

.....

# SLOVAKIA

.....

ID #21920068



Sonia Ferencikova, Andrea Zacharova

## Content

FOREIGN DIRECT INVESTMENT IN SLOVAKIA.....	3
INDUSTRY 4.0 IN SLOVAKIA.....	15
SURVEY RESULTS - EFFECTS OF INDUSTRY 4.0 ON FDI IN THE VISEGRAD COUNTRIES.....	24
Appendix 1.....	26
Appendix 2.....	30
LITERATURE.....	31

### *Acknowledgements:*

*This country chapter has been drafted as part of the final report of the project funded by Visegrad Fund- EFFECTS OF INDUSTRY 4.0 ON FDI IN THE VISEGRAD COUNTRIES - ID#21920068. We are grateful to all our interviewees who agreed to take part in our research project. All remaining errors are ours.*

Table 1 - FDI inflows, FDI outflows .....	4
Table 2 - FDI stock (in billions of USD and as a % of GDP .....	5
Table 3 - Reshoring from Slovakia .....	5
Table 4 - Reshoring to Slovakia .....	5
Table 5 - Regional differences in inflow of FDI.....	6
Table 6 - Foreign Trade Indicators.....	7
Table 7 - FDI Slovakia - direct position at the end of 2018 broken down by continents .....	7
Table 8 - FDI Slovakia direct position at the end of 2018 broken down by countries .....	8
Table 9 - FDI inward position at the end of 2018 broken down by economic zone .....	9
Table 10 - FDI inward flows, 2018, broken down by continent .....	9
Table 11 - FDI inward flows, 2018, broken down by economic zones .....	9
Table 12 - FDI, inward flows, 2018, top countries.....	10
Table 13 Table 11 - FDI inflows, 2018, broken down by country – top 10 Europe .....	12
Table 14 - Main countries of origin for FDI located in Slovakia,2018 .....	12
Table 15 – FDI position broken down by economic activity, 2015-2017 .....	14

# FOREIGN DIRECT INVESTMENT IN SLOVAKIA

Slovakia as a country in the heart of Europe benefits from its geographical position. The country has long industrial tradition, has skilled and not so expensive workforce, developing (slowly) infrastructure and offers tax incentives for foreign investors. GDP and economic growth since 2009 have been driven mainly by exports.

Slovakia and its economy can be described as a small economy and a very open one. The openness index in 2018 – share of foreign trade on GDP - was the highest in the short history of independent Slovakia reaching 190,31 % of GDP (World Bank). This shows how open is the Slovak economy (third place in openness in the EU). The average value of this index from 1990 to 2018 is 139,06% which is very high compared to the average of 161 ranked countries in 2018 of 93.35%. (theglobaleconomy.com). Slovakia belongs to the most rapidly growing economies in Europe with 3.9% in 2018 and 2.4% in 2019 - even though the growth has been recently heavily affected by Corona crisis - in the second quarter of 2020 GDP compared to the same period in 2019 decreased by 12.1% (Statistical office, 2020).

The strongest industry is the automotive industry with a production of 198 cars per inhabitant in 2018– i.e. Slovakia is no.1 in the world in this indicator. The overall manufacturing industry employs 24.7% of the population. The automotive industry – leads to high re-exportation (representing almost 25% of country's exports in 2018). To the most exported goods belong also reception apparatus for TVs, parts of automobiles. The highest imports are in the field of parts of motor vehicles, radio/telephony transmission tools, cars, crude oil, and petroleum gases.

Slovakia can build on its political stability and good international relations. As a member of the European Union and with the adoption of the euro in 2009 the country has better and easier chances to be included into international trade. To other strong points count stable banking system, attractive business environment for foreign investors and favorable tax system with tax incentives for foreign investors. On the other hand, the high dependence on the automotive sector and exports belong to the weak points of the country together with high energy costs (almost 90% of the needed energy must be imported). No access to the sea and still not very well-developed infrastructure hinders more investment. Domestic purchasing power is low, and the size of the domestic market is small.

For doing business and investing in Slovakia the country offers many advantages. To the most attractive ones belong the country's strategic geographical position in the heart of Europe with strong export potential, political and economic stability, use of euro currency (in contrast to its Central European neighbors – Czech republic, Hungary and Poland), high productivity of labor, skilled and well educated and still cheap workforce, openness of the country, potential for R&D and innovation, improving infrastructure and attractive investment incentives (SARIO, 2019). The country ranks 42nd out of 190 economies in terms of ease of doing business, according to the 2019 World Bank Doing Business Report (losing 3 positions compared to the previous year).

On the other hand, the drawbacks of investing in Slovakia must be mentioned as well: sharp regional differences, high level of corruption, slow speed of changes in infrastructure, slow dispute resolution, recent increases in corporate taxes, changes to the Labor Code, and recurring corruption issues.

For the foreign investors, the country offers freedom of establishment of a company and possibility to own majority stock in a company. Some procedures are not so easy, and investors must apply for various authorization. There are some technical and administrative barriers such as requirement of import licenses especially for raw materials, energy and some agricultural products.

Slovak government encourages foreign investments, offering a wide range of investment incentives in form of tax credits and subsidy system which are offered depending on the type of investment project, geographical location, and sector. These incentives are granted and depend on project, geographical location and sector of investment. Foreign investors in Slovakia can benefit from European financial grants and aids and they can also get involved in many of the renovation and modernization projects in the country where the grants can range from 20 to 50% of investment costs. The low tax rate is another attractive point for FDI.

Comparing GDP and FDI developments in the Slovak economy, there is a certain correlation between these indicators. The impact of FDI on GDP development indicates that each FDI unit contributes to economic growth, respectively GDP growth; it affects employment and contributes to the solution of unemployment. It can be said that any increase in FDI also resembles in an increase in GDP even though not proportionally and consequently also in the fall in unemployment. Since there are also other variables that affect the economy the impact of FDI on GDP is not proportional but rather a certain lag can be seen. Overall, the state of FDI in the Slovak economy has been gradually increasing since 2010, but the sectoral and regional differences seem to be harsh. The difficulties of FDI in the Slovak economy are strong orientation on the automotive industry and at the same time their location mainly in Western Slovakia.

In Table one we can see the foreign direct investment inflows and outflows in the period of 2013 to 2018.

*Table 1 - FDI inflows, FDI outflows*

<b>FDI Inflows, millions of USD</b>						
<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	
604	-512	106	805	2277	475	
<b>FDI Outflows, millions of USD</b>						
<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>	
-313	43	6	99	350	234	

Source: own elaboration, using data from NBS

As can be seen from the Table 1, the inflow of foreign direct investment has shown no stable development, going deep to - 512 million USD from 604 million USD in 2013, then increasing rapidly in the following three years and reaching its highest level in 2017 of USD 2.2 billion, FDI decreased substantially to USD 475 million in 2018. FDI outflows showed increasing

pattern from -313 million USD in 2013 up to 350 million USD in 2017 and copying the development of FDI inflows in 2018 decreasing to 234 million USD. Total FDI stock was at USD 57 billion (53,6% of GDP) in 2018 (2019 World Investment Report, UNCTAD).

In Table 2 we can see the changes in FDI outward and inward stock in Slovakia in the period of 2013 to 2018 as total amounts of billions of USD and as a percentage of GDP.

Table 2 - FDI stock (in billions of USD and as a % of GDP)

<b>FDI outward stock</b>					
<b>2010</b>	2013	2014	2015	2016	2017
<b>-3.45</b>	-4.83	-2.82	-2.46	-2.63	-3.41
<b>% of GDP</b>				2.9	3.6
<b>FDI inward stock</b>					
<b>2010</b>	2013	2014	2015	2016	2017
	58	n/a	46	47.6	55.8
<b>% of GDP</b>				52.9	58.3

Source: own elaboration using data from NBS

Changes in the global economy and implementation of Industry 4.0 bring also various movements of large investments from offshoring countries back to the original country of companies. These movement take away some investment from Slovakia back to other European countries but also some investments from abroad back to Slovakia. The main reshoring companies and the reason why they have moved their investment can be seen in Tables 3 and 4.

Table 3 - Reshoring from Slovakia

<b>Company</b>	<b>Offshored to</b>	<b>Reshored to</b>	<b>Industry</b>
<b>Sitteco</b>	SK	Germany	Manufacturing
<b>Can Pack</b>	SK	Poland	Manufacturing
<b>Oxymat</b>	SK	Denmark	Manufacturing
<b>Turolla</b>	SK	Italy	Manufacturing

Source: own elaboration using Eurofound data

Table 4 - Reshoring to Slovakia

<b>Company</b>	<b>From</b>	<b>To</b>	<b>Reason</b>
<b>Glutz and Jensen Holding</b>	China	SK	Improvement of efficiency
<b>Palma Group</b>	CZ	SK	Proximity to supplier
<b>SWEP SL</b>	Switzerland	SK	Global reorganization

Source: own elaboration using data from Eurofound data

Despite the country's attractiveness to FDI, not all regions can attract major investments which leads to regional disparities. The big regional differences between various regions in Slovakia have already been mentioned. In the table 5 below we can see how these differences are reflected by the inflow of foreign direct investments. In this table we can see the cities with main FDIs, the region where they are located, and sum of euros invested in these cities. We can see that most of the FDIs flow into the cities in western part of Slovakia, some in central part of Slovakia and the least in the eastern part of Slovakia, mainly in the city of Košice.

Table 5 - Regional differences in inflow of FDI

District	Region	Thousands of euro
Bratislava	West	29712813
Košice	East	1748980
Žilina	Center	1553742
Nitra	West	915799
Senec	West	751522
Púchov	Center	640590
Trenčín	West	623387
Trnava	West	614130
Malacky	West	536851
Galanta	West	535794

Source: Dudas, 2019

The main reason of these geographical differences is availability of workforce, better educated workforce, better infrastructure (or missing infrastructure in eastern part of Slovakia) and existence of clusters. Moreover, western Slovakia is the gate to western Europe and its market. There are three main advantages to invest in west Slovakia for investing companies:

- Geographical – the closeness to the important markets;
- Infrastructural – better connections to the important markets;
- Network-related – closeness to a dense network of suppliers and producers in the same value chain enabling them to use related synergies. (Dudas, 2019)

One of the factors that influences the volume of FDI flowing into a country is the availability, structure, and volume of investment support. Slovakia offers a variety of forms of support for incoming investors as well as for existing companies. The goal is to bring the investment that could lead to lower level of unemployment, creation of new jobs, possibilities for local companies to get new contacts and contracts. Slovakia also offers incentives for companies investing in research and development. (SARIO, 2020)

Regional investment aid is one type of investment incentive. It is offered to both domestic and foreign investors. The main condition is the linkage to a specific region. Research and development super deduction tool was introduced by the Slovak government in order to motivate companies to spend more on R&D, and through it to create more jobs and increase competitiveness (SARIO, 2020).

Geographically – most exports (2018) flow to Germany (22.2 %), Czech republic (10.3%) and Poland (7.7%). On the other hands more imports arrive from Germany (18.1%), Czech Republic (10.3%), China and South Korea (6% each) (EU data). Altogether the main part of trades goes to and from the EU - 85.1% of exports and 59.8% of imports. (WTO,).

FDI inflows according to UNCTAD and its 2020 World Investment Report increases to 2,5 billion USD in 2019 compared to 1,1 billion USD in 2018. The total FDI stock in 2019 was 60 billion USD. Country depend on the Eurozone and its economic health, especially Germany and France and is sensitive to regional tensions (Russia-Ukraine). According to data by OECD, the main investing countries in Slovakia are the Netherlands, Czech Republic, Austria and Germany. As per sectors of activity, manufacturing and industrial production, financial and insurance services, wholesale and retail are those that attract most investments (OECD, latest data available). Bilateral investment conventions signed by Slovakia - Slovakia has signed 63 bilateral investment treaties (UNCTAD Investment Policy Hub).

Table 6 - Foreign Trade Indicators

Foreign Trade Indicators	2014	2015	2016	2017	2018
<b>Imports of Goods</b> (million USD)	81,953	73,509	75,471	83,304	93,891
<b>Exports of Goods</b> (million USD)	86,460	75,584	77,634	84,469	94,267
<b>Imports of Services</b> (million USD)	8,948	7,933	7,950	9,374	10,605
<b>Exports of Services</b> (million USD)	9,062	8,031	8,323	10,344	11,485

Source: WTO, 2017

Based on the data from NBS here is the FDI direct position of Slovakia at the end of 2018 broken down by continents. The strongest is of course Europe with more than 147 billion of EUR, followed (after a huge gap) by Asia with more than 3294 million of EUR.

Table 7 - FDI Slovakia - direct position at the end of 2018 broken down by continents

Continent	Total in millions
Europe	147 132,6
Africa	49,2

America	572,3
Asia	3294,7
Oceania and polar regions	-6

Source: own elaboration using NBS data

FDI inward position broken down by countries – top 10 in the world– end of 2018

From the table 8 we can see that there are mainly European countries with the highest inward FDI, the only exceptions is South Korea in the sixth place. The highest total FDI are coming from the Netherlands, Czech Republic and Austria.

*Table 8 - FDI Slovakia direct position at the end of 2018 broken down by countries*

<b>Country</b>	<b>Total FDI, millions of EUR</b>
<b>Netherlands</b>	13 072
<b>Czech Republic</b>	6 561,6
<b>Austria</b>	5 901
<b>Germany</b>	3 658,6
<b>Luxembourg</b>	3 453,7
<b>South Korea</b>	2 955,9
<b>Belgium</b>	2 691
<b>Hungary</b>	2 672
<b>Italy</b>	2 485
<b>United Kingdom</b>	1 566

Source: own elaboration using NBS data

When we group individual countries into various economic zones, we can see that main investment in 2018 was the OECD countries and from EU28 countries.

Table 9 - FDI inward position at the end of 2018 broken down by economic zone

<b>ECONOMIC AND MONETARY ZONES</b>	<b>Thousands of euro</b>
<b>EU28 (fixed composition)</b>	47 827 463
<b>Extra-EU 28 (fixed composition)</b>	3 215 124
<b>OECD countries</b>	50 101 502
<b>NICs 1 (Core Newly Industrializing Countries)</b>	2 980 631
<b>Euro area 19 (fixed composition)</b>	35 461 836

Source: own elaboration using NBS data

As the second indicator of FDI in Slovakia we use the inward flows – based on the directional principle with geographical breakdown where (-) signifies the withdrawal of capital from Slovakia.

Table 10 - FDI inward flows, 2018, broken down by continent

<b>Continent</b>	<b>Millions of euro</b>
<b>EUROPE</b>	<b>1 038 998</b>
<b>Africa</b>	<b>8 825</b>
<b>America</b>	<b>-124 880</b>
<b>Asia</b>	<b>82 469</b>
<b>OCEANIA AND POLAR REGIONS</b>	<b>-2 912</b>

Source: own elaboration based on NBS data

As with the FDI stock also with the flow, main FDI flow from European countries, followed by Asia.

Table 11 - FDI inward flows, 2018, broken down by economic zones

<b>ECONOMIC AND MONETARY ZONES</b>	<b>Total – thousands of EUR</b>

<b>EU28 (fixed composition)</b>	1 037 546
<b>Extra-EU 28 (fixed composition)</b>	-35 045
<b>OECD countries</b>	1 205 025
<b>NICs 1 (Core Newly Industrializing Countries)</b>	68 729
<b>NAFTA (North American Free Trade Association)</b>	-140 313

Source: own elaboration based on NBS data

Here in Table 12 we can see inflow but also countries with huge withdrawal of capital from Slovakia. The leading three countries are Czech Republic, United Kingdom and France. First non-European country in position 6 is South Korea. The countries with the highest withdrawal of capital are Germany and the Netherlands.

Table 12 - FDI, inward flows, 2018, top countries

<b>country</b>	<b>Total – thousands of EUR</b>
<b>Czech Republic</b>	431 478
<b>United Kingdom</b>	424 705
<b>France</b>	418 129
<b>Belgium</b>	247 888
<b>Austria</b>	236 790
<b>South Korea</b>	127 725
<b>Italy</b>	113 916
<b>Malta</b>	109 515

<b>Switzerland</b>	<i>104 169</i>
<b>United States</b>	<i>-101 591</i>
<b>Ireland</b>	<i>-102 597</i>
<b>Jersey</b>	<i>-155 563</i>
<b>Luxembourg</b>	<i>-161 181</i>
<b>Cyprus</b>	<i>-168 137</i>
<b>Netherlands</b>	<i>-210 517</i>
<b>Germany</b>	<i>-473 473</i>

Table 13 Table 11 - FDI inflows, 2018, broken down by country – top 10 Europe

<b>Country</b>	<b>Thousands of EUR</b>
<b>Czech Republic</b>	431 478
<b>United Kingdom</b>	424 705
<b>France</b>	418 129
<b>Belgium</b>	247 888
<b>Austria</b>	236 790
<b>Jersey</b>	-155 563
<b>Luxembourg</b>	-161 181
<b>Cyprus</b>	-168 137
<b>Netherlands</b>	-210 517
<b>Germany</b>	-473 473

Source: own elaboration using NBS data

Table 13 demonstrates FDI inflows in Slovakia in 2018 broken down by country within Europe. Among European countries, Czech Republic has the most significant share in FDI inflow to Slovakia, followed by United Kingdom and France.

In Table 14 we can see the list of main countries of origin for FDI located in Slovakia. They come in descending order as valued in 2018 and their FDI positions in millions of USD dollars.

Table 14 - Main countries of origin for FDI located in Slovakia, 2018

<b>Country</b>	<b>2015</b>	<b>2016</b>	<b>2017</b>	<b>2018</b>
<b>NLD: Netherlands</b>	9 077	13 231	15 300	14 967
<b>CZE: Czech Republic</b>	4 537	5 423	7 731	7 513
<b>AUT: Austria</b>	7 714	6 861	7 652	6 756

<b>DEU: Germany</b>	3 076	2 666	4 559	4 189
<b>LUX: Luxembourg</b>	3 872	3 304	4 019	3 954
<b>KOR: Korea, Republic of (South Korea)</b>	3 230	3 060	3 446	3 384
<b>BEL: Belgium</b>	2 165	2 340	2 995	3 082
<b>HUN: Hungary</b>	2 613	2 597	3 000	3 059
<b>ITA: Italy</b>	3 400	2 311	2 791	2 845
<b>GBR: United Kingdom</b>	492	546	1 442	1 793
<b>CYP: Cyprus</b>	1 383	1 809	1 795	1 729
<b>FRA: France</b>	917	882	817	1 337
<b>CHE: Switzerland</b>	718	594	842	874
<b>SWE: Sweden</b>	258	351	823	840
<b>ESP: Spain</b>	587	651	838	795
<b>DNK: Denmark</b>	431	407	522	470
<b>POL: Poland</b>	317	196	472	456
<b>IRL: Ireland</b>	520	421	548	438
<b>ARG: Argentina</b>	119	182	208	270
<b>JEY: Jersey</b>	-629	-1 144	-1 618	-1 714

Source: Own elaboration based on OECD data

In the table 14 we can see the development of FDI inward stock from the most important partners over the period of 2015 to 2018. The lead continuously remaining in the hands of the Netherlands, Czech Republic and Austria close together and changing their positions on the 2<sup>nd</sup> and 3<sup>rd</sup> place.

Table 15 – FDI position broken down by economic activity, 2015-2017

Economic activity	2015	2016	2017
FDI_T: All FDI activities	46 016	47 592	59 510
A: Agriculture, forestry and fishing	164	150	181
B: Mining and quarrying	111	94	76
C: Manufacturing	15 302	15 358	19 091
D35: Electricity, gas, steam and air conditioning supply	1 949	3 484	3 920
F: Construction	477	609	765
GTU: Services	27 886	27 774	35 323
H: Transportation and storage	1 856	1 833	2 149
I: Accommodation and food service activities	69	125	159
J: Information and communication	2 370	2 142	2 632
K: Financial and insurance activities	11 236	11 048	12 870
L: Real estate activities	3 289	3 004	4 369
M: Professional, scientific and technical activities	1 599	1 636	3 315
N: Administrative and support service activities	2 883	3 158	4 019
Q: Human health and social work activities	134	126	422
R: Arts, entertainment and recreation	166	252	181
S: Other service activities	145	103	113

Source: Own elaboration based on OECD data

As can be seen from the table 15 direct investment companies are mainly investing in the areas of services, manufacturing, financial and insurance activities, real estate activities, and administrative and support service activities.

## INDUSTRY 4.0 IN SLOVAKIA

The concept of Industry 4.0 was first time used in Hanover, Germany, 2013 and was introduced in the time of analysis of the impact of new technologies on the country's economy. The Slovak economy is very closely bound to the German one and that's why this process is also very much affecting Slovak economy as well.

One of the goals of this process is to bring the industrial production back to Europe particularly on the technological level with the productivity that could compete with other countries. Many large companies have already undergone a long way in this process and many billions of euro have been invested into the concept of Industry 4.0. It is a large challenge for the production sector as well as for the sector of services and education.

The origin for the industry 4.0 developed over last decades with the introduction of information technologies and internet, with new socioeconomic behavior and lead to the necessity of technological preparation. The modern and smart manufacturing which is enabled by the industry 4.0 changes the whole life cycle and production cycle of companies in various areas of business. (Johanesová and kol, 2019)

Industry 4.0 is defined as a sort of technology that combines and unites the digital, physical and biological areas. It brings digitalization to all phases of the production cycle (Bendová 2018). Main principles of Industry 4.0 are:

- interoperability – the ability of all fragments of companies to communicate and interact with each other through internet of systems and internet of things;
- visualization - the linkage between physical systems with virtual models and simulation tools;
- decentralization – the possibility for subsystems to make decisions and manage themselves;
- capability of working in real-time - real-time reaction is a key pre-condition for fast communication, decision-making and management;
- service orientation – movement towards service-oriented architectures (SOA);
- modularity and reconfigurability – the chance to modulate and reconfigure the Industry 4.0 systems is crucial for success. (Kolektív autorov 2017).

New technologies are the reason that new categories of jobs will be created that replace the others partially or totally. This will bring changes in needed skill sets in most industries and will affect the way how and where people work. The Future of Jobs Report tries to provide detailed information on the relative extent of these tendencies separated by individual industries and geography, on the expected time when these changes influence job functions,

employment levels and skills (World economy forum). In Slovakia we experience imbalance in the labor market in the context of technological progress where the deficit of IT specialists in the Slovak labor market was around 10,000 people in October 2016 and in 2020 is expected to rise to 20,000 (ITAPA Association (IT Association Slovakia), (SME 2016).

In Slovakia, just like in other countries, companies cannot think whether they should implement industry 4.0 or not. On the level of acceptance and its speed depends the competitiveness of each company. Together with their flexibility and adaptability. Ability to adapt to changes, focus more on the customer and be ready to give them what they need, and often even in advance, before they realize it. For most companies it's necessary to first look at the opportunities to reduce costs and a better use of resources. Industry 4.0 is perceived as an evolutionary process. (Morháč 2018). Studies have shown that Slovak companies recognize the importance of technological changes, and many have already begun with their implementation. However, there are still many that are not sure how and where to start. (SOVA Digital 2017). Two thirds of companies in the study understand the importance of Industry 4.0 applications for their future, even though large proportion of their representatives consider the applications of Industry 4.0 not to be crucial for their future and success. (Quark 2017).

According to Jeck's research, Slovakia's the main barriers to the introduction of Industry 4.0 in Slovakia include risk capital exposure, R&D corporate expenditure, product or process innovations of SMEs. The low level of innovation can result from the existence of various other barriers such as lack of financial resources (Jeck 2017).

Slovakia has been on the lowest positions in Europe in the field of innovation and the state should understand very fast that supporting innovation and science is an investment for Slovakia and a fundamental base of maintaining competitiveness (SOVA Digital 2017). In October 2018, the Slovak government approved 35 measures to support the construction of infrastructure for the development of intelligent industry prepared. These measures are part of the Smart industry conception.

Currently, two thirds of companies in Slovakia have reached the stage where they are in the real implementation of Industry 4.0. Martin Morháč, as chairman of the board of directors of SOVA Digital, reports that Industry 4.0 implementation is in progress, but the pace is not equal in all processes and technologies. This means that, even though Industry 4.0 is becoming a priority in most businesses, it is not yet perceived as a necessity, and a large proportion of companies are just beginning to think about solutions (SOVA Digital 2017).

It is necessary to understand that the gradual change and implementation of the processes of Industry 4.0 is crucial for maintaining the competitiveness of the Slovak industry and strengthening of its independence from the external environment. In today's fast moving technological development flexibility and adaptability is unavoidable.

Thanks to Industry 4.0 and its application companies gradually optimize their processes and apply new technologies. This application demands investment since the innovation and research and development are financially demanding and according to analysis the state support of R&D and innovation has been continuously very low – less than 1% of the GDP that

belongs to the lowest percentages in Europe. According to studies only 18% of small and medium sized enterprises invest in innovations.

Besides the investments and technologies, human beings remain the key to successful implementation. The technological development imposes growing demands on employee's knowledge. The Industry 4.0 brings more demand for positions as technological personnel, managers and maintenance providers and less demand for positions with physical orientation and manual labor (McKinsey,...) . That means that knowledge from the area of technologies, software, development and managing of individual subsystems will be crucial. The whole Industry 4.0 is built on the abilities of people, machines, equipment, logical systems and products to communicate with each other and cooperate. And since the basis is still in knowledge and information an ongoing revolution in the area of education is very necessary.

The Industry 4.0 should lead to ever-present usage of robotization, automation and intelligent devices as a supplement to work force which leads to a dramatical change in inclusion of human work and new forms of skills. The precondition of success will be market research and research of demand in real-time and flexible and highly automated production. So even though companies are formulating strategies and solution for optimization of their processes and implementation of Industry 4.0 sometimes the human factor is the one that causes slow-down of these processes. Often there is fear, denial and negativity to changes. A solution to this problem seems to be in including the employees into the problem-solving, creation of strategies and submission of own insights and opinions.

#### Industry 4.0 Slovakia Strategic Documents

- Action plan
- Concept for Intelligence Industry
- Smart Industry Concept for Slovakia
- Operational Program Research and Innovation
- Strategy of Digital Transformation of Slovakia 2030

#### Smart Industry Concept for Slovakia

Smart industry concept for Slovakia has had an explicit goal of convincing the public of necessity of particular steps through recommendations that keep the position of the Slovak companies on the industrial map of Europe and in the global structures to contribute to the strength and influence in economy and society. The concept of smart industry was created as a reaction to Industry 4.0 and the era of digitization. The main participants are the Slovak enterprises and it should positively affect also the small and medium size enterprises.

#### The Action plan

The Action Plan was created by a team of experts; it describes awareness-raising activities and use of Smart Industry Platform (working group of different experts) as a coordinating body for the implementation process.

The goal of the Action plan is to support the industrial companies, service companies and trade companies and create for them better conditions for implementation of digitalization, innovative solutions and increasing of their competitiveness through decreasing bureaucracy, changes in legislative, changes in educational system, etc.

The main points of the Action plan can be summarized as follows:

1. Raising awareness and promoting cooperation amongst industry.
2. Promoting research orientated toward Smart Industry.
3. A focus on manufacturing and 'Factories of the Future'.
4. Improving access to finance.
5. Identifying the future needs of the labor market and guiding education and skills-development in that direction.
6. Enacting an innovation-focused legislative framework and eGovernment

#### The 2030 Strategy for Digital Transformation of Slovakia

The strategy is a framework cross-sectional government strategy that defines the policy and priorities of Slovakia in the context of currently on-going digital transformation of economy and society under the influence of innovative technologies and global megatrends of the digital era.

The Strategy represents a key and decisive document for Slovakia at the beginning of the 21st century, when the transformation of industrial society into information society is necessary. It covers the time period from 2019 to 2030 and it has been prepared as part of already launched and partially managed processes of digitalization, informatization and agenda of single digital market of the European Union, as well as in the context of global priorities of a broad digital transformation. Thus, the Strategy stresses mainly the importance of current innovative technologies such as Artificial Intelligence Internet of Things, 5G Technology, Big Data and Analytical Data Processing, Blockchain and High-Performance Computing that will become the new starters of the economic growth and strengthening of competitiveness. At the national level, it will be essential to speed up already launched processes, tie national strategic procedures with global trends as well as implement new procedures built on the latest overall priorities of the EU and country - specific needs of Slovakia. The strategy is a complement of the creation of new Multiannual Financial Framework of the EU for 2021-2027.

It underlines the necessity of the process of digital transformation as key factor for achieving sustainable and inclusive growth. It also respects and uses the existing national strategies and action plans and it is based on the Action plan for smart industry.

If the strategy will be implemented in the real-life by 2030, Slovakia will become a modern economy based on innovative and ecological industry and built on knowledge-based and data economy. The country will have an operative public administration ensuring smart use of land.

For Slovakia to succeed in this process of digitalization and implementation of Industry 4.0 several aspects have been identified as prerequisites:

- Human resource – educated work force that can recognize and use the possibilities of digitalization;
- Infrastructure – complex of necessary technologies, technical solutions, devices and systems;
- Regulatory framework.

All of this must be implemented in various areas such as economy, society, public administration, territorial development, education, and science, research and innovation. The final goal of this whole process is to create conditions for satisfied living in the digital era with the framework of digital humanism.

The Action plan of the digital transformation of Slovakia for 2019-2022 covers the following priority areas:

- Digital transformation of schools and education in order to increase its quality, improve preconditions for employment and acquire competences necessary for the digital era,
- Setting the basis for modern data and digital economy and for the digital transformation of the economy in general,
- Improvement of abilities of the public administration to use data and innovations for the benefit of citizens. (Action plan).

Besides these short-term objectives, there are also goals set for the long-term horizon, such as:

- Innovative digital and data economy,
- Educated, healthy and secure society,
- Modern and effective public administration,
- Smart territorial development,
- High-quality science, research and world-class innovations. (Action plan)

Digital Single Market Strategy for Europe is an opportunity for accelerating a general digital transformation of Slovakia. The problem of digital change is right now one of the most important tactics in the process of building and managing strategies and visions for countries, companies and organizations. Based on the latest studies and analyses of global scientific and analytical companies and expert media, the most important technologies from the global viewpoint are the following ones:

- artificial intelligence
- internet of things
- 5G technology,
- Big data and analytical data processing,
- Edge computing and cloud computing,
- Blockchain.

Position of Slovakia in international indexes concerning Industry 4.0

Digital Economy and Society Index (DESI)

Effective comparison of Slovak performance to 27 other EU Member States in a broad spectrum of areas is provided by the Digital Economy and Society Index. It consists of five main areas of measurement: connectivity, human capital, use of internet services, integration of the digital technology and digital public services.

In the 2018 DESI index, Slovakia ranked 20th out of 28 EU Member States. Overall, Slovakia belongs to a group of countries with low performance – besides Slovakia, it includes Bulgaria, Cyprus, Greece, Croatia, Hungary, Poland, Romania and Italy.

#### Country Report Slovakia 2019

Strategic investments into needs related to education, innovations, infrastructure and technologies can provide the country with growth and prosperity in the future. To make the economy rely more on knowledge, it will be necessary to invest into the digital connectivity and the digital transformation of companies into sustainable and ecological investments, into skills increase and build-up of social infrastructure.

The Slovak economy ranked among the fastest growing economies in OECD in 2019. The year was defined, above all, with historically lowest unemployment level and sound public finance in the country. However, challenges such as lack of labor force with advanced digital skills and weak support to innovations in the business sector remain. The automation can have the most difficult impacts on the labor force in Slovakia from among OECD countries due to existing prevailing focus of industry on closely specialized production with low added value and low level of digital skills of the labor force.

#### Index of Electronic Public Administration Development (UNO)

Slovakia ranked 49th out of 190 countries in the e-Government Index of the United Nations Organization, which measures the state of electronation of the state and public administration, which is improvement by 18 places compared to the preceding study of 2017, however, it failed to reach its level from 2005, when Slovakia ranked 36th. In the Visegrad Group, we are on the 3rd place with the Czech Republic ranking worse.

#### Rank of the Digital Competitiveness (IMD)

In the global rank of digital competitiveness by the Institute for Management Development (IMD) for 2018, Slovakia ranked 50th out of 63 countries, which was a decline from the 43rd place in the preceding year. Among its strengths, the analysis emphasized the amount of investments into electronic communications and wireless broadband connection; on the contrary, its identified weaknesses were insufficient support to the technological development, low number of foreign experts and missing legislation for supporting the scientific research.

#### Where is Slovakia - starting point for implementing Industry 4.0

Labor force with basic digital skills - Based on results of the DESI index for 2018, we can conclude that 59 % of Slovaks reached at least the basic level of digital skills, which is above the EU average (57 %).

Good potential for Internet of Things and life-long learning in IT: Based on experience of Slovak IT companies the content of education at various types of schools (primary, secondary, college) already contain the matter of IoT and Slovak students have excellent results in IoT and robotics at competitions for secondary school and college students and in international contests (e.g. RoboCup junior<sup>17</sup>, Robocup, First Lego League<sup>18</sup>). There are several companies in Slovakia providing high-quality further education in IT, such as GOPAS, ELCT, and a successful program Cisco Networking Academy at secondary schools and universities that prepares specialists in computer networks and IoT.

Digital coalition and its activities: Digital coalition, which was set up in 2017 upon the initiative of the IT Association of Slovakia, and with a support from the Office of the Deputy Prime Minister for Investment and Informatization is a successful example of activism across a broad range of public, private, academic and civic organisations and institutions in Slovakia in order to improve the digital skills of citizens.

Action plan for smart industry: Slovak government has already approved its own Action plan for smart industry, which represents a means for creating conditions for development of industry in Slovakia and which responds to global digitalization trends in order to increase the competitiveness of companies and maintain sustainable increase of incomes, employment and quality of life.

#### Slovak Strategy for Smart Specialisation – Industry 4.0

Attention paid mainly to automotive industry, machinery, transformation of electrical engineering, not so much to services, crafts and SMEs. There are several programs to support startups, for example the Digital coalition already mentioned above which enables cooperation between state institutions, industry, universities and companies from IT sectors.

#### Concept for Intelligence Industry

The Concept was created for public sector, industry and academic sector together. It arose as a state initiative with the goal: to transform and strengthen the industry through technological development and to help Slovakia to adapt to the changes coming with this transformation. The support for industry, service and trade should include all styles of businesses and create better conditions for digitalization implementation, innovative solutions and increasing of competitiveness. It should bring less bureaucracy, legislative changes, defining standards, change of educational programs, co-financing of research and establishing of CDIs. The goals should be achieved till the end of 2020.

Some issues that has to be solved in the short time period in order to achieve the goals set for the bright technological future and implementation of Industry 4.0. We will mention the most important ones:

Obsolete system of education: As indicated by Slovak IT companies and academic institutions, the current model of the education in Slovakia is based on mass education and collection of knowledge. Its main problems is huge uncertainty concerning future jobs of graduates because the priority is put on knowledge and less importance and time is paid to its transformation into solutions or development of analytical thinking. A huge difference has

developed between existing knowledge and achieved results, so called knowledge-performance gap.

Low and declining share of students and graduates on information and communication technologies, science, engineering and mathematics (STEM): A McKinsey report shows that the share of male university graduates in information and communication technologies, science, engineering and mathematics is alarmingly low at about 6.7 %. Even worse is this percentage among female graduates – only 0.6%. Besides, Slovakia has been short of experts in digital technologies as well.

The experience show that there has been a shortage of work force with advanced digital skills where the companies and public administration lack employees with advanced digital skills and ability to use technologies.

We see the success of the digital transformation of Slovakia in finding a balance to satisfy needs and priorities in a new arrangement of five areas that will undergo a fundamental digital transformation:

- Economy,
- Society and education,
- Public administration,
- Territorial development,
- Science, research and innovations.

If Slovakia wants to fully benefit from the digital transformation and the huge opportunities it brings with itself, the time to implement it is now. A responsible and ambitious implementation of this strategy will transform Slovakia by 2030 into a modern country with innovative and green industry benefiting from the knowledge-based digital and data economy. Efficient public administration will manage the intelligent territory and infrastructure use, and an information society will be created where the citizens will fully benefit from its full potential and live the quality and safe lives in the digital age. Thus, the implementation of the Strategy of Digital Transformation of Slovakia can truly move the country among the digital leaders by 2030 and make the country become one of the top digital states worthy of being followed.

Trends are showing that digitalization and robotics will impact all areas of life – it will create new professions, some others will disappear, but all the employees should have digital skills. Industry 4.0 will affect all kinds of businesses including representatives and suppliers' chains. Currently, Industry 4.0 contributes with 25% to GDP, from which approx. 5% in agriculture, 60% in services, 10% in construction, 80% in exports. Digital transformation is strongest in financial services, marketing, document processing, the weakest in production, logistics and management of labor force.

Slovak government has formulated its strategic goals considering the digital transformation as follows:

- 1. Increase competitiveness enabling successful digitalization of enterprises

- 2. Create conditions for development of new technologies, methods and applications for domestic industries and for exports as well
- 3. Connect multinationals, large companies and SMEs with university incubators and scientific parks on financial, technological and mentor bases to increase knowledge of students and their competitiveness on the labor market
- 4. Ensure necessary quality and quantity of human resources for digital and digitalized industry.

SWOT analysis made for the government concerning Industry 4.0 SK sees the strengths of Slovakia in the fact that scientific research basis is prepared for implementing Industry 4.0, the regional structures of research institutions are well balanced. Moreover, the new legislation for universities enables them to do business with research results and a communication and relations between applied research institutions and entrepreneurs already exist.

On the other hand, the analysis describes also some weaknesses as missing comprehensive state politics for RD, fragmentation of resources, low mobility of researchers and administrative barriers by intellectual property protection.

The opportunities of Industry 4.0 in Slovakia can be seen in concentration of RD centers on limited number of priorities, increasing export potential and better usage of European programs.

The threats for the success of Industry 4.0 implementation in Slovakia can be a possible new crisis, continuous low innovative activity of SMEs and low enforcement of law.

The areas where Industry 4.0 can help are numerous, digitalization of traditional SMEs, new ways of customer acquisition, cost reduction, individual reaction to customers' needs are the most obvious ones. We can also add energetic effectiveness, better management, improved business processes and better communication. All of them leading to better competitiveness.

To summarize the competitive advantages in this area for Slovakia are skilled labor force, international scientific cooperation, number of postgraduate students and share of high technologies on exports.

The disadvantages can arise from risk capital implementation, low expenditures of companies into RD, low share of own RD and design, and low number of industrial or patent design.

# SURVEY RESULTS - EFFECTS OF INDUSTRY 4.0 ON FDI IN THE VISEGRAD COUNTRIES

PROF. SONIA FERENCIKOVA, ANDREA ZACHAROVA / SLOVAKIA

V4 PROJECT

**N: 21920068:** Effects of Industry 4.0 on FDI in the Visegrad Countries

REPORT ON INTERVIEWS

SUMMARY

---

Interviews were conducted personally in January – February 2020 with 6 following respondents – representatives and experts from government, business and academia: state secretary of the Ministry of Economy (P), HR director of a global French pharma company (M), Professor of international business (E1), Head of local car industry manufacturer association (E2), SME owner (service industry – HORECA) – S1, SME owner (ice hockey academy) – S2. Interviewer took the notes and recorded the answers in Appendix 1. Structure of the interviews was standard, developed and recommended by all the researchers for the reasons of this project.

Other two interviews were done in June and July 2020 – E3 – university professor – networks and network technologies, CISCO program manager, S3 – SME sales manager – IT company.

Based on the answers we can summarize the views of the interviewees on three major areas:

I4.0 Understanding in the eyes of interviewees

I4.0 Impact on MNCs and FDI in the eyes of interviewees

I4.0 Attractiveness of host location in the eyes of interviewees

## **I4.0 Understanding in the eyes of interviewees**

Majority of the respondents understand I4.0 as a set of technologies. Only the youngest respondents from SMEs and one expert understand it either as new business models or in combinations with it. Our understanding based on the opinion of the respondents as well is that the public in Slovakia usually associates I4.0 with technologies, digitalization and robotization. However, specialists and younger population see it also as a business opportunity resulting in new business models. Especially two young

respondents – owners of SMEs find it as natural to implement the factors of I4.0 into their business, reaching the customers, adjusting their offer and product and services.

#### **I4.0 Impact on MNCs and FDI in the eyes of interviewees**

Respondents agreed on the fact that I4.0 will mean growing amount of investment into services, research and development and knowledge-intensive industries and lowering the amount of investment into manufacturing. However, they express the worry if Slovakia is prepared enough for I4.0 given the development of the educational sector and infrastructure in the country. They also believe that changing nature of the investments will result in the war for talents that is becoming more and more visible in the country.

Here are some citations from the interviews, the views on the FDI inflows to the country:

*P: With Industry 4.0 FDI flows to Slovakia first will go down, later will grow again (mostly fueled by the growing number of business service centers in the country)*

*E1: Industry 4.0 will mean lower amount of investments into manufacturing, however growing amount of FDI into support centers for research, software development, product development, testing new products etc.*

*E2: Industry 4.0 will mean growing FDI into electromobility, self-driving and autonomous driving and car industry generally*

*M: Industry 4.0 will mean decrease of investment into production and increase of FDI into pharma business, health services and leisure and lifestyle “industry”*

*E3: Industry 4.0 will lead to decrease in the demand for workforce - up to 40 % and this workforce will have to be requalified, less people but more qualified will be needed*

#### **I4.0 Attractiveness of host location in the eyes of interviewees**

All the respondents agreed on the fact that Slovakia is an attractive investment location given the following factors: level of the economic development of the country, EU membership, stable legal and political environment, international economic and political institutions membership, euro currency area, central location of the country, positive relationship between efficiency and cost of labor, educated and skilled labor force able to learn very quickly, talented local management, relatively low numbers of expatriates needed.

However, they stated the cons of the country as following: cost of labor that high in comparison with some other EU countries (even with V4 countries given the euro currency in Slovakia) or some Asian countries. Brain drain of the best talents, lack of specific labor force in some regions, and the need to “import” it from Ukraine or Serbia for example, lower digital literacy compared to the neighboring countries, big regional differences and shortages in infrastructure.

---

# Appendix 1

## INTERVIEWS

MNE (M), EXPERT (E1, E2), POLICYMAKER (P), SME (S1,2)

---

- 1 Define how do you understand the term Industry 4.0?
  - a. As set of technologies - the most important being AI, VR, 3D, robots, clouds, H2M, M2M... P, E1, M, E3, S3
  - b. or as new business models – platforms (firms like AirBnB, Uber etc.) S1
  - c. both of them E2, S2
- 2 Which effects of I4.0 from the list below do you see as most important for company, national economy, region/location
  - a. Improved innovativeness P, S1, E1, E2, S2, M, E3, S3
  - b. less defects /downtime P, M, E3
  - c. new smart products, new services, new business models and new efficient processes, S1, S2, S3, E3
  - d. customization with mass production, P
  - e. alleviated resource scarcity,
  - f. better energy efficiency; P, S2, E1, E2, M
  - g. urban production possible
  - h. alleviated consequences of demographic change
  - i. other...
- 3 What can be the direction of FDI flows in consequence of I4.0 (i.e. V4 might be losing due to flows to):
  - a. To the poorer /cheaper economies – e.g. Asia or in Europe Romania, implying that V4 is losing to less developed (cheaper)countries E1, S1, M, E3, S3
  - b. Flows to more advanced economies – “home” - implying back /reshoring P, E2, S2, E3 E3 – cannot be said unambiguously, if high educated workforce needed – can return to more advanced countries, also because the wanted independence, on the other hand – or less educated workforce– to the poorer countries
- 4 What are the most pervasive direct effects of I4.0 – FDI becoming less tangible, more footloose, creating less jobs, can quicker withdraw...  
P, M, E2, E3, S3: FDI becoming less tangible,

E1: War for innovation talents, “virtual settlements”, usage online capacity and virtual networks

S1: When we are talking about Industry 4.0 (I4.0), we are talking about another technological revolution. I4.0 wants to simplify life, reduce costs (employees, material) and to make

manufacturing process more efficient. We are thinking that this is slowly transition to complete automation.

S2: In our opinion Industry 4.0 has many amazing benefits but there are still some challenges to be overcome. For example, cybersecurity can be one of the disadvantages of industry 4.0. We as a small company work hard to be ahead in cybersecurity and it is also important for us to stay adaptable and ahead in this area of change.

E3 – less tangible, less commitment, easier to leave the country, less jobs

S3 – creating less jobs

- 5 Which type of FDI seems most affected:
  - a. Upstream/ design/R&D P, M, E1, E2, S2, S3
  - b. Production, assembly P, E1, E2, S1, E3
  - c. Downstream/sales/marketing E1, S3
- 6 Which sectors are mostly affected by I.4.0 and in consequence by possible backshoring?  
P: car industry, components  
  
E1: research-intensive industries (pharma, telecom, IT)  
  
E2: car industry due to electromobility and new forms of energy usage  
  
M: service industries – those who move to internet  
  
S1: IT, services generally  
  
S2: Services, marketing, IT technology  
  
E3: automotive industry - automation, logistics – who is the customer  
  
S3: car industry, services
- 7 The I4.0 induced changes in location preferences can lead to more concentration – e.g. capital cities “winner takes it all” and further polarization/inequalities or create a chance for peripheries?  
P: Yes, especially BSC and data analyzing centers  
  
E1: capitals and universities locations  
  
E2: Business and research clusters  
  
M: Universities, companies scientific and research parks and centers, sometimes far from the capitals  
  
S1: No differences between cities and peripheries  
  
S2: More opportunities for peripheries and SMEs due to digital revolution and improved connectivity  
  
E3: capital cities and clusters – because of cheaper logistics  
  
S3: no differences, chance for peripheries
- 8 Which are the most pressing host attractiveness’ challenges:
  - a. technical issues – infrastructure P, E1, E2, M, S1, S2, S3
  - b. legal standards and law safeguarding the rights and obligations under Industry 4.0. P
  - c. labor market solutions – education, training, skills P, S1, E3

- d. other .... GDPR - P
- 9 In terms of shaping the FDI policy (how to attract FDI?) what would be most critical aspect:
- Macro / general ecosystem (e.g. as measured by DESI) S2, E1, E3, S3
  - Existence of clusters (mezzolevel) P, E1, E2, M, E3
  - IPAs – concrete tailor-made incentives P, S1
  - Concrete politics – educational / labor market / others...P, E1, E2, M, S3
- 10 In general, I4.0 is in your opinion more a threat or a chance for your country?  
Chance P, M, E1, E2, S1, S2, E3, S3
- 11 How do you see the readiness in your country to host FDI in I4.0 – digital maturity of domestic firms, infrastructure, capabilities of foreign subsidiaries, etc.?  
P, M, E1, E2, S3 – digital maturity of domestic companies is low
- S1, S2 – digital maturity is sufficient
- P, M, E1, E2, S1, S2 – physical infrastructure is not sufficient. IT infrastructure is very good
- P, E1, E2, M – knowledge transfer from parent HQ and foreign subsidiaries will continue and it is a must for the Slovak economy
- E3 – skilled IT workforce (AT&T, Deutsche Telekom), technical education, engineering
- 12 How do you see the dominant strategy of HQ of MNEs – “appropriation” (i.e. keeping know – how to themselves which is detrimental for host country) or “sharing” (beneficial for subsidiaries sharing know-how and technologies possessed by MNEs)  
P, M, E1, E2, S1, S2, S3 – “sharing” is necessary for Slovak economy and businesses
- E3 – keeping know-how to themselves, little R&D in SK, mainly in other countries
- 13 Consequence of I4.0 impact on business activities and manufacturing location - more power to MNEs (concentration, market dominance of few) or more to SMEs (distributed, nimble scattered activities)?  
P, M, E1, E2 - MNCs
- S1, S2, S3 – SMEs
- E3 – both, automation enables also small companies to produce more
- 14 V4 countries - how the I4.0 consequences will play out - which country of V4 seems best prepared?  
P, M, E1, S2, E3, S3 – Czech Republic
- E2, S1 - Slovakia
- 15 Any comments, remarks  
P: With Industry 4.0 FDI flows to Slovakia first will go down, later will grow again (mostly fueled by the growing number of BSC in the country)
- E1: Industry 4.0 will mean lower amount of investments into manufacturing, however growing amount of FDI into support centers for research, software development, product development, testing new products etc.
- E2: Industry 4.0 will mean growing FDI into electromobility, self-driving and autonomous driving and car industry generally

M: Industry 4.0 will mean decrease of investment into production and increase of FDI into pharma business, health services and leisure and lifestyle “industry”

S1: My area of business is gastro and catering. In this sector I will welcome better payment systems. Today’s virtual cash registers are not optimized. I will be very pleased with better communication with authorities and less bureaucracy

S2: In general, we think people do not have to be afraid of I4.0, modern times bring modern technologies to our lives. Our expectation is very clear. We hope that power of I4.0 will help change industry models to their best. Also, will help with other issues which seems to be big problems for our society. Our role will take place in VR and AI industry and we will boost ourself to develop apps and programs for hockey training development (for coaches, players, officials and umpires). Our own hockey academy will hopefully be the first and the most advanced sport centrum in Europe.

E3: Industry 4.0 can be seen as a chance since we have quite good technical education, we are flexible and the mobility is improving, on the other hand there has been a lack of cooperation between universities and companies, advantages of SK with regard to Industry 4.0: education, concentration, logistics, geographical location and closeness

S3: Industry 4.0 will change the industry models and the need for employers’ skills

Interviewer: Sonia Ferencikova

Andrea Zacharová (E3, S3)

Interview period: January – February 2020 (all before COVID-19 crisis), June-July 2020

Interviewees:

P – State secretary of the Ministry of Economy

M – HR director of a global French pharma company

E1 – Professor of international business

E2 – Head of local car industry manufacturer association

S1 – SME owner (service industry – HORECA)

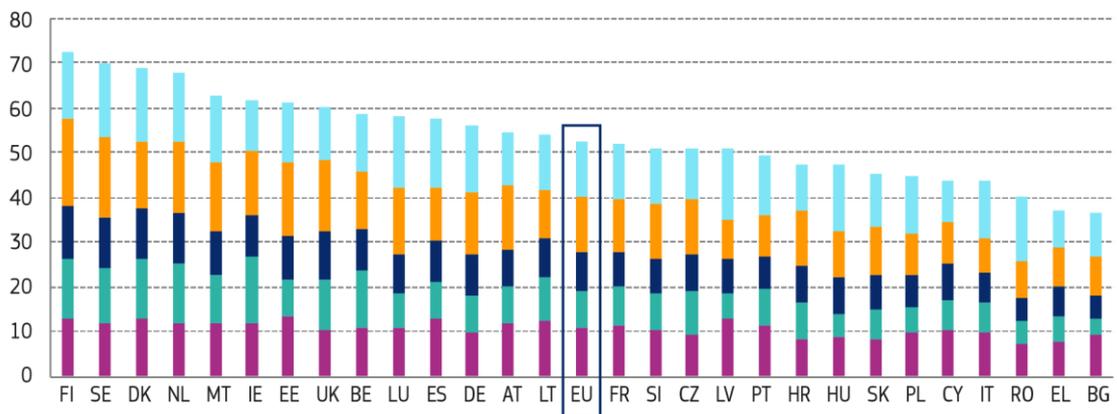
S2 – SME owner (ice hockey academy)

E3 – professor of networks and network technologies

S3 – SME sales manager (IT sector)

# Appendix 2

## DESI SCORE AND SLOVAK POSITION



Source:

<https://ec.europa.eu/digital-single-market/en/desi>

Retrieved: 4.8.2020

# LITERATURE

Status of FDI in SR by economic sectors in 2010 and 2015 FDI inward positions in SR/Economic activity in 2010 and 2015 Source: Statistics of Balance of Payments - [www.nbs.sk](http://www.nbs.sk)

Bendová, A. (2019). Čo priniesol slovenským podnikom rok 2018 v Industry 4.0. Retrieved from <https://industry4um.sk/co-priniesol-slovenskym-podnikom-rok-2018-v-industry-4-0/>; (Accessed: 06 June 2020)

Dudas, 2019 Tomas & Grancay, Martin. (2019). Regional Structure of Foreign Direct Investment in Slovakia – a District-level Gravity-type Model 2009 – 2016. *Ekonomický časopis*. 67. 811-836

Eurofound. European Reshoring Monitor. Retrieved from: <https://reshoring.eurofound.europa.eu/reshoring-cases>; (Accessed: 01 August 2020)

Jeck, T. (2017). Slovenská ekonomika a štvrtá priemyselná revolúcia: faktory a predpoklady. Retrieved from [http://www.ekonom.sav.sk/uploads/journals/373\\_w\\_p\\_4\\_priemyselna\\_a\\_sk\\_final.pdf](http://www.ekonom.sav.sk/uploads/journals/373_w_p_4_priemyselna_a_sk_final.pdf); (Accessed: 16 June 2020)

K Industry 4.0 your smart (r)evolution (2018). O Industry 4.0. Retrieved from <http://industry4.sk/industry-4-0>; (Accessed: 06 July 2020)

Johanesová, V., Stupavská, L., ČAMBÁL, M., & VAŇOVÁ, J. (2019). Linking Industry 4.0 and Slovak Republic. *Annals of DAAAM & Proceedings*, 30.

McKinsey&Company. Getting the most out of Industry 4.0. Retrieved from: <https://www.mckinsey.com/~media/McKinsey/Business%20Functions/McKinsey%20Digital/Our%20Insights/Getting%20the%20most%20out%20of%20Industry%204%200/Getting%20the%20most%20out%20of%20Industry%2040.pdf> (Accessed: 25 May 2020)

Morháč, M. (2018). Priemysel 4.0 zásadne zmení trh. Šikovní to využijú. Retrieved from: <http://www.ezisk.sk/clanok/priemysel-4-0-zasadnezmeni-trh-sikovni-to-vyuziju/4322/>; (Accessed: 13 July 2020)

OECD. FDI flows. Retrieved from: <https://data.oecd.org/fdi/fdi-flows.htm>. (Accessed: 10 July 2020)

Quark. Industry 4.0 na Slovensku. Retrieved from: <https://www.quark.sk/industry-4-0-na-slovensku/> (Accessed: 10 July 2020)

SARIO. Prečo investovať na Slovensku. Retrieved from: <https://sario.sk/sk/investujte-na-slovensku/preco-investovat-na-slovensku>. (Accessed: 10 July 2020)

SOVA Digital a.s. (2017).. Retrieved from <http://industry4.sk/>; (Accessed: 04 May 2020)

Táncošová, J. (2019). The role of foreign direct investment in the economy of Slovakia. *Entrepreneurship and Sustainability Issues*, 6(4), 2127-2135.

Foreign trade figures of Slovakia. Retrieved at: <https://www.nordeatrade.com/en/explore-new-market/slovakia/trade-profile> (Accessed: 6 July 2020)

UNCTAD. World Investment report, 2019. Retrieved from: [https://unctad.org/en/PublicationsLibrary/wir2019\\_en.pdf](https://unctad.org/en/PublicationsLibrary/wir2019_en.pdf) (Accessed 4 May 2020)

WTO. International Trade Statistics. Retrieved from: <https://data.wto.org/> (Accessed 25 May 2020)

Štatistický úrad. Retrieved from: [slovak.statistics.sk](http://slovak.statistics.sk) (Accessed: 31 July 2020)

Trade openness – country rankings. Retrieved from: [theglobaleconomy.com](http://theglobaleconomy.com) [https://www.theglobaleconomy.com/rankings/trade\\_openness/](https://www.theglobaleconomy.com/rankings/trade_openness/), (Accessed: 4 July 2020)

World Bank. Trade (% of GDP). Retrieved from <https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS>. (Accessed: 6 July 2020)