Impacts of digitization on employment and social security of employees

Analytical study

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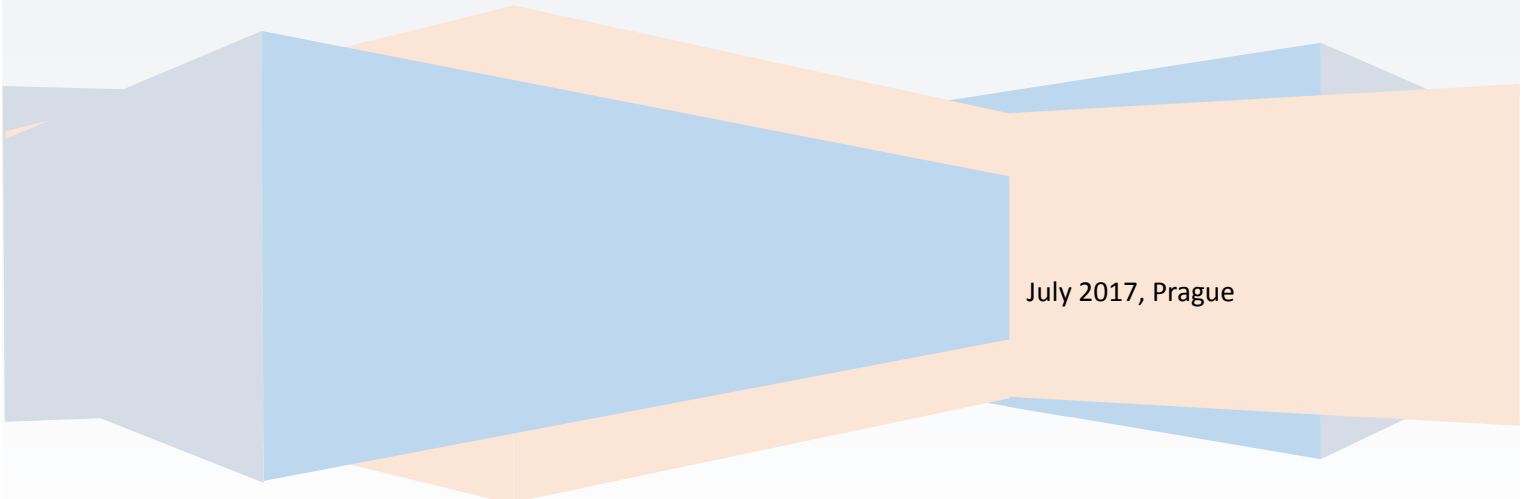

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1. Introduction to the problematics

Society is at the beginning of a new era - the 4th industrial revolution. In relation to that, a wide range of uncertainties, hypotheses and unanswered questions arise. A fast development of new information and communication technologies, robotics as well as cybernetics brings some qualitative (revolutionary) changes in the area of production. The main vision of the Industry 4.0 is a creation of the so-called smart factories (*Smart Factory*), which are going to be equipped by fully automatic systems that will be able to communicate with one another by means of the technology of radio frequention identification (RFID), and will fully control all parts of the supply and production process. It is not easy to estimate when the vision will be fulfilled. The process of digitalization and automatization of systems takes place and will take place on various levels of intensity in different countries and industries. There are existing smart factories that work with some elements of Industry 4.0 in the Czech Republic today (e.g. Siemens in Mohelnice). This company belongs to the new generation of digitalized factories; it regularly uses electronic monitoring of how the machines are used, it has fully digitalized production documentation, manipulation technology contains GPS modules etc. New production processes also require a new approach in an organisation of work, especially as they impose completely different (usually higher) requirements on workers.

There is some idea (vision) about a development of the Industry 4.0, many more uncertainties are, however, related to the questions connected with a human - his capital and social status; What influence will the fourth industrial revolution have on labour market? How will the requirements on workers change in respect of their knowledge and skills? Which professions will cease to exist, which will last in some modified form, and which new professions will be created? How will the employment relations and the forms of employment change? How will the changes effect the social area? Where are dangers but also opportunities? What can we do today to prevent the negative impacts on labour markets? Etc. etc. The fourth industrial revolution will significantly change the society as a whole.

To better understand the ongoing changes, it is appropriate to look at least briefly into the history and explain some basic terms related to the Industry 4.0.

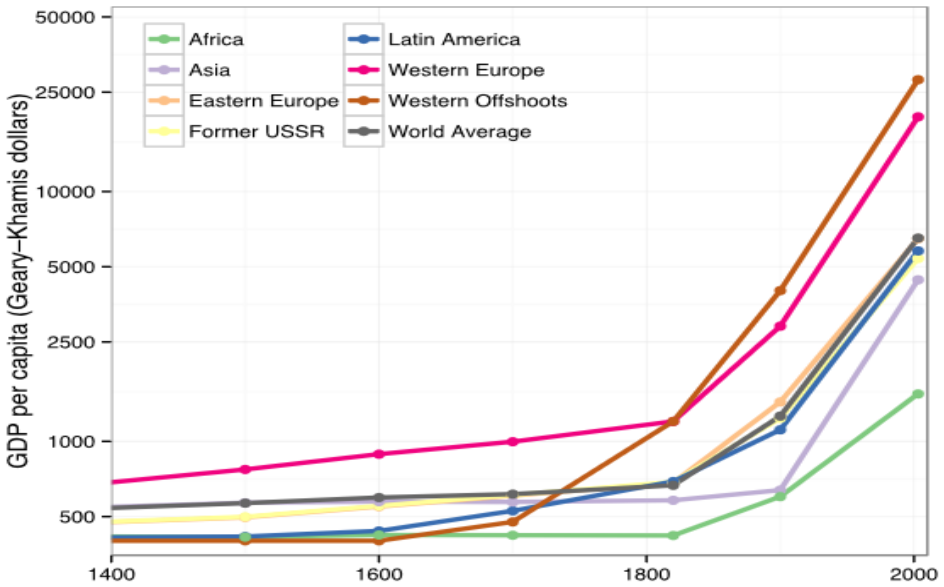
1.1 From the first industrial revolution to the Industry 4.0

A beginning of the **first industrial revolution** is considered to be the start of the first mechanized weaving loom in **1784**. The end of the first industrial revolution cannot be specified

so precisely, it ran through the 19th century when there was a transfer from manual work in manufactures to mass production in factories. This era can definitely be marked as one of the key eras of human society development. A few centuries continuing era, the basis of which was farming and agriculture, finished. Industrial production started and was connected with a whole range of new technical inventions, especially the steam engine. The first steamer had been built by American Robert Fulton in 1803, and a year later Englishman Richard Trevithick built the first steam engine that moved on tracks. Other significant inventions included e.g. a treadle sewing machine that came on market thanks to company Singer in 1832. New technologies and machines were invented in agriculture, too (yields per hectare and animals performance increased). Production of machines and machine parts led to a development of a whole range of new sectors and branches: engineering, metallurgy, mining (coal became a new energy source). Thanks to the rail transportation there were qualitative changes in transportation. It was also possible to send messages via telegraph network from the 1930s.

Changes in farming caused more significant changes in social sphere, culture, social care and politics. Thanks to the machines, there was an increase in productivity of work and GDP. Better medical care, easier transportation of food and a better quality of food for people created conditions for a higher living standard.

Picture 1.1 Relation of industrial revolution and GDP / p.



Source: https://cs.wikipedia.org/wiki/Pr%C5%AFmyslov%C3%A1_revoluce.

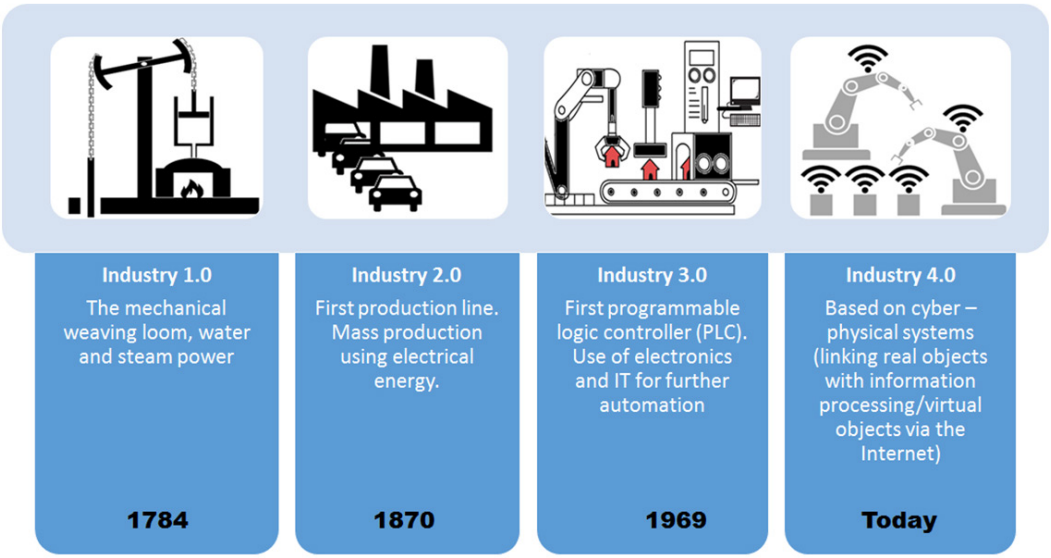
The second industrial revolution continuously followed the previous development. It is connected especially with electrification and mass production. In relation to that, especially two events became significant: T. A. Edison invented a light bulb in 1879, and in **1870**, company Cincinnati installed the first assembly line in their company (at that time without electrification). The start of the second industrial revolution is occassionally connected with the year **1913** when the first electrificated mass production line was installed in automobile industry, in the Ford Motor Company, which was the world biggest producer of automobiles until the end of the 1930s. It employed over 13 000 workers in 2014. To increase the motivation and performance of employees, Henry Ford made two important decisions: he set up fixed wage per day amounting to five dollars (no other businessman offered such a high wage at the time) and he decided to have shorter working hours - to eight hours (usual working hours in industry were between 9 and 12 hours). Higher wages resulted in a great interest in working at Ford´s, people from all parts of the USA moved to work in Detroid. The success of that automobile company also meant the beginning of the social revolution in the USA. Ford´s workers usually lived in company semi-detached houses and belonged to the first generation of workers who could send their children to schools. High productivity of work made it possible to have a very cheap production, they could therefore have their own cars, too (in 1914, a car could be bought for four monthly salaries). This social progress had a great impact on the creation of the lower middle class in the USA. Similar processes took place in Europe, too; mass production made products accessible to a wide spectrum of people.

Picture 1.2 Henry Ford´s mass production

Source: https://www.google.cz.

The third industrial revolution has some characteristic features, such as automatization, electronics and information technologies development. It brought the automatization of production lines using computer technology. Its start cannot be precisely determined, as just like there was a transition from using the power engine to electric one (no jump) marked by continuous technical development, also the transition from the mechanic production to the automatic one was a result of natural evolution development. **1969**is the year most often considered as a beginning of the season when the first programmable logical automat was made (*Programmable Logic Controller,*PLC) . Its development is again connected with the production of automobiles, and specifically with company General Motors. At the beginning of the 60s, they started to think about whether it would be appropriate to replace the relays-controlled systems with a fixed logic by computer systems capable of more flexible reactions to reaquired changes, therefore flexible automatic systems. In 1968, the General Motors announced a competition for a supply of computer management for its production plants. The company Bedford Associates won in the competition and they made the first PLC. The PLC (later it was called *Programmable Automation Controller,* PAC) is really a relatively small industrial computer used for the automatisation of processes in real time, respectively to manage and control machines and assembly lines in a factory. PLC differs from the common computers, as it processes a programme cyclicly, and its periphery is adjusted to being connected to technological processes. Originally quite small computers for automatozation have gradually turned into the high-performace management systems.

Picture 1.3 From Industry 1.0 to Industry 4.0



Source: https://www.ibm.com.

The fourth industrial revolution (the Industry 4.0) is a name for current trends connected with a process of digitalization. The concept of the Industry 4.0 was first introduced at the tradefair in Hanover in 2013. The main idea of the concept is to build ´smart factories´ which will use cybernetic - physical systems. There are many technical and production processes connected to that: methods of machine perception, autodiagnostics, computer interconnection od machines and products in all phases of production, using cloud repositories and data centers, 3D print, smart warehouses that are able to inform about the stock etc. It is likely that these changes will have a great impact not only on the labour markets but also on the society as a whole.

If the year 1913 is considered to be the start of the Industry 2.0, when the first electric assembly line was started (it is characteristic for the second industrial revolution), we can see the following turning years: 1784 – 1913 – 1969 – 2013. It is possible to say that changes in society are faster and faster, and the time period between the individual industrial revolutions is getting shorter.

Despite the fact that the single industrial revolutions differ a lot - they relate to different stages of society development, development of science and technology, with a different level of human capital in society etc. - **they have many common features:**

1. New technical inventions, production processes and technology lead to growing productivity of work (see Picture 1.1) Whereas the average production growth per person in Europe was 0,2 % in the 18th century, in the 19th century, it was 1,1 % and 1,9 % in the 20th century (Pikkety, 2015). In fact, the growth was even greater, as the working hours decreased significantly. The Industry 4.0 will lead to increasing productivity of work by up to one third according to the estimates of the German National Academy of Sciences.
2. As a result of the industrial revolutions, the structure of economics has been changing. New industries and fields appear, others last in modified form and some disappear altogether. Power sources are changing.
3. Economical changes have an impact on labour market. The so-called structural unemployment appears, when the number of people without work increases especially in the disappearing branches, like mining, their knowledge and skills do not correspond with the new requirements of labour market. On the other hand, some jobs appear in the new and developing areas of production and services. New jobs are usually connected

with higher requirements of knowledge and skills of workers. Social structure of inhabitants is changing.

4. Industrial revolution therefore leads to increasing wealth of the society as a whole and to an increase of a living standard of inhabitants. The growth of the productivity of work enables faster economic growth (GDP creation) an it strengthens competitivness. A level of GDP per person is one of the signs of achieved living standard.

1.2 Selected terms

There is a whole range of new terms related to the Industry 4.0. To understand the problematics better, it will be useful to explain and look closer at at least the basic ones: cybernetic - physical systems, the Internet of things, services and people, digital economics.

1.2.1 Cybernetic - physical systems

One of the characteristic features of the Industry 4.0 is using the cybernetic - physical systems that are based on electronics and inteligent sensors embedded to physical systems and processes. In future, it can be expected that miniature processors, memory units to store data, sensors and transmitters will be embedded to almost all machines, production facilities, unfinished products and materials and also to tools and new software to structure data flow. This will enable the devices and products to communicate with one another and to exchange orders. **From the very beginning of a production process (including intra-logistics), products will bear digital memory and will communicate during the whole production process with their environment.** It therefore becomes a cybernetic - physical system which enables to connect the virtual world and reality. It will be possible to monitor the production process and direct it through the so-called terminal equipment (e.g. smart phones with the use of communication in Cloud). These inovations will enable significant optimatization of production processes and production of highly individualized products (even series of one piece is talked about, the so-called batch-size 1). Management of cybernetic-physical systems, the highly intelligent interconnection of machines, mobile systems, software devices and robots, will be in the hands of a human.

In this relation, the arrival of the **new working class** is spoken about, the so-called **light blue collar workers**, who are somewhere on the boarder of manual and engineering positions. Their job will involve some aspects of manual work as well as deeper knowledge and skills as far as the running and management of the more and more interconnected systems are concerned.

Workers will be connected with technologies and also with one another much more. That will make it possible for them to join planning, maitenance etc. even when they are not present at work (when they are e.g. on business trips). Thanks to a simple software interface, they will be able to e.g. design new production processes for new products and optimalize according to selected criteria (costs, availability etc.) and then decide about the best process. In a similar way, they will closely cooperate with colleagues on both sides of a life cycle of products, thanks to which it will be possible to optimalize the supply chains and consider individual requirements from customers.

Production devices will be able to adjust to the requiremets there may be at the time much more than now.

Picture 1.4 An example of interconnection of virtual environment with real device

Source: Presentation of company Siemens PLM Software.

1.2.2 The Internet of things, services and people

At present, many companies use technologies that fall into the concept of Industry 4.0 in selected areas. These modern processes are based on interconnecting things, services and people via information and communication technologies. It is possible to speak about stepping towards a creation of cybernetic - physical systems. There are several **examples** below.

In 2006, company ABB Group introduced a new technology which changed motors into inteligent devices. Sensors placed right on the motor use a wireless connection to provide data about production conditions and

current state, for example vibrations, temperature, overload or energy usage. Provided data are analysed using a special software, which produces - based on the results analysis - a maintenance graphic plan. Technology enables to decrease the time of machines shutdown by up to 70 %, to lenghten a lifetime of motors by 30 % and to decrease consumption by up to 10 %. An investment into such inovation will return in less than a year.

A robot YuMi started to work together with a human in the Joblonec company ABB Elektro-Praga in the same year (the name comes from the English You and Me). It is the first robot in the world that can cooperate with people. It plays its part in the assembly of electrical sockets in the company. It results in higher effectivity, higher quality of products, safety as well as better ergonomy.

Picture 1.5 YuMi - cooperation of a human and a robot

Source: http://www.mmspektrum.com/clanek/internet-veci-sluzeb-a-lidi.html.

YuMi is monitored during the production and operation. Diagnostic technology makes it possible to replace the reactive way of maintenance by the predictive one, and the proactive one by an immediate service support (before using the Internet of things, services and people, the maintenance of robots went on using a previously agreed timetable). Using new technology results in increasing effectivity of a robot, decrease of expenses for service and longer durability.

The internet of things, services and people is also used by e.g. the management of buildings platform ABB KNX, which makes it possible for the building to communicate with its outside environment. At present, this system is being installed all over the world in thousands of buildings. An example could be buildings of company Microsoft in Denmark. Intelligent system of building management enables to have an ideal climate inside the building though an optimalisation of temperature, quality of air and lightning. The facade as well as the building ceiling are made of glass which makes it possible to use daily light. The sensors measure the intensity of the sun light

and presence of people in the building and the system controls lightning and blinds. This modern technology enables to decrease the energy consumption for lightning ranging from 20 to 60 % (which comes to 30 % of the total energy consumtion of buildings) and to maintain comfort for employees.

The Internet of things (*the Internet of Things*) has been creeping into our personal lives for many years. As an example, we can mention using modern technologies for heating houses, smart households, electronic protection of houses or flats. There is growing demand for the sports bracelets that measure pulse, body temperature or environment and humidity. Smart phone applications make it possible to measure the intensity of physical activity (running, walking, distance, height and elevation difference etc.). Once all the data are obtained it is possible to reccommend a change of intensity, load, visiting a doctor and to share them on social networks.

Interconnecting things, people and services makes it possible to achieve higher effectivity in a production process, to increase productivity and quality of products and therefore company competitiveness. This way it possible to increase a level of safety and health protection at work as well as the overall comfort of working environment. A big advantage is also significant energy saving and considerate approach to environment and nature.

1.2.3 Digital economy

Digital ecomomy is one of the new industrial branches (the so-called *emerging industries*), and its typical characteristic is a frequent usage of digital technologies and creating brand new chains. Digital economics currently rises a lot worldwide, and the rise is connected with a creation of new employment positions, which is - into some extent - a compensation of the fact that jobs in traditional industries cease to exist. It, however, does not mean that digital economics would be connected with completely new companies; on the contrary, even traditional companies attempt to use the opportunities brought by digital ecconomics through innovations. For example banks are behind the P2P platforms for lending money (people to people); e.g. Zonky in the Czech Republic.

According to the data of the Institute of Digital Ecconomics (IDE), this new industry made 4,2 % of the world GDP in 2015. There were 17 million people employed in the digital ecconomics and it indirectly boosted a creation of another 15 million jobs in other sectors. It is assumed that the number of people employed in digital ecconomics shall rise significantly in the next years. Concerning the Czech Republic, its contribution of GDP is estimated to be 9 %. Development of digital ecconomics will have a fundamental impact on the Czech market as over 32 % of it

is industry, which is greatly influenced by digitalization. This corresponds with the fact that the highest part of the expenses in the business sector assigned for science and research goes to digital economy (18,86 %, which is 9,981 billion CZK in 2014).

The term ´digital economy´ was first used by *Don Tapscott* in his book *Digital economy: hopes and threats of the information society age.* The book was published in 1995 and even then, its author was one of the first people who could assess the importance of the Internet correctly for the future of economy. In 2006, he published his other book *Wikinomie*, which was a follow-up of his first work; he focused on new approaches and inovations as well as strenthening the competitivness of businesses in it. According to Tapscott (2010), we live in a revolutionary era, the typical characteristic of which is a dvelopment of the so-called collaborative economics where ´businesses can exist next to one another with millions of separate creators, who can interconnect and build values together (through works, contents etc.) in loosely connected networks.´

Digital economics is still developing. At the start, there was a digitalization of business transactions, expansion of internet banking, and digital infrastructure has been built gradually. In the following time period, there was a development of the concept of *e-business*, therefore a complex of processes that enable various forms of business and enterprise on the Internet (e-commerce, e-shops, e-services, e.g. a possibility to pay by card or online complaints). Digital economy is currently often connected with the ´virtualization of material assets´. It is called economy with the minimum or even zero marginal costs, as the automatization of production, decentralization of economy and a shift to renewable energy sources should make it possible for the costs of production that cannot be digitalized to be decreased. An example of digitalized industries can be the production of books or the distribution of music. Digital economics currently focuses on several areas, which include public administration (*e-government*), healthcare (*e-health*) and digital education (*e-learning*).

Security of systems constitutes an important part of economy: securing money transfers, protection of information and measures taken against falsification of electronic signatures. The development of the new area will require specific regulations and new legal modifications in the future (e.g. changes in regulation of consumer protection).

Digital economics should integrate with new trends (comming of the Industry 4.0) and technologies (e.g. mass expansion of 3D printers) in the future.

1.3 Strategic and legal framework of the digitalization process

The problematics of digitalization and the Industry 4.0 is paid great attention on the EU level as well as in the national economic politics. The text below briefly introduces the main strategic framwork of the digitalization process on the EU level as well as the Czech Republic one. In the next phase, it will be necessary to create appropriate legal environment for the strategic aims - to form and adopt needed legislation on both national and European level.

Fast development of digital technologies and building common digital market in Europe requires modernization of current regulation framework. It is essential to ensure that legislation corresponds with the technological development. New legislation is needed for example in the area of protection of personal data[1] and privacy or ownership and using data generated in industrial links or access to the data. Considering the current legislation from the viewpoint of safety and responsibility, it is the systems that function independently which constitute a problem (for example automobiles without drivers or drones). It is also possible to expect wider legal consequences in connection with starting the Internet of things etc. The first task will therefore be to create environment of legal security and to remove prospective barriers of inovation processes.

1.3.1 European Union level

Strategy Europe 2020

The main strategic framework of the economical development of the EU is the *Strategy Europe 2020* (EC, 2010). It is an important tool of the coordination of economical politics of the member states that describes the main priorities and goals of the European politics development to 2020. The Strategy also contains seven ´principle initiatives´ which focus on the area with the greatest potential to contribute to the stimulation of economic growth and employment. One of them directly concerns digitalization, and it is called **Digital agenda for Europe** - it supports faster implementation of the high-speed Internet, greater use of information and communication technologies (ICT), focuses on cybernetic safety; it currently focuses on more effective services

[1] In May 2008, not only the EU but also the whole European economic area (that is the EU + Iceland, Norway and Lidchtenstein) will have the Regulation of the European Parliament and the Council (EU) 2016/679 from 27 April 2016 on the protection of natural persons comming into force in connection with the processing of personal data and about free movement of the data, and the directive 95/46/ES (general regulation of personal data protection) known under the abbreviation GDPR from English *General Data Protection Regulation* shall be cancelled. It can be considered as a breakthrough legal norm, the purpose of which is to create environment of legal trust that will enable a development of digital economics throughout internal market, and especially through a unified level of protection for natural persons.

of electronic public administration and new services in medical care. As a part of the Agenda, a programme for research and inovation has also been adopted, which is called the **Partnership of the public and private sectors in the area of the Internet of the future** (FI - PPP); its goal is to increase the competitiveness of Europe in ICT supporting smart services and applications. The ´Digital agenda for Europe´ is directly connected with another ´key initiatives´, especially the *Union of inovations, the Industrial politics for the globalization era* and also *the Agendas for new skills and jobs*.

Strategy for a single digital market

In 2015, the European Commission accepted *the Strategy for a single digital market* (EC, 2015). Its aim was to create such conditions that would enable more effective use of opportunities offered by ´digital technology with no limits´. Creating a single market will not, however, be so easy, as it is expected to have wide harmonisation of legislation as well as single conditions, especially in the areas of the regulation of telecommunications, management of radio spectrum, copyrights, protection of personal data and also in the area of application of protection law.

There are 3 pillars of the strategy:

1. **Improving the access of consumers and businesses to online services in Europe** - requires to remove obstacles of across-the-boarder online activity.
2. **Creating suitable conditions for the evelopment of digital networks and services** - requires to create a high-speed and safe infrastructure and services providing a content which will be supported by appropriate regulation conditions for inovation, investments, fair competition and equal opportunities.
3. **Maximizing of the growing potential of European digital economics** – requires investments into infrastructures and ICT (especially cloud computing, big data), investments into research and inovations to increase competitiveness of branches, to support public services and improving skills.

The strategy for *a* single digital market is a part of a wider strategic framework of initiatives of the Comission, and their aim is to strengthen the overall competitiveness of industry, especially the small and medium-size businesses (they make 99 % of all European companies and more than 75 % jobs in some branches, e.g. textile, construction). The wider framework also includes the *Investment plan for Europe*, which shall - by 2018 - activate additional investments of 315 billion Euros, and the implementation of which shall contribute to general improvement of investment environment.

The strategy for single digital market is supported by other significant documents of the European Comission, especially the following **statements**:

- *Digitalization of European industry. Achieving maximum benefits of single digital market* (EC, 2016a). The statements includes the steps to strengthen competitiveness of the EU in digital technologies and to ensure that every industrial business in Europe regardless its area of business, location and size can fully use digital inovations.
- *The European initiative in the area of cloud computing – building competitive European economies based on data and knowledge* (EC, 2016b). It introduces a plan to build a premium cloud and data infrastructure for science and technology. The ´European cloud for open science´ should come to existence, which is virtual space with open and smoothly working services for storing, administration, analysis and re-use of data from research across the boarders and scientific fields.
- *The Priorities for the normalization of ICT for single digital market* (EC, 2016c). The statement defines the main norms in ICT and includes steps to speed up their creation; its goal is to support digital inovations in the whole economy.
- *The Action plan of the EU for „eGovernment" for 2016–2020. The Acceleration of digital transformation of public administration* (EC, 2016d). Its goal is to remove current obstacles which stand in the way of development of single digital market, and modernization of public administration.
- *The Internet of things - action plan for Europe* (EC, 2009) It defines the opportunities and challenges in the sphere in Europe. It assumes that in future, the Internet of things will apply to 50 - 70 billion pieces of equipment; today it is about 1 %.
- *The New agenda of skills for Europe. To work together to strenghten human capital, employability and competitivness* (EC, 2016f). There are three main aims formulated in the message: 1. To improve quality and relevance of acquired skills. 2. To ensure better visibility and comparability of skills and qualifications. 3. Improvement of knowledge and awareness of skills in order to choose a job better.

1.3.2 The Czech Republic level

National programme of reforms in the Czech Republic in 2017.

On a national level, it is the national programmes of reforms of the individual EU member states that include the main strategic scope of economic development. The main goals included here correspond with the goals of the Strategy Europe 2020, their fulfillment and setting up priorities

but reflect the specifics of single national economies.

The National programme of reforms of the Czech Republic summarizes the issues which are or will be performed in connection with the building of a single digital market in the EU and fulfillment of the *Action plan of development of digital market.* Both documents are continuously evaluated.

The Action plan for development of digital market

In August 2015, the government approved the *Action plan for development of digital market;* the last updated version of this document so far is the one from February 2017. The action plan defines two primary groups of priorities, specifically the priority to coordibate digital agenda and sector priorities.

The priorities of digital agenda coordination involve the so-called framework priorities including for example the procedures related to lawmaking and evaluation of their impacts on digital agenda or the activities of the Society 4.0 or the problematics of measuring the digital economy development. Other priorities include e-skills, e-commerce, e-government and e-security (protection of personal data and privacy; cybersecurity). Last group is formed by the e-invitations which includes e.g. the problematics of shared economics and online platforms or Smart Cities.

The sector priorities include five main areas: 1. Expansion of infrastructure (for example building the Internet networks, digitalization of TV broadcasting, ensuring cybernetic security). 2. Expansion of digital competences and informatic thinking (for example increasing digital literacy of people). 3. Access of goods and services on the Internet (including protection of online data, inspection of copyrights). 4. Expansion of electronic public administration (for example electronic health care, electronisation of social services). 5. New trends (for example open data).

To achieve the harmony among activities related to building of digital market, the coordination platform **Aliance Society 4.0** was established in February 2017. The Society 4.0 agendas are aimed at the impacts of digitalization in economy as well as the society as a whole. It is for example the problematics of inovations in industrial production (automatization, robotization, the Internet of things, artificial intelligence), future development on labour market, changing requirements on education system etc. During 2017, the Aliance is going to prepare *the Action plan for the Society 4.0*, which is going to replace the above mentioned Action plan for

development of digital market.

It is now a priority to fulfill the *Strategic framework of development of the Czech Republic public administration for 2014-2020*, aiming to speed up public administration digitalization.

Putting the above strategies into practise is essential for the Czech Republic, as the country has slowed down in the area of digital economy, as shown in the digital development measurements (see below), and it is behind average especially in the area of inovation and quality of institutions.

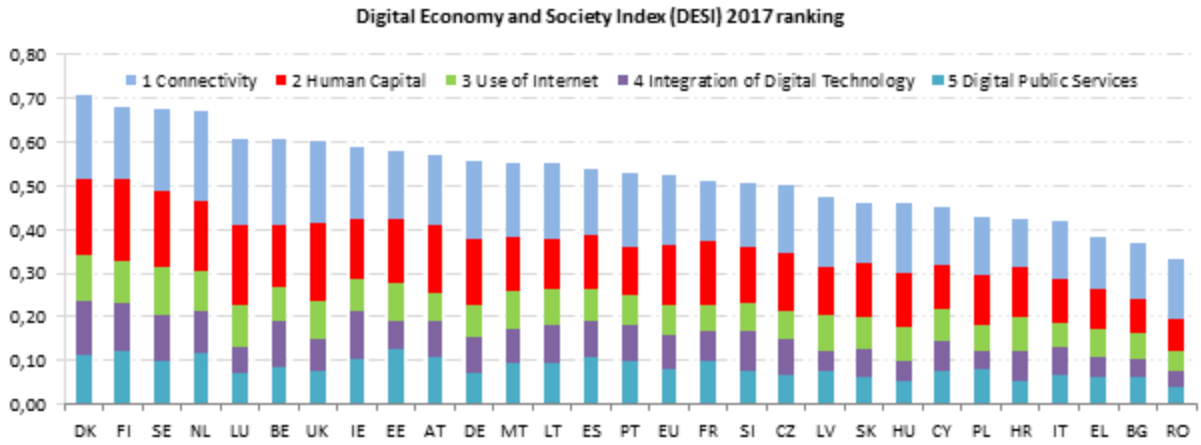
2. Level of digitalization in the Czech Republic and an influence of foreign capital

2.1 Level of digitalization in the Czech Republic

Measurement of the digitalization process within the EU is done by **the index of digital economy and society** (*Digital Economy and Society Index*, DESI). The index is composed of five main components which are assessed:

1. Connectivity (connection) - a fixed broadband connection, mobile broadband connection, speed and prices of broadband connection.
2. Human capital - using the Internet, basic and advanced digital skills.
3. Using the Internet - using the content, communication and online transactions by inhabitants.
4. Integration of digital technologies - digitalization of companies and electronic business (e-commerce).
5. Digital public services - electronic public administration (e-government).

Picture 2.1 Sequence of countries according to DESI 2017.



Source: Europe's Digital Progress Report (2017).

Notes: DK – Denmark, FI – Finland, SE – Sweeden, NL – the Netherlands, LU – Luxembourg, BE – Belgium, UK – Great Britain, IE – Ireland, EE – Estonia, AT – Austria, DE – Germany, MT – Malta, LT – Lithuania, ES – Spain, PT – Portugal, EU – EU-28, FR – France, SI – Slovenia, CZ – the Czech Republic, LV – Latvia, SK – Slovakia, HU – Hungary, CY – Cyprus, PL – Poland, HR – Croatia, IT – Italy, EL – Greece, BG – Bulgaria, RO – Romania.

Within the EU, the Czech Republic holds place 18, and it is therefore placed among the countries with medium or moderately good results together with Austria, Germany, Malta, Lithuania, Spain, Portugal, France, Slovenia and Latvia.

Table 2.1 Position of the Czech Republic in the individually monitored areas DESI (comparison of 2016 and 2017)

Area / Field	DESI 2017 - sequence	DESI 2016 - sequence	Change in sequence
Connectivity	Place 16	Place 13	↓
Human capital	Place 13	Place 13	→
Using the Internet	Place 22	Place 21	↓
Integration of digital technologies	Place 12	Place 11	↓
Digital public services	Place 22	Place 26	↑

Source: Europe's Digital Progress Report (2017), own work.

Note: DESI 2017 - summarizes data for 2016, accordingly, DESI 2016 contais data for 2015.

The biggest fall in the Czech Republic, compared to the previous year, was recorded in the area of **Connectivity** (fall by three places in total sequence). Compared to the EU average, the Czech Republic is at a standhill. Although the fixed broadband connection has almost achieved a full coverage, the access networks coverage of new generation (NGA) has improved only minimally.

There was no change in the area of **Human capital** compared to last year. The number of people who use the Internet has grown (from 77 to 79 percent) but at the same time, the level of digital skills has decreased. There is a high demand for the IT specialists on the Czech market. In 2016,

66 % of the Czech companies had a problem to find the specialists, which is the highest percentage in the EU, and the number grew from the 47 % in 2012 The Czech Republic adopted *the Strategy of digital education*, the aim of which is to improve students´ competences when working with information and digital devices. Besides that the *Strategy of digital literacy for 2015–2020* was approved with the aim to support digital literacy of Czech inhabitants. Attention is paid to the area of lifelong learning and support of programmes that will enable the workers to gain digital competences required to enter the labour market. Besides that, more attention is paid to a support of requalification of the workers who have to come to terms with some changes relating to digitalization and globalization.

Concerning the area of **Using the Internet**, the progress of the Czech Republic was minimal, and the country therefore went one step down to the 22nd place. The Czech Republic is above the EU average in the number of people who use the Internet to read the news online, although when compared to previous year, there was a decrease by 4 p.b. to 82 % (the EU average is 70 %). The Czechs also perform online bank transactions more often than other Europeans (63 % compared to 59 %). A number of the Czechs who shop online has been growing, too, although we are behind the EU average in this ratio (57 % compared to 66%). Also social networks are used less than the EU average.

Considering the **Integration of digital technologies,** the Czech Republic has a better position despite the fact that there was hardly any progress last year. Czech companies widely use online shopping; the turnover from online shopping is above the EU average quite significantly (21,7 % compared to 9,4 %), and Czech companies are in the 2nd place in the EU. On the other hand, the Czech Republic falls behind the EU average in using RFID, electronic invoices, social media and cloud.

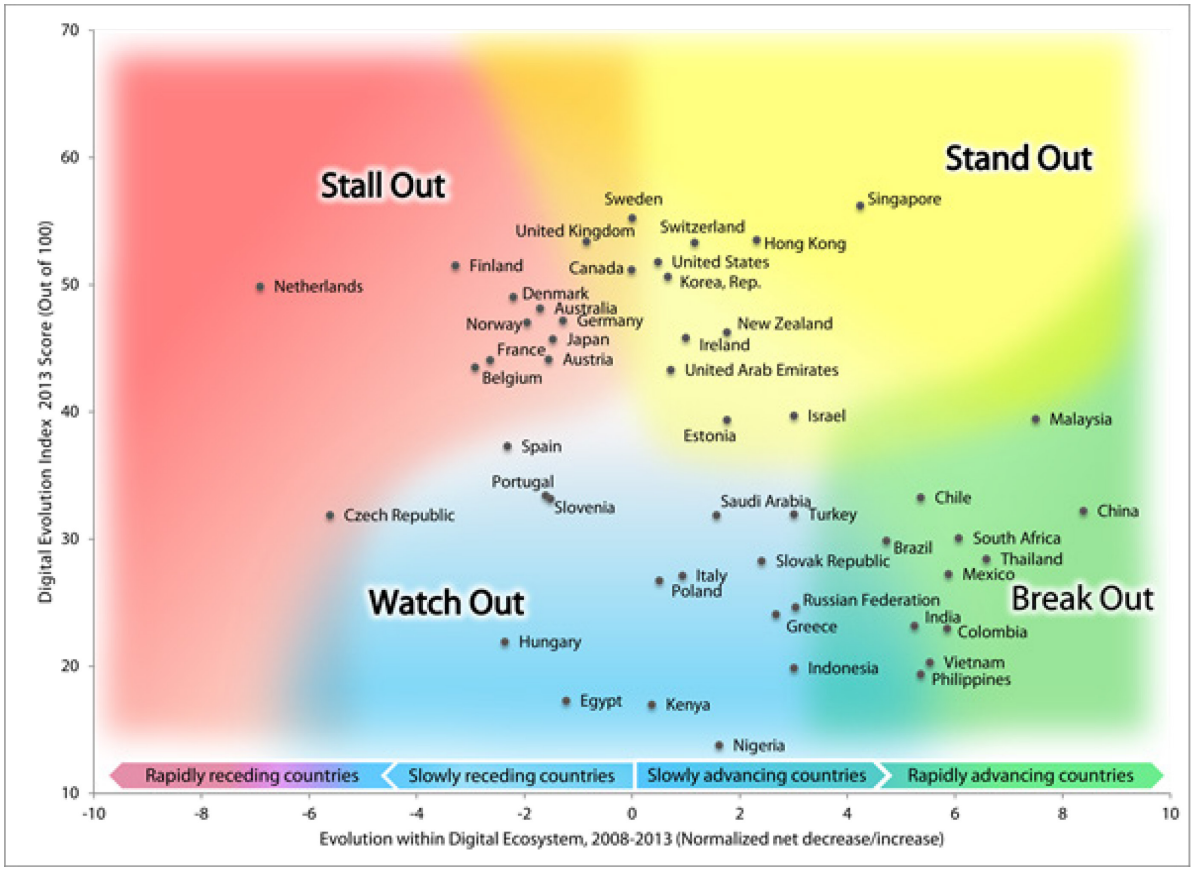
Digital public services are an area in which the Czech Republic made the biggest progress, even though it falls behind the EU average in all indicators. Only 15% of the Czech Internet users actively use the services of electronic public services. In 2016, the government began to fulfill the *Initiative 202020*, the goal of which is to have the Czech Republic among 20 European countries with the highest rate of using services of electronic public administration until 2020. Better accessibility of electronic public administration is also one of the aims of the *Strategic framework of the public services development for 2014-2020.*

Besides DESI, digitalization process is also measured by the **Index of digital development**

(*Digital Evolution Index,* DEI), which enables international comparisons (outside the EU) of achieved digitalization level (see Picture 2.2).

The indicator is based on four groups of factors including supply, demand, inovation and institutions, and concerns the 2008-2013 time period. Countries are divided to four groups based on the results. *Stand Out* – this group involves countries with a high level of digitalization, which is still growing and developing (Singapore, Sweden, Hongkong, Great Britain, Switzerland etc.). *Stall Out* – involves countries that have been losing development dynamics. Although they reached a high level of digitalization in the past, now there is a threat of losing their good positions and they will gradually fall behind (the Netherlands, Finland, Belgium, France, Denmark etc.). *Watch Out* – is a group of countries that has to „be careful". At present, they face significant opportunities as well as challenges. Only the future will tell which country will manage to start a faster digitalization process (through innovation and other appropriate steps). Some countries may get stuck in the same place and fall behind the global development (the Czech Republic, Hungary, Spain, Portugal, Slovakia etc.). **The Czech Republic** is, according to an index considering 50 countries monitored, on the **31st place**; in the monitored time period (2008–2013), however, there was the highest fall of total score, therefore a **significant slowdown process of digitalization** (the Czech Republic was at the 49th place; the Netherlands had the last 50th place but it has much higher level of digitalization and is on the 10th place). The Czech Republic falls behind the average in respect of inovation and quality of institutions, on the other hand, it is above average in the area of digital infrastructure (DEI, 2013). *Break Out* – countries in this group have a potential of fast development of digitalization, they have growing ascending trajectory of development in terms of preparedness. In future, some of them will probably reach the Stand Out group (Malaysia, Chille, China, South Africa, Brasil etc.).

Picture 2.2 Evaluation of digital development (digital development speed 2008 - 2013)



Source: http://fletcher.tufts.edu/eBiz/Index.

Notes: Rapidly receding countries. Slowly receding countries. Slowly advancing countries. Rapidly advancing countries.

Summary

According to DESI 2017 index, the Czech Republic is on the 18th place in the EU-28. According to DEI which compares a level of digitalization in 50 countries, it is on the 31st place. So the Czech Republic belongs to the countries with medium good digitalization results. It has the best results in the area of integration of digital technologies by enterprises (online shopping). Digital infrastructure is on quite a high level, too. Using online services, especially electronization of public administration, is the biggest challenge. There are inadequate results in the area of inovations. The international comparison indicates there is a threat for the Czech Republic in the form of stagnation of digitalization process. **The Czech Republic now stands on a seeming crossroad - either it will be succesfull at making the digitalization process faster and will fully use the opportunities created by digitalization or there will be a threat of falling behind and weakening its competeitivness. It is therefore desirable for the government and public administration to pay attention to the topic.**

2.2 Impact of foreign capital on labour market in the Czech Republic

The Czech Republic belongs to the small and very open ecconomies oriented on export. Czech export is dependant on the European economies into a great extend; in 2015, 83 % of Czech export went into the single internal market, of which 32 % went to Germany. **Connection to the EU and Germany plays a key role for economic development and also the situation on labour market.**

Foreign capital plays a significant role in the Czech economy. **Strong representation of the foreign investors in economics** has its advantages as well as disadvantages. Foreign investments have helped the Czech economy to a fast growth after 2000 into some extent (many businesses have started ´on the greenfield´, production has been renewed and modernized in existing companies). These are often connected with an implementation of modern technologies into production, thanks to which there is higher productivity and performace of the whole economy. These are the positive influence so far. One of the disadvantages resulting from foreign investments is especially the fact that the owners pull up a part of the profit and keep it for themselves. And this is exactly the problem of the Czech Republic which belongs to the countries with the highest **money outflow abroad**. The 2008 - 2013 recession of the Czech economy was to a great extent caused by the fact that foreign owners changed the proportion of profit division for the benefit of dividends very quickly - reinvestments that made about 50 % of the profit fell down to about 25-30 %. A reason for that was probably the need to supply capital to mother companies. Only from January to September 2015, the Czech Republic lost 285 billions CZK due to relocation with foreign markets. (which comes to 8,6 % GDP) that could have been reinvested into businesses and used to increase the wages. The Czech economy has falled into a so-called **trap of medium income**.

Table 2.2 Ownership structure of Czech companies according to holding in the capital (2017)

Owner	Percentage (billion CZK)	Percentage (in %)
Czech capital	1.498,42.	54,77.
Total foreign capital	1.014,59.	37,08.
Tax heavens	374,81.	13,70.
Unknown owner	222,91.	8,15.
Total basic capital	2.735,92.	100.

Source: Bisnode (April 2017)

Beginning in 2015, there is a shift in an ownership structure for the benefit of the Czech capital. Volume of foreign capital invested into registered capital of the Czech companies has been

decreasing since 2015, when it reached its maximum. It decreased by 7,2 billion in 2016 CZK and reached the lowest number in the last six years; the percentage is only slightly higher than 37 %. It is caused especially by a significant outflow of capital from tax heavens. A share of the Czech capital - on the contrary - reaches its maximum, and it is almost 56 %. Annual increase comes to 66 billion Czech crowns. **The increase of Czech capital is caused by a great interest of Czech businessmen in setting up new companies. In spite of the positive development, the influence of a foreign capital on the Czech economy is still significant.**

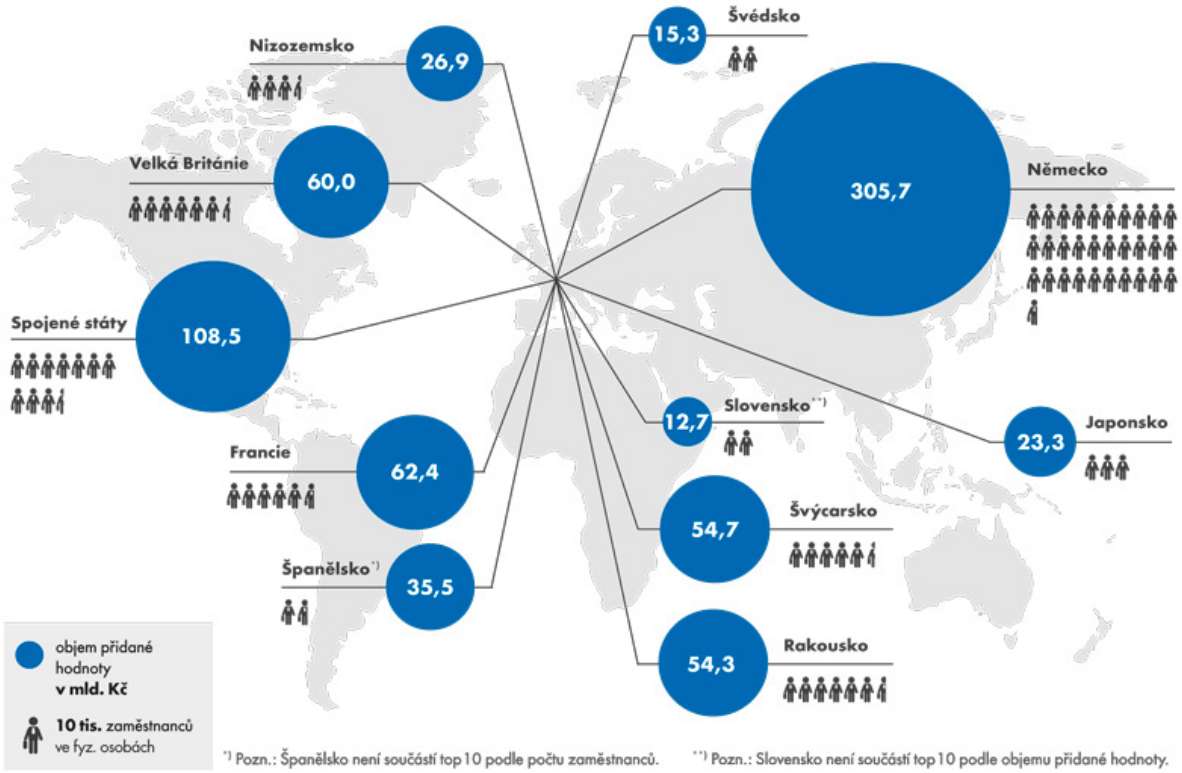
2.2.1 Businesses under foreign control as significant employers

Companies under foreign ownership belong to important employers on the Czech market. It is good to mention the fact that considering the numbers, the businesses with foreign ownership make approximately 2 % of all companies in the Czech Republic. But their economic importance is incomparably greater. According to the ČSÚ data for 2012, [2]industrial businesses under foreign control (CZ-NACE B to E) reached 58,9 percent of total sales (which is 3020 billion CZK), and the added value made by the businesses, which confirms their importance from the viewpoint of economic performance, was 50 %! (that is 501 billion CZK) and there were 45,1 % of all employees working for a foreign owner, which is approximately 546 thousand people (ČSÚ, 2014).

Concerning the country of origin in case of foreign owner, majority of them come from the European Union countries. These businesses make 40 % of turnover, they made 34,4 % of added value and there were 31,3 % employees working for them. The importance of Germany plays a crucial role (22 % sales, 17,9 % added value and 16,3 % employers). After a big gap, Germany is followed by the USA, France, Great Britain, Switzerland, Austria and other countries (see Picture 2.3).

[2] New information is not available yet.

Picture 2.3 Ten most important countries with foreign owners according to the added value volume and number of emploees (2012).



ČSÚ (2015).

A look into the foreign ownership from the viewpoint of the individual sectors is also interesting (see Table 2.3). Foreign investors are the most interested in the information and communication technology companies; their percentage in the added value comes to 64,6 % in this sector and 50,7 % of employment. IT is followed by the processing industry where the foreign owners have 57,6 % share in added value and 46,1 % in employment. In the processing industry, the situation is quite exceptional in the sector Production of motor vehicles (except motorcycles), trailers and semitrailers where the companies under foreign control have the greatest influence (94,4 % share in turnover, 92,4 % in added value and 82,4 % share in employment).

Table 2.3 Percentage of foreign owners in added value of individual spheres (classification CZ-NACE, 2012)

Share	Industry
64,6 %	J - Information and communication activities
57,6 %	C - Processing industry
47,4 %	B - Mining and quarrying
40,8 %	E - water supply; work related to water waste, waste and sanation
38,4 %	G - Wholesale and retail, repairs and maintenance of motr vehicles
28,9 %	LMN + section S95 – Other market services
26,0 %	H - Transportation and storage
22,8 %	I - Accommodation, food and food service activities
14,9 %	F - Building
9,0 %	D - Production and supply of electricity, gas, heating and airconditioned air

Source: ČSÚ (2015).

Companies in foreign ownership in the Czech Republic usually work as the sub-suppliers and the situation is not likely to change very much in the following few years. Foreign purchasers (technological leaders) keep the top technologies in their mother countries, although Czech branches also benefit from their know-how to some extent. Nevetheless, there has been some progress in the past few years when the companies in the foreign ownership had begun to transfer a part of their development activities to the Czech Republic. Combination of a good quality workforce with relatively low expenses for business are still considered to be competitive advantages for the Czech Republic. A sufficient number of qualified professionals and managers on labour market constitute a prerequisite for the process to take place in the future, too.

2.2.2 The impact of the ownership structure on the relation of companies to the Industry 4.0

It is clear from practise that the ownership structure of companies influences their approach to implementation of the Industry 4.0 elements to a great extent. From this point of view, three different behaviour patters can be seen (MPO, 2016).

Business which is a part of a big transnational corporation

Technological leader and often also the one who determines which technology (production as well as communication) will be used within the whole supranational company are the most often the foreign corporate development centers, and these workplaces are sometimes outsourced (based on contract). Global corporations join their Czech subjects into their own process of industrial production in a wide spectrum - from completion and assembly works with the minimum added value to the highly sofisticated works of development and prototype centers. Many Czech parts of the supranational corporations are very succesfull at partial

innovations leading to the Industry 4.0, especially in electrotechnology, electronics and engineering. Nevertheless, there is only a minimum direct impact of the inovations on other foreign parts of the corporations. Strict requirements to implement the basic principles of the Industry 4.0 are still unique so far; one exception is automobile industry where the subsupliers have to have compulsory certification besides other things.

Czech business owned by a foreign or domestic financial group

It is typical for this group of businesses to have strategic management and decision making absent. The main mistake is frequent changing of management [3]that focuses especially on operative decision making and fulfilment of short-term economic indicators. Application of the Industry 4.0 elements is therefore not a priority, as the process has a strategic character. Innovations implementation often depends on a possibility to use financial resources from donation programmes. More advanced technologies paid from own resources are preferred especially in the area of external economic relationships, that is purchasing, sales, logistics and reporting.

Czech business owned by top management (or owner with a different tight connection to business management)

It is the research-development or the engineering companies working exclusively for foreign customers that form a high percentage in this group of business subjects. Management (or management together with an owner) is willing to consider the strategic development of their business but there is often a lack of the basic and relevant information; in many cases, it is ´driven´ by the information from their customers. The investments into the inovation processes usually do not have any strategic character, but are rather a tool to increase the competitiveness. Besides their own research and development centers, conctractual capacities are also used.

Summary

Global investment offers and an absence of strategy in Czech economic development in the past led to development of especially those areas of business into which foreign investors were willing to invest. A structure of Czech economy is therefore deformed into some extent; there is **a high percentage of the so-called procyclic fields** (those that depend on economic cycle,

[3]General director - about 7 years, financial director - about 3 years and technical director - about 12 years or more, but usually with the lowest decision making powers (MPO, 2016).

typically e.g. automobile industry) and **a high percentage of businesses under foreign control** at the same time. Both factors empose a **risk**for Czech ecconomy.

Czech businesses and their branches work within the international corporations especially as the sub-suppliers of the technically more complex components of products that are later bought and sold under different label. In other words, they exist on the lower levels of the system of values, whereas foreign producers of final products are technological leaders in the relation to the Czech businesses and branches (therefore on the top of the system of values). In can be assumed that the situation will not change significantly in the future. According to McKinsey´s study (2016), technological leaders are going to focus on the highest technical inovations that will be connected with up to ten times higher profits, which will further increase their investments potential. They will employ highly qualified workers with a high level of knowledge, mainly the development software specialists and experts on smart intelligence. Czech businesses will probably continue to be important sub-suppliers for [4]a foreign owner.

Czech companies may benefit from the know-how and increasing investment potential of technological leaders into some extent. Some modern operations, development activities or even digitalization of the whole production processes are transferred to Czech branches from mother countries in some cases even now. **Relation between the price and the quality of human resources** plays a key role in this process.

Increasing the amount of investments into research, development and inovations, fast transfer of scientific results into practise and building suitable environment to set up businesses with Czech owners is the way how to decrease the dependancy of Czech economy on foreign capital.

[4] Czech businesses are usually in a position of sub-suppliers of types TIER1-2 and OEM. Marking TIER is used in the automobile industry. TIER 1 is a term for a direct supplier with more assembly groups and systems, TIER 2 is a supplier of sub-sets and individual assembly parts, TIER 3 is a supplier of raw materials and individual components (e.g. joining material). The higher a sub-supplier is in the chain, the higher are the requirements for processing and replacement of data within a business but also among sub-suppliers or directly with an automobile plant. OEM (*Original Equipment Manufacturer*) is a term for a manufacturer of equipment, a product of which is sold and promoted by another brand (typically base computer plates, monitors and other components of consumer economy). The term is often used in the automobile, paper and chemical industries.

3. Impacts of the digitalization process on labour market and preparedness of human resources

Labour market is not static, on the contratry, it requires continuous change. As human knowledge becomes greater, new working processes and organisation of work are implemented, the requirements and conditions for workforce change. Ceasing and creating some new professions and jobs is characteristic for labour markets. The changes are, however, not even in all sectors or fields but they differ in deepness as well as intensity. Compared to previous development, changes resulting from the digitalization process and the Industry 4.0 are much faster and they touch all aspects of our lives. This is why it can also be assumed that they will have a great impact on labour market as well as the whole social structure of society. It is therefore important to understand and recognize the influence of the processes, even though it is often very difficult, as the society is a very complicated system where its individual parts are interconnected and influence one another; small changes can often have big impacts and can be often unpredictable. If this can be achieved succesfully at least partly, it will be possible for the society to prepare for changes to at least some extent and use them as opportunities for further development.

3.1 Presumptive changes in a demand for workforce

Today there are several studies available that attempt to deal with or quantify the impacts of digitalization on labour market. A study of Frey and Osborne (2013) is considered to have a key role, as they came up with methodology of estimating probability of digitalization of different professions on American labour market. The study has been followed up by the work of Chmelař and col. (2015), which publishes the so-called **index of threat by digitalization** of present profession categories on the Czech labour market in a horizont of fifteen to twenty years (see below).[5]

[5] Other interesting studies include for example Levy and Murnane (2003); Hardy, Keiste and Lewandowski (2016); OECD (2016b).

3.1.1 Barriers to replacement of work by technology

The process of replacing work by technique will probably not be continual but **will come in waves**. Frey and Osborne (2013) estimate that the first to be effected will be the professions in transport and logistics (self-driven vehicles), majority of support and administrative workers (data algorhytmization will make it possible to replace their work by special computer programmes; e.g. accounting) and workforce in production (continuing digitalization process of the whole production including distribution). There will be changes in services, sales and construction, too. This first wave of replacing the work by capital will be followed by a slowdown of the process, nevertheless, there will be a further development of technologies, which will make it possible to overcome further **barriers of replacing work by technology**, connected especially with creativity and smart intelligence (see Table 3.1). In the long-term horizont, another wave of replacing of work can be expected, which will be connected with implementing of self-driven and auto-optimalization systems and smart intelligence. And it will concern highly qualified and sofisticated works. Similar process will probably appear in the Czech Republic, too, even though later.

Table 3.1 Barriers of the process of replacement of work by technology

Barriers	Specification of a barrier	Description
Perception and manipulation	Fingers movability	Ability to perform precise coordinated movements with fingers of one or both hands for hodling, manipulation or building very small objects.
	Skillfulness (manual skills)	Ability to move hand quickly, hand together with arm or with both hands when grasping, manipulation or assembling objects.
	Cramped work environment	How often the profession requires to work in cramped work environment, which requires atypical (stressful) position.
Creative inteligence	Originality	Ability to come with unusual ideas on specific topic, with a smart solution of given situation, respectively ability to come up with some creative ways of solving problems.
	Art	Theoretical knowledge and knowing techniques needed for creating, production and realisation of musical, dance, art, theatre and sculpture arts.
Social intelligence	Social perception	Ability to perceive reactions of others and understand why they react in certain way.
	Negotiating	Ability to connect others and attempt to overcome (unite) differences.
	Persuading	Ability to persuade others to change their opinion or behaviour.
	Assistance and care for others	Ability to provide personal assistance, medical care, psychological support or different kind of personal support (to colleagues, clients, patients). In other words - ability to help and be empatic.

Source: Frey a Osborne (2013, s. 31); modified and added.

Barriers of the digitalization process have to be perceived in a greater context. Then it is possible to include the following basic barriers:

- Absence of digitalization strategy on national level, respectively inadequate attention paid to digitalization on the side of government.
- Limited investments into research and development as well as the digitalization process as a whole.
- Achieved development level of technologies that does not make it possible to overcome the barriers connected especially with creative and social intelligence.
- Lack of qualified workers in society, lack of unity between demand and supply on labour market with attention paid to required knowledge and skills.
- Legal framework falling behind technological development (e.g. legal provisions of liability concerning drones or self-driven automobiles).
- Psychological barriers in the relationship of the human and robot cooperation (e.g. a worker will reject to accept instructions from a robot).
- Lukewarm approach of customers to automatization of some services (e.g. self-service cash desks). It usually involves transfering the costs from a provider to a customer on the dentriment of his comfort. Not all customers are satisfied with such approach.
- Digitalization process line in services (e.g. healthcare, education). Depersonification of the communication process can cause a reaction in a form of greater interest in classical services provided by people (there is growing popularity of the so-called retro - increasing interest in vinyl records, retro furniture, fashion style, retro-food production etc.).
- There are remaining open questions relating to increasing stress and health impacts of the digitalization process on workers.

3.1.2 Process of creating and ceasing of jobs

The process of ending and creation of jobs (the so-called creation-decline process) will take place differently in different countries (taking into account national economic structure), in different industries and areas of work. A possibility to replace different tasks will play a key role, respectively also the work processes by new technologies (by automatization, robotization, ICT). In this context, professions under greatest threat include **rutine professions**, manual as well as simple cognitive (recognition) jobs, which can be easily transformed to programme algorhytm. Also some **non-rutine professions** will be under threat due to digitalization in the

years to come. Using sufficient amount of data (the so-called *big data*), it will be possible to recognize certain pattern of decision-making / behaviour and replace some non-rutine cognitive professions by modern technology. Replacing non-rutine manual jobs will be possible by means of the so-called machine learning (*machine learning*),[6], however, its condition will be to decrease the entrance investments into modern technologies (robots).

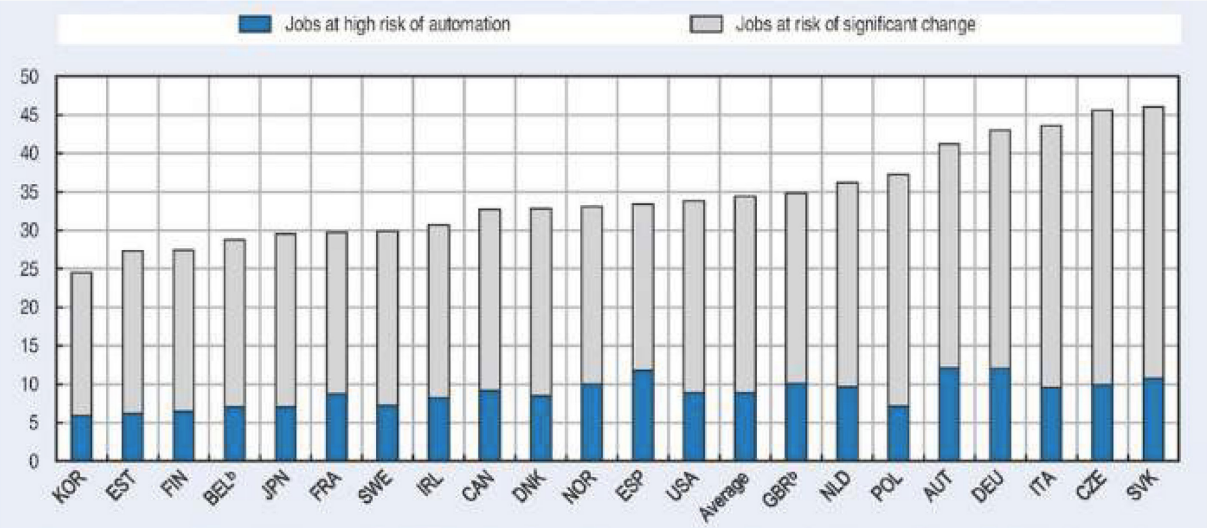
Individual studies vary quite a lot in terms of estimating a number of jobs which shall be effected by the creation-destruction process. The reason for that is especially a different calculation methodologies, that work either with professions or work tasks, but also different time horizont which is considered when doing calculations, and overall entrance parameters. Concerning quantification based on professions, it is important to realize that the professions described as those under a high threat by digitalization may involve a range of tasks that cannot be replaced by automatization. Most professions will not cease to exist altogether but the way of performing tasks will change. Many studies are quite skeptical and their estimates are that 40-50 percent of jobs will disappear in the next 15 years (e.g. Frey and Osborne, 2013). According to Chmelař and col. (2015, p. 3), a proportion of the jobs that will cease to exist and the new ones will be 5: 2. On the other hand, there are also estimates according to which digitalization will lead to an increase in productivity of work by as much as 30 % (Korbel, 2015); this will create a base for bigger sales and increasing turnover of business, and for hiring new employees. Some jobs will cease to exist in the first phase of digitalization but some new jobs will appear. For every one job that will disappear, there will be up to 2,5 new jobs (MPO, 2016, p. 19). Qualified estimates therefore vary from the pessimistic visions to the optimistic ones. It is therefore important to consider the reservations about them, too.

The problematics of a rate of threat concerning employment is also described in the OECD study from 2016 (see Picture 3.1). In the picture, there are clear differences between countries; these are influenced by a range of factors, for example a volume of investments put into the digitalization of economy, structure of national economy (aimed at products and services with high added value), volume of investments into education (countries that achieved a high level of human capital and that focus on highly wualified workers have a lower rate of workers under a high level of threat by automatization). It is apparent from the conclusion of the study that there is 6–12 % of employees working in professions under a high threat by automatization.

[6] Machine learning is a sub-area of artificial intelligence dealing with algorhytms that make it possible for a computer system „to learn“. In the context, „learning“ means a change in a system internal state which will make the ability to adjust to changes in surrounding environment more effective.

The highest percentage is in Germany, Austria and Spain (12 %).

Picture 3.1 Workers in professions with a high threat by automatization and professions threatened by a significant change (in %)



a) Jobs are at high risk of automation if the likelihood of their job being automated is at least 70%. Jobs at risk of significant change are those with the likelihood of their job being automated estimated at between 50 and 70%.
b) Data for Belgium correspond to Flanders and data for the United Kingdom to England and Northern Ireland.
Source: OECD calculations based on the Survey of Adult Skills (PIAAC) 2012; and Arntz, Gregory and Zierahn (2016), "The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis", *OECD Social, Employment and Migration Working Paper*, No. 189, OECD Publishing, Paris.

Source: OECD (2016a).

Concerning the Czech Republic, it is said in the study that during the next 20 years, 10 % of jobs are likely to be at risk due to automatization, and another 35 % jobs will go through significant changes. In absolute numbers it means that there will be about 408 thousand jobs in danger and about 1,4 million jobs will undergo significant changes. The Czech Republic together with Slovakia and Italy belong to the countries with the highest percentage of jobs which will undergo a fundamental change.

Chmelař and col. (2015, s. 8) states that **compared to the advanced economies, only a relatively small part of professions in the Czech economy will not be threatened by digitalization at all.** The authors followed up the study of Frey and Osborne (2013) when they transfered the results relating to the probability of threat by digitalization from Americal classification of professions (SOC) to the international CZ-ISCO classification used in the Czech Republic (see Tables 3.2 and 3.3).

Table 3.2 Professions with the highest indicator of a threat by digitalization

ISCO-3 Code	Profession	Index of threats by digitalization
431.	Officers for processing numerical data	0,98.
411.	General administrative workers	0,98.
832.	Motorcycle and automobile drivers (except lorries)	0,98.
523.	Cashiers and tickets sellers	0,97.
621.	Qualified workers in forestry and related areas	0,97.
722.	Smiths, toolmakers and related workers	0,97.
441.	Other officers	0,96.
412.	Secreteraries (general)	0,96.
834.	Manipulation with mobile equipment	0,96.
612.	Keepers of animals for market	0,95.
921.	Assistants in agriculture, forestry and fishing	0,95.
811.	Manipulation with equipment for mining and processing minerals	0,94.
814.	Manipulation with machines for production and processing products from rubber, plastic and paper	0,94.
432.	Officers in logistics	0,94.
821.	Assembly workers with products and equipment	0,93.
816.	Manipulation with machines for production of foods and related products	0,93.
961.	Workers with waste	0,93.
421.	Cashiers in financial institutions, bookmakers, money lenders, claims collectors and workers in related areas	0,93.
831.	Train drivers and workers ensuring correct setting and safe journey of trains	0,92.
818.	Other workers with stationary machines and equipment	0,92.

Source: Chmelař and col. (2015) based on Frey and Osborne (2013).

Note: Index reaches numbers from 0 to 1. The higher the index number is the higher is the threat for the profession resulting from digitalization.

Table: 3.3 Professions with the lowest index of threat by digitalization

ISCO-3 Code	Profession	Index of threats by digitalization
142.	Managers in retail and wholesale	0,000.
221.	Doctors (except dentists)	0,001.
222.	General nurses and specialized midwifes	0,002.
134.	Managers in education, healthcare, social care and other areas	0,002.
122.	Managers in business, marketing, research, development, advertising and public relations	0,005.
231.	University and college teachers	0,008.
133.	Managers in the area of information and communication technologies	0,008.
141.	Managers in accommodation and catering	0,010.
131.	Managers in agriculture, forestry, fishing and environment	0,011.
226.	Other specialized workers in healthcare	0,011.
215.	Specialists in electrotechnology, electronics and electronic communications	0,015.
252.	Specialists in databases and computer networks	0,021.

143.	Other managers	0,021.
312.	Masters and related workers in mining, production and construction	0,022.
214.	Specialists in production, building and related areas	0,044.
111.	Legislators and the highest officers in public administration, political and free-time organisations	0,048.
213.	Specialists in biology and related areas	0,050.
263.	Specialists in social care, church and related areas	0,054.
132.	Managers in industrial production, mining, building, transportation and related areas	0,054.
242.	Specialists in strategy and personal management	0,056.
264.	Writers, journalists and linguists	0,058.

Source: Chmelař and col. (2015) based on Frey and Osborne (2013).

As far as the **impacts of digitalization within the individual sectors of Czech economy are concerned**, the index shows how much will the sectors have to be transformed internally depending on the number of employees with a high indicator of threat by digitalization. Consequences of the changes in global economic structure will probably be more intensive in the sectors with higher level of digitalization. Greater connection to global economy means not only greater opportunities but also more competitive environment. It can therefore be assumed that the replacement of work by capital will be faster and more effective. In the final effect, the process will have a positive impact on global competitiveness of the mentioned sectors. In limited cases, some level of threat may be apparent in some sectors and their activities may be replaced by activities of other sectors. This is, however, a relatively small risk, as the substitution usually appears on the lowest level (in related areas), not on the level of sectors.

Table 3.4 Indicator of threats by professions digitalization - distribution according to economic sectors

Indicator value	Economic sector
above 80	H - Transportation and storage
	B - Mining and quarrying
80 - 70	A - Agriculture, forestry and fishing
	C - Processing industry
	F - Building and constructions
	E - Water supply
	N - Administrative and support work
70 - 60	G - Wholesale and retail; Repairs and maintenance
	I - Accommodation, food and food service activities
	D - Production and distribution of energy
	L - Work in real estate
	O - Public administration and defence
60 - 50	R - Work in culture, entertainment and recreation
50 - 40	S - Other work activities
	K - Banking and insurance
	Q - Health care and social care
	M - Professional, scientific and technical work

	J - Information and communication activities
below 40	P - Education

Source: Chmelař and col. (2015), own work.

The digitalization process of economics does not only mean the destructiou and threat for some professions and jobs or their transformation though, but it also creates conditions for **building some brand new professions and jobs**. It therefore has a positive influence on the labour market at the same time. The authors (Chmelař and col, 2015) pay attention also to this problematics. Using the so-called **index of digitalization potential**, they present a list of professions with the highest and the lowest positive potential. The ICT specialists represent the greatest potential within digitalization and related processes (specialists on databases and computer networks, management workers in ICT, analysts and software or computer applications developers). On the other hand, assistants in various areas, ticket sellers etc. have the lowest potential.

An interesting look into the development of jobs within the EU in 2011–2015 is described in the results of the *European monitoring of jobs* (Eurofound, 2016) (see Tables 3.5 and 3.6).

Table 3.5 Ten professions with the fastest growth of employment in EU (2011 - 2015)

Occupation	**Area of business**	**% change 2011-2015**	**Wages category**
ICT specialists	ICT programming and assistance	+38,6.	5.
Specialists in business and administration	Services provided to companies	+33,6.	5.
Specialists in law, social field and culture	Sports and recreation activities	+23,0.	3.
Workers in services / personal care	Households as employers	+20,5.	1.
Specialists in law, social field and culture	Creative, artistic and entertainment activities	+17,1.	4.
Mechinery and equipment technicians	Production of food products	+16,7.	2.
Workers in care	Social care in households	+16,2.	2.
Specialists in business and administration	Financial services	+16,1.	5.
Specialists in law, social field and culture	Legal and accounting services	+15,2.	5.
Assistants in kitchens	Catering	+14,7.	1.

Source: Eurofound (2016), own work.

Note: The wages cathegory reaches numbers from 1 (jobs with the worst income) to 5 (jobs with the best income).

The highest increase in employment was recorded in case of the ICT specialists, almost 39 %. Nevertheless, there is still less than 1 % of the Europeans working in this field, there is therefore limited impact on the total employment and employment structure for now.

Since the end of the 1990s, it has been possible to see a rise in employment in the professions with the highest salaries on the European labour market (at times of economic growth as well as recession). This trend is also confirmed by the developments in 2011 - 2015. The four professions with the highest increase in employment also belong to the best paid ones at the same time (wages cathegory 5). These include the IT specialists (programmers and consultants), specialists in financial sector and specialists in services provided to companies.

Table 3.6 Ten jobs with the fastest decrease of employment in EU (2011 - 2015).

Occupation	Area of business	% change 2011-2015	Wage category
Sellers	Wholesale	-14,4.	2.
Workers in construction in related areas	Specialized construction works	-12,5.	2.
Workers in construction in related areas	Construction of buildings	-9,0.	3.
Officers and administrative workers	Public administration and social security	-8,0.	3.
Qualified workers in agriculture	Growing of crops and animal production	-7,7.	2.
Managers in catering and retail	Retail	-7,5.	4.
Workers in cleaning and assistants	Household as an employer	-6,7.	1.
Workers in metalurgy, engineering and related areas	Production of metallic parts	-6,5.	3.
Security workers	Public administration	-5,6.	4.
Workers in electro	Specialised construction works	-4,8.	3.

Source: Eurofound (2016), own work.

Table 3.6 shows that there is a significant decrease in the number of workers for example in public administration where are lower numbers of especially administrative and social workers. It is caused mainly by financial savings in public sector, which were adopted by most member states of the EU in the past years. There are also less employees in retail. In an attempt to decrease the costs and to strengthen their competitiveness, many businesses did some restructuralization which resulted in a decrease in a number of jobs, especially on the middle management level. A purpose of the changes was to maximize a number of employees in direct customer service. The described steps as well as a decrease of sellers and workers in construction has to be viewed in the context of the 2008 financial crisis (decrease of competitiveness, steps to achieve savings), as its consequences remained in the next years, too.

The labour market therefore goes through continuous changes, jobs and professions come and cease to exist. But in fact, the causes of the changes vary a lot - economic cycle, saving in public administration, attempts of businesses to strengthen their position against competition by means of more effective organisation of work, technological progress, changes in the structure of

economy (job opportunities move from primary and secondary sectors to services, education, science and research) etc. Because of that, it is very difficult to precisely predict how the jobs will develop with an arrival of the Industry 4.0.

Summary

A study aimed at Czech labour market (Chmelař and col., 2015) assumes that within the next fifteen years, technical workers and specialists (ISCO-3), the number of whom will decrease significantly, will be effected the most by digitalization and its impacts. On the other hand, there is an increasing number of workers who operate machines and equipment (ISCO-8) and people working in services and sales (ISCO-5). The study concluded that in 2029, there will be about 420 thousand less jobs on the labour market (compared to 2015). Such a deep fall of a demand for workforce shall not be seen too pesimisticly though, as it will be accompanied by a decrease in an offer of jobs at the same time. Demografic projections of ČSÚ assume a significant decrease in the number of people in productive age by about 400 thousand (compared to 2015). It can also be assumed that the following will also continue to reflect the labour market: structural unemployment, disharmony of demand and supply as far as the knowledge and skills are concerned, and also longer time for preparation for a job, or other factors.

The digitalization process opens a great potential for further economic growth as well as creation of new jobs, higher living standard and improvement of quality of life. **But to be able to use the positive impacts of digitalization, it is necessary to build appropriate professional structure and digital infrastructure.**

3.2 Preparedness on the side of the jobs offer

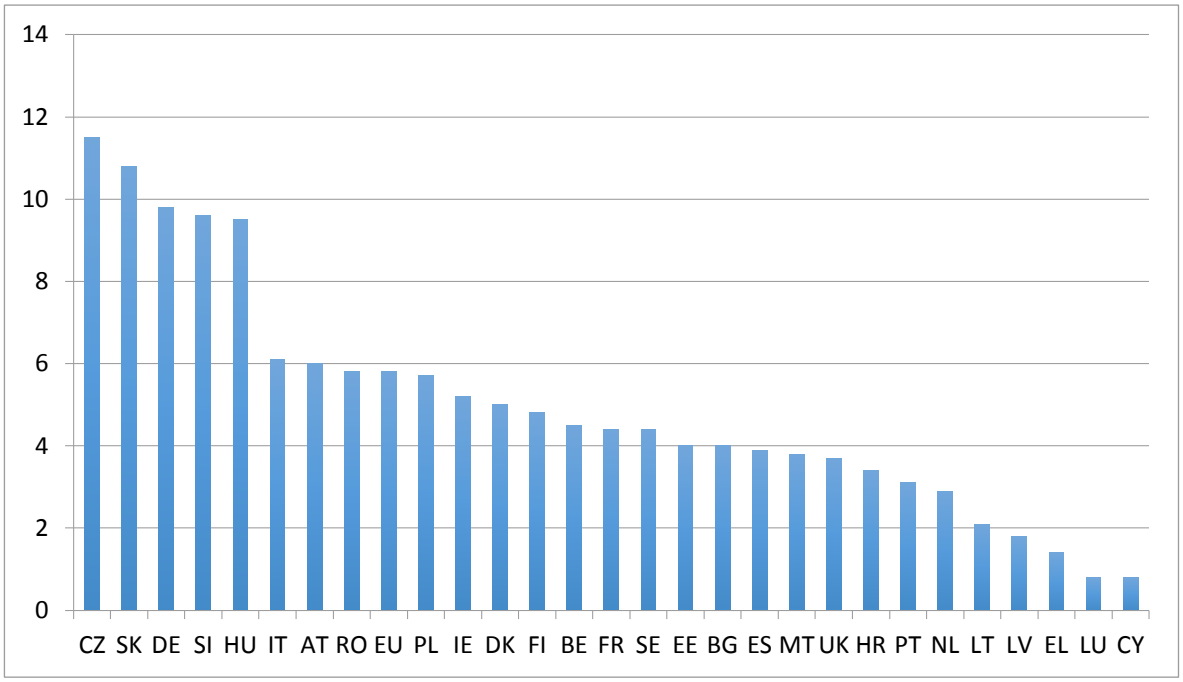
3.2.1 Shifts in the structure of employment and the level of education

At the start of the chapter, it is good to mention that every country has a slightly different structure of workers depending on the overall structure of its economy. The Czech Republic is a small open economy, which is also called ´industrial heart of Europe´. **In industry, there is a high percentage of employees who may be at risk of losing their jobs once the transfer to the Industry 4.0 appears. On the other hand, the expansion of industry makes it possible for society to have a good level of technical knowledge and skills.**

There are about 38 % of all employees working in industry in the Czech Republic, which is the most when compared to other EU countries. Almost one quarter of all employees work in the

processing industry (24 % in 2014), in spite of the fact that its part in total employment has been decreasing from the long-term point of view. Majority of people employed in processing industry work in technologically less demanding professions (55 % in 2014) and areas with a lot of manual work, which is easily replaced by modern technologies. This fact is influenced by ownership structure of businesses into a great extent (for a closer look, see Chapter 2.2).

Picture 3.2 Percentage of workers in high-tech and medium high-tech processing industry in total employment in the EU countries (2016)



Source: Eurostat, own work.

Note: CZ – The Czech Republic, SK – Slovakia, DE – Germany, SI – Slovenia, HU – Hungary, IT – Italy, AT – Austria, RO – Romania, EU – EU-28, PL – Poland, IE – Ireland, DK – Denmark, FI – Finland, BE – Belgium, FR – France, SE – Sweden, EE – Estonia, BG – Bulgaria, ES – Spain, MT – Malta, UK – Great Britain, HR – Croatia, PT – Portugal, NL – The Netherlands, LT – Lithuania, LV – Latvia, EL – Greece, LU – Luxembourg, CY – Cyprus.

It is clear from the picture that the processing industry plays an important role in ecomomy is Slovakia, Germany, Slovenia and Hungary, too. But an arrangement of employment in the individual economic sectors is different in Germany. Globalization and ICT development result in a shift in the economic structure and lead to a transfer of jobs from agriculture and industry

to services. This trend is typical in the developed economies, where services constitute a much more important employer than in the so-called new member states. For example in Luxembourg, the Netherlands or Great Britain, a percentage of people employed in services comes up to 80 % of all employees. Table 3.7 presents an arrangement of workers in different sectors in the EU countries.

Table 3.7 Participation of workers in different economy sectors in the EU countries (2014, in %)

Country	Agriculture	Industry	Services
Luxembourg	1,5.	12,1.	86,4.
The Netherlands	2,0.	16,0.	81,4.
Great Britain	0,9.	19,0.	80,0.
Cyprus	2,5.	17,7.	79,8.
Sweden	1,8.	19,4.	78,8.
Denmark	2,3.	19,6.	78,0.
Belgium	1,3.	21,8.	76,9.
Ireland	4,8.	18,5.	76,7.
Malta	1,2.	21,7.	76,6.
Spain	4,2.	19,8.	75,9.
France	3,1.	21,4.	75,5.
Finland	3,8.	23,0.	73,1.
Germany	1,3.	28,1.	70,6.
Austria	4,2.	26,2.	69,6.
Italy	3,4.	27,4.	69,1.
Greece	12,9.	15,3.	69,0.
Latvia	7,8.	24,2.	67,9.
Portugal	6,5.	24,3.	67,0.
Lithuania	8,4.	25,6.	65,6.
Hungary	4,9.	30,0.	65,1.
Estonia	4,3.	30,8.	64,8.
Bulgaria	6,5.	30,4.	63,1.
Croatia	9,6.	28,1.	62,3.
Slovenia	7,2.	31,5.	61,3.
Slovakia	3,3.	35,9.	60,8.
The Czech Republic	3,0.	37,8.	59,2.
Poland	11,7.	30,8.	57,5.
Romania	25,7.	29,8.	44,5.

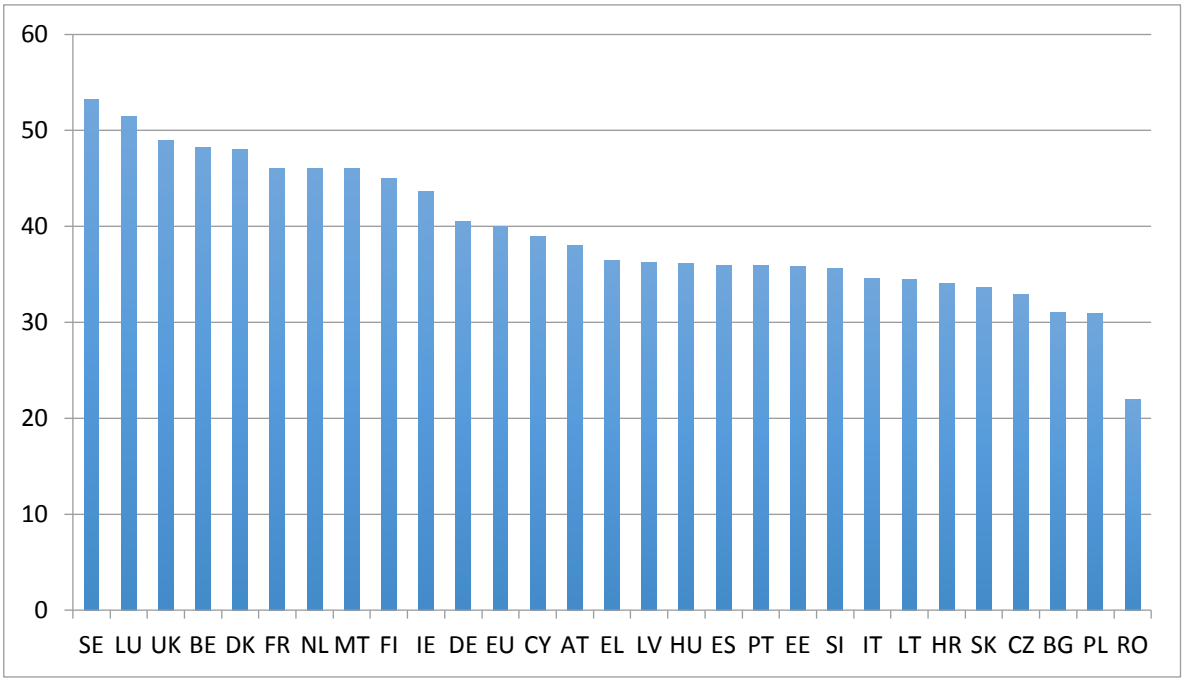
Source Eurostat, ČSÚ (2014).

The countries are written in the table according to their employment percentage in services. It is clear from the information that there are big differences in economic structure between the member states. On one hand, there is less than 1 % of total workforce working in agriculture in Great Britain, on the other hand, it is more than one quarter in Romania. It was just in this sector where work was replaced by capital in the past (mechanization and automatization) and therefore to a huge increase in productivity of work and decrease in the number of jobs. This is

an ongoing process, even though its pace is slower; a number of jobs in this sector is moreless stabilized and no big changes can be expected in the future. There is the highest percentage of people employed in industry in the Czech Republic (37 %), the lowest is in Luxembourg (12,1 %) and Greece (15,3 %). It can be assumed that the number of jobs in this sector will go down in future, and their structure will change. As the Industry 4.0 comes, the requirements of knowledge and skills of workers will change significantly. The Czech Republic is among the countries with the least developed level of services in the EU, the percentage on employment of this sector is lower only in Poland and Romania. **Services constitute a great potential for Czech economy from the viewpoint of creating of new jobs. The services sector could be the one that will absorb the workers released from industry.**

Concerning the gradual transfer to the platform of the Industry 4.0, an important factor is **development of services that require high level of knowledge**, especially the technologically demanding services[7] (e.g. work in telecommunication, information, automatization and cybernetic technologies).

Picture 3.3 Percentage of workers in services that require high level of knowledge in total employment in teh EU countries
(2016, v %)



Source: Eurostat, own work.

[7] The following industries belong to technologically demanding services according to the NACE classification: 64 – Connections, 72 – Work in information technology, 73 – Research and development.

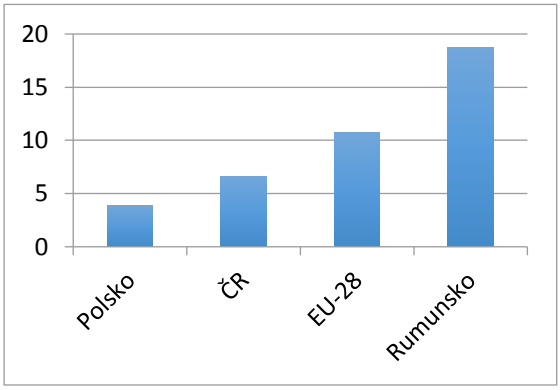
Note: SE – Sweden, LU – Luxembourg, UK – Great Britain, BE – Belgium, DK – Denmark, FR – France, NL – the Netherlands, MT – Malta, FI – Finland, IE – Ireland, DE – Germany, EU – EU-28, CY – Cyprus, AT – Austria, EL – Greece, LV – Lithuania, HU – Hungary, ES – Spain, PT – Portugal, EE – Estonia, SI – Slovenia, IT – Italy, LT – Latvia, HR – Croatia, SK – Slovakia, CZ – the Czech Republic, BG – Bulgaria, PL – Poland, RO – Romania.

Sweeden and Luxembourg are leaders in the area of services that require high level of knowledge, and they are followed by other western European countries. Except for Malta, the new member states move below the EU average. From the original EU-15 countries, this area of services is the most advanced in Italy. In the Czech Republic, part of services requiring high level of knowledge is one of the lowest (32,9 %), nevertheless, a drop in 2015 was followed by an increase by almost 1 % in the following year. As already suggested above, it is an area of services with a great potential of creating new jobs.

Nevertheless, a higher level of human capital is a necessary requirement for the Czech Republic to be able to use all the positive effects arising from the changes in the structure of employment and development of the Society 4.0 development and to move forward to production with higher added value in the value-creating chain.

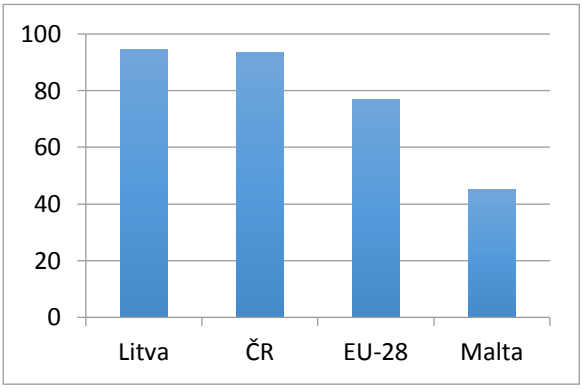
Achieved human capital level has a key role when considering the EU competitiveness as a whole but also on the level of national economies and businesses. Achieved level of education plays a crucial role for individuals who want to prove succesful on labour market. Several indicators have been therefore monitored in the EU systematically - especially a number of people who graduated from university, a number of people with secondary education and a number of people who left education system prematurely.

Picture 3.4 Premature leaving from education[8] (2016, in %)



Source: Eurostat, own work.

Picture 3.5 People with secondary education[9] (2016, in %)



Source: Eurostat, own work.

Note: Pictures show the Czech Republic, country with the best and with the worst result and an average in the EU-28.

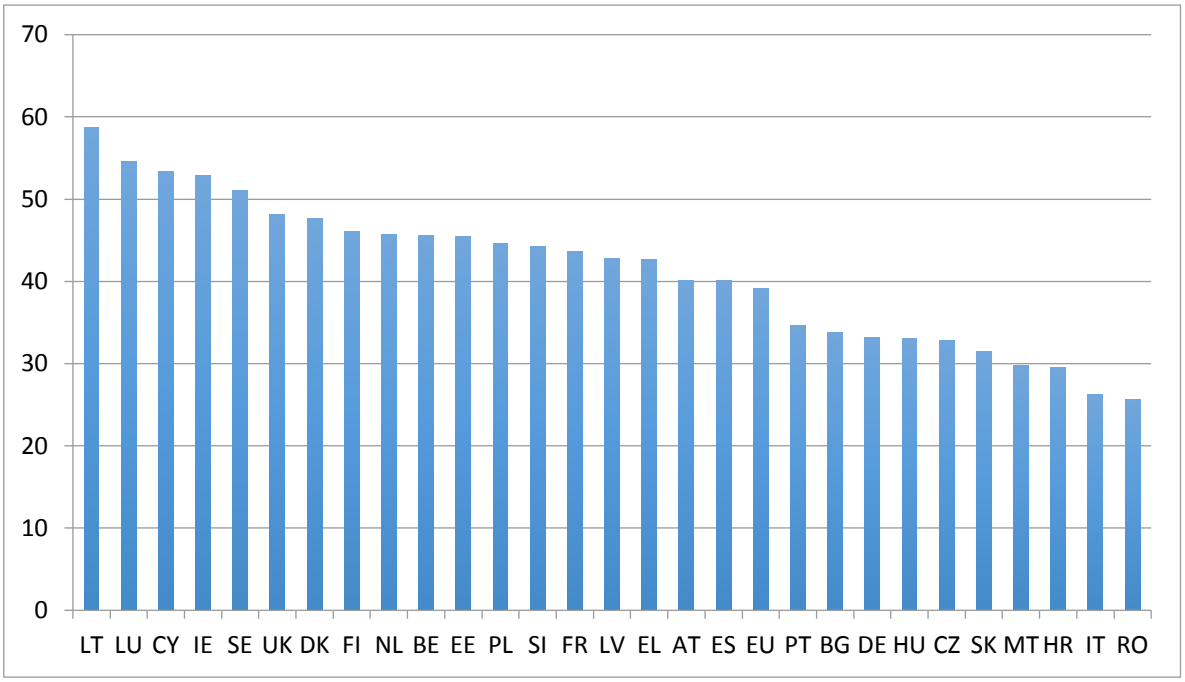
For a long time, the Czech Republic belongs to the leaders as far as the *numbers of people with secondary education* are concerned. The number of people with secondary education is as high as 93,4 %; it is better only in Lithuania with 94,6 % of people with secondary education and also Latvia (90,7 %). On the other hand, the lowest number of people with secondary education is in Malta (45,2 %) and Portugal (46,9 %). In Germany and Austria, the percentage of people with the secondary education is 86,5 %, respectively 84,5 %. The EU average is 77 %.

Also regarding the indicator *Premature leave one´s education*, the Czech Republic is in one of the best positions for a long time, as it has a very low percentage of premature leaving from education (6,6 %). Only Poland (3,9 %) and Lithuania (4,8 %) are better off. The biggest problem is early leaving from education in Romania (18,7 %), Malta (15,8 %), in Spain (15,1 %) and Bulgaria (13,9 %). The EU average is 10,7 %. In Germany, 10,2 % leave education system prematurely and 6,9 % people in Austria.

As far as the *number of university graduates* is concerned, the Czech Republic is under the EU average, though the percentage of the university educated workforce has been growing. It is a development trend which is apparent in all member states of the EU and which is a reflection of the growing requirements of knowledge and skills of workers.

[8] Indicator of premature leaves from education shows % of people aged 18–24 who achieved lower secondary education as their maximum (grade 0–2 according to the ISCED 2011 classification).
[9] Indicator People with secondary education expresses % of people aged 25–64 who completed at least higher secondary education (grade 3–8 according to the ISCED 2011 qualification).

Picture 3.6 University graduates[10] in the EU countries (2016, v %)



Source: Eurostat, own work.

Note: LT – Lithuania, LU – Luxembourg, CY – Cyprus, IE – Ireland, SE – Sweden, UK – Great Britain, DK – Denmark, FI – Finland, NL – The Netherlands, BE – Belgium, EE – Estonia, PL – Poland, SI – Slovenia, FR – France, LV – Latvia, EL – Greece, AT – Austria, ES – Spain, EU – EU-28, PT – Portugal, BG – Bulgaria, DE – Germany, HU – Hungary, CZ – The Czech Republic, SK – Slovakia, MT – Malta, HR – Croatia, IT – Italy, RO – Romania.

The picture shows significant differences between the countries. The highest percentage of university graduates live in Luxembourg (54,6 %), Cyprus (53,4 %), the Scandinavian countries (ranging from 51 to 46,1 %), then Ireland, Great Britain, the Netherlands and Belgium. Surprisingly, Lithuania is in the first place (58,7 %). After a closer look into the available data, we can see that high level of education is a tradition in this country. From the new member states, also Estonia, Poland or Slovenia have a good position in this indicator. The EU average is 39,1 %. From the original EU-15 countries, Portugal but also Germany and Italy are below average, and Italy has a low number of university graduates for a long time. The Czech Republic (32,8 %) is behind other member states in the number of university graduates, even though there is not a big difference when compared to technological leader - Germany (33,2 %). Concerning Austria, there was a great progress in the past four years, from 27,1 % in 2013 to 40,1 % in 2016.

[10] The indicator University graduates expresses % of people aged 30–34 who succesfully graduated from university (tertiary level, grade 5–8 according to the ISCED 2011 clasification).

Many people will be perhaps surprised by a position of Germany. But it is important to realise that the indicator says nothing about a quality of university education. There is a big added value for Germany thanks to a high level of education system but also a concept of the so-called dual education that enables schools to be closely connected to practical education (from the secondary schools level). Many students work to gain work experience during their studies and go to a company where they will work for once they finish their studies. Germany is succesful in other monitored indicators (number of people who finished secondary school, number of people who leave education prematurely). Despite the lower number of the university graduates, it belongs to the countries with the highest number of patents, it is a home of traditional industries and businesses as well as many excellent centers.

A number of the university graduates in society is one of the many important prerequisites for building the Industry 4.0. A coordination with other factors is important - investing into science, research and education, inovation, quality of a system of education, connecting schools with practical experience etc.

Summary

Globalization process together with development of information and communication technology create great opportunities on one side but on the other hand also much bigger competition. Development of modern technologies causes shifts in the traditional structure of economy, there is a transfer of jobs from agriculture and industry to services. It is still more and more common to speak about the fourth sector, particularly a sector of education, science and research. Sector of services is an important employer in advanced economies, it creates over eighty percent of job opportunities. The Czech Republic belongs to the countries where services are less developed, nevertheless, there is a great potential to create jobs in the future.

Education is an important factor in competitiveness both on the level of the EU, national economies, businesses and also individual on labour market. As a result of technological development, there are growing requirements of knowledge and skills. New jobs are much more often than in the past connected with university education, and this trend will become more and more apparent in the future (see e.g. CEDEFOP, 2008).

The Czech Republic (together with Lithuania) has the highest number of people with secondary education in the EU; also a number of people who left their education prematurely is very low. On the other hand, it falls behind a little in the number of people with tertiary education. **It is**

apparent that a higher level of human capital makes it possible to better use the positive effects which creating the Industry 4.0 and the Society 4.0 will bring. A lack of qualified workforce could be a barrier that could prevent Czech businesses from moving to ´higher floors´ the valuemaking chain. That would definitely have a negative impact on the level of wages and overall living standard.

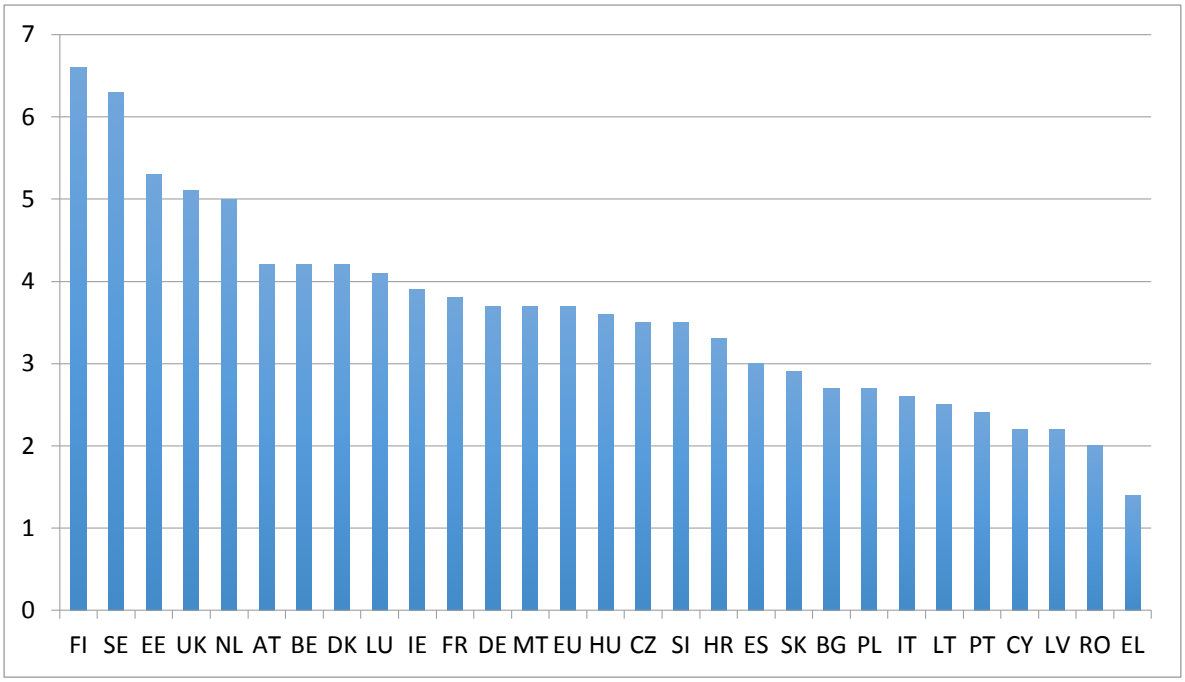
3.2.2 Preparedness of human resources

The speed of the modern technologies expansion and the implementation of the Industry 4.0 elements will very much depend on the **preparedness of human capital on the side of production and services providers and on the side of consumers likewise.** It is necessary to gradually create a congenital qualification structure of inhabitants and to generate a sufficient number of prefessionals and specialists in information and communication technologies, automatization, robotization, cybernetics etc., who will secure required production and services but also research and development (science and development has a key role for a better position of the Czech Republic in the value-setting chain). However, there must be an increase in the level of computer literacy as well as creating adequate ICT infrastructure alongside this process, too. It is very difficult to express the level of both processes, but it is possible to gain some overall view through selected indicators.

Employment and education level in ICT

Based on the available statistical data from Eurostat, it is possible to say that the employment rate in the ICT sector has not been greatly effected by the negative consequences of the financial crises and the following recession, which was apparent in global labour markets. During last decade (2006-2015), the unemployment rate in this sector continously grew in the EU, by 3 % a year on average (which was 8 times more that the average rate of growth for toal employment).

Picture 3.7 Percentage of ICT specialists in total employment in the EU countries (2016, v %)



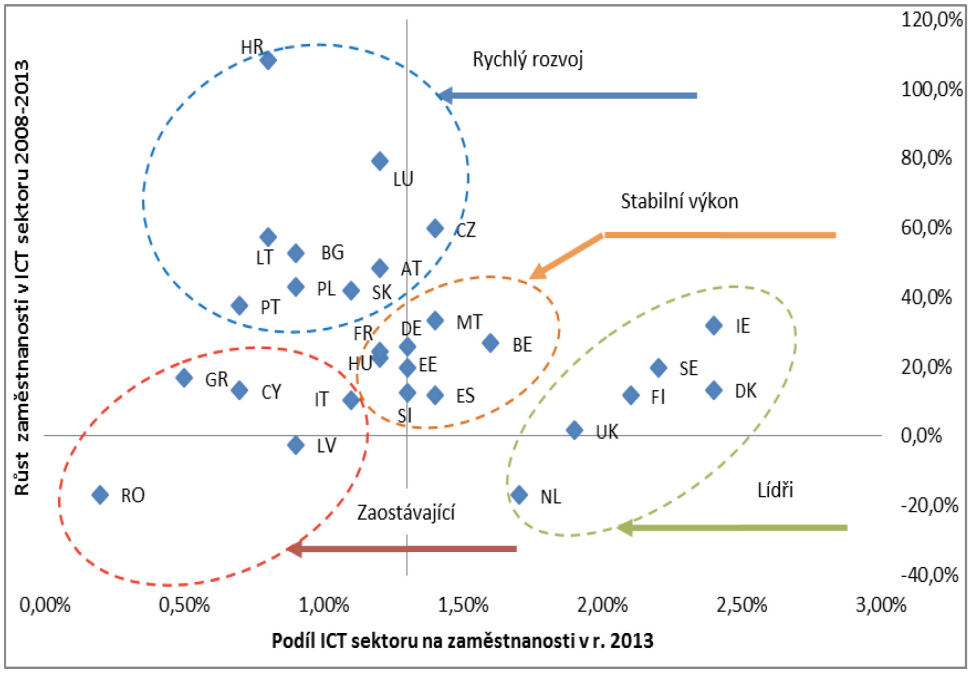
Source: Eurostat, own work.

Note: FI – Finland, SE – Sweden, EE – Estonia, UK – Great Britain, NL – The Netherlands, AT – Austria, BE – Belgium, DK – Denmark, LU – Luxembourg, IE – Ireland, FR – France, DE – Germany, MT – Malta, EU – EU-28, HU – Hungary, CZ – The Czech Republic, SI – Slovenia, HR – Croatia, ES – Spain, SK – Slovakia, BG – Bulgaria, PL – Poland, IT – Italy, LT – Lithuania, PT – Portugal, CY – Cyprus, LV – Latvia, RO – Romania, EL – Greece.

In 2016, the percentage of ICT specialists in total employment in the EU was 3,7 %, in the Czech Republic, however, it was less than average - 3,5 %. Traditionally high percentage of ICT specialists in total employment is in the Scandinavian countries, especially in Finland (6,6 %) and Sweeden (6,3 %). They are followed by Estonia (5,3 %), Great Britain (5,1 %) and the Netherlands (5,0 %). Compared to other new member states, Estonia is outstanding, as (besides Malta) they are under the EU average, and it is Hungary (3,6 %), the Czech Republic, Slovenia, Croatia, Slovakia, Bulgaria, Poland, Lithuania, Cyprus, Latvia and Romania (2 %). From the viewpoint of the central and the eastearn European countries, the position of the Czech Republic is satisfactory; it is behind Estonia (with a big lead) and Hungary. Considering the changes in methodology, it is not possible to use a longer timeline to express the dynamics of this indicator, however, should we look at the development of the indicator in 2012-2016, then there is the highest increase in Estonia (by 1,5 p.b.), whereas there is stagnation in the Czech Republic. **Year on year** (when comparing 2015 and 2016), **the Czech Republic recorded even the worst result of all EU member states**, and that is a drob by 0,2 p.b.! There was a lower decrease also in Slovenia and Slovakia (note: slight decrease in Finland has a completely different context). In already mentioned Estonia, there was a high increase in the percentage of the ICT specialists

in total employment, and it is 0,9 p.b. (followed by Croatia with an increase by 0,6 p.b. and Lithuania by 0,4 p.b.). Considering the analysis, it is possible to indicate that **the digitalization processes of economy in the Czech Republic recently lose their dynamics and are delayed.** Similar conclusions were reached before by the Initiative Industry 4.0 (MPO, 2016) and the following picture 3.8 is taken from it. The EU countries were divided into four groups according to size and dynamics of employment development in ICT sector in 2008 - 2013 (see Picture 3.7).

Picture 3.8 Division of the EU-28 countries according to size and dynamics of the employment development in the ICT sector



Source: MPO (2016, s. 219).

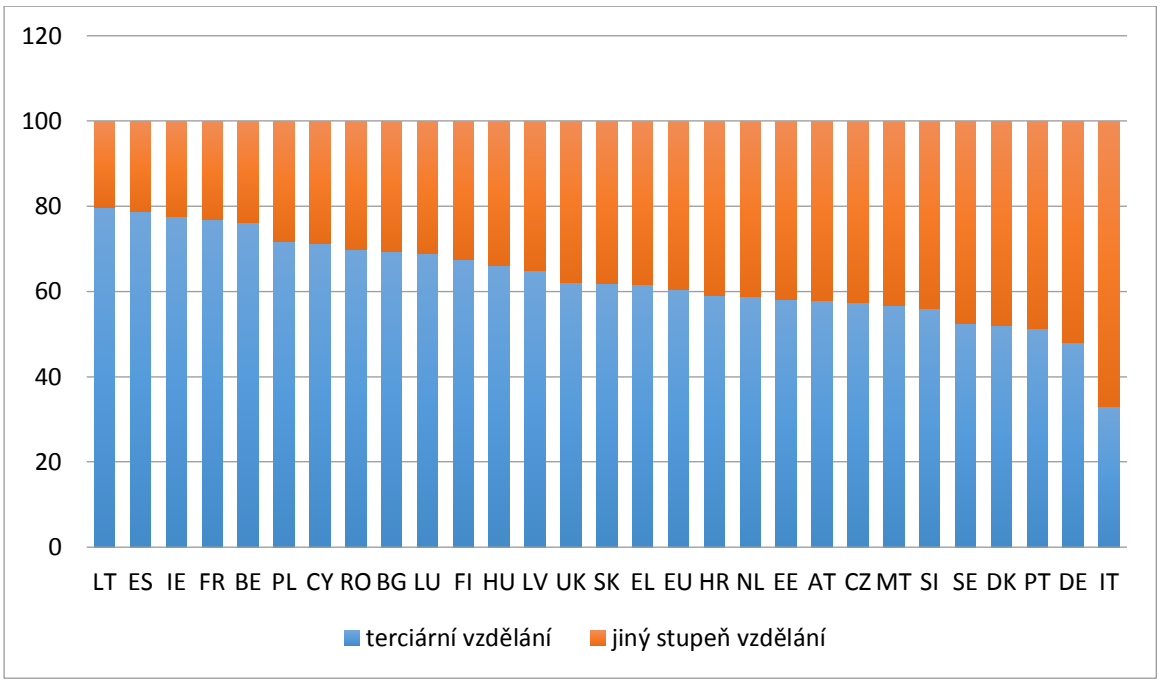
Note: RO – Romania, GR – Greece, CY – Cyprus, IT – Italy, LV – Latvia, HR – Croatia, LU – Luxembourg, CZ – The Czech Republic, AT – Austria, SK – Slovakia, PL – Poland, BG – Bulgaria, PT – Portugal, LT – Lithuania, HU – Hungary, FR – France, DE – Germany, EE – Estonia, SI – Slovenia, MT – Malta, ES – Spain, BE – Belgium, NL – The Netherlands, UK – Great Britain, FI – Finland, SE – Sweden, IE – Ireland, DK – Denmark.

The Czech Republic has been placed among the countries with a quick development of the ICT sphere. It is clear from the development that employment in ICT sector has been growing and there is a higher need of the ICT specialists in the user environment, therefore outside ICT sector. In the monitored time period (2008 - 2013) for example, there were around 381 thousand new jobs that required some knowledge of ICT created outside the ICT sector in the EU. The most of the places appear in the area of services aimed at providing information, company advisory services and public administration, there is also a significant increase in

administration, education, in scientific and technical work and healthcare. In the Czech Republic, the process of separating ICT services from the user areas to specialized agencies still goes on; there are new jobs that require ICT knowledge outside the ICT sector, too, but dynamics of the process is lower. Some delay in the digitalization process in the Czech Republic can also be assumed (MPO, 2016).

As already said above (see Chapter 2.2), quite fast rise in employment in the ICT sector in the Czech Republic is influenced, among other things, by outsourcing of ICT activities from mother countries, especially the medium to difficult activities (like databases maintenance or programming). Work with the highest added value (development of information and cybernetic systems, development of new applications etc.) is still allocated in the head offices of mother companies. Shall the Czech Republic move towards the trend at least partly, it is necessary to focus on **increasing the qualification level of ICT specialists** (see Picture 3.9).

Picture 3.9 ICT specialists in the EU - 28 - according to a level of education (2015, v %)



Source: Eurostat, own work.

Note: LT – Lithuania, ES – Spain, IE – Ireland, FR – France, BE – Belgium, PL – Poland, CY – Cyprus, RO – Romania, BG – Bulgaria, LU – Luxembourg, FI – Finland, HU – Hungary, LV – Latvia, UK – Great Britain, SK – Slovakia, EL – Greece, EU – EU-28, HR – Croatia, NL – the Netherlands, EE – Estonia, AT – Austria, CZ – the Czech Republic, MT – Malta, SI – Slovakia, SE – Sweden, DK – Denmark, PT – Portugal, DE – Germany, IT – Italy.

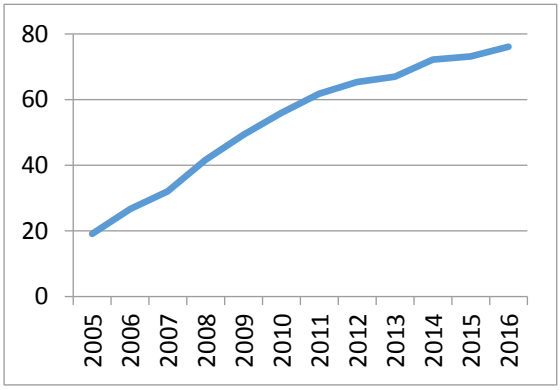
Majority of ICT specialists with the EU-28 have achieved teriary education (60,5 %). The highest percentage of specialists with this level of education live in Lithuania (79,8 %), Spain (78,7 %) and Ireland (77,5 %). On the other hand, the lowest percentage are in Italy (33,1 %),

Germany (48,1 %) and Portugal (51,4 %). **The Czech Republic moves above the EU average** with its 57,4 %. In 2005 - 2015, there was a slight increase in the percentage of the university education by 7.2 p.b. in the EU. There were, however, differences between the EU countries. The highest increase in the number of the ICT specialists with tertiary education was recorded in Hungary (by 26,3 p.b.) and Malta (by 25,6 p.b.) **Another country with great dynamics of a development of education structure of ICT specialists towards tertiary education is the Czech Republic, too,** with an increase by 23,3 p.b., Lithuania, Austria and Romania. On the other hand, there are countries where there is a decrease in the percentage of the ICT specialists tertiary education; majority on Cyprus (by 9 p.b.), Germany (by 3 p.b.). and Belgium (by 1,9 p.b.); at the same time, Cyprus and Belgium are countries with a high percentage of the ICT specialists with tertiary education.

Households equipped by the Internet and a level of computer literacy

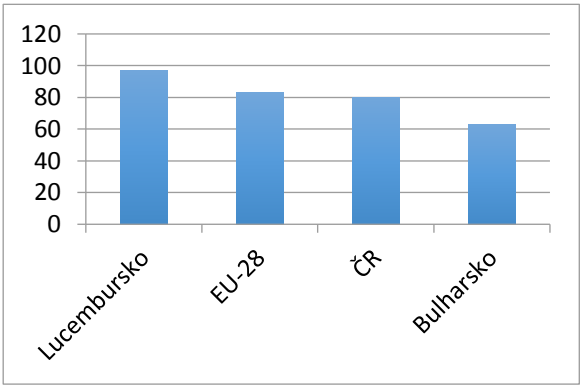
On the consumers´ side, there are two main conditions of building the Society 4.0, and these are *households being connected to the Internet* and *computer literacy*.

Picture 3.10 Czech Republic households connected to the Internet (in %)



Source: ČSÚ, own work

Picture 3.11 Households connected to the Internet in EU (2016, in %)



Source: Eurostat, own work.

Note: Picture 3.10 shows the Czech Republic, country with the best and the worst result and an average in the EU - 28.

Connection of the Czech households to the Internet has been growing dynamically since 2005, whereas in 2005, not even 20 % of them were connected to the Internet, and it was four times more in 2016 (about 80 %). International comparison (see Picture 3.11) indicates that in spite of the dynamic increase, **the number of Czech households connected to the Internet still is slightly below the EU average**, which is 83 %. Countries with the highest number of households that are connected to the Internet include Luxembourg (97 %), the Netherlands (95

%), Great Britain, Denmark (both 92 %), Finland (91 %) and Germany (90 %). The indicator reaches 85 % in Austria. The lowest percentage of households connected to the Internet is in Bulgaria (63 %). **The Czech Republic is in relatively good position among the central and eastern European countries;** only Estonia is better in this indicator (with 85 %). The comparison again confirms quite outstanding results of the Scandinavian countries and how the western Europian countries are ahead in general. Nevertheless, there are big differences among the EU-15 countries - the southern European countries (Spain, Italy, Portugal and Greece) are behind the EU average in the number of households connected to the Internet, Spain is the best of them (81 %) and Greece is the worst (68 %). The same thing can be said about France, where 79 % of households are connected to the Internet.

Table 3.8 People with high, medium and low knowledge of computer work in the EU (% people aged 16–74, 2014)[11]

Country	High level	Medium level	Low level
Finland	46.	27.	13.
Luxebbourg	42.	33.	14.
Denmark	39.	30.	15.
Sweden	38.	28.	18.
Estonia	37.	24.	15.
Austria	34.	29.	15.
Lithuania	34.	23.	11.
Portugal	34.	20.	10.
Great Britain	33.	29.	16.
France	33.	28.	15.
Spain	33.	22.	12.
Slovenia	31.	21.	12.
Germany	30.	31.	18.
Latvia	30.	23.	13.
Greece	30.	15.	13.
EU-28	**29**	**26**	**15**
The Czech Republic	**27**	**23**	**18**
The Netherlands	27	32	22
Malta	26	24	14
Ireland	26	22	13
Italy	26	21	12
Slovakia	25	32	20
Belgium	24	28	23
Hungary	24	26	18
Cyprus	23	22	19
Croatia	22	18	20
Poland	21	23	14

[11]Respondents are asked about performing specific things on computer: copying / moving files, copying and pasting data within a document, basic calculations in table processors, comprimation / zipping documents, attachments / installation of new devices or using programming language to create programmes. Such high level means that an individual manages 5 to 6 activities, at a secondary level it is 3 to 4 activities and at a low level it is 1 or 2 ones.

Bulgaria	15	21	16
Romania	7	13	18

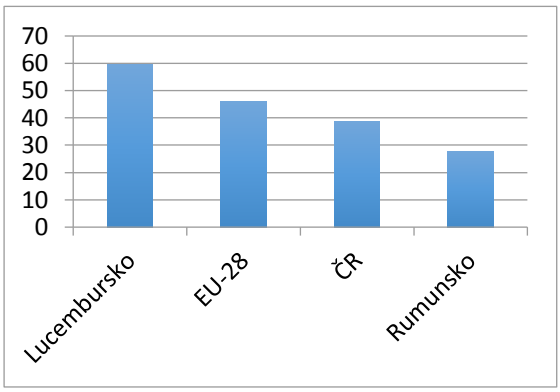
Source: Eurostat, own work.

It is apparent from the Table 3.8 that majority of with high level of computer skills are again in the Scandinavian countries, Luxembourg and also Estonia. **The Czech Republic is slightly below the EU average in this indicator** but **compared to the countries of central and eastern Europe, it is behind the Baltic States (Estonia, Lithuania and Latvia) and Slovenia.** People from Romania and Bulgaria have the worst level of the work with computer.

Other indicators of preparedness

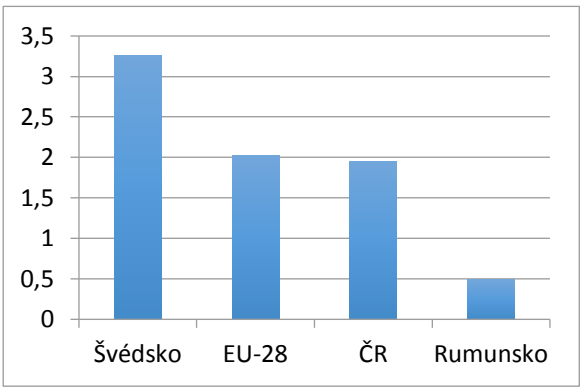
Besides the indicators that directly concern the information and communication technology, there is a range of other indicators that may help to express the preparedness of society to the arrival of the Industry 4.0. Considering the importance of science and technologies for further digitalization process, there are two indicators that make it possible to obtain a more plastic picture, and these are Human resources in science and technologies (LZVT) and Expenses on research and development.

Picture 3.12 Human resources in science and technology (2016)



Source: Eurostat, own work.

Picture 3.13 Expenses for research and development (2015, % GDP)



Source: Eurostat, own work.

Note: Picture shows the Czech Republic, a country with the best and the worst result and an average in the EU - 28.

Human resources in science and technology are defined as people who either successfully completed tertiary education or who work in science and technology sectors. The indicator expresses a LZVT percentage on economically active people aged 25-64. The highest LZVT percentage is in Luxembourg (59,6 %) and then Sweden (57,9 %), Great Britain and Finland (both 56,9 %). Over 50 % of the people are in Ireland, Denmark, Belgium, France and Cyprus.

On the other hand, the lowest percentage of LZVT is in Romania (27,6 %), Slovakia (34,2 %) and in Portugal (36,2 %). **In the Czech Republic, the percentage of LZVT is 38,7 % and it is under the EU average** (46 %). We are not the worst among the middle and western European countries but e.g. Slovenia, Poland, Lithuania and Latvia have better results. The position of the Czech Republic below average in this indicator is closely connected to a lower percentage of people who finished tertiary education in society as well as investments into science and research besides other things. In Germany, the percentage of LZVT is 48,4 %, and it is 49,1 % in Austria.

Expenses on research and development are one of the key indicators that is systematically monitored when fulfilling the Strategy Europe 2020; one of the goals set in here is to set a limit for annual expenses on the research and development in the EU, which would be 3 % GDP. The greatest volume of finances for research and development in available in the Scandinavian countries (Sweeden 3,26 %, Denmark 3,03 %, Finland (2,90 %), Austria (3,07 %) and Germany (2,87 %). On the other hand, the lowest expenses going to research and development is in Romania (0,49 %), Croatia, Malta and Bulgaria (under 1 %). **As far as the Czech Republic is concerned, its volume of expenses (1, 95 %) is slightly below the EU-28 average,** which is 2,03 %. **The Czech Republic has one of the best positions among the central and the eastern European countries** – Only Slovenia has a higher volume of expenses for science and research (2,21 %).

Summary

After succesful building of the Industry 4.0 and the Society 4.0 in general, another important thing is preparedness of human resources on the side of producers and providers of services and on the side of their users likewise. Based on analysis of selected indicators, it is possible to say that **preparedness of human resources in the Czech Republic is slightly below average among the EU countries**. **Compared to the countries of central and eastern Europe, a position of the Czech Republic is very good.** It is among the countries with fast development of ICT, however, there has been some stagnation of the digitalization processes as well as some delay recently (which is confirmed by the year-on-year decrease of the number of ICT specialists in total employment, the highest in the EU). On the other hand, dynamic changes in the education structure of the ICT specialists towards tertiary education are very positive. Computer literacy of Czech inhabitants is slightly under the EU average, too. A position of the Czech Republic is not outstanding among the central and the eastern European countries

concerning this indicator, and it is slightly above average (on average, there is 25 % people who have a high level of working with a computer, it is 27 % in the Czech Republic).

4. Social aspects of the digitalization process

Putting the Industry 4.0 concept into practise is connected with higher and higher requirements for education and human resources skills, and in general, it assumes a growing level of human capital in society. From this point of view, it is an important shift towards the so-called **knowledgable society** (society based on knowledge).

Fast technological development together with growing requirements of knowledge and skills of workers are reflected not only in the situation on labour markets but also it changes businesses significantly. There are changes in the organisational structure of businesses (towards flattening and decentralization) and also changes in management style (from orders towards leadership and knowledge management). In theory, a business that is able to share knowledge fast and effectively, make inovations and react to changes in market quickly is called a **knowledge creating company** (*Knowledge-Creating Company*).

There is growing importance of **work teams** in companies. In future, a role of **virtual work teams** will be much more important, and those will change on request; ad hoc teams will come into existence, the aim of which will be to create projects, complete tasks, solve problems etc. Virtual connections will enable communication of experts and specialists on global level (creation of a team will not be limited by a company, region or country). On one hand, it creates great possibilities to share and to use knowledge, to solve problems and complete tasks effectively etc., on the other hand, this form of cooperation emposses high requirements on team members, their knowledge, language equipment and communication abilities.

One of the important characteristics of the Industry 4.0 is the mass individualization of production, that is ability to react flexibly to customers requirements. There will be closer cooperation and communication between producers and service providers and final consumers. This ability, however, requires **more adaptable and flexible forms of employment and organisation of working hours and also the requirements of the knowledge and skills of workers are changing.**

The outlined trends as well as many others that have been mentioned in the text create new opportunities as well as threats on markets.

4.1 Changes in the form of employment

Expansion of modern technologies allows much greater space for having flexible forms of employment. Flexible and less traditional forms of employment are still not very common in the Czech Republic, nevertheless, there is a great potential for the future. Many of the now developing forms are not even defined in the labour law. Classical flexible forms of employment include especially entering temporary contracts or shorter working hours; some new include entering employment through job agencies, work from home or another place, rotation of work or a job share. The below text outlines the most common flexible forms of employment, desccribes their advantages, disadvantages as well as possible threats for workers.

4.1.1 Flexible forms of employment

Perhaps the most common form of flexible employment is a temporary contract. The indicator *Percentage of employees with a temporary contract* is together with the indicator *Percentage of employees working part-time* an important indicator of the labour markets flexibility. Both indicators are monitored for a long time in Europe.

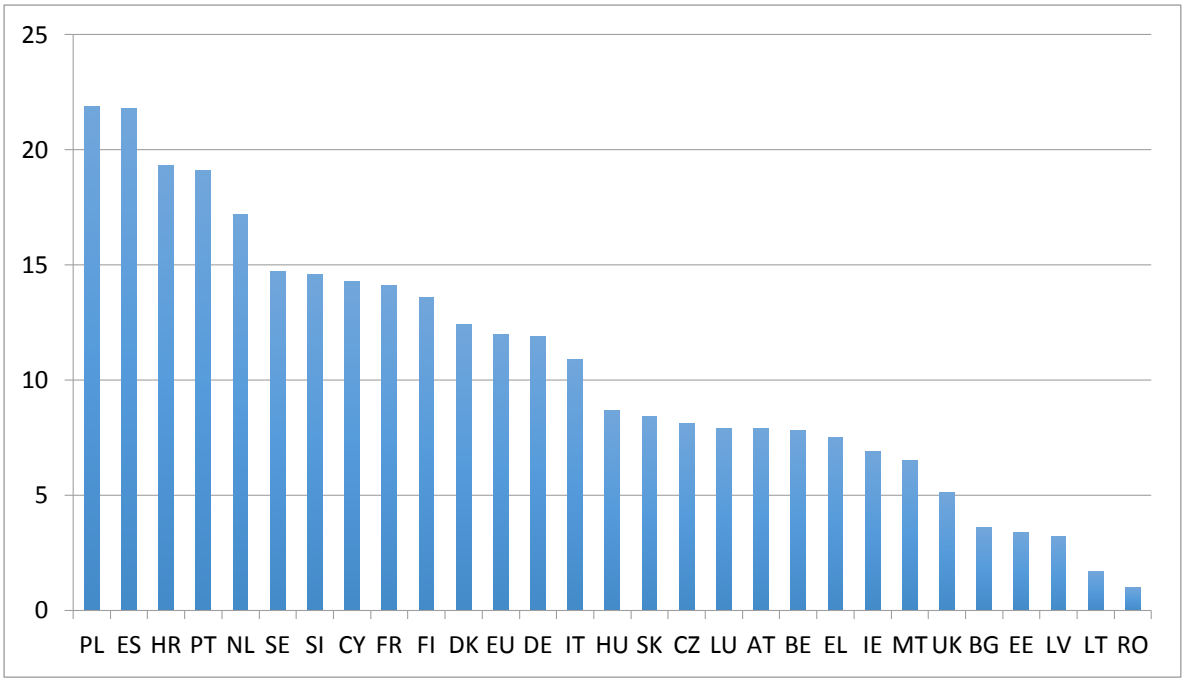
Temporary contracts

Temporary contracts are an important tool of the so-called **contractual flexibility**. They are entered into especially by the workers who do seasonal work, then those who are employed through agencies or job centers and who perform some tasks for the third parties, but also by the workers whose contracts are bound with educational or training programmes. Regulating this form of employment has a long tradition in the EU-25 countries (e.g. in Austria since 1811). ES directive concerning temporary contracts [12]contributed to some sort of harmonization, nevertheless, there are differences in the regulation of this form of employment in different member states. This problematics is reagulated by the labour code in the Czech Republic.[13]

As the analysis of legal environment showed (Nekolová, 2010), the lowest flexibility based on temporary employment can be found in the labour law in France, Portugal and Romania, on the contrary to that, Austria, Hungary and Poland have the most flexible legal environment.

[12] The Council directive 1999/70/ES from 28th June 1999 on the framework agreement about temporary employment which was entered into by organisations UNICE (European Union of Confederations of Industry and Employers), CEEP (European Center of Public Companies) a EKOS (European Confederation of Trade Unions).
[13] The Act no. 262/2006 Sb., the labour code, as amended.

Picture 4.1 Percentage of employees with temporary contracts in the EU-28
(% of the total number of employees in productive age 15–64 years, 2016)



Source: Eurostat, own work.

Note: PL – Poland, ES – Spain, HR – Croatia, PT – Portugal, NL – the Netherlands, SE – Sweden, SI – Slovenia, CY – Cyprus, FR – France, DK – Denmark, EU – EU-28, DE – Germany, IT – Italy, HU – Hungary, SK – Slovakia, CZ – the Czech Republic, LU – Luxembourg, AT – Austria, BE – Belgium, EL – Greece, IE – Ireland, MT – Malta, UK – Great Britain, BG – Bulgaria, EE – Estonia, LV – Latvia, LT – Lithuania, RO – Romania.

It is apparent from the Picture 4.1 that there are great differences among the member states. In 2016, most temporary contracts were entered into in Poland (21,9 %) and Spain (21,8 %). Generally speaking, this form of employment prevails in the EU-15 countries, especially in the Scandinavian countries; from the new members, it is common in Poland, Slovenia and Croatia, where it grew very fast in last decade. **The Czech Republic is significantly below the EU average in this indicator** (12 %); only 8,1 % of all employees were employed with temporary contracts in 2016. This form of employment is the least common in Romania (1 %) and Lithuania (1,7 %).

Looking at this indicator in time horizont within the EU, it was continuously rising from 2000 to 2007 when it reached its maximum (12,2 %); there was a slight decrease from 2008 (to 11,5 % in 2012 and 2013) and only from 2014, the percentage of temporary contracts has been increasing again. The trend indicates that at the time of economic crises and recession, it is just

the workers with temporary contracts who are dismissed first. Available data also show that **temporary employments lead to permanent employments less often than before 2008.**

Advantages: The contractual flexibility is an important tool for adapting the number of employees to incurred needs inside business and from external labour market, too. This way, businesses can better react to incurred situation on market; it is easier to dismiss people but also to employ new workers. Contractual flexibility makes it possible for the employers to screen their employees as for their qualifications, skills and abilities that are sometimes impossible to assess during the three-month trial period.

Disadvantages: Workers with temporary contracts often have worse working conditions and legal protection than those with permanent contracts (worse access to training, lower autonomy of workplace, absence of benefits).

Recommendations: For the future, it is desirable to organize especially better access to business training for the workers. Temporary contracts should not ´isolate´ the workers from access to new information, as it could otherwise lead to further deterioration of their positions on labour market. There is a great potential for the cooperation of trade unions and employers as well as collective negotiation in this sphere.

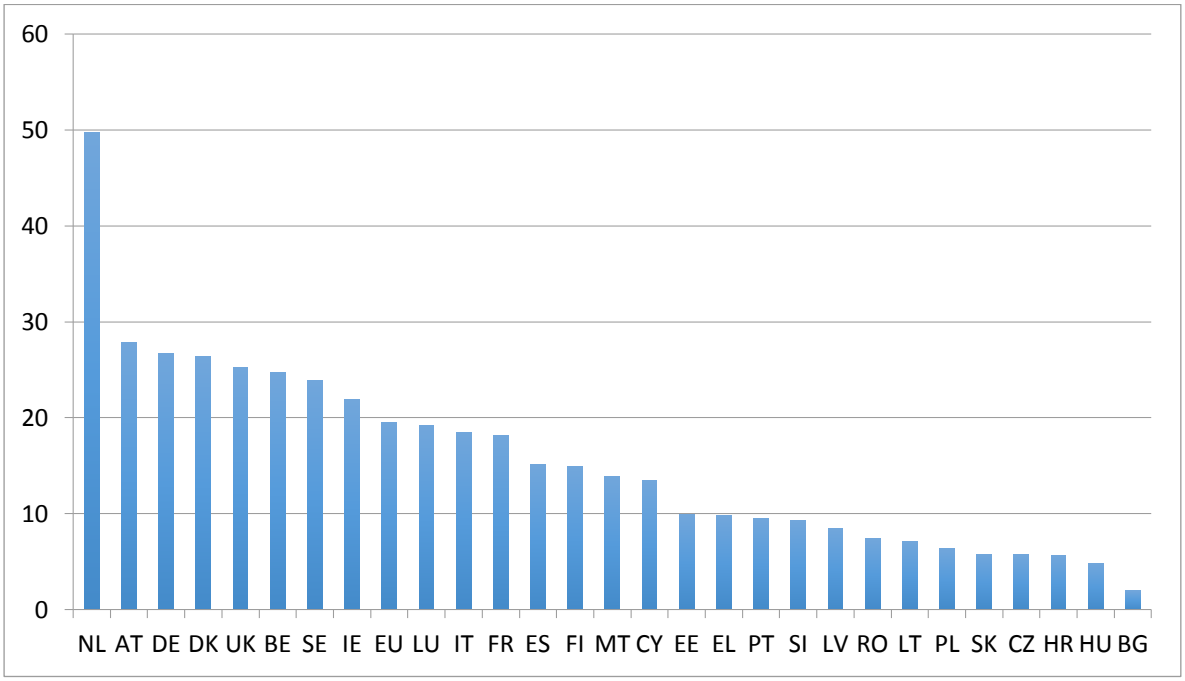
Part-time work

Part-time work belongs to important tools of the so-called **flexibility of working hours** (also time flexibility). It makes it possible for the businesses to ensure higher flexibility through adjustments and better organisation of the working hours as well as more flexible payment terms. This is to do especially with part-time work, working overtime, weekend work, changeble or irregular working hours. Some forms of setting the working hours will be preferred by businesses, some other by the workers. For example flexible working hours, part-time work, premature or later retirement may be a mutual advantage.

Also part-time working hours (just like temporary contracts) are subject to significant regulation in the EU countries; from the second half of last century in the EU-15 countries. In the central and the eastern European countries, this form of employment was legalized only in connection with an implementation of the EU directive about part-time work. It is included in the Labour Code in the Czech Republic.[14] Regulations vary a lot in different countries, nevertheless, part-time contracts can be temporary as well as permanent in all countries.

[14] The Act no. 262/2006 Sb., the labour code, as amended.

Picture 4.2 Percentage of the employed in part-time work in the EU-28
(% of total unemployment, 15–64 years, 2016)



Source: Eurostat, own work.

Note: NL – the Netherlands, AT – Austria, DE – Germany, DK – Denmark, UK – Great Britain, BE – Belgium, SE – Sweden, IE – Ireland, EU – EU-28, LU – Luxembourg, IT – Italy, FR – France, ES – Spain, FI – Finland, MT – Malta, CY – Cyprus, EE – Estonia, EL – Greece, PT – Portugal, SI – Slovenia, LV – Latvia, RO – Romania, LT – Lithuania, PL – Poland, SK – Slovakia, CZ – the Czech Republic, HR – Croatia, HU – Hungary, BG – Bulgaria.

Differences in using part-time workers are much greater across the EU than in case of using temporary workers. Almost a half of the employees in the Netherlands work part-time, whereas in Bulgaria it is only 2 %. Working part-time also differs a lot between the original and the new member states. They are widely used in Austria (27,8 %), Germany (26,7 %), but also Denmark, Great Britain, Belgium and Ireland. This indicator moves somewhere under ten percent only in the new member states, with an exception of Greece and Portugal. **There is only minimum of part-time contracts in the Czech Republic (5,7 %).**

Benefits: This flexible form of employment has advantages especially for women who return from maternity or parental leave, for students or people who gradually retire. It is therefore a tool suitbale for the harmonization of time and work and personal life (*work-life balance*). It usually brings higher productivity and greater effectivity of work for an employer.

Disadvantages: Although the part-time workers have the same formal status as the full-time workers, they are often put to disadvatage in practise. The volume of work they carry out often exceeds the number of set hours, so in reality, they work for lower wages. Also, they usually do not have access to all employee benefits and only a limited access to education.

Reccommendations: It is desirable to have more of such form of employment in the Czech Republic. This combination of a small number of part-time contracts and insufficien number of pre-school facilities is a barrier especially for mothers with young children, also together with a very poor level of related services. Another important thing is also to *de facto* equalize the position of the employees who work part-time with the full-time workers.. In connection with the arrival of the Industry 4.0, it is necessary that all workers, no matter what form of employment they enter into, have access to company traning, opportunity to share the newest information from their industry etc. There should be a closer cooperation of trade unions and employers in this case, too.

Temporary employment through employment agency

Agency employment belongs to the so-called **triangle working relations**, which means one employee between two employers. It is a relatively new but rapidly developing flexible form of employment within the EU, even though a proportion of agency workers is still relatively low (estimates are about 2 %). The harmonization framework is described in the ES directive on agency employment. The biggest problem of employment through agency within the EU constitutes the fulfilment of the requirement of the same conditions of work for agency workers and stem workers. The directive is limited only to BOZP (health and safety at work). The principal of equal opportunities including wages is therefore regulated differently in different countries, either by law or collective agreement, or not at all.

Agency employment is described in the employment law in **the Czech Republic**. Recently, there has been a great **increase in agency employment**; according to data of the Association of Employment Agencies, there were 1830 employment agencies working in the Czech Republic in the middle of 2016, which intermediate employment for about 200 thousand people every year. In previous years though, especially large businesses used this form of employment, today it is more and more common in the mid-size and small businesses.

Advantages: This form of employment fulfills the requirement of employers to have flexibility and a decrease in the administrative costs (especially in the area of personalistics and wages accounting). It makes it possible for them to hire workers flexibly according to current needs. Temporary employment through agencies is traditionally used especially to cover seasonal work, temporary short-term jobs, projects for limited period of time and to add to the number of stem workers in case of large contracts etc.

Disadvantages: One big disadvantage for employees is often worse conditions when compared to stem workers, and this usually appears in all aspects - protection of the position, amount of wages, access to company education, minimum health and safety at work etc. In most cases, a character of work is uncertain for the agency workers. Another important disadvantage is low enforceability of securing the same conditions for agency workers.

Reccommendations: It is necessary to define the ´comparable working conditions´ precisely for the agency as well as the stem workers, especially for the blue-collar professions where the situation is the most serious. Creating suitable conditions to achieve effective controls by the work inspection may be a cultivation tool. Lately but not lastly, there should be stricter conditions to set up labour agencies and their functioning.

Work from home

Home working has a long tradition in the EU. Development of modern technologies, however, greatly extended the use of this form of employment to the so-called *teleworking*. Legal regulation of home working varies in different EU countries. In some countries, this form of work is a part of the labour law (for example Greece, Poland, Portugal), whereas it is a part of collective agreements on national level for example in the Scandinavian countries. Also the legal status of employees working from home varies. Home working is usually based on standard employment contract, however, in some countries (e.g. Germany or Great Britain), it is possible to work from home and be self-employed.

In the Czech Republic, work from home is described in the employment law [15]and is carried out under a standard employment contract. This form of employment is used for many years in the Czech Republic, nevertheless, there have been changes in the structure of workers due to the ICT developments, and it extended significantly.

An employee works from home as much as 90 % in home working / teleworking. Only a few years ago, this form of work was performed especially by women on maternity leave or in pre-pension age, respectively people with disabilities. Teleworking is now common in many professions, like for example graphics, programming, translations, business dealers, insurance agents, accountants etc.

Advantages: For an employer, this form of employment brings lower costs per employee, e.g. in a form of savings of the office costs, and also happier employees and therefore increase in

[15] The Act no 262/2006 Sb., the Labour Code, as amended.

productivity. Teleworking has some benefits for employees, too, especially more flexible planning of time, saving the costs of travel to work including saving their time, possibility to balance working life with a personal one more.

Disadvantages: For an employer, the main disadvantage of working from home is losing full control of employee´s work performance and also his motivation is more difficult, or possible increase in the IT costs together with communication tools and services. For employees, teleworking is connected with some expenses on their own work equipment, and a disadvantage could also be limited social contacts, especially with the colleagues at work.

Reccommendations: Contributions and costs of teleworking are moreless balanced between employers and employees. It depends on their mutual agreement and on how they will proceed. Higher level of regulation cannot be reccommended, it would significantly limit the attractivity of this form of employment for employers as well as employees. (Note: Proposal of the Labour Code amendment involves certain regulation of the reimbursement of costs that emerged to an employee in relation to teleworking, employer.)

4.1.2 Extension of new flexible forms of employment

Besides the presented ´traditional´ flexible forms of employment that are based in national as well as European legislation, there is a range of brand new flexible forms of employment on labour markets. Their implementation depends on agreement of employer and employee; **so far, they have no legal base**.

An Eurofound study (2015b) identified **ten new forms of employment that have appeared or become important in the EU countries since 2010:**

- Employees sharing (*emploee sharing*) – a group of employers will hire one employee together to cover personnel needs of different companies; the employee works full-time.
- Sharing a job (*job sharing*) – employer will accept two or more employees to work together on specific position; two or more part-time jobs are joined into one.
- Temporary management (*interim management*) – highly qualified specialists are temporarily accepted to manage a specific project or solve specific problem; it leads to integration of external managers within the work organisation.
- Casual work (*casual work*) – an employer is not obliged to give work to an employee on regular basis but can ask him to work as needed (similar to work on call).

- Mobile work based on the information and communication technologies (*ICT-based mobile work*) – employees can work from any place and anytime with the help of modern technologies.
- Voucher-based work (*voucher-based work*) – employment is based on payment for services by voucher, which is based at authorised organisation and includes wages as well as contributions to social security. This type of employment is used especially in the quickly growing sector of services for households in countries in western Europe.
- Portfolio work (*portfolio work*) – work when a self-employed person (OSVČ in the Czech Republic) does a small amount of work for a large amount of clients.
- Group employment (*crowd employment*) – employers look for employees and employees look for work using an online platform, and large works are divided among „virtual group of" workers.
- Employment based on cooperation (*collaborative employment*) – it is a cooperation of independent workers, self-employed people or micro businesses to overcome restrictions arising from their size and professional isolation.

New forms of employment are also connected with new impacts on labour markets, which have not been studied more closely so far. Even today, it is possible to see some **charakteristics**:

- Job sharing, employees share and temporary management provide the workers with a good level of work security and also higher flexibility at the same time.
- Work is done independently via ICT at a place of work, so there is a high level of flexibility, greater autonomy, but also a risk of higher intensity of work, greater amount of stress and diappearing boundary between work life and personal life.
- Portfolio work, group work and work based on cooperation make it possible to have a high level of diversification and therefore enrichment of work, which becomes more interesting and more motivating.
- Voucher-based work is connected with a higher level of employment insecurity, limited access to career growth, with specific professions and social isolation, nevertheless, it is possible to work legally (not in informal zone).

Recent labour markets development indicates that traditional forms of employment - permanent contracts - have been retroceding if favour of a wide scale of atypical forms of employment. These involve higher flexibility on one hand, on the other hand, employees have less security

and are often under a threat of **precarization of work**.[16] That most often applies to occasional work (agreement to do a task, one-off purchase of a service), agency employment or part-time work; especially with the least qualified, often blue-collar professions.

Summary

Economic and related social changes caused by the globalization process and ICT development lead towards significant changes on labour markets. One of the changes involves **the abatement from standard employment and shifting to atypical flexible forms of employment.** Majority of these employment forms contribute to labour marketr inovations, to higher attractivity for employers as well as a wide range of potential workers. Some of them are, however, less suitable, they are connected with higher level of insecurity for employees and a threat of labour market segmentation.

Fast expansion of the new forms of employment brings **several problems**. Firstly, there is only little information about their characteristics and their impacts on labour markets and working conditions. Secondly, there is no legal base, therefore the rules depend exclusively on agreement between employer and employee.

Great space opens here for trade unions and other social partners. It will be necessary to find answers to many questions, e.g.: How to ensure greater flexibility and inclusion of labour market? How to prevent standard forms of employment from being replaced by the forms that involve a high threat for employees? How to ensure adequate social security and working conditions? How to legalize the unreported work?

Reccommendation

It is possible to outline the following reccommendations:

1. First of all, it would be good to define the new forms of employment precisely to make it clear what they are, what is typical for them, what is the proportion of flexibility and security etc. This will make a communication between subjects that participate easier, especially on national level. Something similar should apparently appear on Europan

[16] The term *precarization* comes from the French word *précarité*, which can be translated as awkwardness or incecurity. In connection with labour market, the term means replacement of full-time work by some other form of relation between employer and employee. In sociology, the term is used as *precariate*, which describes a socio-economic group of people who are short of the work-oriented security and needs, e,g, security of employment, people working part-time or casually, usually with only minimum security of work.

level, it would make it easier to exchange information and experiene in specific areas and it would clear away any obscurities to do with what exactly we can imagine under the new forms of employment.

2. It would be appropriate to implement a security system for the forms of employment that are connected with higher insecurity for employees (especially casual work). That can be reached in collective agreements or in legislation.
3. Prospective future regulation of the new forms of employment should be well considered and based on deeper consideration of possible effects. (Regulation, which is suitable as a form of some protection from polarization of employment, will not be suitable for flexible forms of employment, such as ICT based mobile work.)

4.2 Increasing requirements of knowledge and skills of workers and a risk of employment polarization

Building the Society 4.0, therefore the knowledge-based society, will empose higher requirements of knowledge and skills of workers as well as their flexibility. Nevertheless, it is very difficult to specify the requirements due to rapid technological developments. It is possible to specify them on general level into some extent.

4.2.1 Expected requirements of knowledge and skills of workers

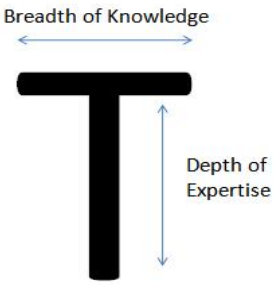
It is possible to conclude from the current trends on labour markets that the one who will possess more complex knowledge and skills shall be more succesfull, it will be the one who can think and decide in wider context and who is willing to receive continuous education.

It is possible to assume that **especially the following knowledge and skills will be required in the future:**

- Digital literacy as a part of basic education of every individual. Especially the ability to use technologies to solve problems in a better way as well as ability to work with information effectively. This is also connected with mastering new trends in technologies and continuous extending the ICT knowledge and skills.
- Narrow specifications in one subject will stand back and *T-shaped professional,* or professional T-shaped knowledge, which means deep and wide spectrum of knowledge, shall be required. *Depth of Expertise*, therefore deep and wide knowledge in one field, and at the same time *Breadth of Knowledge*, therefore wide knowledge in many disciplines, but also communication skills, critical thinking etc. This ability of

interdisciplinary thinking is considered a prerequisite of inovations. Considering the interconnection of technologies, production processes and the whole chain (also value creating) of values, a good orientation in the system will be a must.

Picture 4.3 T-shaped professional



Source: http://darrennegraeff.com/the-importance-of-t-shaped-individuals/.

- Besides the *hard skills* (that is hard skills; specialized, technical, language etc.) the *soft skills* will be more and more important. It means especially the communication skills, conceptual thinking, ability to lead a team and cooperate, resistance against stress, ability to react and decide fast, ability to share information, tolerance ability, self-management etc. Soft skills are an essential prerequisite for effective team work and work in virtual teams within the platforms of cooperation etc.

4.2.2 Creation of new jobs

As already explained above (Chapter 3), the digitalization process is accompanied by the creation-destruction process on labour market. Besides the fact that some professions and jobs will cease to exist, there is also a large space for having some brand new professions and jobs, respectively for transformation of the existing ones.

Creation of new jobs in ICT

In the respect of creation of new jobs, the greates potential is put into the ICT development and implementation of new technologies, in other words, building the Industry 4.0 platform and the Society 4.0 in general. In the following years, there will be a demand especially for the professions specializing in ICT, especially the experts on development of applications and customer application modules, developers and analysts of business solutions (with a high level of knowledge of environment in which the applications will work; e.g. banking, telecommunications), system integrators (solving interconnection of systems, applications and

data repositories) and ICT integrators, specialists in the area of mobile devices and applications and cloud computing. Even today, new professions come into existence aimed at the working with big data, their collection, storage and transmission and their transformation to applications that can be used in production and services. New professions will appear in connection with the development of the Internet of things and services, too.

There will be an increasing demand for related professions especially in the connection with the expansion of customer modules - computer graphic designer, designer / architect of solutions, workers for testing - who will have a difficult job, and that is to ´overturn´ technical solutions to a user-friendly look.

New jobs will come to existence in the area of security to do with storing and transmission of data, which applies to computer as well as system global security. Security specialists in cyberspace will cooperate with architects of corporate systems, creators of user applications etc.

Demand for the ICT specialists and related professions will grow in relation to how digitalization will flow into the individual sectors of economy. The digitalization process is now apparent especially in the automobile industry and logistics, digitalization is also apparent in engineering, electrotechnology, technology in medical care and energetic systems. With some delay, digitalization will also appear in chemical and flying industries (Berger, 2014).

Creation of new job opportunities in other spheres

A big increase in the number of jobs in industry, especially engineering and services, can be expected.

The hypothesis about jobs creation in industry is also supported by the results of the Boston Consulting Group study (2015) aimed at development of processing industry in Germany. According to the study, there will be a significant increase in employment in this sector in 2015 - 2025 (by 6 %). The fastest increase is, however, expected in engineering (0,9 %), food processing (0,7 %) and automobile industry (0,2 %).

Engineering industry is a producer of modern technologies and production devices of the Industry 4.0 for other sectors. It is the reason why we can expect a high demand for new professions that will require knowledge of mechanical engineering and informatics, electronics and cybernetics at the same time. There will be a demand for specialists in the area of robotics, constructions of built-in systems of smart machines, creators of applications of realtime

management etc. Many jobs will also begin to exist in relation to maintenance and setting up of production processes, software maintenance and updating, reinstalation of systems etc. People even speak about arising of a new working class sometimes, the so-called **light blue collars**, which will be on the boudary of manual and engineering work. These professions will gradually flow to other fields of work, too.

The digitalization process will also cause changes in the traditional sectors of production where some professions - especially those connected with rutine work and with the lowest or medium level of education - will gradually cease, and there will be a demand for highly qualified professions.

Orientation to customer and production individualization will cause **an arrival of some new professions to do with communication with consumers and costumers.** A possibility of personal configuration in automobile production, which is common today, can be expected in a wide range of other products and services. This will increase demand for designer professions and related advisory services. Expansion of services related to after-sales service can also be expected. As described in some studies in the past (for example CEDEFOP, 2008), due to stronger competition, business managers and sales specialists will become more and more important, and current trends confirm that.

A number of jobs in **environment and nature** has been increasing for a long time, and further development in the areas can be expected, too. Jobs in ´green economy´ will appear in public as well as private sector (for example specialists on the impacts of production on the air and water cleanliness, specialists on efficient management of water, recyclation of waste etc.).

As the living standard grows, the **sector of services**, which has a great potential in terms of creating new jobs, will also develop. As described in Table 3.7, the Czech Republic falls behind other western European countries significantly, and its position is very weak among central and eastern European countries, too. With an exception of transport and storage, it falls behind in all segments of the sector; the greatest differences are in the percentage of people employed in medical and social care. In the future, we can expect especially an increase in the number of jobs related to services for companies (all kinds of advisory services - taxes, accounting, information technology, law, strategy, personal advice etc.). The process of population´s ageing will lead to a growing demand for services of medical and social care. Growing standard of living and an increase of fair income will be accompanied by a greater interest in free time activities - new jobs will appear in hotel industry and boarding, spa industry, wellness and

tourism. There will be development of services for households and personal care services (cosmetics, hairdressers, etc.); a problem of this area is the provision of services on market that is not regulated and for lower prices (some western European countries attempt to solve this negative feature by means of the voucher-based work described previously).

It is possible to expect a significant **development of quaternary (knowledge-based) sector** in connection with building knowledge of society, which involves university education, science and research. Importance of education will grow on all levels. Business education will develop and lifelong education will be a must on all levels of employment.

Creating new job opportunities in shared economy

Shared economy, which expands a lot worldwide, is a new phenomena on labour markets. There are several reasons for that - development of modern technologies, attempt to avoid classical economic structures (possibly also due to decreasing trust in them in relation to financial crisis). The economy of sharing also corresponds with the resources saving trend. It is getting more and more popular for the new generation, for which it is characteristic to have a smaller need to own a property when compared to previous generation (this is likely to change in latter age).

According to available data (Eurobarometer, 2016; EC, 2016e), gross domestic product from the individual platforms of shared economy in the EU in 2015 was about 28 billion. EUROS; according to the experts´ estimates, in the years to come, there will be dynamic growth up to as much as 160 - 572 billon EUROS. Sharing platforms are currently in five key segments of economy: accommodation (short rentals), transportation of people, services for households, professional and technical services, and collective financing. It is the people aged 25 - 39 who use the shared economics services the most, men more often than women (see Table 4.1).

Table 4.1 Using the shared economics services in the EU-28 countries (in %, 2016)

Total population	**17**
Men	21
Women	15
People aged 15 - 24	18
People aged 25 - 39	27
People aged 40 - 54	22
People aged 55+	10

Source: Eurobarometer (2016).

In the Czech Republic, the size of shared economy is still relatively small; its proportion in GDP is around 0,1 %, nevertheless, expert estimates expect it will grow to 0,5 % by 2020 as as much as 2 % by 2025. In Czech environment, shared economy exists especially in transportation

of people (local, intercity), accommodation, on real estates P2P market (arrangement of sales and rentings of property, arrangement of shared accommodation), in crowdfunding financing (debt or shared crowdfunding) and carsharing. Intermediating of work on shared market also starts to develop.

Shared economy makes it possible for the users to save time and money and provides greater flexibility. It also represents possible source of income and extra income. According to the results of a research done by British Hertfordshire University (Huws, 2016), 21 % of the respondents tried to find a job with a help of one or another shared economy services, 11 % of them were succesfull, which makes around 5 million working people.. But in fact, 5 % of them receive their whole income in shared economy, it is just extra work for majority. Similar conclusions were reached also by the Czech research of the Association for International Questions (2016). The Czech consider shared economy to be a possibility how to earn some extra money, and state that its biggest advantage is having more freedom to organize their time.

From the viewpoint of employment, a key problem in shared economy is **an absence of standard employment relationships**, and problematics of establishing fair employment conditions and social security relates to it. So far, the impacts of shared economy on employment and labour markets cannot be specified more precisely. It is a brand new phenomena but still peripheral. It will be necessary to modify the employment legislation in the future - for example traditional differentiation between the self-employed and employees in the context of shared economy. Even today´s practise shows that shared economy represents a big employment potential, however, since it is highly flexible environment, also potential precarization of economy. Besides the problematics of employment, protection of consumers of the shared economy services shall be referred to in law, too.

4.2.3 Lack of balance between demand and supply from the viewpoint of skills and qualifications

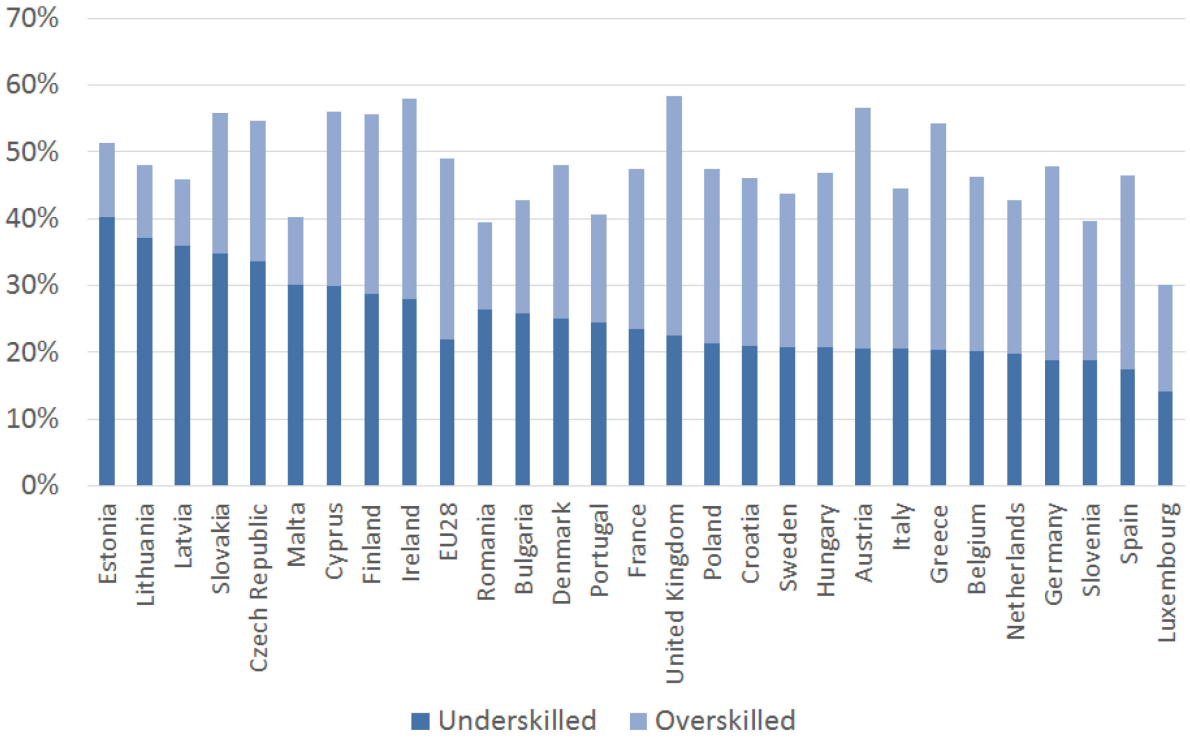
For a long time, there has been disharmony between demand and supply concerning qualification and skills on European markets. It is clear from practise that only a higher level of education itself is not enough, it must be accompanied by a corresponding offer of qualifications and skills, which have to correspond with the needs of labour market.

The situation in individual the member states varies a lot, there are different qualification structures of inhabitants as well as different division of jobs according to sectors. This imbalance between demand and supply is apparent moreless in all countries. **There are at least three main causes why it occurs:**

- Education systems (in all grades) and practical traning react very slowly to changes in he needs of labour markets - graduates do not gain knowledge and qualifications that would correspond with the character of new jobs. Problems arise even on the elementary education level where almost 11 % pupils (within the EU) leave schools not having adopted any basic skills needed on labour market. The problem is much lower in the Czech Republic - number of such pupils is around 6,5 % (see Picture 3.4).
- Absence of effective systems of lifelong education - lifelong learning and gaining desirable knowledge and skills should apply to all employees, not only those with higher qualification; there is, however, 7 times lower probability that workers with lower education would participate in lifelong education (EC, 2008). Obtaining higher qualifications is behind in case of older workers considering demographic development, their position on labour market grows, which is also supported by increasing employment rate of this group of workers in the last decade (in 2007–2016, the employment rate of workers aged 55–64 increased by 10,8 p.b. in the EU, in 2016 it reached 55,3 %; in the Czech Republic, it increased by 12,5 p.b. to 58,5 %).
- Existing barriers due to which it is not possible to have free movement of people within single internal market - this involves not only some longlasting administrative obstacles but it is also important to achieve mutual recognition of qualifications; to unify the requirements of qualifications and skills, especially in case of regulated professions. This is the only way to strengthen the professional, sector and geographic mobility.

The problematics of balancing gained knowledge and skills of workers with requirements of labour market is also a topic dealth with by the European Centre for Development of Vocational Training (*European Centre for the Development of Vocational Training,* CEDEFOP). Results of the research done in 2014 in the EU showed that approximately 30 % of Europeans are equipped by skills which are not in harmony with the requirements of their jobs (see Picture 4.4).

Picture 4.4 Gaps in skills and excess skills observed when recruiting employees in the EU countries (2014)



Source: CEDEFOP (2015).

Note: Underskilled. Overskilled.

For a long time, the EU member states have to deal with especially the shortage of workers with technical education, shortage of employees (on all levels) in medicine, social services and qualified manual workers in various professions. There is a considerable shortage of IT specialists in connection with development of modern technologies. According to qualified estimates of many personnel agencies, European businesses have a shortage of more than 700 thousand computer specialists; it should grow to as much as 800 thousand in 2020.

The information technology sector belongs to the segments that record the greatest shortage of workers in the Czech Republic, too. At the same time, the demand for IT services continuously grows with increasing difficulty of IT work in the whole economy. According to some sources, there are up to 20 thousand IT specialists missing (Žák and Zajíc, 2017). Czech labour market is now most interested in programmers for development of desktop, website and mobile applications, specialists on IT security, specialists on big data and data analyses; it is also difficult to find e.g. Java programmers or Java technical designers.

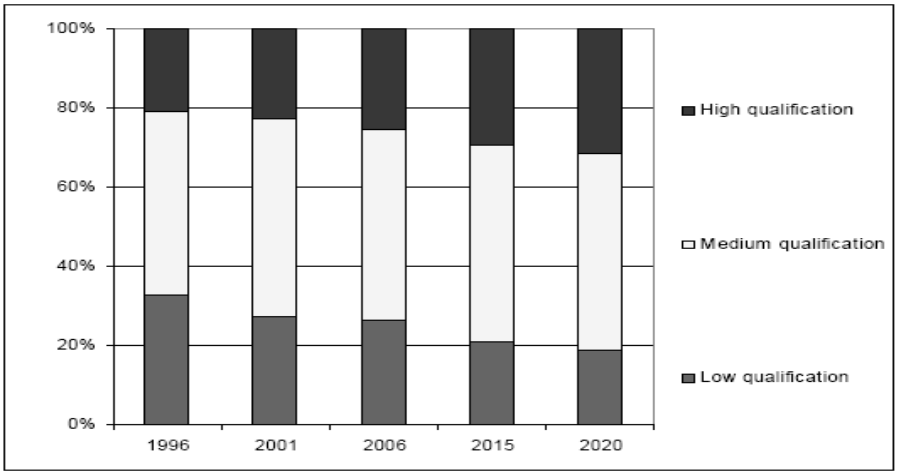
If a country, including the Czech Republic, does not adopt some effective solution of this more and more apparent problem, the lack of balance between supply and demand for skills and

qualifications may become **a barrier in development of the Industry 4.0 and the Society 4.0. A consequence of that would be considerable weakening of economic competitiveness and negative impacts on the living standard of inhabitants.**

4.2.4 Threat of labour market polarization

The process of creation of jobs that are more and more demanding in respect of education and skills has been apparent on the European labour markets since the 90s, when there was a boom of ICT (computers, mobile phones, the Internet); comming of the Industry 4.0 strengthens the trend yet further. A shift in the structure of jobs towards higher requirements is outlined in Picture 4.5.

Picture 4.5 Number of jobs prognosis according to basic categories and achieved levels of education in EU - 25



Source: CEDEFOP (2008).

Note: High qualification - high level of qualification (education). Medium qualification – medium level of qualification. Low qualification – low level of qualification.

The picture is taken from the CEDEFOP study, which was created ten years ago, and a wide spectrum of tendencies identified here can be seen on the labour market today. The study involved the time period 1996 - 2020 and the following conclusions have been reached:

- Required level of education will increase significantly in all categories of professions.
- There will be an increase in the number of jobs that require a higher level of education (to 31,5 % in 2020), whereas there will be a decrease in the number of jobs on the opposite pole (to 18,5 %). Percentage of the jobs that require the medium level of education will decrease only very slightly. *The presented quantified conclusions have only an indicative character, as the labour market is constantly developping. The digitalization process can make the indicated trend faster.*

- Only less than a half of the jobs that do not require any qualification will be done by people with a low level of education. Qualified professions will be done by workers with secondary education much more often. Majority of non-manual jobs that require qualification will be performed by highly qualified workers. *Considering the fact that the level of education has probably been growing faster when compared to the changes on the labour market, many jobs are now taken by people with higher education (higher qualification) than the job requires.*

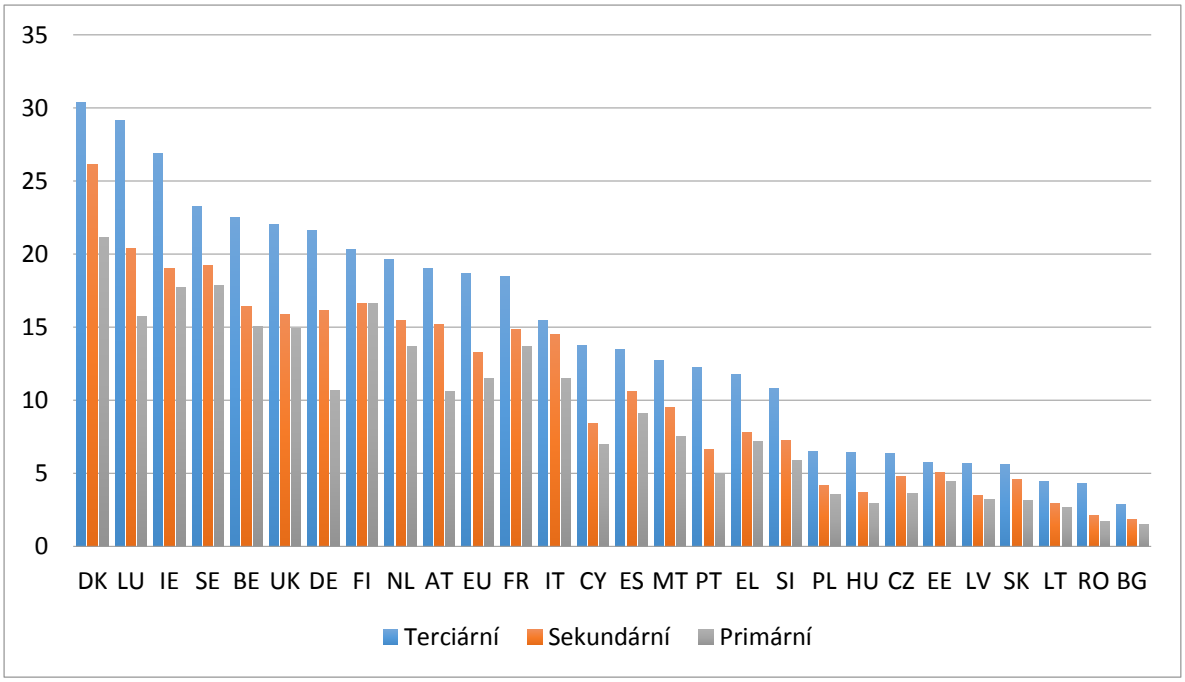
New jobs will arise on both profession poles but especially on the higher level. The process of comming to existence of the ´new generation´will, however, be slower, whereas the decrease in the number of the ´old generation´ jobs will be faster - at least in the initial phases of building the Industry 4.0 platforms. The process when the number of jobs with medium level of qualification and income level decreases as a result of automatization of work is called **employment polarization** (Frey and Osborne, 2013). The process involves some risks (threats); it can cause a descent of a part of workers from the middle qualification level to positions with lower qualifiations and therefore lower earnings, or transfer of workers from industry to the sector of services where - even in case of the same qualification level - lower incomes can be expected. Employment polarization is therefore connected with **the growth of income differentiation**. But it needs to be said that income differences have been growing much more slowly in the Czech Republic than in other western European countries. The present situation on labour market - lack of workers in almost all professions on both poles of employment - push on the wages increase a lot. In the long-term point of view, it is, however, necessary to expect higher polarization as well as wages differentiation on the Czech maket, too. Picture 4.6 shows income differences in the individual EU countries according to achieved level of education.[17]

When looking at the picture, there is a clear big difference in the incomes in the individual countries, which is caused by differences in productivity of work and generally different economic and living standard. It is also apparent from the picture that the differences in the incomes according to a level of education are differentiated in different ways in different countries. Table 4.2 is more specific. The biggest differences in incomes among workers with primary and tertiary education are in Romania (average wage per hour of a person with primary

[17] Primary (low level) education involves pre-primary education, primary education and lower secondary education (level 0-2 qualification ISCED, 2011). Secondary (medium level) education involves secondary and postsecondary non-tertiary education (level 3-4). Tertiary (high level) education involves university education (level 5-8).

education is only about 39 % of the average wage per hour of a person with tertiary education). On the contrary, the lowest differences in incomes are in Finland where income of a person with the lowes qualification comes to about 82 % of income of a person with the highest qualification.

Picture 4.6 Average wages per hour according to obtained level of education (2014)



Source: Eurostat, own work.

Note: DK – Denmark, LU – Luxembourg, IE – Ireland, SE – Sweden, BE – Belgium, UK – Great Britain, DE – Germany, FI – Finland, NL – the Netherlands, AT – Austria, EU – EU-27, FR – France, IT – Italy, CY – Cyprus, ES – Spain, MT – Malta, PT – Portugal, EL – Greece, SI – Slovenia, PL – Poland, HU – Hungary, CZ – the Czech Republic EE – Estonia, LV – Latvia, SK – Slovakia, LT – Lithuania, RO – Romania, BG – Bulgaria.

Table 4.2 Differences in average working hours between people with primary and tertiary education (expressed as a percentage of a worker with primary education on an income of a worker with tertiary education)

Country	**%**	**Country**	**%**
Finland	81,9	Malta	58,8
Estonia	77,1	Latvia	56,5
Sweden	76,7	Slovakia	56,3
Italy	74,4	**the Czech Republic**	**56,2**
France	74,1	Austria	55,9
The Netherlands	69,8	Poland	54,4
Denmark	69,6	Slovenia	54,0
Spain	67,7	Luxebbourg	53,9
Great Britain	67,6	Bulgaria	50,9
Belgium	66,8	Cyprus	50,6
Ireland	66,0	Germany	49,1

EU-27	61,5	Hungary	45,0
Greece	60,7	Portugal	40,2
Lithuania	59,3	Romania	39,2

Source: Eurostat, own work.

The lowest differences in wages are traditionally in the Scandinavian countries and the Netherlands (which corresponds with the northern social model), then Estonia and also Italy and France (where it is probably influenced by trade unions). Germany, on the other hand, belongs to the countries with quite big differences in wages (wages increase is connected with productivity of work in Germany). In the Czech Republic, an average wage per hour of a person with the lowes qualification makes about 56 % of income of a highly qualified person. Differences in wages should reflect achieved level of education and skills and should represent a motivation tool in obtaining education.

There is a range of indicators used to express the income inequality in society (see below for selected ones). Available OECD data (for 2014) confirm that **income inequality in the Czech Republic is one of the lowest among the developed countries:**

- One tenth of the Czech people with the highest income earn on average „only" 5,6 times more than one tenth of the poorest; the Czech Republic belongs to 35 OECD countries and is on the 4th place (Iceland – 5,0; Denmark and Finland – 5,3; the Czech Republic – 5,6; Slovenia – 5,7).
- The Gini coeficient[18] belongs to the lowest in the Czech Republic – the lowest is in Iceland (0,242), then Norway, Denmark, Slovenia, Finland and the Czech Republic (0,262).
- There is only a small percentage of people who face a threat of income poverty in the Czech Republic.[19] The lowest percentage of people who face a threat of income poverty is on Iceland (4,6 %), in Denmark (5,4 %), in the Czech Republic (6,0 %), Finland (6,8 %) and Norway (7,8 %). Young Czechs aged 18–25 let are threatened by income poverty even the least of all OECD countries (4,9 %). Also the income poverty of people aged 65+ is one of the lowest (3,0 %); situation is better only in the Netherlands and Iceland in this respect.

[18] The Gini coeficient varies from 0 to 1, where 0 represents absolute income balance; 1 would mean that there is only one person in society who gets all income.
[19] According to OECD, income poverty is considered to be a situation when one´s income falls under 50 % of income median in his/her country. (Eurostat considers the income poverty boundary to be 60 % of incomes median in a country after social transfers.)

Summary

Except for the shift in the employment forms there will also be other important changes in the labour markets as a result of digitalization. Firstly, **more and more jobs and professions will become or cease to exist or will go through transformation**. Secondly, **there will be higher requirements of qualifications and skills of workers on all levels of employment.**

It is currently very difficult to determine precisely how the individual professions will change or cease to exist or how the new ones will come to existence, and what specific knowledge an skills will relate to them; it is only possible to identify certain general trends. It is a definite fact though that received knowledge and skills are going to grow older much faster than now. This is the reason why the lifelong education will be more and more important including company education.

Even today, there is a problem of disharmony between demand and supply from the viewpoint of required knowledge and skills. It is important to find a solution fast, in the opposite case, a shortage of workers in highly demanded professions could become an obstacle in the development process of the Industry 4.0. Competitiveness of the Czech Republic could get weaker.

It is apparent that the creation-destruction processes on labour market will be a threat especially for workers on the lowest levels of employment, with the lowest level of education, especially in industry. Job opportunities will move to the developing sector of services including the shared economy, an importance of which will grow further. Changes in the structure of jobs are connected with employment polarization and increasing differences in income. Income differentiation emposes only minimum risk to the Czech Republic.

Reccommendation

Education is alfa and omega of a success in the society as a whole and being succesfull on labour market. The following reccommendations are based on that:

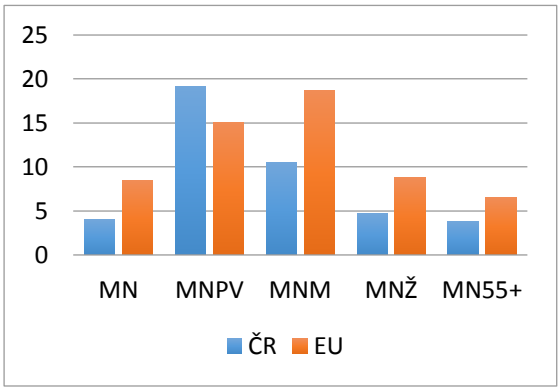
- Lack of balance between demand and offer on labour market from the viewpoint of required qualifications and skills needs to be solved conceptually, in the whole system of education. It is possible to reccommend a dual education concept which has a great success in Germany, Austria and the Netherlands; schools are able to react better to practical needs.

- Complying to the requirements of digitalization, it is important to adjust the content conception of education, too - the aim should be to increase a level of digital literacy (on all levels of education system). The conception of teaching individual subjects in secondary schools and universities shall change to achieve higher interdisciplinarity and then putting the knowledge into practise. To make people more interested in the technical and mathematical subjects (e.g. in the form of scholarships).
- To create an effective system of lifelong education which does not exist in the Czech Rep. In productive age, one should be sure that should s/he lose a job s/he will get a chance to gain qualification, skills that s/he can use on labour market.
- There will be a growing importance of company education - better access to company training systems for employees with atypical forms of employment can be reccommended. In opposite case, it could lead to deeper sedmentation on labour marker. Large space opens here for the work of trade unions and colective negotiations.
- It is a must to adjust and modify legislation for it to reflect the employment specifications in shared economy with the aim to prevent the excess precarization of work. Also here is a great potential for the trade unions and social partners to cooperate.

4.3 Impacts of the digitalization process on the groups of people at risk on labour market

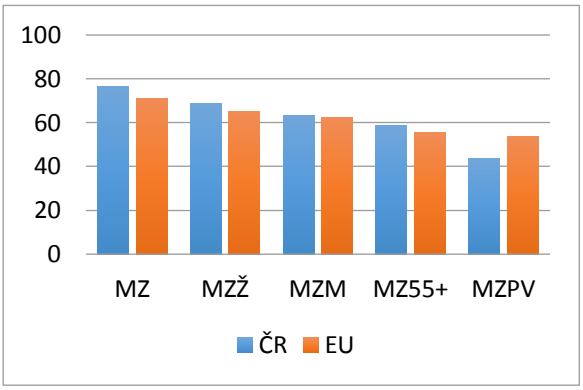
One of the largest groups on labour market which faces a higher threat of losing work are the graduates and the youth, older workers, people with low level of education and women. Their differing position on labour market can be expressed using the indicators of unemployment and employment rate.

Picture 4.7 Level of unemployment of selected groups in the Czech Rep. and the EU (2016, v %, 15–64 years)



Source: Eurostat, own work.

Picture 4.8 Level of unemployment of elected groups in the Czech Rep. and the EU (2016, v %, 15–64 years)



Source: Eurostat, own work.

Note: MN - ratio of unemployment. MNPV - ratio of unemployment of people with primary education (0 - 2 ISCED 11). MNM - ratio of unemployment of the youth (15 - 24). MNŽ - ratio of female unemployment. MN55+ - ratio of unemployment of people above 55. MZ - ratio of employment. MZŽ - ratio of unemployment of women. MZM - ratio of unemployment of the youth. MZ55+ - ratio of unemployment of people above 55. MZPV - ratio of unemployment of people with primary education.

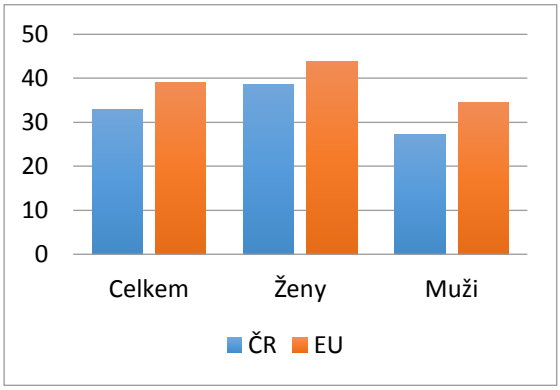
Both indicators confirm a good condition of Czech market when compared to the EU as a whole. In the Czech Republic, a group of people with the highest unemployment rate is the people with the low level of education. Within the EU, it is most often the young people who have to deal with the unemployment, which is caused by an unfavourable situation on especially the labour markets of the southern countries of the Eurozone. People aged 55+ have a low level of unemployment; which is, besides other things, a result of a current high demand for workforce (another reason may be a shift in the age of population or better protection of workers with temporary contracts - which the older employees usually have). There is the lowest unemployment among the people with primary education.

4.3.1 Analysis of selected indicators

Impacts of digitalization will have a different forms of impact on different segmented groups. Considering that formation of potential threats relates especially to inadequate level of education and gaining desirable knowledge and skills and also to higher employment flexibility, the text below is aimed at analysis of selected groups of relating indicators (education, e-skills, flexible work) and their possible impacts on the groups of people under threat.

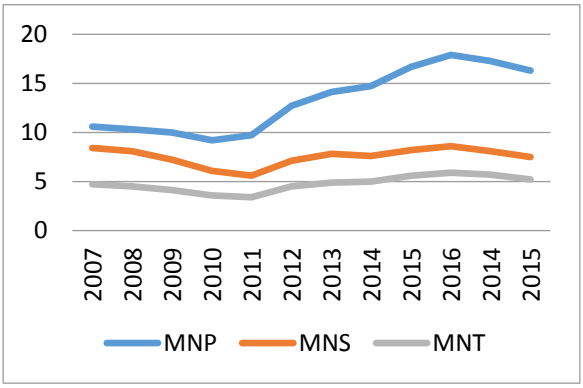
Level of education and lifetime education

Picture 4.9 People aged 30–34 with tertiary education in the Czech Rep. and EU (2016, in %)



Source: Eurostat, own work.

Picture 4.10 Unemployment rate development for people with primary, secondary and tertiary education (EU-28, in %)

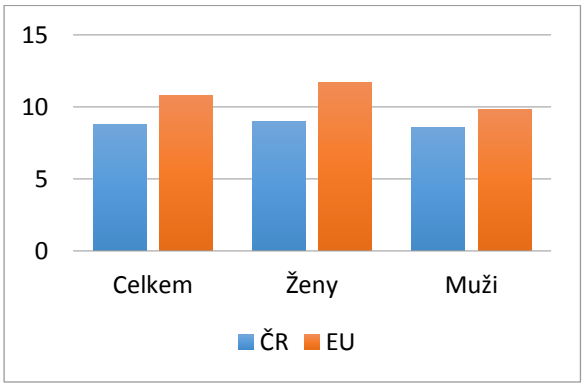


Source: Eurostat, own work.

It is clear from Picture 4.10 that there is a definite relationship between achieved level of education and being succesfull on labour market. The unemployment rate of people with primary education reaches the highest numbers and is the most volatile, too - most influenced by economic cycle (in 2007 it reached the minimum - 9,2 %, then it was influenced by the financial crisis and it began to grow rapidly until it reached 17,9 % in 2013, and from 2014, it has been decreasing due to the end of stagnation and fresh economic start). On the contrary to that, the unemployment rate of people with tertiary education is the least volatile, and is around 5 % for a long time. Regarding the gender aspect, there are more women than men with university education in the EU as well as the Czech Republic (in the Czech Rep., there were 38,7 % women and 27,2 % men with tertiary education).

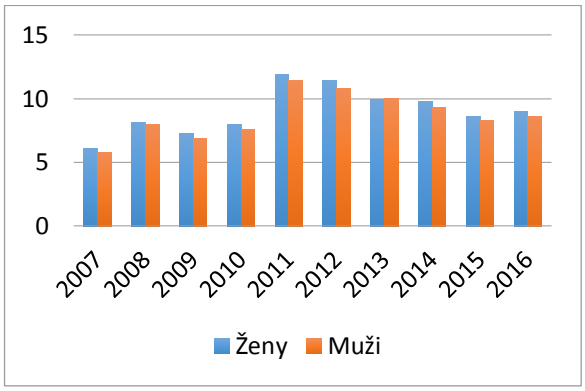
There is significantly **increasing importance of lifelong education** lately and there are two reasons for that. Firstly, technological development leads to faster obsolescence of knowledge in all spheres of human work. Secondly, living longer and higher retirement age change the age structure of all who participate in labour market, as people work longer. Lifelong education makes it possible to update knowledge of individuals in specific spheres but also to obtain some new qualifications.

Picture 4.11 People who participated in lifelong education in the Czech Rep. and the EU (2016, in %, 25–64 zears)



Source: Eurostat, own work.

Picture 4.12 People who participated lifelong education in the Czech Republic (2007–2016, in %, 25–64 years)

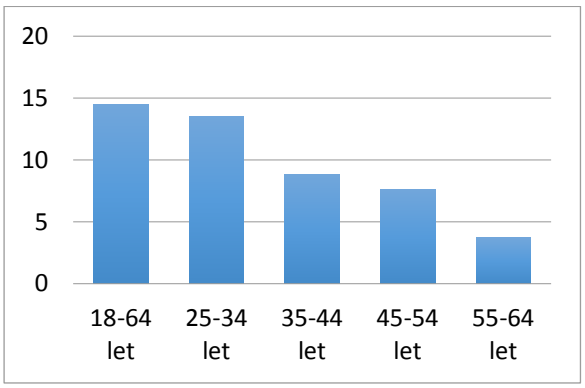


Source: Eurostat, own work.

Compared to the EU average, there are less people in productive age who participate in lifelong education in the Czech Republic (10.8 % in the EU in 2016, 8,8 % in the Czech Republic). Just like in case of the university education, men are also more active in the lifelong education. In 2016, there were 11,7 % of women and 9,8 % men that participated in lifelong education in the EU (9 % women and 8,6 % men in the Czech Republic).

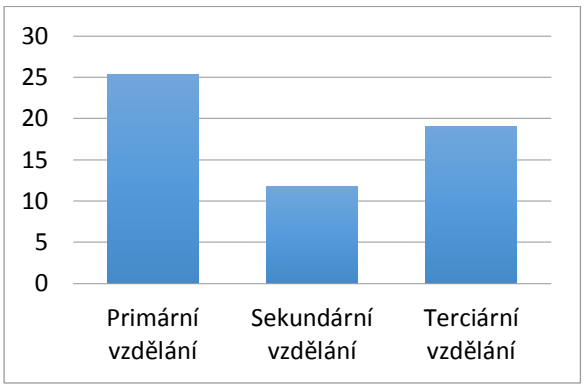
Picture 4.12 describes a percentage of men and women in lifelong education in the Czech Republic in last decade. It shows that the number of participants (men and women) increased during the decade (from 6 % in 2007 to 8,8 % in 2016); a jump increase in 2010 and 2011 indicates that lifelong education (especially requalification) was used as a tool to decrease unemployment. In the following years, the number of participants in lifelong education was decreasing, there was a breakthrough in 2016.

Picture 4.13 Participants in lifelong education in CZ according to age (2015, in %)



Source: Eurostat, own work.

Picture 4.14 Percentage of participants in lifelong education according to achieved level of education in the Czech Republic (2015, in %)



Source: Eurostat, own work.

A composition of participants in lifelong education according to age is not very satisfactory (Picture 4.13). The most people up to 34 participate but then the participation decreases; **the long-term situation is the worst for the age cathegory of people above 55.** Looking at a constitution of those participating in life-long education from the viewpoint of achieved education, one may be surprised. In 2015, 25,3 % people with the lowest education, 11,8 % people with secondary education and 19 % people with university education joined lifelong education in the Czech Republic. It is definitely a good idea to increase the number of people on especially the lower education levels and people of higher age in future.

E-skills level

From a viewpoint of the qualification preparedness for changes connected to the digitalization process, the so-called e-skills area plays a key role (managing information and communication technology). Computer skills are already important for finding one´s place on the labour market today; their importance is therefore likely to increase in future.

Table 4.3 People with the highest level of computer skills* according to achieved level of education (2014, in %)

Country	Total inhabitants	25 to 64 years			55 to 74 years		
		primary	secondary	terciary	primary	secondary	terciary
The Czech Republic	60	17	56	93	7	28	82
EU-28	64	34	65	92	16	41	75

Source: Eurostat, own work.

Note: People with the highest level of computer skills doing at least 5 or 6 computing activities.

Number of people with the highest level of computer skills equals achieved education. Only very small number of people with primary education have these skills in the Czech Republic; the group is much larger within the EU. On the other hand, there are more university graduates with the highest level of computer skills in the Czech Republic compared to the EU, which applies to both categories. **Differences according to achieved education are greater in the Czech Republic compared to the EU in this ratio.** It is desirable to strengthen the level of e-skills especially for people with elementary and secondary education in the future, and to eleminite their lagging behind the university graduates.

Table 4.4 People with the highest level of computer skills* according to age and gender (in %)

Country	Total inhabitants	20 to 64 years		25 to 29 years		25 to 64 years		55 to 74 years	
		men	women	men	women	men	women	men	women
The Czech Republic	60	92	87	77	82	62	59	37	29
EU-28	64	87	87	84	85	68	64	43	33

Source: Eurostat, own work.

Note: People with the highest level of computer skills doing at least 5 or 6 computing activities.

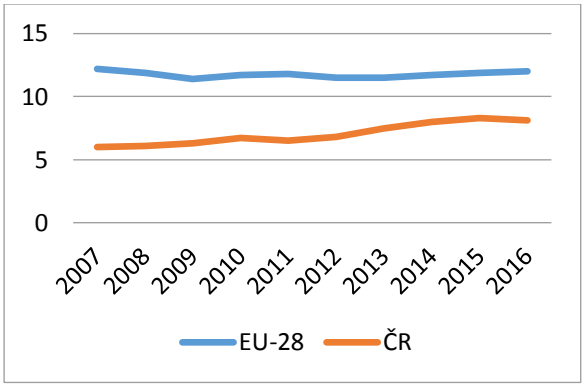
It is apparent from the data that there are more women than men aged 15 - 29 with the highest level of computer skills, and the difference is greater in the Czech Republic than the EU. The situation is, however, changing with age to a disadvantage of women.

Difference between men and women in ICT is generally greater in the Czech Republic than in the EU. There are only 10 % of women working as the IT specialists, whereas it is over 16 % in the EU. Women incline less to technical subjects and informatics, therefore achieving some balanced numbers of both genders in the ICT cannot be expected in the future. Nevertheless, the difference between men and women is too high in the Czech Republic; schools as well as businesses should promote a greater interest of women in working in ICT.

Flexible forms of employment

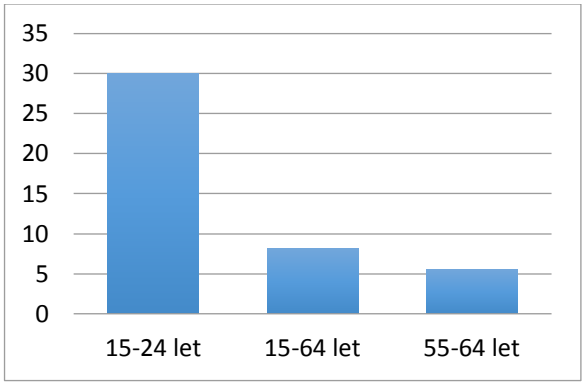
As explained in the text above (see Chapter 4.1), the digitalization process in accompanied by greater flexibility of employment, which, however, is also connected with greater risk of threat for employees. Main indicators of flexibility of labour markets are now the temporary contracts and part-time working hours.

Picture 4.15 Development of the number of workers with a temporary contract (15–64 years, in %)



Source: Eurostat, own work.

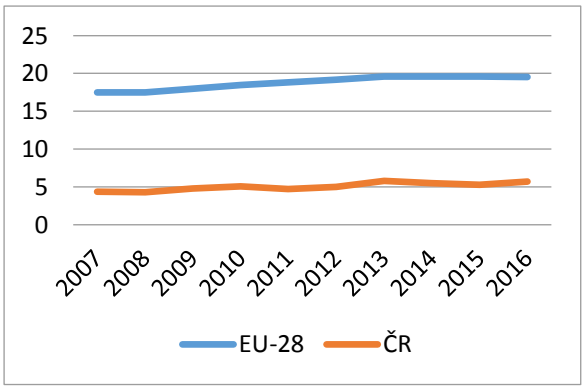
Picture 4.16 Percentage of workers with a temporary contract according to age, CZ (15–64 years, in %)



Source: Eurostat, own work.

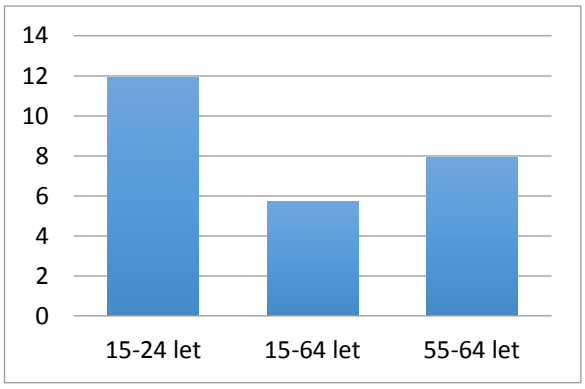
The Czech Republic belongs to the countries where the temporary contracts are not so common (see Picture 4.1), however, their number has been growing. The highest percentage of these contracts (almost one third) is in the category of the people up to 24 who just enter the labour market; in some cases they may form a certain barrier in building career.

Picture 4.17 Development of the number of workers who work part-time
(15–64 years, in %)



Source: Eurostat, own work.

Picture 4.18 Percentage of workers who work part-time in the Czech Republic
(15–64 years, in %)



Source: Eurostat, own work.

There is even greater gap between the Czech Republic and the EU in the part-time work. Despite a slight increase (4,4 % in 2007, 5,7 % in 2016), part-time contracts are used only minimally compared to other European countries (see Picture 4.2). They are the most common for people up to 24, in which case they are the way to earn some extra money during studies. For people aged 55+, it can be the way to gradually enter active retirement age. On the other hand, they may cause underemployment (one may want to work full-time but has no possibility). Working part-time is more common among women, when it may be an important tool how to manage family life and work, on the other hand, it may have a negative effect (underemployment, barriers to career building etc.).

Summary

Education plays a key role in being succesful on labour market. People with elementary education will be effected by cyclic crisis much more; higher education goes together with ability to better adjust to changing conditions. This is showed in the indicators of achieved level of education, besides other things. Concerning age, the level of computer skills decreases a lot in case of people aged 55+, their participation in lifelong education is on minimum. Women participate in education more than men; there are more women who completed tertiary education and women also participate in lifelong education more often. Up to the age of 29, it is women who have better computer skills than men.

Flexible forms of employment are much less common in the Czech Republic in comparison to the original EU-15 countries. They make it possible to react to the labour market changes and can be a suitable tool to gain a better balance between the interests of an employer and an

employee. On the other hand, there is a greater risk of insecurity for employees, there is a threat of underemployment as well as a barrier of career building etc.

4.3.2 Specification of the groups at risk - identification of strengths and weaknesses, forming of reccommendations

Position of selected groups on labour market varies, each one of them has its own specific characteristics and also different possibilities how to cope with external changes. For some, the digitalization process is more of a threat, yet for others it can be an opportunity.

Young people on labour market

Young people are put together with opportunities in connection with the Industry 4.0. However, this group has to deal with many problems on labour market. To be able to use a potential of the youth fully, it is essential to create suitable conditions.

Young people, especially the graduates, are one of the groups under the highest threat on labour market. Financial crisis effected young people the most. As the economy has revived since the end of 2014, the unemployment rate of the young people has been decreasing, nevertheless, it is still considered a serious problem in some EU countries (e.g. in Greece and Spain where it is above 40 %). A recent problem Czech labour market has to face is lack of workers. A level of unemployment reached the minimum numbers last year (4 %), and unemployment rate of the youth reached 10,5 %.

Flexible forms of education are the most common among the young people up to 24 compared to other age groups (see Pictures 4.16 and 4.18). It is in harmony with the digitalization process, however, in practise, a temporary contract or part-time work means also worse access to business training, career growth, sharing information etc. - and these facts are in contradiction with the requirements of digitalization. In the post-crisis era, temporary contracts are much less often transformed to permanent contracts - which can have serious consequences especially for the young people with lower level of education and lower qualification, for example in a form of higher unemployment or in a form of absence in getting required practical education and remain in a profession. On the other hand, part-time work is a good way to gain work experience and some extra money for students. There is an increasing interest in flexible forms of employment among young people. Development of the digitalization process is connected especially with new flexible forms of employment (see Chapter 4.1).

Compared to the older participants on labour market, the youth have **competitive advantage in the form of better knowledge of IT technologies** (they know how to use the Internet, commonly use applications in smartphones and tablets). It is, however, apparent from practise that the skills needed for practical work are often missing. This was confirmed also when comparing the results in the internation certification of IT knowledge and skills - ECDL (*European Computer Driving Licence*), from which became clear that the Czechs underestimate the importance and the need of the so-called mobile digital skills (that is general knowledge of basic hardware and software principles, which can be used no matter what the profession or qualification is). And these general principles are missing in schools schemes and education plans. This international comparison proved that the Czechs make the most mistakes in IT safety and security (24 %) and also when working with the office programmes (especially Excel). **The young generation has sufficient knowledge for common ´digital life´ but has no skills required by the labour market.**

Imbalance between gained knowledge and skills and what is required in practise goes through the whole education system. This fact is also confirmed by the results of the whole range of examinations and studies (e.g. National Observatory of Employment and Education, IBM, CERGE-EI), which all identified the following main problems: study programmes do not react fast enough to changing market requirements, graduates are short of knowledge and skills (deeper professional knowledge, communication skills, good knowledge of languages), they also do not have the interfield knowledge needed to solve practical problems, they have lower functional literacy which means ability to use their knowledge in practise. Employers, on the other hand, require especially teamleading skills, communication, flexibility and creativity.

The most important thing for the young people to be successful on labour market is their **achieved level of education** and also selection of a suitable subject of study. On the Czech labour market, there is a greater and greater imbalance **between the supply and demand in terms of desirable qualifications and professions.** There is the greatest shortage of qualified technicians. Businesses are interested especially in the graduates from robotics, automatization, electroprojection, construction workers, developers, programmers, IT specialists in banking etc. There is also a shortage of qualified manual workers.

Achieved level of education influences the risk of losing a job because of automatization to a great extent. According to the OECD study (2016b), the threat applies to 55 % of graduates

from subjects without Maturita exam, 12 % of graduates from secondary schools with Maturita, 9 % of graduates from higher vocational schools and max. 2 % of university graduates.

Generation Y and how to work with it? According to the IBM study (2015), there will be a generation Y from 2020 (people born in 1986–2000, also millenium generation, millenians), which will fill approximately half of the USA workforce; they will have a growing influence on decision-making in organisations and companies.. Similar development can be expected in Europe, too. The biggest difference between the members of generation Y and the older generation is that the first have a high level of digital literacy, so it is a big opportunity for businesses - should they get an opportunity they can help the businesses to direct investments into inovations and brand new ways of working with customers. As apparent from research (e.g. Kaspersky Lab, 2017), majority of businesses cannot approach the youth effectively, and fail to make them interested or keep them for a long time.

Work with millenians is more difficult. They have some characteristic features - they prefer flexibility at work, work effectively, emphasize a balance between work and personal life (they are less willing to spend time at work) and health. They are very creative, come with new ideas and inovations and putting them into practise is important for them. In education and development, they prefer an individual approach (mentoring and coaching), which enables them to look for their own ways in career as well as personal life. Company culture and relationships at work are important for them - if they are not satisfied at work they have to problem to leave their jobs and find another employment. They want to be a part of an organisation that will fulfil the values they believe themselves.

These specific characteristics, however, require a different approach from management of companies, especially in the area of personalistics and organisation of work. Personal processes, especially the selection, grasping young talents and working with them (*Talent Management*), motivation, management of work performance., are usually „set“ for older generations in most companies. **The Industry 4.0 and comming of the generation Y to labour markets also needs a big change in operation of the companies.**

The strengths: High level of digital literacy, flexibility, creativity.

The weaknesses: Knowledge and skills that do not correspond with the labour market requirements.

Reccommendation

Effective use of the young generation potential is a prerequisite for succesful management and realisation of the Industry 4.0 concept. In relation to that, it is possible to form the following reccommendations:

- To reform the education system to provide the knowledge and skills in accordance with the requirements of labour market. Experience from Germany indicates that the so-called dual system of education, which is based on a close interconnection of the theory and practise, is very effective. It is desirable to open not only the brand new ´digital´ subjects but also the ´traditional ones´, for example law, medicine or economics, which have to be adjusted to new requirements.
- To create suitable conditions for the development of trainee education. To achieve higher prestige of those who complete trainee schools and also more respect for craft / manual work by means of suitable marketing.
- To change the organisation of work in companies (incl. personnel processes) to reflect the needs of the Industry 4.0 and specifications of work with millenians.
- To create the employment environment where it would be possible to use more flexible forms of employment.
- It is important to have a dialogue of all economic subjects: state, businesses as well as trade unions.

People 55+ on labour market

People above 50 make one quarter of the population in Europe. Considering the demographic development (ageing of population and decreasing number of births), it is possible to assume that the importance of the people 55+ will be more and more important on labour market, and **it is therefore desirable to maintain a high level of their employment.** In the Czech Republic, the employment rate of people aged 55+ reached 58,5 % last year (see Picture 4.8); the unemployment reached 3,8 %, therefore lower numbers than total unemployment rate, which was 4 % (see Picture 4.7).

Older employees are considered to be a group significantly threatened by digitalization. The threat is especially a result of **a low level of e-skills**. Whereas the highest level of computer skills applies to almost 80 % of people to 35 years old, there are not even 40 % of those aged

55-64 on even similar level. This huge difference, however, decreases significantly as the level of education grows (see Table 4.3). The decrease of computing skills is faster in case of women (see Table 4.4). The threat also becomes higher due to the fact that people above 55 have lower level of formal education, a compensation of which may be more practical experience into some extent. Another negative for older people is also the fact that employment decreases in precisely those professions in which they work. All factors together further increase the overall threat by the digitalization process.

People above 55 with education in computers have a great potential on labour market. It is therefore desirable for the older people to participate in educational programmes much more than what was common so far, even in higher age. The aim of all these attempts should be to increase their computer literacy and all required skills related to the digitalization process. Picture 4.1 describes the participation in lifelong education according to age categories in the Czech Republic - whereas there is the highest number of the 24-34-year-old (13,5 %), the lowest numbers are among the people 55+ - only 3,7 %, which is an alarming number.

A position of older people on labour market reflects their wages, too (see Table 4.5).

Table 4.5 Average gross monthly wages according to age in the Czech Republic in 2016 (in CZK)

Total average wages	**29.061 CZK .**
20 to 24 years	21.125
25 to 29 years	25.922
30 to 34 years	29.954
35 to 39 years	31.218
40 to 44 years	30.846
45 to 49 years	29.911
50 to 54 years	29.275
55 to 59 years	**27.912**
60 to 64 years	**30.126**
above 65 years	29.823

Source: ČSÚ, own work

Wages of employees aged 55 - 59 have decreased significantly compared to previous age group. Working activity decreases with age quite significantly, too. Whereas in the category of those aged 50-54, there are 445 thousand people who earn wages, it is only about 390 thousand in the category 55-59, and only 202 thousand in category 60-64 (wages grow again in this category; it is especially the top specialists, experts, people with excellent knowledge, advisors and managers who remain on market). Only 51 thousand people in retirement age above 65. Moreover – compared to the western countries, older people and especially the retired are very dependant in the Czech Republic (96 % of pensioners´ incomes is paid by state, whereas it is

only about 30 % in the Netherlands). **It is clear from presented data that people aged 55+ are underestimated on the Czech labour market, and their skills are not used fully. However, just the opposite trend is desirable.**

Concerning the flexible forms of employment, only 55% workers above 55 have a permanent contract (see Picture 4.16) On the other hand, many employees from this category often use part-time work (see Picture 4.17); That may be a suitable form of how to gradually transfer to economic inactivity, on the other hand, this may mean underemployment.

Also the older generation has some characteristics that can be used very well in business. These include loyalty, reliability, work experience and contacts in their area of business. One of the ways to improve the effectivity of company and its functioning is a suitable *Age Management* , therefore having all age cathegories represented. Every age involves a different look at things, different experience and common cooperation, which can bring some interesting innovative processes.

The strengths: Rich work experience and professional contacts.
The weaknesses: Low level of computer skills, generally lower willingness to learn new things.

Reccommendation

Considering demographic development, people above 55 with a higher level of computer literacy represent a huge potential for labour market. It is therefore possible to put together the following reccommendations:

- To create a well-working system of lifelong education - it is a strategic matter and well needed part of the society knowledge. It is desirable to involve the people above 50 in the lifelong education much more.
- Considering the needs of the Industry 4.0, it would be good to immediately consider and put into practise a concept of education aimed solely at achieving a higher level of computing skills of the people aged 50+.
- Companies can be recommended the concept called *Age Management*, which makes it possible to effectively use the advantages of workers of all age groups. Greater involvement of older workers in the company education systems can be also recommended, not considering the part-time contracts.

- Also the matter of increasing digital literacy of the 50+ people calls for a dialogue and cooperation of all social partners - government, employees and trade unions.

People with low qualification on labour market

People with low qualification have the least secure position on labour market; unemployment development of the group is highly volatile depending on economic cycle (see Picture 4.10). Although leaving education prematurely slightly increased in the last decade (from 5,2 % in 2007 to 6,6 % in 2016), the Czech Republic belongs to the countries with the lowest rate of the indicator in the EU. The unemployment rate of the people with the lowest education, [20]considering the good economic development, has been continuously decreasing since 2013 (in 2016, it was 19,2 %). Comparison with Germany provides an interesting look at unemployment of people with the lowest level of education.

Table 4.6 Unemployment rate according to education, comparison of the Czech Republic and Germany (2016, in %)

Country	Total MN	MN of people with the lowest education	MN of people with secondary education	MN of people with the highest education
The Czech Republic	4,0	19,2	3,2	1,8
Germany	4,1	10,0	3,7	2,2

Source: Eurostat, own work.

Having almost the same level of unemployment, there is a big difference between the unemployment rate of people with the lowest level of education. It is 10 % in Germany, whereas nearly a double in the Czech Republic. There could be several causes; inadequate usage of flexible forms of education (see Pictures 4.1 and 4.2), deficiencies in the requalification system, low participation in the lifelong education (in 2015, about one quarter of people with the lowest education participated in some form of lifelong education, see Picture 4.14), incorrectly set relationship between minimal wage and social security benefits, which does not motivate to participate on labour market, or other things. It is usually several factors together. **The Czech Republic may not use the mechanisms that could decrease the unemployment of people with low level of education effectively.**

The digitalization process, which is connected with building knowledgable society, makes the space for employment of people with low level of education and skills much smaller. There is

[20] Level 0-2 according to ISCED 2011 classification; preprimary, primary and lower secondary education.

smaller and smaller demand for workforce in a range of professions with a high percentage of the people with the lowest education (especially manual or building professions, machine and equipment operation, assemblers etc.), in processing industry, construction, transport, storage and other (for a closer look see Chapter 3).

Table 4.7 Percentual change in employment according to profession.
(projection CEDEFOP, 2015–2025 in %)

Vocational class ISCO-08	Projection of demand 2015 - 2025	Change in employment in p.b. (projection, 2015–2025)			Percentage of people with elementary education (2015, ČR, in %)	Percentage of people with secondary education without Maturita exam (2015, ČR, in %)
		Level of education				
		low	medium	high		
Legislators and managers	24	-0,3	0,6	0,8	0	6
Specialists	34	-0,1	0,6	1,0	0	1
Technical and other workers	176	0,0	1,0	1,3	1	10
Officers	0	0,2	1,3	1,4	2	13
Workers in services and sale	**-7**	-0,1	0,8	1,3	**13**	**46**
Qualified workers in agriculture, forestry and fishing	**-10**	-0,4	0,6	1,8	2	**55**
Craftsmen and repairmen	**-53**	-0,1	1,0	1,9	**11**	**68**
Manipulation with machines and equipment, assemblers	**-6**	-0,1	0,9	1,8	**18**	**68**
Assistants and unqualified workers	**-25**	0,2	1,0	1,6	**23**	**58**

Source: CEDEFOP (2016), ČSÚ, own work.

Two contradictory pocesses go on here; there is an increasing number of people with the lowest level of education (even if only slight) and at the same time, the digitalization process puts the jobs with the lowest requirements on qualification and skills under the biggest threat.

Earnings of people with the lowest level of education (without Maturita) grew faster than earnings of people with higher education in last decade. Available ČSÚ data about a development of real gross wages (when we compare 2015 and 2016) show that about 18 % of employees had to cope with its decrease, there was a stagnation in case of 9 % of employees and 73 % had an increase. Employees who experienced an increase in real wages were represented by those working in public administration and healthcare as well as in employment categories „operation manager in services and business“ and „assistants and workers without qualifications“. There were decreasing wages in case of employees working in mining, excavation and building, in categories ´qualified builders and producers´ and ´machines and equipment operators´.

Table 4.8 Average weges according to level of education in the Czech Rep. in 2006 (in CZK)

Achieved level of education	Amount of average wages
Elementary and unfinished	19.452
secondary without Maturita	22.325
Secondary with Maturita	28.438
Higher and bachelor	32.992
University	45.906

Source: ČSÚ, own work

In 2016, there was a significant increase in incomes of people who received minimum wages but the highest earnings grew the least, **therefore the imbalance related to earnings decreased**, which was a breakthrough in the long-term trend. These changes in the distribution of wages were a result of a growth of minimum wages and guaranteed wages in a combination with negotiated wages as well as growign demand for workforce with medium and lower qualifications (manual workers, drivers, shop assistants etc.). **The dynamics of the wages growth was bigger than the one of productivity of work;** if such trend continued in the future it could have a negative impact on competitiveness.

Temporary contracts, seasonal work, employment through agencies etc. are common among the workers with a low level education. They are at the highest risk of the so-called work precarization.

The strengths: No strengths can be identified.

The weaknesses: Low level of achieved education, skills do not correspond with the requirements of labour market, high threat by digitalization.

Reccommendation

A low level of knowledge and skills is a much greater handicap at the time of the Industry 4.0 compared to how it was up until now. Majority of arrangements should therefore lead towards the education sphere. There are the following reccommendations:

- It is essential to provide such knowledge and skills that will correspond with the needs of labour market and it must start in primary education or and/or study subjects without Maturita (school system reform, development in the apprentice education, dual education).
- In productive age, many more people with lower level of education need to join the lifelong education (effective system of lifelong education needs to be created).

- It is characteristic for this group of people on labour market to have temporary contracts, part-time work or they are employed through labour agencies. Although the law puts the employees with flexible employment into the same position as those who have a permanent contract, when compared to the permanent workers, the flexible ones are *de facto* in disadvantage - one area is the access to company training. A main aim should therefore be to achieve a higher participation of the people with a low level of education in the business training processes. This approach can be beneficial for both sides: the employer does not have to terminate employee´s contract as soon as the demand is lower but his knowledge and skills can be used on different position in his business; the employee will become more flexible and less dispendable for his employer, and should he look for a new job in the future, he would have much higher chances.
- Also the employment politics should better react to the new requirements of digitalization. It would be desirable to achieve a shift from a passive employment politics to an active one, that is to solve not only the impacts of unemployment but first of all to see how to prevent it (especially for people with low level of education). The main aim should be therefore to have a closer look at education to create a system that would make it possible to gain required qualification or respectively requalification. To achieve this goal, it is important for the state, employers and trade unions to closely cooperate on local as well as national level.
- Active politics of employment is an impartial part of the flexicurity concept.[21] The concept is based on creating a balanced relationship between flexibility and security. Security does not mean the security of employment but security of access to education (opportunity to gain required knowledge and skills and use them on labour market) in any phase of active life. The concept is succesfull for example in the Scandinavian countries where education plays an important role. An important condition for effective functioning of the concept is to make company training accessible to employees with flexible forms of employment.
- It is clear from practise that it is just the individuals with low education who participate in lifelong education less than desirable. The above roccommendations aim to achieve a better access to education in labour market for this group, too. On the other hand, some unwillingness from employees to gain new knowledge and skills must be taken into

[21] EC (2007). The Commission´s Communication *To the general principles of flexicurity: greater number and higher quality of jobs through flexibility and security.* Brussels: EC, 27. 6. 2007. KOM(2007) 359 final.

account, too. And this is the reason why it will be appropriate to interconnect one´s willingness to join further education with a social security system (especially with benefits for the unemployed) in the future.

- In future, there will be space for the people with low level of education to find work especially in services, which will futher develop; higher number of jobs can be expected in this area. Finding a job in services, however, requires a certain level of specific professional knowledge and skills; communication skills, assertive manner etc. are very important.

Women on labour market

Position of women on labour market is determined by motherhood and care for a family into a great extend. One of the main characteristics of the group is **a higher level of achieved education**; more women than men graduate from universities in the Czech Republic and in the EU (see Picture 4.9). Women also join in lifelong education more often than men (see pictures 4.11 and 4.12). The above analysis of selected indicators also proved that women up to 29 are better in computer skills than men (see Table 4.4), their level of knowledge, however, descreases quickly with age (and maternity).

Compared to men their position on labour market is quite steady. Women have lower employment level, the unemployment, on the contrary, reaches higher numbers than in case of men. In the Czech Republic, the unemployment rate of men reached 84,6 % in 2016, whereas the unemployment rate of women reached 68,6 %; the unemployment of men was 3,4 %, the unemployment of women was 4,7 %.

Women are also employed **part time** much more often than men, and part-time contracts are a good tool of *work-life balance*, which means balancing personal life and work. A problem in the Czech Republic is only a limited offer of shorter working hours, which - together with an inadequate amount of pre-school institutions and related services - makes it more difficult for women to return to work after maternity leave and balance their work and family. In the western European countries, part time jobs are much more common (see Picture 4.2). In the Czech Republic, part time work is used by approximately 10 % women (whereas it is 30 % in the EU) and less than 3 % men (around 9 % in the EU).

Some other characteristics of women on labour market when compared to men include also **slower career building**, which is often stopped by the so-called glass ceiling (*glass ceiling*),

which makes it more difficult for them to get a position in top management.[22] Another small and long-term problem is **the differences in wages between men and women**. But the available data show that **these differences are bigger in the countries with longer maternity leave**.

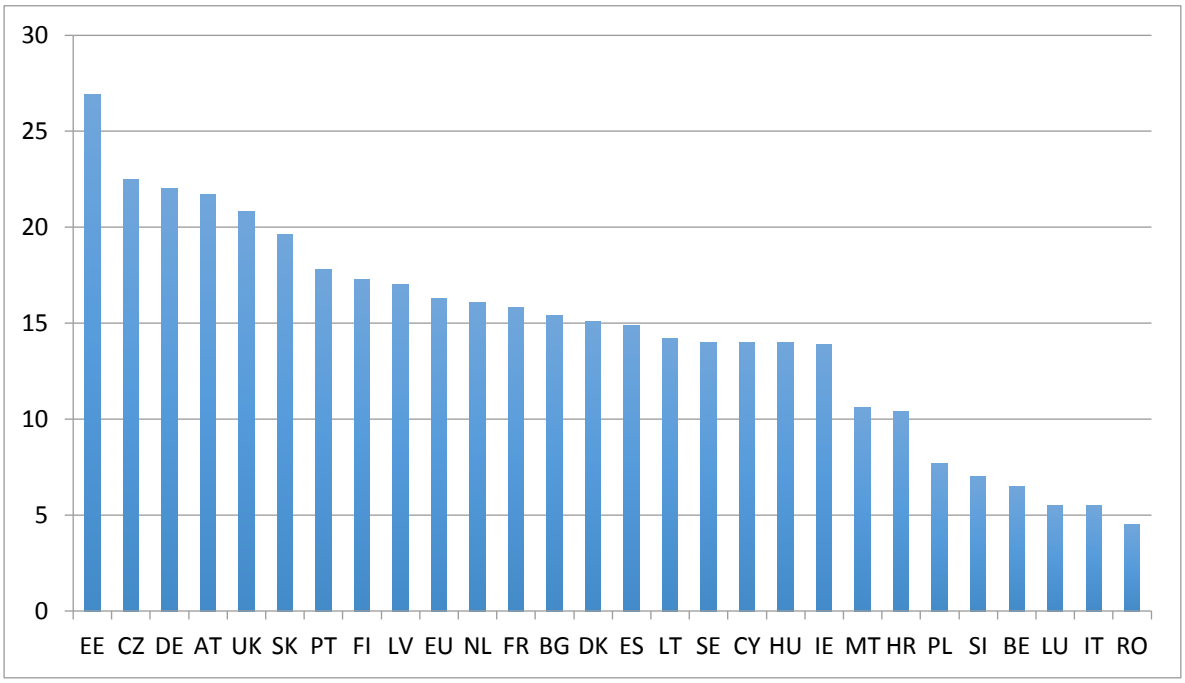
There are different reasons for the differences in wages, the main ones include: stronger role of women in childcare, more women work in less paid jobs (cleaning, cashiers, employment in services, some professions in healthcare, education) and lower percentage on women on management positions. The so-called direct discrimination where women and men of the same positions and with the same qualifications receive different remmuneration is also not rare on labour markets. There is an indicator expressing the difference in wages between men and women, which is called *Gender Pay Gap* (GPG).[23] The following caricature brings some humorous picture into the serious problematics.

According to the data for 2015, there were the second highest differences in the wages of men and women in the Czech Republic compared to other member states of the EU (see Picture 4.19).

[22] More information about the problematics can be found for example on the website Deloitte Governance Centre, the Czech Republic, see http://www.corgov.deloitte.com/site/cz. The problematics of a position of women in society including their different position on labour market has been studied also by the sociological institute AV, the Czech Republic, since 1990; visit http://www.soc.cas.cz.

[23] GPG – relative difference of wages median of men and women (related to men´s wages median); it is expressed in %. Higher GPG does not necessarily mean any discrimination. A big part of the difference can be explained as a result of various factors with different structures for men and women (education, area of business, employment, how long they had worked etc.).

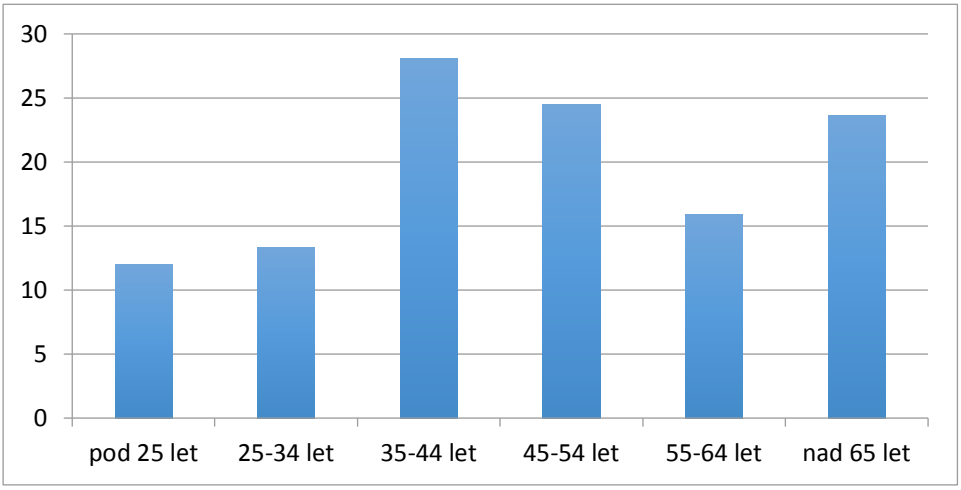
Picture 4.19 Gender Pay Gap, EU-28 (2015, in %)



Source: Eurostat, own work.

Note: EE – Estonia, CZ – the Czech Republic, DE – Germany, AT – Austria, UK – Great Britain, SK – Slovakia, PT – Portugal, FI – Finland, LV – Latvia, EU – EU-28, NL – the Netherlands, FR – France, BG – Bulgaria, DK – Denmark, ES – Spain, LT – Lithuania, SE – Sweden, CY – Cyprus, HU – Hungary, IE – Ireland, MT – Malta, HR – Croatia, PL – Poland, SI – Slovenia, BE – Belgium, LU – Luxembourg, IT – Italy, RO – Romania. Data for Ireland, Malta and Croatia are for 2014; data for Greece are not available.

Picture 4.20 Gender Pay Gap according to age (2015, v %



Source: Eurostat, own work.

An influence of maternity leave on career building is well seen in Picture 4.20, which describes Gender Pay Gap in productive age. The difference is growing once women become 35 years

old and usually come back from maternity leave. Differences in wages further deepen after reaching the age of 65, when lower wages in productive age reflect the amount of pension.

In relation to the digitalization process, it is possible to expect that women will be more slowly effected by the process, since there are more men working in the areas of business that are under the greatest threat because of digitalizetion (especially automatization and machine tool work). Concerning women, administrative work is under the highest threat due to digitalization.

In general, only very few women work in information and communication technologies in the Czech Republic, in 2015, it was less than 10 %, which is a very low number if compared to the EU average (16,1 %).

New flexible forms of employment connected with the digitalization process make it possible to use working hours much more effectively, but on the other hand, they also create a risk because of a disappearing line between private and business life; they can be more psychologically demanding and have negative impact on family life.

The strengths: Achievement of higher level of education and participation in the lifelong education, high level of flexibility.

The weaknesses: Very limited offer of part*time jobs on labour market, lack of the pre-school institutions and related services, limited availability of services for households, glass ceiling.

Reccommendation

Position of women on labour market is determined by motherhood and family care a lot. Majority of suggested solutions are therefore aimed at creating such conditions that would make it possible to gain harmony between employment and personal life in a better way.

- Having part-time employment is desirable - together with an insufficient number of pre-school institutions and related services as well as little availability of services for households for most families, little use of part-time jobs create a barrier for women to return to work after maternity leave.
- It is apparent from practise that the longer the maternity leave is the more difficult it is to return to labour market. The Czech Republic together with Slovakia are in leading positions in the EU as for the length of maternity leave, which is 28 weeks; it is usually between 16 and 18 weeks in other EU countries. It could be appropriate to make maternity leave shorter in the future and increase financial aid during maternity at the

same time. The currently suggested increase of the amount of contributions and keeping the same length of maternity leave is not a solution of the barrier in returning to labour market. (The question is therefore whether this solution will really solve the problem of young women postponing their maternity until they are older.) It is a complex problem - lack of part-time positions, shortage of pre-school institutions, low accessibility of services for households, too long maternity leave.

- The analysis showed that women gain higher level of formal education than men and they also participate in lifelong education. Nevertheless, a level of knowledge decreases with age (and with maternity). In connection to that, it is essential to have access to company training even when working part-time, or to be able to join other forms of lifelong education.
- The results of analysis also showed that there are big differences in wages between men and women in the Czech Republic (GPG was the second highest in the EU in 2015); and the difference is the biggest after the age of 35 when women usually come back after maternity leave. The amount of wages has a negative impact on the amount of pensions (GPG grows after reaching 65). There is no easy solution but using the ICT development that suffers from a shortage of specialists could be the way. Developing ICT area with high earnings could be a good opportunity for women to become succesful on labour market (with positive impact on GPG). It is important for the government to consider and discuss the question - a potential of educated women should be used in the digitalization process.

When solving the suggested reccommendations, it is important that all subjects cooperate on labour market - the state, employers, trade unions - on all levels.

The Attachement - Robots at work

´I was fired, ´said a cartoon joke in the 70s, just as a shattered man dressed in a suit and with his work bag was comming home to his wife, ´I was replaced by a calculator´.

The joke appeared really funny at the time it came out, in the era of mass use of calculators. At that time, a newly invented pocket calculator came as a welcomed help that no one considered a threat. Not even the current devices, large hall computers programmed in Fortran and COBOL emposed any threat for employment. On the contrary, many more jobs were created in computing industry compared to how many ceased to exist.

It was the same when small and cheap personal and home computers started to be used. Economists were surprised for a long time that massive use if information technology did not influence effectivity too much. They spoke about a productivity paradox. A famous economist Robert Solow said in 1997 that ´computers can be seen all around except for the productivity statistics.´

Why the fifth generation failed

The term ´artificial intelligence´ became popular at the same time. It existed from the 1960s when people thought they could control wind, rain and methematical logic principals, but people started to take it seriously in the 80s. The artificial intelligence of that type was not really smart, though. Computers ´learnt´ to play chess quite well, but only thanks to quite simple algorhytms of searching the possibilities tree and using relatively uncomplicated heuristic functions (it is better to have figures in the centre of board rather than a corner, the king should be protected etc.). Computer playing chess and similar games was therefore not a proof of how smart the computers were but more of how the living programmers were smart.

The 1980s was a time period when people believed that Japan was going to reign, also thanks to its ambicious programme of how to develop the fifth generation computers besides other things. Those should have been smart machines able to understand the text, translate automatically, understand the verbally ordered tasks, provide logical proofs. All that using logical programming and paralel processes.

It should have worked but it did not. Japanesse project of artificial intelligence has failed, though - not due to insufficient money but because its concept was wrong right from the beginning. It was proved that the logical programming was only a fashionable step with very limited usability.

The term ´smart intelligence´ was declining from the 80s. Computers were used for solving other problems: all kinds of communication, management of production and finances, databases, processing of text, picture and sound, playing games. Computers became supereffecgtive calculators, automatic card indices, comfortable typewriters, mixing devices, dark rooms for digital photos and many other things. None of the things, however, matched the romantic ideas of the 60s about artificial brains with miraculous abilities.

But why did the fifth generation project fail? Why was the artificial intelligence only an imaginary thing? Because - said mathematically - the predicate logic of the first grade and the programming language Prolog based on it are not enough to simulate the processes happening in human brain. These hardware and software media are not enough to solve logical puzzles

like the Einstein task, but a truly functional thinking is nowhere their possibilities. Practical use is very limited.

Logical programming and generally any mathematic-logical manipulation with symbols is only one of the possible ways a human can use when trying to simulate the intelligence. These attempts are not absolutely useless, and you can try yourself on www.wolframalpha.com. You can bet that a machine will calculate uncertain integral – for example from the function $\sin(\ln(x^2))$ – much faster than you can!

What are some other ways? There is a whole range of approaches which can be called, with little exaggeration, artificial intelligence. Searching the possibilities tree or base for all chess algorhytms belong to the oldest ones. Wide possibilities are provided by statistics and theory of probability, especially the Bayes conditional probability. It is an interesting example how quite simple rule can lead to some very sophisticated applications.

Probability intelligence simulation

As an example, take one of his favourite topics of the Internet discussions: how it is with the terrorism and islam. „Only a very small percentage of muslims are terrorists," says one side. „But a vast majority of terrorists are muslims," argues the other side.

The Bayes rule admits that both sides can be right, and says how to grasp things correctly. Let´s express a probability that a person accidentally selected from certain population will be a terrorist as Pt. Probability that coincidential person from the same population will be a muslim, is described as Pm. Probability that an accidentaly selected muslim will be a terrorist is described as Ptm. What is the probability that an accidentally selected terrorist will be a muslim (Pmt)?

According to the Bayes rules, Pmt = Ptm * Pm / Pt. Let´s for example (only for orientation and not matching fact) add variable values: Pt = 0,1 percent, Pm = 20 percent, Ptm = 0,4 percent. Although there are only 0,4 percent terrorists among muslims in the given hypothetic population, the probability that a terrorist will be a muslim is 80 percent.

The example is obviously trivial (although not quite trivial for the many who discuss it on social networks). In practise, a very strong mechanism can be built on the Bayes rule. Even the simplest algorhytm for processing statistical data, with a not very ambitious name ´naive Bayes´, is applicable and very useful in practise. The algorhytm which fits in a few lines of a regular programming language can process data so effectively that it will, for example, make it possible for an internet shop to predict what other goods a customer might buy on condition that he has bought this ot that product.

Modern Bayes systems function so well that even a human can sometimess feel like someone is reading his thoughts. Besides online shops they are used in advertising and spam filtration. But it is still not anything we could mark as real intelligence. Despite undoubtable results the bayes algorhytms still belong to a superficial imitation of thinking.

We copy brain

Neuron networks are a step further. Here it is a simulation of neurone functioning together with using common information technology. Software will make it possible to simulate the activity

of neural cells that are interconnected in various schemes and they pass a signal converted by linear functions to one another - about the way it works in reality. An artificial neuron has entrances (variables) comming either from internal environment of from synapses of different neurones. There is non-linear function inside, the entrance of which is a total of entrance variables and exit is a number that can be an entrance variable for another neurones or it is a part of a result. Individual synapses have numerically determined weights.

One cell cannot do very much on its own but a sufficient number on neurones can do wonders. As few as 800 artificial neurones recognize hand-written numbers and letters reliably. For a comparison, a bervous system of a simple worm Caenorhabditis elegans contains 302 nerve cells, an average human brain about 100 billion.

What does it mean in practise? Even quite simple neuron network is able to manage tasks which computers traditionally had a problem with. One of the main weaknesses of artificial intelligence is something that is a piece of cake for natural intelligence: indentification of shapes, objects, sounds, moves, or pictures in the most general meaning of the word. Not even a very intelligent person can easily identify faces because human brain is designed to do so. It is, however, a very difficult job for a computer considering calculation as well as algorhytms.

Only today computers´ performance has become so high that they enable relatively routine tasks e.g. in industry, medical diagnostics, recognition of fingerprints and other biometrical data, and so on. Logical brain-twisters are not a domain of artificial networks - as it is in case of logical programming - but it is universal recognition of patterns. Universality is a big advantage of the neuron networks.

Their second advantage is the ability to learn. Neuron network does not have to be programmed in a classical way (it is not even possible), it learns from its successes and failures on its own. If we present the neuron network with one hundred pictures of a dog, cat or fish, it will learn what is the visual basis of dogs, cats or fish. It is trivial for a human but a breakthrough for a computer.

Even better thing is that the neuron network can learn on its own. Company Google (now officially renamed to Alphabet Inc.) constructed a network with capacity several million neurones, which played a board game go with itself many times. After some time, the network was able to beat the world champion. The game GO is much more difficult than chess from the computer points of view, as the number of all possible moves is hundreds thousands grades higher. Until recently, go was one of the last board games in which a human champion was better than a machine. This does not apply today any more.

Nevertheless, it is still a fact that machines really do not know what they are doing. Even the most advanced neuron network today able to learn on its own is nothing but a mechanism. A machine does not understand the fact that it plays chess or go. It is able to recognize a picture of a cat or a dog but it does not know what the cat or the dog is. It has no conscience. It is still true that knowledge of the neuron network remain on the level of a worm.

But machine learning does not apply only to the neuron networks. In majority of cases, this term can be understood as a complex algorhytm based on traditional and not really so outstanding techniques of mathematical statistics and linear algebra. When we say ´vector spaces´ it sounds very distant, but this way it is possible to build a functional algorhytm of machine translation. How?

Intelligent algebra

Very simply: every word or a term appears in language in relation to other words or terms. Vector space can be imagined like a system of coordinates with words placed at different places. As we know, where there is for example an English word „light“, we can only reach to a similar place in Czech vector space and we can see that it is a word „světlo (opposite of dark)“. But should the word „light“ appear in a slightly different group of words, the system will reach to a different place and it will translate the word as „lehký (opposite of heavy)“. Or it can be said in a different way: if we know that the Czech word „královna“ means „queen“ in English, then a certain operation (shift in vector space) will produce the plural forms of both words. A different shift in vector space is going to relace the female gender by a male one.

The artificial intelligence modelling using the vector spaces is connected with a work of a young Czech mathematician Tomáš Mikolov, who worked for Google and now he is an employee of the Facebook development department. Mikolov has noticed that the weights of the neuron networks links between entrances and hidden sections correspond with the vector representation of words in multidimensional space, writes Jiří Materna, a specialist on the neuron networks. A ground-breaking disertation work of Tomáš Mikolov from 2012 can be found on address http://www.fit.vutbr.cz/~imikolov/rnnlm/thesis.pdf. Model Word2vec, which was invented by a team of Tomáš Mikolov in company Google, is now a top worldwide.

Nevertheless, it is apparent that machines translate words and sentences only to numbers that are used to carry out mathematical operations. Knowing that human language can be interpreted purely on mathematical level is outstanding: but it is still true that not even the genius algorhytm Word2vec understands what is written in that language. Machine translator Google Translate is much more advanced today than machine translations ten or more years ago. It is still apparent that it is a product of machine translation, not a result of consciousness, understanding of a text and its transformation to another language. Professional translators do not have to worry about work yet.

Which brings us to a question of for which professions is the artificial intelligence a threat. And there are quite a few.

Professions at threat

One of the professions that ceased to exist were counters. Only a few know that the English word ´computer´ comes from around 1640 and it was a word for a human profession, not a machine. As far as the advantages of machines compared to people are concerned, the more precisely a problem is formulated the better for the machine; the higher the requirements of speed and the longer the databases are needed the better for the machines.

Researchers Carl Benedikt Frey and Michael A. Osborne from the Oxford University published a large work in 2013, which attempted to estimate the possibilities of automatization in different professions. Those under the greatest threat include office jobs in banks, insurance companies, broker companies, advisory companies, libraries and so on. The threat of losing jobs arises anywhere people do routine work with information. This applies not only to wages accountants, bank creditors but also sports coaches and even models. (Artificial beauty generated by

computer graphics will perhaps look a little bit impersonal at the beginning but will be much cheaper than Eva Herzigová or Giselle Bündchen. Yes, even physical beauty can be interpreted as rutine processing of information).

Let´s go back to the sphere o artificial intelligence. Until recently, there were only a few applications that could win when competing with a man: chess belonged to the first ones. But as the processors grew stronger, with greater capacity of databases and a progress in algorhitmisation, there is a weaker and weaker leadership of a human.

Chess is only a game but as soon as a computer defends a graduated doctor of medicine in medical diagnistics it is a different matter. The university in American Indiana did an experiment during which they ´fed´ the IBM Watson system by medical data indcluding high blood pressure, diabetes and chronic depression. The result: the system was 42 percent better in diagnostics and prescriptions compared to human doctors.

Doctor Joshua Denny from the University of Vanderbilte, Nashville, is a co-author of an expert system which gives advice to physitians regarding complications and side effects of medications based on data of 16 thousand patients. The system is based on the matematical statistics and it is not that ´smart´ on its own. „The system is very good, better than my own intuition," says doctor Denny.

For now, there is no „electronic doctor", which would replace a human doctor in full extent. So far, medicine is too difficult subject requiring analysis of many different kinds of data including those which are still very difficult to recognise for machines. That is why medicine is the most immune against the developments of artificial intelligence - it is especially difficult to replace the therapists by machines, much more than diagnostics.

The most difficult areas are those that require the greatest amount of human approach no matter if it is a soft motor activity (surgery, dental medicine), empathy (psychology and psychiatry), top perception abilities (X-ray diagnostics) or elementary medical research, as the machines are the weakest in the areas that require creativity, hypotheses and searching for new solutions. Whereas the role of machines will grow in diagnostics, therapy shall probably remain a domain of humans.

Although machines will probably remain just doctors´ assistants in medicine, other areas and fields are much worse off. Look at finances, for example. Approvals of insurance contracts used to be a process where it was necessery to have human experience and practical knowledge in the past. It could take days or even weeks. Today insurance is approved online using algorhytm, without a touch of human hand. A sentence ´I have no job, I have been replaced by a calculator´ is not a joke any more.

The same applies to loans: should or should not a bank grant a loan to one or another applicant? The loan specialist profession used to be respected as well as well paid. They now belong to endangered kinds, especially in the area of consumer loans and mortgages where are many clients, applications can be easily standardized, statistically evaluated and either granted or rejected very fast. Work with loans is not so demanding in terms of computer capacity, nor difficult in terms of algorhytm compared to e.g. medical diagnostics or processing natural language: mathematical statistics and bayes probability are enough.

On the other hand, it is interesting how little impact the artificial intelligence has had on the area of investments so far. It seems logical to replace a portfolio of an investment fund manager

by a machine. Despite that there are only a few attempts - if we do not count the automatic and high-frequency shopping, which is completely different from artificial intelligence. There are even less succesful attempts.

Where artificial intelligence fails so far

The area of investments on stock market is in fact an ideal place where to replace a human judgement by algorhytm. Algorhytm does not have any testosteron and cortisol swings like the stock brokers, there are no good or bad feelings towards politicians or members of the central bank committee, there are no hopes or fears. In other words, all undesirable influences that have a negative impact on the results of investment process can be eliminated by automatization. Why has it not happened so far?

Besides traditional conservatism of regulation bodies, there is also a fact that the artificial intelligence techniques, which are famous for example in medical diagnostics, fail in the area of investments. The reason: they are too perfect. Financial information is - more than any other kind of information - contaminated by ´information murmuring´). Neuron network is able to learn perfectly what were the circumstances like when the stock went up or down in the past, but a descripion of the circumstances contains a lot of informational ballast.

It can therefore easily happen that the knowledge system trained for historical financial data will completely fail in the future, since the future growths or drops of shares, currencies or commodities will take place under completely different circumstances. For example: no neuron network or bayes algorhytm would not be able to predict a decrease of the interest rates in many advanced economies and their drop to negative values recently. This was something absolutely new and it had the roots in the fact that central bankers decided to go for a creative solution in time of distress, they did something no one had ever done before.

That does not say that the artificial intelligence methods cannot be used in the area of investments. It is obviously possible but we need to use a new, unusual way. A robust solution has to come before precision. There will never be any miraculous financial ´crystal ball´. However, there can be an expert system which will be based on rules and which will decide about a content of investment portfolio more wisely than a common portfolio manager. But primarily it will happen without emotions that always devastate a quality of human investment decision-making.

In finances and management, robots will never replace a human in the area of difficult business negotiations. Automat can replace a human at a petrol station, in a supermarket, when applying to get a credit card or a mortgage, however, it will never replace a good human salesman in any more difficult matter starting with investments or life insurance. Although both can be automatized, a human will tend to discuss any important financial decisions with other humans. The same applies to any shopping connected with emotions. (You will probably not buy Bentley or Aston Martin on eshop. Even if you had that opportunity.)

Automatization and robotization can play an important macroeconomical role in industry. There is remarkable progress even now and it is only a beginning. In the years to come, an automobile factory will look like a huge hall, with almost no people, at the entrance there will be raw materials, intermediate products and basic parts, at the exit, there will be finished cars. This all was supervised by only a few engineers, technicians and managers.

The importance of manual work will move to the background in a similar way as in the textile industry in the past. Only a very few people now remember what was the role of textile industry when Britain, France or Switzerland were industrialized. It is almost non-existing in these countries today. Could something like that happen with the so praised automobile industry in the Czech Republic? Yes, it could, why not. 20 years from now, the Czech industry may stand on completely different bases. Alternatively, it does not have to exist at all.

There is a question of what about the current employees and what people will do at all. There is a possible analogy with a big agricultural revolution that appeared at the beginning of the 20th century and which completely changed a structure of employment from California to Košice in a few decades. Mechnization and fertilisers increased productivity so much that agriculture employs only a few percent of workforce in advanced economies today. Others started working especially in services.

But is it the way to the future when a great number of jobs in services is under threat? What will the people do?

There is an existing opinion that humanity will divide into a small, elite and well-paid group of developers, physitians, engineers and other creative professions, and a mass of proletariate that will live on basic unconditional income and will kill time watching TV and escaping from reality playing computer games or drugs. If it really happens, it would perhaps be wise to support these perspective professions and not give them a hard time by means of progressive taxation. The future, however, does not have to be so gloomy.

Why? Let´s look at the time of the greatest losses of jobs in agriculture: 1920 - 1960 in the USA, slightly later in Europe. What was the labour market like at the time? The answer is: flexible, untied by complicated codes of conduct, employers were free to employ and to let go. Free market has solved the problem of what to do with the people who have not found jobs on farms. The market worked much better than most people realize.

But how does the European labour market look at present? As byrocratic marthyrium for employers. A trap or a mine everywhere you look. Under these circumstances, it is worth to either move production to China or invest into automatization. Until the polititians realise that, the vision of the elite group managing our automatic world on one side and unemployed proletariate on the other side unfortunately seems very realistic.

And what if everything is different?

A base of creative thinking is to ask questions. These questions include ´What if everything is different from what everyone thinks?´

What if the worries related to smart intelligence and robotization constitute a false fear? What if there isn´t be any tragic decrease in the number of jobs? What if the benefits and the number of newly created jobs outweights the loss of traditional jobs? (Who needs human counters today? Operators of the phone directories? Or the workers who woke up builders to go to work by tapping the windows at times when an alarm clock was a luxury for a normal family?)

In relation to that, economs, analysts and sociologists,whose ambition is to evaluate possible results of technological progress, should be warned. There are many cases when specialists

educated in humanistic subjects, who are quite intelligent but do not have technical knowledge, may be quite mistaken in their conclusions.

Example: problems called Y2K. At the end of 1990s, a global panic appeared as a result of the hypothesis that a catastrophe would come at the very beginning of 2000. Computer systems, which were programmed with a short description of the year that had only two numbers before, would ´think´ incorrectly that there is a date 1 January 1900. The consequence of this technical misunderstending will be a breakdown of the information systems of banks, pension schemes, insurance companies, state authorities, power networks etc. The civilization will possibly not disappear completely but the threat of the systems failure was considered to be so real that central banks began with the preparations of special arrangements in the area of monetary politics if needed.

Reality? Nothing happened as we already know. No systems crashed down. Bank crises arose eight years later and there were completely different reasons for it. False alarm.

But why did the world panic? Partly because people just like panicking. It is a nature of people to prefer the information that sound more dramatic. Partly because the experts with technical education had less space in media than half-educated stock market analysts and economs.

Every software engineer could explain to the world that the worries are often unfounded. Every bank, insurance company, pension fund or investment company had to - even before 1970 - take into account the fact that the 30-year state bonds - a very popular tool for long-term investment - would mature in 2000. Every developer of information systems in finances must have worked with that fact even in the 1960s.

The same applied to counting of human age in the public administration systems. And concerning the management systems of power stations, energetic networks and other strategic systems: no one has ever given reasons why specific dates should be entered into the calculations controlling a nuclear reactor or distribution network.

The Y2K problem was found to be just a bubble. Now there is a question of whether the worries about mass unemployment, once the artificial intelligence comes, aren´t unnecessary.

Partly, they may be. Even today it is definite that some traditional jobs are going to cease. But will it really be such a loss for humanity if a large part of public administration officers, officers in banks, insurance companies or other companies lose their jobs? Won´t it be a chance for the mentioned institutions to a bit more attention to a contact with customers and work on higher employment in this sector, which would be difficult to replace by artificial intelligence? Is it really necessary for a client to wait on customer line for long minutes before it is his/her turn (and only then he is attended to but often with no willingness and poor quality?)

These or similar questions will be answered in the future.

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