checkbox"/> Guest lectures
<input type="checkbox"/> Lectures
<input type="checkbox"/> Papers (Assignments, Comments, etc.)
<input type="checkbox"/> Presentations
<input type="checkbox"/> Role Plays
<input type="checkbox"/> Others: _____
6. Which technologies do you use in your courses/ lessons? (Multiple choice possible)
<input type="checkbox"/> Audios/Podcasts
<input type="checkbox"/> Computers
<input type="checkbox"/> Mobile devices/ tablets
<input type="checkbox"/> Videos
<input type="checkbox"/> Virtual games/ simulations
<input type="checkbox"/> Virtual platforms (f.i. Moodle)
<input type="checkbox"/> Others: _____
7. Which other supporting material do you use in your courses/ classes? (Multiple choice possible)
<input type="checkbox"/> Articles/Papers
<input type="checkbox"/> Books
<input type="checkbox"/> Flip Charts
<input type="checkbox"/> Games
<input type="checkbox"/> White Boards
<input type="checkbox"/> Others: _____
8. If you assign tasks to your students are the subjects more:
<input type="checkbox"/> Interdisciplinary
<input type="checkbox"/> Subject specific
9. How many subjects are you holding in English? (please indicate it in %)
<b>Adaption of teaching</b>
10. How often do you update your teaching method and content?
11. What are the main criteria/ factors for the update?
12. Where do you look for new methods and contents?
<b>New skills/jobs in 2020</b>
13. What do you think are further jobs in 2020?
14. Which jobs do you think are at risk in 2020?
15. What are the five most important skills that graduates of your university should gain today?
16. What are the five most important skills that graduates of your university should gain in 2020?
17. How do you prepare your students in your subject to gain these skills?
18. How is your university in general preparing the students to gain the requested skills?
19. Please rank the following skills according to the importance in 2020: (1= most important, 9 = least important)
<input type="checkbox"/> Social skills (f.i. negotiations, emotional intelligence, communication)
<input type="checkbox"/> Technical skills (f.i. new technologies, programming)
<input type="checkbox"/> Cognitive skills (f.i. creativity, analytics)
<input type="checkbox"/> Content skills (f.i. ICT literacy, active learning)
<input type="checkbox"/> Personal/mental abilities (f.i. dealing with pressure and persistence)
<input type="checkbox"/> Process skills (f.i. critical thinking)
<input type="checkbox"/> System skills (f.i. decision making, entrepreneurial skills)
<input type="checkbox"/> Resource management skills (f.i. people management, time management)
<input type="checkbox"/> Intercultural skills (f.i. open mind-set)
<b>Personal trainings</b>
20. How do you educate yourself to be able to provide students with the latest training?
21. How often do you take part in trainings/ seminars to expand your knowledge?

22. Trainings in which subjects/ areas are you attending?
23. Do you give guest lectures/ talks at other foreign universities? <input type="checkbox"/> Yes <input type="checkbox"/> No
24. If yes, to which topics do you give guest lectures/ talks? <input type="checkbox"/> Interviews/feedback of companies <input type="checkbox"/> Interviews/feedback of students <input type="checkbox"/> Recommendations of accreditation committee <input type="checkbox"/> Recommendations of own researches <input type="checkbox"/> Recommendations of professors <input type="checkbox"/> Recommendations of professors from other universities <input type="checkbox"/> Recommendations of students council <input type="checkbox"/> Others: _____
25. Does your university offer students the possibility to conduct projects with companies? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
26. Is it obligatory within the undergraduate program to do an internship? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
27. Is your university providing services that help students to find an internship? <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> I don't know
28. If yes, what kind of services?

A4: Curricula Content Evaluation

Skills portfolio

Criteria	Loading	Corricula																				Average fulfillment	
		Cambridge		Austria/Germany				Latvia				Spain											
		Business Management	FH Joanneum Industrial Management	Campus02 International Marketing	FH International Engineering	BA School of Business and Finance "Business Administration"	The University of Latvia "Business Administration"	Stockholm School of Economics "Economics and Business"	Universitat pompeu fabra "Business Administration"	University of Barcelona "Business Administration"	University of Valencia "Business Administration"												
C	CxL	C	CxL	C	CxL	C	CxL	C	CxL	C	CxL	C	CxL	C	CxL	C	CxL	C	CxL	Average	Ranking		
Social Skills	3	5	15	4	12	4	12	3	9	4	12	4	12	5	15	5	15	3	9	5	15	4,2	3
Technical Skills	3	4	12	4	12	2	6	3	9	2	6	2	6	3	9	5	15	4	12	4	12	3,3	9
Personal/Mental abilities	3	5	15	3	9	4	12	3	9	3	9	4	12	4	12	3	9	3	9	4	12	3,6	8
Cognitive Skills	2	5	10	3	6	4	8	4	8	4	8	4	8	5	10	4	8	4	8	3	6	4	5
Content Skills	2	5	10	3	6	4	8	4	8	5	10	5	10	5	10	5	10	5	10	5	10	4,6	1
Process Skills	1	4	4	3	3	3	3	4	4	5	5	5	5	5	5	5	5	4	4	5	5	4,3	2
System Skills	1	5	5	3	3	3	3	4	4	5	5	3	3	4	4	4	4	4	4	3	3	3,8	6
Resource Management Sk	1	4	4	4	4	3	3	3	3	4	4	3	3	5	5	5	5	3	3	4	4	3,8	6
Intercultural Skills	1	5	5	4	4	3	3	4	4	5	5	3	3	5	5	4	4	4	4	4	4	4,1	4
<b>Total</b>	<b>14</b>	<b>Value</b>	<b>65</b>	<b>47</b>	<b>46</b>	<b>49</b>	<b>52</b>	<b>50</b>	<b>60</b>	<b>60</b>	<b>60</b>	<b>54</b>	<b>56</b>										

Legend

<b>Evaluation criteria:</b>	5	4	3	2	1
Level of fulfillment	very good	good	accept	poor	very poor

<b>C</b> - Number of fulfillment
<b>CxL</b> - Number of fulfillment x loading

max. of 70 points