

MANIFESTATION OF INDUSTRY 4.0 IN THE CZECH REPUBLIC

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Abstract

Industry 4.0 is the name given to the current trend towards digitalisation and automation of production and related changes in the labour market. Some changes are already visible now, others will come. The aim of the paper is to introduce how the so-called 4th industrial revolution - Industry 4.0 manifests itself in the Czech Republic and its individual regions. Advancing automation and digitalisation is of course not only affecting the sectoral structure of employment, but above all the job content of individual professions. Industry 4.0 manifests itself in the labour market mainly by replacing physically demanding but routine and low-skilled work with technology. Some professions are therefore becoming less important. On the other hand, technological development is an opportunity that brings with it entirely new professions. This unstoppable development can, of course, also be seen from the employees' point of view. Some groups of people are more vulnerable to technological progress than others. The problems that could arise from this need to be prevented. One possible measure is to ensure that retraining and sufficient training is offered to enable employees to upgrade their skills. Education should also respond flexibly to these labour market changes.

Key words: Industry 4.0, employment structure, labour market

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Introduction

The impact of technological development on the labour market can be traced back to the 18th century. The period of the first industrial revolution can be characterised by the introduction of the first mechanisation in agriculture and industry and the use of water and steam power. The second industrial revolution took place at the turn of the 19th and 20th centuries. The most significant changes it brought were the use of electricity and internal combustion engines. Then, from the 1960s onwards, the third industrial revolution, also called the scientific and technological revolution, took place. It started with the invention of the transistor, followed by the massive development of computing. The 21st century has brought with it the so-called

fourth industrial revolution, also known as Industry 4.0. Its main features are digitalisation and automation. Its basic visions originated in Germany. The first was presented by Henning Kagermann, Wolf-Dieter Lukas and Wolfgang Wahlster - representatives of business, politics and science - at Hannover-Messe 2011. They outlined the course of the paradigm shift in industry and new possible business models based on cyber-physical systems. The Industry 4.0 Working Group, chaired by Siegfried Dais (Robert Bosch GmbH) and Henning Kagermann (acatech), submitted the "Implementation Recommendations for the Future Industry 4.0 Project" (Umsetzungsempfehlungen für das Zukunftsprojekt Industrie 4.0) to the German Federal Government in October 2012. The call for the continuation and further development of Industry 4.0 was accepted and a cooperation agreement for the operation of the Industry 4.0 platform was concluded in April 2013 by the German associations Bitkom, VDMA and ZVEI, which together represented over 6,000 members. The official launch of the Industry 4.0 platform was announced at the Hannover-Messe 2013 on 14 April 2013. Other countries, including the Czech Republic, are gradually joining the Industry 4.0 initiative. It is a gradual process, so the fourth industrial revolution is definitely not a closed stage. On the contrary, we can say that we are at its beginning. The key elements of Industry 4.0 are presented in detail in (Kosacka-Olejnik, Pitakaso, 2019).

1 Manifestation of Industry 4.0

In (Branco et al., 2023), three main areas where the advancing Fourth Industrial Revolution is manifesting itself are identified. These are infrastructure, big data processing and custom Industry 4.0 applications. The rate of change varies at country and sector level.

1.1 Expected manifestation

The main features of the fourth industrial revolution are the transformation of manufacturing companies into smart factories using cyber-physical systems. The first tool is the smart factory, or smart factories. The principle of smart factories lies in the ability to exchange information between suppliers and customers and the ability to trigger the actions that are necessary for the flawless functioning of factories. A smart factory is essentially a self-contained unit that is capable of leading, managing and controlling itself. The factory will be able to analyse and configure itself in the event of errors or malfunctions and will also be able to adapt to the conditions imposed on it. (Sergi et al., 2019)

Cyber-physical systems are an integral part of the whole Industry 4.0 concept. Within these systems, it is possible to monitor physical processes, create virtual copies and create various solutions. The basis of the systems is the cooperation of independent units that are controlled by algorithms. The cyber-physical system is therefore one large organism that enables the interconnection of all other systems and tools within Industry 4.0. (Sergi et al., 2019) Cyber-physical systems include systems for automatic configuration, optimization, diagnostics and worker support. The issue of cyber-physical systems and the implementation of Industry 4.0 is discussed in detail in e.g. (Zezulka et al., 2016).

Industry 4.0 methods and tools are expected to bring time and money savings and greater flexibility for companies. The labour market is also gradually changing. Human labour is increasingly being replaced by machines in the performance of monotonous and physically demanding activities. This should lead to a reduction in the number of employees in manufacturing and a shift of labour to other sectors. A prerequisite for the functioning of cyber-physical systems is the existence of a reliable Internet network and high-quality hardware. Manufacturing companies also need employees who can handle new technologies. It is therefore necessary to enable existing employees to upgrade their skills accordingly. Job applicants are expected to be able to work with cutting-edge technologies. The education system should therefore adapt to this and equip future employees with the necessary knowledge and skills.

1.2 Initiatives supporting the introduction of Industry 4.0 in the Czech Republic

The Ministry of Industry and Trade of the Czech Republic developed the Industry 4.0 initiative with the aim of maintaining and strengthening the country's competitiveness at the onset of the fourth industrial revolution (MPO, 2016). This initiative was approved by the Czech government in August 2016. The main idea of the Industry 4.0 Initiative is to support the impulses brought to the Czech industry by this completely new philosophy of systemic use, integration and interconnection of various technologies with a view to their permanent, very rapid development, and to prepare conditions for the industrial production and non-production sphere to realize a new industrial revolution in the Czech Republic.

In 2016, the Ministry of Labour and Social Affairs commissioned the preparation of the Work 4.0 Initiative Study. Study (MPSV, 2016) deals specifically with the expected impacts of digitalization (computerization and cybernetization) on employment, the labour market and selected social aspects related to these areas. Considerable attention is also paid to issues of further education, the development of which and participation in it is a prerequisite for acquiring

the knowledge and skills newly required by the labour market. Based on an analysis of selected aspects of the impact of technological developments on the labour market, broad measures have been proposed for each of the areas analysed.

Employees need to be adequately prepared for the changed job roles and the associated skills requirements. Therefore, at the end of 2016, the Ministry of Education, together with representatives of various sectors of industry and trade union representatives, started to develop a material called Education 4.0. The changes should concern three areas: education in primary and secondary schools, universities and further education. Measures will focus on strengthening key competences, digital skills and lifelong learning. The necessary changes in the school system are discussed in more detail in e.g. (Boháčová, Jindrová, 2021), (Jindrová, Boháčová, 2023) or (Kot'áková Stránská, Košťálek, 2023).

The Czech-Moravian Confederation of Trade Unions has prepared a concept called Industry, Education, Labour, Society 4.0 (ČMKOS, 2017). It presents a vision of how to respond to the demands of the fourth industrial revolution while avoiding possible negative social impacts.

1.3 Industry 4.0 barriers

An overview of the barriers to implementing Industry 4.0 and how to overcome them is summarised in (Zhang et al., 2021). The barriers listed in this paper can be divided into five main categories - technological, organisational, personnel, economic and security barriers. Technological barriers include, in particular, inadequate infrastructure. We can also include the safe, fast and efficient processing of large volumes of data. There are many organisational obstacles. Among the most important are insufficient communication with external subjects, the need for interdisciplinary communication and short-term planning. The need for proper comprehensive planning processes and establishing an open-minded and flexible corporate culture can also be seen as barriers. Personnel barriers include, of course, the lack of skilled labour and the need to integrate employees into the implementation process. The economic obstacle is not just a lack of funds, as it might seem at first sight. It also includes the uncertain economic benefits of investing in digital technologies. The security obstacles are obvious. There is a need to ensure the safe transfer of large amounts of information and resources.

All the above obstacles can also be seen as challenges. Overcoming them will make it easier to implement Industry 4.0 principles. Understandably, overcoming these obstacles is easier for large companies with good facilities. It is the large companies that are the first agents of change in the context of the ongoing industrial revolution. Medium-sized and smaller

companies will follow. The prerequisites for successful implementation of Industry 4.0 at the enterprise level are discussed in detail in (Sony, Naik, 2019). The readiness of companies to implement Industry 4.0 is assessed, for example, by (Honková, 2018).

2 Impact of Industry 4.0

Industry 4.0 affects the entire labour market, some sectors less, others more. Changes are sometimes gradual and sometimes dynamic, some are already underway, others are yet to come. Of course, the structure of employment changes over time. (MPSV, 2016) lists the occupations and groups of people in the labour market that may be most at risk as Industry 4.0 progresses. It also details the expected changes in labour market demand. It is expected that the replacement of labour by technology will not be continuous, but in waves. In the first wave, a reduction in the number of employees in transport and logistics, administration, trade and construction can be expected. After the first wave, technological decline and a slowdown in replacement is expected. After some time, a second wave is to follow, which will be characterised by the development and introduction of artificial intelligence, self-optimising systems that will be able to replace human work even at the level of decision-making. Let's see whether the effects of the first wave of changes have already been felt in the Czech Republic and its individual regions.

2.1 Development of the employment structure in the Czech Republic

From the data of the Czech Statistical Office, it is possible to obtain the number of employees in individual sections according to the CZ-NACE classification in the years 1993 - 2023. The Common European Classification of Economic Activities (NACE) distinguishes 21 sections, which are listed in Table 1.

The development of the number of employees in individual sections is described in detail in (Boháčová, Jindrová, 2021) and (Boháčová, Jindrová, 2023). Given the above, we will be interested in the number of employees in sections F, G, H and N. We will compare the share of these sections in total employment in the Czech Republic in 2011 and 2023.

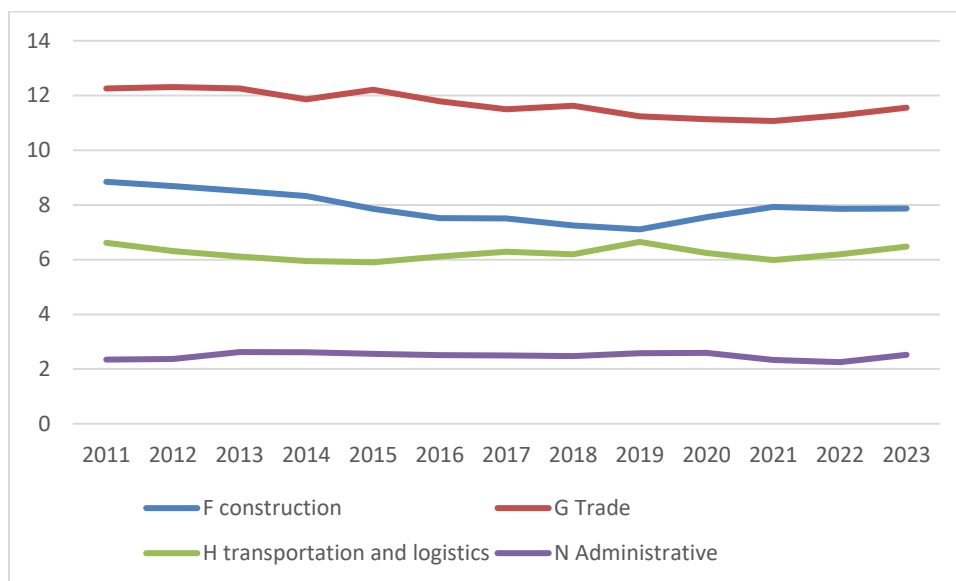
Tab. 1: The expanded concept of the sectoral structure of economy

Section code	Economic area
A	Agriculture, forestry and fishing
B	Mining and quarrying
C	Manufacturing
D	Electricity, gas, steam and air conditioning supply
E	Water supply; Sewerage, waste management and remediation activities
F	Construction
G	Wholesale and retail trade; Repair of motor vehicles and motorcycles
H	Transportation and storage
I	Accommodation and food service activities
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M	Professional, scientific and technical activities
N	Administrative and support service activities
O	Public administration and defence; Compulsory social security
P	Education
Q	Human health and social work activities
R	Arts, entertainment and recreation
S	Other service activities
T	Activities of households as employers; Undifferentiated goods and service producing activities of households for own use
U	Activities of extraterritorial organisations and bodies

Source: Eurostat

Figure 1 shows the evolution of the percentage share of the four selected sectors in total employment in the Czech Republic between 2011 and 2023. The graph shows a slight decline in sections G (Trade) and F (Construction). The evolution in sections H (Transportation and logistics) and N (Administrative) can be assessed as rather constant. The percentage representation of these 4 sections in 2011 and 2023 is summarised in Table 2.

Fig. 1: Share of selected industries in total employment in the Czech Republic, development between 2011 and 2023



Source: own processing, data of the Czech Statistical Office

Tab. 2: Share of selected industries in total employment in the Czech Republic, comparison of 2011 and 2023

	F (%)	G (%)	H (%)	N (%)
2011	8.85	12.26	6.61	2.35
2023	7.87	11.55	6.48	2.52

Source: own processing, data of the Czech Statistical Office

It is clear from the table that there has been a decline in the percentages in sections F (Construction), G (Trade) and H (Transport and Logistics). In contrast, there was a slight increase of 0.17 percentage points in section N (administration).

2.2 Development of the employment structure in the regions of the Czech Republic

The Czech Republic is divided into 14 regions at the NUTS 3 level, one of which is the capital city of Prague. The development of the sectoral structure of employment in the regions of the Czech Republic is discussed in detail in (Boháčová, Jindrová, 2023). At the regional level, the number of employees in each sector is only available until 2022. We will therefore compare the situation in 2011 with 2022.

Table 3 shows the differences in the percentages of the four sections in 2022 compared to 2011. The values of the calculated differences are given in percentage points.

Tab. 3: Difference in percentage in 2022 compared to 2011 in the regions of the Czech Republic

	F	G	H	N
Prague	-0.92	-3.97	-1.37	-0.28
Central Bohemian	0.21	-0.84	-0.35	0.24
South Bohemian	-0.58	-0.41	-1.09	-0.05
Plzeň	-1.98	-1.14	2.09	-0.08
Karlovy Vary	-1.46	-1.08	-1.15	-0.51
Ústí nad Labem	-2.73	1.19	0.76	-0.66
Liberec	-2.24	-2.36	1.35	-0.06
Hradec Králové	-1.64	0.56	-2.72	0.87
Pardubice	-0.16	0.68	-1.57	0.60
Vysočina	-0.54	0.37	-0.37	-0.59
South Moravian	-0.12	-0.35	-0.70	-0.39
Olomouc	-2.49	-2.82	0.22	-0.25
Zlín	-1.04	-0.21	-1.27	-0.51
Moravian-Silesian	0.32	-1.06	0.18	0.17

Source: own processing, data of the Czech Statistical Office

The table shows that in most cases there has been a decrease in the percentage. In five regions, there was a decrease in all four sections monitored. These are Prague, South Bohemia Region, Karlovy Vary Region, South Moravia Region and Zlín Region. The largest recorded decline was in the capital city of Prague in section G - trade, where there was a decrease of almost 4 percentage points. A decline of more than two percentage points also occurred in section F - Construction in the South Bohemia, Ústí nad Labem, Liberec and Olomouc regions. Furthermore, in section G - Trade in the Olomouc Region and in section H - Transport and Logistics in the Hradec Králové Region. The most significant increase in the percentage representation occurred in Section H - Transport and Logistics in the Plzeň Region by 2 percentage points. A higher increase of more than 1 percentage point was observed in section H - Transport and logistics in the Liberec Region and in section G - Trade in the Ústí nad Labem Region. The table also shows that, in general, there is a more pronounced tendency to decline than to increase in these sections. The average percentage change between 2011 and 2022 was -0,65 percentage points.

Conclusion

So how is the fourth industrial revolution manifesting itself in the Czech Republic and its regions? The first changes have already occurred. Particularly in large manufacturing companies, there is a tendency to automate production and gradually replace monotonous and arduous human work with the work of machines. The anticipated changes in the employment structure are also already visible. In line with Chapter 2, we can confirm that the percentage of employees in the construction, trade, and transport sectors in the Czech Republic in 2023 was lower than in 2011, and a similar trend is also evident in most regions. In the Administration section, there was a slight increase in some regions and a slight decrease in others. Further changes can be expected to follow. Not only in the structure of employment, but also in the job descriptions of individual occupations. It is therefore desirable for society to be prepared for these developments.

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