

**Preparation for Smart Industry, Introduction and the Comparative Study  
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**Abstract**

Although the topic Smart Industry or Industry 4.0 is a relatively new issue, managers perceive it as real and very close matter. This paper focuses not only on the description of the main characteristics, but especially on business initiatives aimed at preparation for the Smart Industry. Many analytical reports are produced by the consulting companies; also national governments present their strategic documents. Initiatives and implementations, however, are expected by enterprises, especially industrial. From the view of development of the Slovak economy, it is interesting to see the relationship of Slovak companies towards this topic and compare it with relationship of companies from Germany, Austria and Switzerland. This paper presents particular findings of our research.

Key words: Smart Industry, Industry 4.0, Innovation.

**1. Introduction.**

Nowadays, the key topic actively discussed in many countries is Industry 4.0 or Smart Industry. Industry 4.0 is a revolution built on the digitalization, on change of production processes, on change on business models with aim to accelerate the production and make it more effective, also with the interconnection of systems from customer requirements to final product through digitalization. To sustain the competitiveness while the innovation frequencies are accelerating creates necessity to react on these changes. In Germany was set a plan to support the production, competitiveness and digitalization already in year 2011. In Slovakia, the development of the action plan in year 2016 is still in progress. Ministry of Economy created a document in March 2016 with the name “Smart Industry for Slovakia“, where describing the key challenges for Slovakia. One of them is the necessity for cooperation and document specified that clusters, research institutions and technological parks should support and lead this cooperation.

**2. Smart Industry**

The concept of industry 4.0 or fourth industrial revolution comes from document introduced on the Hannover Fair in year 2014. There was an idea presented about Smart Factory and Smart Manufacturing to fully interconnect computer with production systems, semi-processed products and other sub-systems of company. It assumes the creation of intelligent distributed network of different subjects across the whole value chain, thus across the production, economic, sales, logistic and other sectors. From that moment, industrial companies have been discussing possible impact on function of internal processes but also on opportunities enabling to reach

higher efficiency and performance and better interconnection and cooperation with partners (European Parliament, 2015; Sujová, 2016; Potkány, 2015; Gažová 2013).

While the first three industrial revolutions resulted from mechanization, electricity and IT, now it is mainly about the consequences of the introduction of new services and technologies related to the context of IoT (Internet of Things). Industry 4.0 assumes the maximum use of the Internet of Things and Internet services, which are based on mutual communication and cooperation.

Content of Smart Industry are particularly:

- System Integration
- Distributes Manufacturing
- Additive Manufacturing
- Autonomous Robots
- Adaptive Logistics
- Internet of Things
- Big Data
- Smart Services
- Cloud Computing
- Cyber security

As previous industrial revolutions led not only to innovation of products and processes but also to innovation of business models, similar can be expected from the latest industrial revolution (Kaplan, 2012; Stachová, 2016; Cagaňová, 2016).

Although at the national level the impact on the economy and on employment begins to be discussed, the great attention is paid especially by global consulting companies (Roland Berger, 2014; Deloitte, 2015; PWC, 2014; McKinsey, 2016; The Boston Consulting Group, 2015; Capgemini, 2015; KPMG, 2016). They are presenting changes and necessities to react on emerging and on expected changes. All of them concurred that number of changes have already begun.

Challenges, which demonstrations we can see today are especially:

- Robotics, robotized production lines, autonomous machineries;
- New forms of supply chain management;
- Personalized marketing, on-demand and personalized shopping;
- Virtualization of the workforce, new ways of working using the Internet;
- Innovation of business models based on shared and cashless economy.

Although in the past were considered as innovations new and unusual activity or output (Schumpeter, 1987), today are also recognized as innovation qualitatively new approaches (Barnett, 1953), or the application of new methods and tools (Drucker, 1993). In terms of adaptability to the needs of Smart Industry, we see a clear need for innovation of products, processes, organization and marketing.

### 3. Methodology

The aim of this research was to analyze behavior of firms in response to changes coming with the Industry 4.0. The research was focused on the comparison of Slovak enterprises (SK) with enterprises in Austria (AT), Germany (DE) and Switzerland (CH). Group of AT, DE, CH enterprises is representing companies from more developed countries, which achieved higher ranking in different innovation evaluations. Research was also focused on companies operating in the industry sector, i.e. companies that are highly affected by changes coming with the fourth industrial revolution. Specifically, we compared the automotive, electrotechnical, machine and construction industries.

### 4. Sample data and collection

The research was conducted during years 2015 and 2016 on a sample of 489 Slovak companies and on a sample of 574 companies from Austria, Germany and Switzerland. The data were collected using electronic questionnaire, which was distributed directly to respondents. Respondents were representatives of companies from different sectors, and mostly held management and senior management positions. For the purposes of this research, we analyzed companies from the automotive industry, electrotechnical industry, machine industry and the construction industry. Together within selected industries we analyzed 186 companies. The following table shows the numbers of firms in each of the analyzed groups.

	SK	AT,DE,CH
Automotive industry	14	12
Electrotechnical industry	18	19
Machine industry	36	14
Construction industry	42	31

In the survey respondents were asked *"Which of the following areas do you consider essential for long-term financial performance of the company (= long-term sustainability performance objectives, such as earnings, ROA, ..)?"* For the purposes of this paper we compared the responses to these answers:

- implementation of IT / ICT for process support and increase of process automation
- investment in human resource development
- investing in own research, development and innovation processes

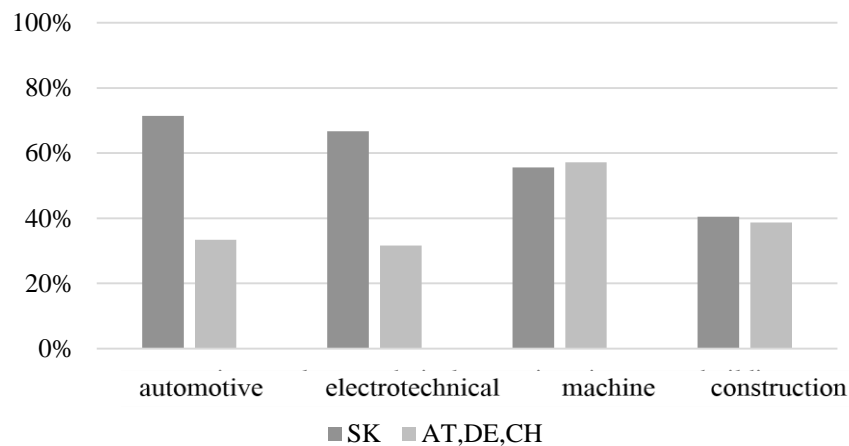
The perception of the importance of respondents was rated on a scale from 1 to 5, where 1 is "not consider it essential" and 5 "are considered very crucial." Analyzed groups were divided into group which considers selected area as essential, meaning companies that selected 4 or 5 on the scale, and group which does not consider selected area as essential, meaning companies that selected 1, 2 or 3 on the scale.

Then we subsequently analyzed questions focused on *measures implemented by Slovak enterprises within their organizations during years 2009, 2011 and 2014-2015*. Respondents could select all answers that are satisfactory. We focused on selected measures: informatization, automatization and process innovation.

For evaluation we used basic descriptive statistics such as average and percentage comparison. To analyze the significance of differences between SK and AT,DE,CH companies, we used statistical analysis using chi square test.

## 5. Research

**Chart 1 Percentage comparison of SK and AT, DE, CH businesses in selected industries, which consider implementation of IT / ICT for process support and increase of process automation as key to long-term financial performance of the company**



Chi      **0,052079**      **0,032818**      0,919134      0,878823

Source: Author

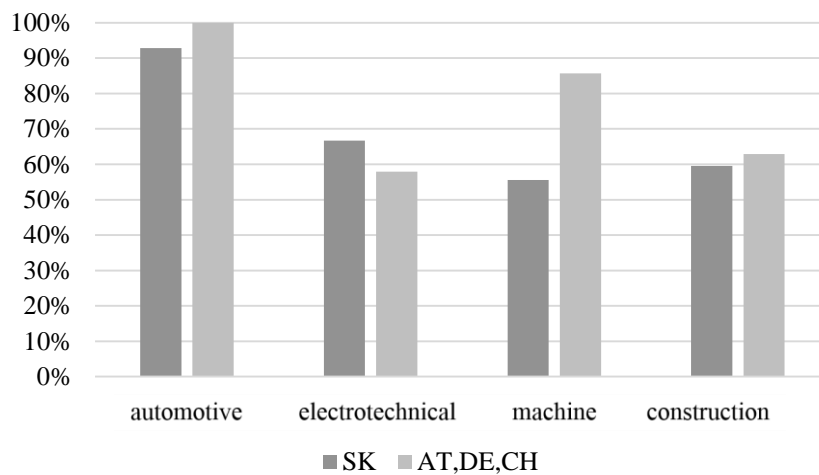
As we can see, the greatest need for the application of IT / ICT in Slovak companies is in the automotive and electrotechnical industry. In these sectors, it is also the biggest difference between the perception of Slovak and group of AT, DE, CH enterprises. Analysis of the Chi square test showed, that difference in each of both cases has a high level of significance. Similarly, the average value of all the responses to this question (Table 1) was higher among Slovak businesses compared to the group of AT, DE, CH enterprises.

**Table 1 Comparison of average assessment of SK and AT,DE,CH enterprises in the question of considering implementation of IT/ICT for process support and increase of process automation as key to long-term financial performance of the company**

	SK	AT,DE,CH
<b>Average</b>	3,31	3,29

*Source: Author*

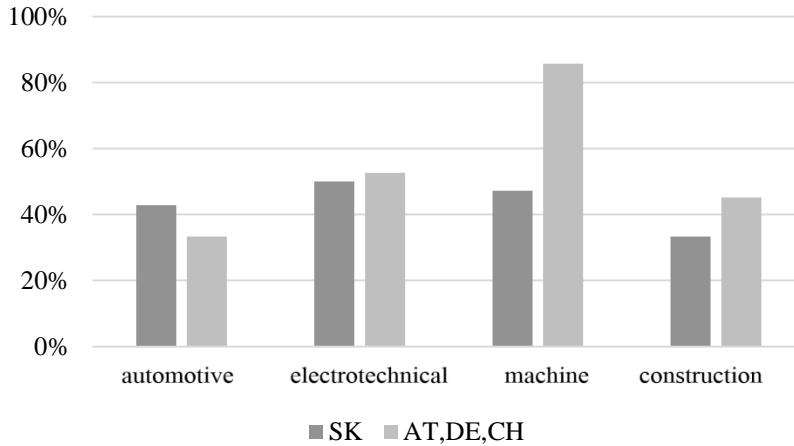
**Chart 2 Percentage comparison of SK and AT, DE, CH enterprises in selected industries, which consider investment in human resource development as key to long-term financial performance of the company**



*Source: Author*

Investing in human resources development is highly perceived mainly in the automotive industry where there is no significant difference between the Slovak enterprises and groups of AT, DE, CH enterprises. The difference is in the machine industry, where higher interest was expressed by companies in the group AT, DE, CH enterprises.

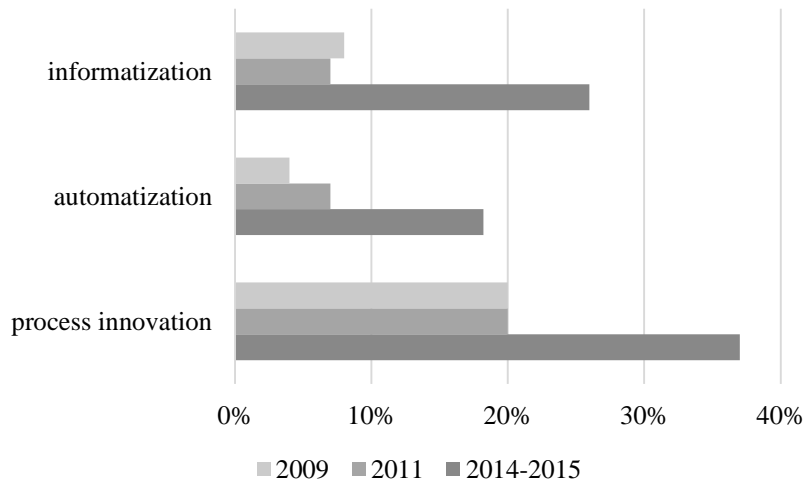
**Chart 3 Percentage comparison of SK and AT, DE, CH enterprises in selected industries, which consider investment in own research, development and innovation processes as key to long-term financial performance of the company**



Source: Author

Machine industry is also an area where companies from the group AT, DE, CH perceive a greater need for their own research and development. Low interest is in automotive and construction industries.

**Chart 4 Annual comparison of the percentages of SK enterprises that implemented selected measurements within the company**



Source: Author

In the evaluation of long-term research of Slovak companies, it is obvious that in recent years expressively increased interest and importance of information engineering, automation and process innovation.

## 6. Conclusion

Smart Industry, as mentioned, is a topic in which the processes of intra and inter-company play a major role. The rapid onset of discussion of topic, as well as the rapid improvement and the availability of advanced technologies and services in the IT field, have brought these changes also to the environment of companies. Significantly, it is seen in evaluation of the differences between Slovak companies in the years 2009-2011 and 2014-2015. Certainly, to a certain matter, the recovery from the crisis period contributed to it also accompanied by recoveries on the markets and at the same time by reduction of interest rates on loans.

High focus on the processes and on support of automation through the implementation of IT / ICT in Slovak companies is also seen in our comparative research. High interest especially in the automotive industry can be explained by the fact that in Slovakia it is one of the key industries, and its importance was reinforced by the arrival of major new investments in Slovakia. On the other hand, the low interest in the automotive industry was found in Germany also by analytical report (PAC-IT, 2013), where 60% of respondents do not perceive the development of production towards Industry 4.0 as important.

Similarly the high level of perception, however, was expressed by companies in the machine industry. In the assessment of comparison of the overall results of the machine industry, where is a very great interdependence with automotive industry, we see a lag of Slovak companies. It is in human resource development as well as in own research and development.

As for the discussion, we are evaluating the need for a comprehensive development of enterprises in Slovakia. The implementation of technology and automation on the level of the company itself is only a part of the concept of Industry 4.0. From our point of view, the main challenges are in corporate culture and in people in relation to the necessary innovation.

The positive news for Slovakia is the trend of interest in the topic Smart Industry, and not only at the level of discussions, but also in the activities of companies. Strong population of highly educated labor force, at the age of 25-45 years (Population Pyramid 2016), now representing the majority of working population, provide an opportunity for innovative behavior and support from the management of enterprises.

Although industrial companies were only a part of the survey sample, the data used in this comparative study can be interpreted in terms of the topic Smart Industry.

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