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Expected Impact of Industry 4.0 on Employment in Selected Professions in the Czech Republic and Germany

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Abstract: The topic of Industry 4.0 is more actual for various companies worldwide. Its impact is anywhere in company and government areas. Due to the individual parts of Industry 4.0, such as digitalization and robotization, we express changes impact on human resource management, where the most changes are defined. This contribution is focused on human resource management in the context of the application of Industry 4.0 in engineering companies operating in the Czech Republic and Germany. The main objective of the paper is to define potential connections between Industry 4.0 and its areas with the forfeiture of professions and preparedness for potential job changes. We employed a primary research approach with in-depth interviews and a questionnaire survey to reach a defined goal. The interviews were aimed at top managers and a questionnaire survey of ordinary employees and students/temporary workers. According to the gained results, there exist relevant statistical dependencies between Industry 4.0 knowledge (including its parts) and up-to-date situations in the companies in the Czech Republic and Germany.

Keywords: Industry 4.0; digitalization and automatization; human resources; productivity and performance

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1. Introduction

The connection between the industry of the Czech Republic and Germany is due to the large influence of German companies in the environment of the Czech Republic, especially in the field of engineering. The German industrial environment itself represents an important player on the world stage. Thanks to the close connection between the Czech industry and the German industry, there is a strong influence of global influences, which will be reflected in the German industry. The establishment of cooperation between companies and their subsequent purchase (an example of the situation from the nineties of the last century) was conditioned, among other things, by mutual cultural similarity and a certain accessibility compared to other more competitive regions and by the effort to strengthen one's economic power and influence. Germany wants to be among the major global players in various industrial fields. From the point of view of the support of individual areas, engineering represents an important area in which it has the opportunity to cooperate with Czech companies. The Czech industry wants to reach a similar level, which is already happening at the level of some types of companies. However, as an overall Czech industry, it tends to achieve long-term success in the European region; when national enterprises are forced to cooperate, their mutually sustainable economic growth occurs.

As a result of the globalization of markets and the recognition of new opportunities, the boundaries of individual sectors are blurring. Individual areas are converging in such a way that traditional manufacturers of these categories focus on the production of new products Peschner and Fotakis [1]. Thus, the industrial market is currently becoming a much more complex environment with complex processes that bring new specific requirements for integrity as well as other modern tools used. In connection with the ongoing economic crisis, new opportunities for innovation are emerging [2,3]. Modern businesses depend on controlling intangible assets such as brands, intellectual property, human capital, or market relationships [4]. In industrial enterprises, it is necessary to use the TQM (total quality management) approach, which, among other things, includes marketing activities in the entire production process. It thus summarizes all activities that are part of the mountain-forming chain [5–7]. It can be assumed that the production intended for the industrial market is based on the requirements of the ordering customer. This means that the company must fully focus on the overall production process—there is no need to use promotional activities to the same extent as in the consumer market. The industrial market is essentially a specific area where it is not necessary to use the entire marketing mix. Businesses usually manufacture to order for a specific customer. In this way, they provide the customer with comprehensive care and create a mutual long-term relationship. A significant benefit of such an approach is the reduction of the possibility of random accidents in the production process and the clear interpretation of the decisions made [8–10]. To achieve relevant quality levels, the processes and technology should be set up correctly, especially in connection with robotization. By the TQM it is possible to achieve higher efficiency by creation correct products and services according to customers time requirements. Actually, the TQM model includes all relevant activities, which are part of value chain [7]. To reach relevant levels of provided value, companies have to focus on the employment of new technologies leading to productivity improvement. Industry 4.0 provides relevant opportunities to influence corporate staff. Therefore, it is important to focus on evaluation staff worries about their jobs [4,6].

2. Theoretical Background

As a result of the expansion of the global business environment and the resulting relocation of divisions to locations with a lower wage level, it creates pressure for enough qualified workers. At the same time, the development of technologies in connection with the automation and robotization of production processes (application of the Industry 4.0 concept) also harms the mentioned state. In the environment of industrial enterprises, it is necessary to focus on current trends and the future within some sectors. The current situation in the field of employment lacks relevant workers in some age groups and professions. This situation is a general reflection of the current situation in sophisticated education and well-educated workers, especially in engineering (such as welders, machinists, or turners). Engineering industrial production represents a key area in the Czech Republic with a long tradition. The volume of engineering production targets export, namely to Germany, with which the Czech economy is closely linked, not only to the automotive industry but also to other areas of engineering. With the new technologies and performance requirements, there is increasing pressure on the companies, which should adapt their corporate production environment.

2.1. Concept Industry 4.0

The concept of Industry 4.0 helps to create a smart factory vision in connection with market requirements. The purpose of the smart factory is the high integration of technologies, implementation of automatization, and continuous improvement of the working environment on the way to reach high-performance machinery and its connection within corporate cyberspace. The corporate long-time competitiveness must be supported by investment into stable and adequate technologies or new innovative solutions for customers. To produce highly specific technologies and software, industrial companies need a compatible specific platform to apply new potential solutions with appropriate interaction to present situations [11–14].

From a general point of view, Industry 4.0 combines various technologies, which could support the flexible implementation of general and sophisticated systems together as technology responses to customers' requirements. In addition, it is possible to adapt these systems according to present competitive pressure, leading to simulation employment and virtual adaptation of the production line. The whole process with relevant high-tech systems and machinery could help to reduce wasting time and save money in costs before product launch. Tjahjano et al. [15] also confirm the necessity of data collection through cloud data storage as an effective tool for supportive production activities, such as quality management or preventive maintenance. Both areas are usually considered key elements of Industry 4.0 [16,17].

Tomek and Vávrová [18], Hecklau et al. [19], and Castagnoli et al. [20] describe Industry 4.0 as a system with both rational and irrational thinking processes at the producer's side, which creates relevant value for the customer with self-confidence, interrogation, or impartiality. The customers' value requirement puts pressure on the company to increase efficiency and performance, putting pressure on the use of new technologies, usually in industries where it is not necessary to use the latest equipment. In the case of the manufacturing industry, this is one of the main requirements of the company's stakeholders, i.e., achieving a profit in almost all possible circumstances. Technology change and development then clearly put pressure on new knowledge and skills to which the company must respond [8].

The classification of individual tools in the Industry 4.0 concept focuses on elements of automation and digitization. In these areas, specific tools can be searched for, which the company can then focus on and incorporate into its environment. The individual considered technologies that can be used can be divided into possible categories according to their focus. Each category can then subdivide specific areas or activities that help influence business processes from a comprehensive perspective. According to Oesterreich and Teuteberg [21], these summary areas are as follows:

- Smart factory
    - Cyber systems;
    - The Internet of Things;
    - Automation;
    - Prefabrication and modularization;
    - Additive manufacturing;
    - Product Lifecycle Management (PLM);
    - The robots;
    - Human–computer interaction.
- Simulation and modeling
    - Simulation tools;
    - About creating information models;
    - Augmented and virtual reality.
- Digitization and virtualization
    - Mobile computing;
    - Virtual computing;
    - Social media;
    - Digitization;
    - Big data.

Against this division, the concept specified [22,23] can be seen as an alternative division, which lists seven sub-areas that interact with each other and affect the smart factory environment. These areas are described by:

- Smart buildings;
- Smart homes;
- Social networks and websites;
- Business networks and websites;
- Smart logistics;
- Smart network (smart grid);
- Smart mobility.

In addition, these elements are affected by four Internet areas that can be considered interconnected, namely: (1) Internet of Things (Internet of Things), (2) Internet of Services (Internet of Services), (3) Internet of People (Internet of People), and (4) Internet of Data. It is crucial for the company to understand the interconnectedness of the mentioned divisions so that they can adequately stabilize their position in the industry and subsequently develop their competitiveness.

2.2. Core Tools of Industry 4.0 for an Engineering Company

In connection with the development of industry in individual regions and at the same time the development of general IT technologies, it is clear that their use requires not only new knowledge and skills (e.g., approaches within the Internet of Things) but also a change in thinking of individuals entering the labor market. Due to strong migration, the demand for quality knowledge is even more acute, which is also reflected in the requirements for educational institutions [9,10,20,24].

According to Gattulo et al. [16], Industry 4.0 focuses on managerial behavior and differences in their approaches, specifying individual areas on which a company must focus, especially in a production environment. These areas are:

- Virtualization provides a simulation environment such as a kind of a twin, which reflects the real world into a virtual one;
- Modularity gives a company the possibility to build approaches to be flexible within product configuration by application of new technologies;
- Decentralization supports the effective coordination of the company and its processes by competency delegation on lower organizational levels. In case of any kind of problems, the information about them is moved to a higher position for decision making and potential elimination;
- Service orientation is described as a future trend of tertiary industry development to reach complex customers' requirements, which helps to solve their problems;
- With the participation of individual parts and staff, a company could improve the whole communication level in the context of connection in both physical and virtual environments. That combination is deemed fundamental for the overall production system;
- Time capability insists obtainment of efficient source consumption and collection of all relevant data of productive processes in real time. This simulation supports the minimization of potential risk appearance and their troubleshooting.

These steps reflect individual parameters of corporate strategy, which includes miscellaneous spheres such as innovative context, technology development, or staff wants and wishes. Therefore, it is possible to understand Industry 4.0 as a set of opportunities how to acquire vision and own autonomy. Corporate autonomy needs increasing staff tiers through professional pieces of training and personal development. Qualified staff facilitate product customization and make customers satisfied [11,25–27]. All connections between all areas of Industry 4.0 focus on value creation, which is depicted in Figure 1.

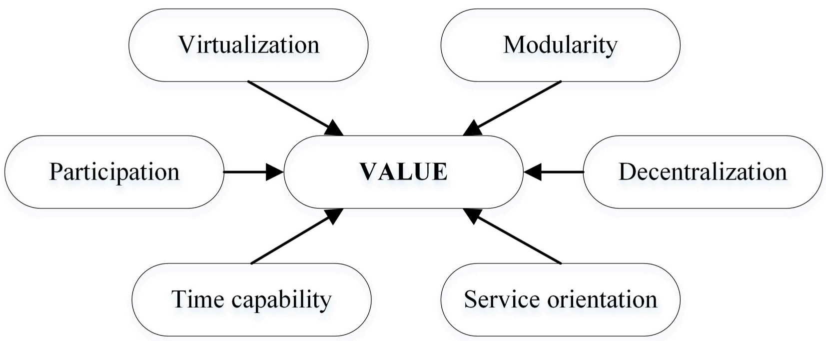


Figure 1. Specific areas of Industry 4.0 supporting the value creation.

The Industry 4.0 application brings to the company possibility to improve the internal system by which is thinkable to find locations and activities with high injury risks for employees. In addition, Industry 4.0 implementation into corporate processes supports improvements in the system of injury prevention at working place, it helps to increase staff productivity, and finally staff satisfaction [28–30].

Considering the above description, it is possible to work with supporting technologies in three possible variants within the Industry 4.0 concept (see Figure 2), namely [31–33]:

- Vertical integration: there is a connection of individual production systems, which are autonomous in many respects and support the creation of the required value in all components and departments in the company;
- Horizontal integration: the creation of links in real time between individual systems and technologies in the company, within which other organizations using these information systems have access from the point of view of their location in the supply–customer chain;
- End-to-end engineering: contains engineering processes that support the creation of value in all links of the internal chain to minimize the costs incurred in individual areas of the concept.

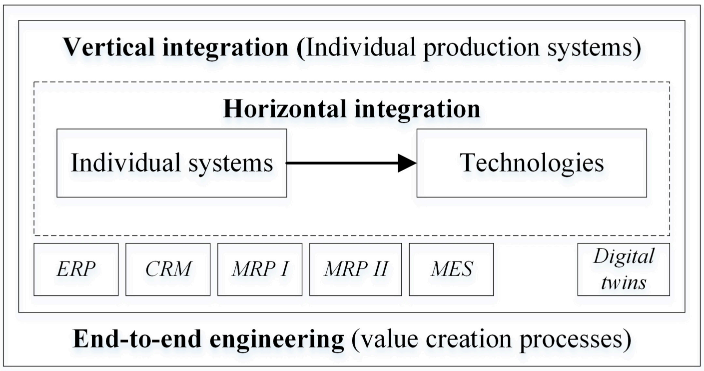


Figure 2. Relations of approaches in Industry 4.0.

Within the concept of Industry 4.0 and its connection to information technology and systems (technology for the introduction of automation and robotization), several sub-parts are considered, which support and complement each other. According to Oesterreich and Teuteberg [21], these areas can be divided into three groups according to their focus. In this way, they identified a smart factory (smart factory), a group of simulations and modeling (simulation and modeling), and digitization and virtualization (digitization and virtualization).

The research of De Sousa Jabbour et al. [34] is based on the concept of a smart factory where they work within main topics, such as the Internet of Things (connection of products to the Internet and their mutual connections), additive manufacturing (products without the need for special tools), virtual manufacturing (cloud manufacturing: production of a product in a virtual environment for debugging deficiencies and adequate setting of the relevant technology), and cyber-physical systems (integration of the virtual environment into physical processes and production workplaces). The aforementioned division is also confirmed by Büchi, Cugno, Castagnoli [35] when they describe the importance of cyber-physical systems concerning achieving business efficiency through the support of production systems and processes through which knowledge and skills are shared within the business environment.

The same topics are also described by Hofmann and Rüsch [36], but in the case of the Internet of Things as a whole, they also elaborate on the sub-area of the Internet of Services (Internet of Services). The essence of the Internet of Services is to simplify the accessibility of the services offered through web applications and portals. The reason for developing the mentioned area is the massive expansion of services and Internet connection.

2.3. Personal Development of Workers under Industry 4.0

Digitization and automation are the basic elements used to describe the concept of Industry 4.0. Through their introduction to the company, they aim to achieve greater competitiveness in the field and consolidate the existing market position [37–39]. Digitization as the main area should not only be a tool for the appropriate sale of standardized products to customers (thanks to the significant development of Internet access); its primary task can be considered the possibility of product adaptation based on specific customer wishes and requirements [35,39–41]. The investment in the digitization of business processes and the modernization of the existing infrastructure represents a significant financial item for which the company must find adequate funds. In the case of large, multinational technology companies, there is already a common use of digitization tools, which facilitates a better and more efficient level of the production process in these companies. The main benefits of digitization are considered [38]:

- Increasing efficiency: the production process demands energy resources, and their use should reach a long-term sustainable level. Sustainable production is then fully compatible with the environment, is efficient, and offers the company a suitable competitive advantage. Due to a large number of measuring devices, the company will produce a large amount of data (big data), which will have to be evaluated quickly and efficiently;
- Higher quality: in the case of products with higher quality compared to competing products, it can be expected to build customer loyalty, which results in the provision of positive references to the product. If the customer is satisfied, this experience is passed on to other potential customers;
- Higher flexibility: the customer's requirements include not only the lowest possible price for the product but also the possibility of modifying the product (product personalization), which is at the price of mass-produced products. Digitization makes it much easier to maintain this flexibility;
- Rapid product launches: the speed with which a business can bring a product to market provides a strong argument for a customer to switch products or brands. The traditional life cycle (PLC) is accelerating and the business must be able to react faster. Within an industrial environment, the faster entity, nor the larger one, has a higher chance of success;
- Achieving higher security: the introduction of digitization into the company reduces the complexity of working with consumer documents but also creates new risks that must be responded to promptly, and the necessary security protocol is created to protect corporate know-how and other sensitive data.

The implementation of digitization in the company, therefore, represents a great potential benefit and strengthens the market position of the company. A large number of companies have already digitized their business environment or are planning to start digitization. However, many companies see the fundamental problem as too expensive an investment and too low a level of knowledge and skills of the workers. Apart from the financial point of view, the representatives of companies also provide an argument against digitization, that a complex design for their needs is too expensive a solution or, on the contrary, they consider their processes too complex, which can be very difficult to transfer to a digital environment. In the case of potential future workers and managers (from students' point of view), the implementation of digitization and automation in the company mostly results in benefits compared than negatives [42].

The main benefit resulting from the introduction of digitization and automation in the business environment can be considered to be an increase in productivity in the relevant sections. Even though as a result of automation and digitization, there will be a change in the needs of workers' qualifications, their shortage is easy. The need for qualified workers is not the result of new technologies and approaches but is the result of an inappropriate level of the education system as a whole. The state that a company needs to have is not so much determined by the level of existing knowledge, but rather by the speed of learning [43]. An appropriate response to the lack of qualified workers and their potential learning speed can be to adopt good experiences, both from other sectors and other world regions.

The Industry 4.0 concept is focused on the use of new production technologies and approaches, as well as the connection of existing technologies to a virtual environment. This connection subsequently creates pressure on the qualification development of workers and their further education [9]. The result of the adequate implementation of the entire Industry 4.0 concept through automation and digitization is the reduction of some jobs, which subsequently has certain impacts in the socio-economic and demographic areas. Employees who are affected by such a reduction are very worried about their future employment in the given field. Due to the requirements for new technologies, however, at the same time as the mentioned reduction of some jobs, new jobs are also created that correspond to the requirements from the introduction of new technologies [44]. Possible prevention of the process of reducing jobs and moving the worker to a newly created position, the given worker must educate himself and develop his skills and competencies to achieve new requirements and trends [9,45,46].

Budanov, Aseeva, and Zvonova [45] list individual areas that influence workers' opinions on changes made, regardless of the reasons for these changes. The most significant impact in the socio-economic and demographic area is that workers fear changes in the working environment (44% of individuals answered positively); in the case of changes in climate and natural resources, and the impact of the middle class in new markets, 23% of respondents indicate some concern. Political changes are ranked fourth (21%), followed by customer behavior (16%).

3. Methodology

Muchiri et al. [47] and Hornungová [48] specified the importance of the focus on three main areas, providing adequate competitive advantage. The correct choice of HR activities is an entire part of the HR management process in each company and all HR activities have to be linked to stated corporate performance. Specification of activities is compounded and theoretical significance is usually affected by individual managerial approaches. Requirements of the stakeholders on the company and its long-time profitability are in close connection to the choice of relevant production activities with technical support.

The main objective of the paper is to define potential connections between Industry 4.0 and its areas with forfeiture of professions and preparedness to change potential job changes. Both lines were evaluated for engineering companies operating in the Czech Republic and Germany. According to the objective of the paper, three hypotheses were stated:

H1. *There exists a relationship between Industry 4.0 knowledge and its parts, and change expectations about the forfeiture of professions for these changes.*

H2. *There exists a relationship between Industry 4.0 knowledge and its parts, and change expectations about preparedness for these changes.*

H3. *Expected changes and preparedness for professions forfeiture are depending on potential job changes.*

Both hypotheses were evaluated in the context of engineering companies in the Czech Republic and Germany. All data were processed by the employment of the statistical program IBM SPSS Statistics 25 under the application of dependency between two variables utilizing pivot tables and Pearson's chi-squared test. For the purpose of the hypothesis H1 and H2, we need to evaluate individual parts of Industry 4.0 according to forfeiture and preparedness according to changes of Industry 4.0 implementation (in both chosen countries).

3.1. Sample Description

The primary research in the form of a questionnaire survey was aimed at employees in manual occupations (regular and temporary workers) and students. In the survey, 90 companies from the Czech Republic and 303 companies from Germany participated.

From this, Germany showed interest in participating in the research. The individual groups of respondents are then listed below, broken down by research focus and location:

- A total of 283 respondents from 67 companies in the Czech Republic;
- A total of 554 respondents from 160 companies in Germany.

The sample population was made up of companies that operated in the Czech Republic. There was only key parameter for the choice the operation in the Czech Republic across the industries. The random choice of companies from the statistical register of economic activities was performed. The respondents in the questionnaire were managers of the companies, who were responsible for marketing and business activities.

3.2. Chosen Methods

Pearson's two-character independence test (χ^2) is used, assuming a two-character statistical dependence. The main condition is the agreement of the theoretical and observed frequency of the observed features. In this case, they are considered independent. In addition, in the case of testing two statistical features, statistical hypotheses in the form of zero and alternative versions are used. At the same time, test statistics with Pearson's distribution are also used. If the significance level α is determined, it is tested in the defined critical range W_α. At the same time, the value $\hat{p}_{ij}$ contains estimates of probabilities with simultaneous characteristics. Assuming that the value of the test criterion belongs to the specified critical field, its null hypothesis is rejected at the 100% α level of significance, and an alternative hypothesis is accepted [49].

If there is a relationship between two variables, the null hypothesis is not rejected at the specified significance level α if the significance is at the required level of statistical error. It is very important to determine the value of the significance level (usually a significance level of 95% is used, but it can also be 99% or 90%). The subsequent intensity of the detected dependence is determined thanks to the contingency coefficient, which takes values in the interval 0 and 1. The closer the detected value is to 1, the higher the dependence is achieved [50,51]. For verification of Pearson's two-character independence test, Kendaull's tau rate was employed. The rate has to reach a significance value of 0.05 to be considered a relevant rate.

3.3. Data Collection

The paper builds on survey data collection in companies from the Czech Republic and from Germany. This survey was realized from November 2020 to July 2021 in the COVID-19 period based on quantitative data through questionnaire. The questionnaire survey to defined companies we sent by personalized emails by which they also made response. In the questionnaire, respondents answer their level of business and marketing activities in their company in connection to the knowledge of marketing-related topics on the application of dichotomy scale score (variable with Yes-No answer). All respondents are competent and reliable according to their organizational decision-making process and their organizational level [52].

4. Results

Based on the theoretical background, we defined two hypotheses, which are focused on the topics' penetration. Both hypotheses were verified in the context of the engineering companies that operate in the Czech Republic and Germany. According to the defined hypotheses, we employed the Pearson chi-square test for independence to test the connection of two variables, which requires hypothesis modification into statistical form. The authors chose only the null hypothesis because of the high numbers for each note:

- H1: There exists a relationship between Industry 4.0 knowledge and its parts and change expectations about the forfeiture of professions for these changes.
    - $H1_{A0}$: Knowledge of the term Industry 4.0 is not closely related to the expectation of change;

- $H1_{B0}$: Knowledge of the concept of the Internet of Things as an integral part of Industry 4.0 is not closely related to expectations of change;
- $H1_{C0}$: Knowledge of the concept of Internet services as an integral part of Industry 4.0 is not closely related to the expectation of change;
- $H1_{D0}$: Knowledge of the concept of the cloud tool as an integral part of Industry 4.0 is not closely related to the expected change;
- $H1_{E0}$: Knowledge of the concept of stand-alone robots as an integral part of Industry 4.0 is not closely related to expectations of change;
- $H1_{F0}$: Knowledge of the term cobots as an integral part of Industry 4.0 is not closely related to the expectation of change.

- H2: There exists a relationship between Industry 4.0 knowledge and its parts, and change expectations about preparedness for these changes.
  - $H2_{A0}$: Knowledge of the term Industry 4.0 is not closely related to the preparation for the possibility of the termination of the profession;
  - $H2_{B0}$: Knowledge of the concept of the Internet of Things as an integral part of Industry 4.0 is not in close dependence on preparation for the possibility of the demise of the profession;
  - $H2_{C0}$: Knowledge of the concept of Internet services as an integral part of Industry 4.0 is not in close dependence on the preparation for the possibility of the termination of the profession;
  - $H2_{D0}$: Knowledge of the concept of cloud tools as an integral part of Industry 4.0 is not closely related to the preparation for the possibility of the demise of the profession;
  - $H2_{E0}$: Knowledge of the concept of independent robots as an integral part of Industry 4.0 is not in close dependence on the preparation for the possibility of the demise of the profession;
  - $H2_{F0}$: Knowledge of the concept of cobots as an integral part of Industry 4.0 is not closely related to the preparation for the possibility of the demise of the profession.
- H3: Expected changes and preparedness for professions forfeiture depend on potential job changes.
  - $H3_{A0}$: The expectation of a change in the profession with Industry 4.0 is not closely related to the potential for a change of job;
  - $H3_{B0}$: Preparation for the possibility of the termination of the profession in connection with Industry 4.0 is not closely dependent on the potential for a change of employment.

If we contemplate a situation with a 95% level of significance and gained error level is over 0.05 in value, then we must reject the alternative hypothesis H_1 (the connection between variables exists), and we have to accept the null hypothesis H_0 (the connection between variables does not exist). The significance value reflects minimal merit to reject the alternative hypothesis and represents the minimum value from which the alternative hypothesis of the existence of dependence is rejected. If the relation $\alpha' \leq \alpha$ holds, the null hypothesis H_0 is rejected. Conversely, if the relation $\alpha' \geq \alpha$ holds, the null hypothesis H_0 is accepted. Due application of the Pearson chi-square test, we defined six potential connections of expectations about forfeiture of professions and knowledge of the term Industry 4.0 for both regions (Hypothesis 1). The values of the contingency coefficient explain the determined intensity of the dependence between the examined variables. The value is in the interval $\langle 0;1 \rangle$, when the extreme values 0 and 1 can also be reached. The closer the detected value is to 1, the greater the intensity of the detected dependence between the variables. If the value of the contingency coefficient is found to be 0.30, this force can be assessed as low to medium weak. In the case of a value between 0.30 and 0.6, the given force is medium. Above 0.7, the force of dependence is very strong; when the value exceeds 0.9, this intensity can be described as almost perfect [53]. The gained results for hypothesis 1 are as follows (all results are shown in Table 1). In Table 1, there is also an evaluation of gained significance by Kendaull's tau rate:

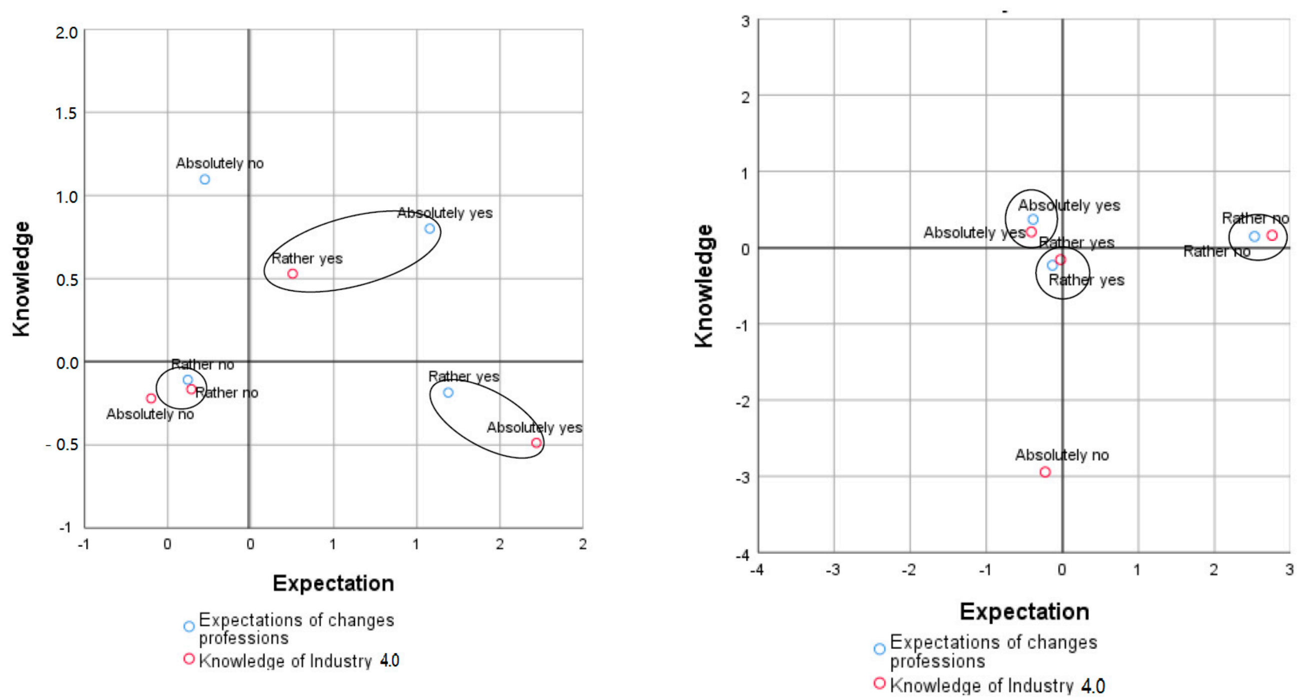
- Specific knowledge of the concept of Industry 4.0 to expectations of change. The detected significance is 0.000 for the Czech Republic and Germany (which is less than the maximum acceptable value of 0.05). The strength of this dependence is given by the contingency coefficient of 0.412 for the Czech Republic and 0.504 for Germany (forces are medium for both countries);
- Knowledge of the concept of the Internet of Things and its essence in the concept of Industry 4.0 concerning expectations of change The observed significance is 0.000 for the Czech Republic and Germany (which is less than the maximum acceptable value of 0.05). The strength of this dependence is given by the contingency coefficient of 0.578 for the Czech Republic and 0.434 for Germany (forces are medium for both countries);
- Knowledge of the concept of Internet services and its essence in the concept of Industry 4.0 with expectations of change. The detected significance is 0.000 for the Czech Republic and Germany (which is less than the maximum acceptable value of 0.05). The strength of this dependence is given by the contingency coefficient of 0.585 for the Czech Republic and 0.425 for Germany (forces are medium for both countries);
- Knowledge of the concept of cloud tools and its essence in the concept of Industry 4.0 about expectations of change. The detected significance is 0.000 for the Czech Republic and Germany (which is less than the maximum acceptable value of 0.05). The strength of this dependence is given by the contingency coefficient of 0.529 for the Czech Republic and 0.361 for Germany (forces are medium for both countries);
- Knowledge of the concept of stand-alone robots and their essence in the concept of Industry 4.0 with expectations of change. The detected significance is 0.000 for the Czech Republic and Germany (which is less than the maximum acceptable value of 0.05). The strength of this dependence is given by the contingency coefficient of 0.616 for the Czech Republic and 0.564 for Germany (force for the Czech Republic is medium–high and for Germany is medium);
- Knowledge of the concept of cobots and their essence in the concept of Industry 4.0 concerning expectations of change. The detected significance is 0.000 for the Czech Republic and Germany (which is less than the maximum acceptable value of 0.05). The strength of this dependence is given by the contingency coefficient of 0.567 for the Czech Republic and 0.530 for Germany (forces are medium for both countries).

The expectations of changes according to implementation of Industry 4.0 brings specific circumstances to the company. Figure 3 shows the relationship between expectations of changes in profession and knowledge of Industry 4.0 in companies from (a) the Czech Republic and (b) Germany. The Figure 3 shows visual status of dependencies between knowledge and expectations about Industry 4.0 in both countries. In the case of Germany, there is a missing value, "Absolutely no for expectation what is made by larger experience in German companies". In the case of German companies, there is an obvious difference in the level of knowledge of Industry 4.0 when the expectation level is almost similar to the knowledge level. In contrast, Czech companies have lower knowledge levels about Industry 4.0, which should be presented with different levels of expectations. However, both situations are supported by gained significances (Czech: 0.000; Germany: 0.000) and by individual dependence power due to contingency coefficients (Czech: 0.412; Germany: 0.504). According to the visual display, there are three defined groups for each country. In Germany, there are similar reactions of employees about their knowledge and expectations. In the Czech Republic, there are differences, and there are similar expectations about new technologies and approaches that should be caused by the knowledge level. Therefore, we can say that German companies have better knowledge levels in comparison to Czech companies.

Table 1. Gained results for sub-hypotheses H1—expectations of changes in professions.

Czech Republic				**Germany**			
H1C$_A$	Knowledge of Industry 4.0	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	57.757 0.000 0.412 0.000	**H1N$_A$**	Knowledge of Industry 4.0	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	188.346 0.000 0.504 0.000
H1C$_B$	Knowledge of the Internet of Things	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	141.832 0.000 0.578 0.000	**H1N$_B$**	Knowledge of the Internet of Things	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	128.485 0.000 0.434 0.000
H1C$_C$	Knowledge of Internet Services	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	146.875 0.000 0.585 0.000	**H1N$_C$**	Knowledge of Internet Services	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	122.296 0.000 0.425 0.034
H1C$_D$	Knowledge of cloud tools	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	109.789 0.000 0.529 0.000	**H1N$_D$**	Knowledge of cloud tools	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	83.131 0.000 0.361 0.000
H1C$_E$	Knowledge of stand-alone robots	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	173.102 0.000 0.616 0.049	**H1N$_E$**	Knowledge of stand-alone robots	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	259.094 0.000 0.564 0.000
H1C$_F$	Knowledge of cobots	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	134.026 0.000 0.567 0.004	**H1N$_F$**	Knowledge of cobots	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	216.134 0.000 0.530 0.000

Own work.



(**a**) (**b**)

Figure 3. Relations between expectation and knowledge of Industry 4.0 in (**a**) the Czech Republic, (**b**) Germany.

Due application of the Pearson chi-square test, we defined five potential connections between the possibility of the termination of the profession and knowledge of the term Industry 4.0 for both regions (Hypothesis 2). One connection is not possible to mark as statistically significant because of a higher significance value (all results are shown in Table 2). In Table 2, there is also an evaluation of gained significance by Kendaull's tau rate:

- Specific knowledge of the concept of Industry 4.0 in connection with the preparation for the possibility of the termination of the profession. The detected significance is 0.000 for the Czech Republic and Germany (which is less than the maximum acceptable value of 0.05). The strength of this dependence is given by the contingency coefficient of 0.485 for the Czech Republic and 0.634 for Germany (force for the Czech Republic is medium and for Germany is medium–high);
- Knowledge of the concept of the Internet of Things and its essence in the concept of Industry 4.0 in connection with the preparation for the possibility of the termination of the profession. The detected significance is 0.000 for the Czech Republic and Germany (which is less than the maximum acceptable value of 0.05). The strength of this dependence is given by the contingency coefficient of 0.591 for the Czech Republic and 0.543 for Germany (forces are medium for both countries);
- Knowledge of the concept of Internet services and its essence in the concept of Industry 4.0 in connection with the preparation for the possibility of the termination of the profession. The detected significance is 0.000 for the Czech Republic and Germany (which is less than the maximum acceptable value of 0.05). The strength of this dependence is given by the contingency coefficient of 0.590 for the Czech Republic and 0.519 for Germany (forces are medium for both countries);
- Knowledge of the concept of cloud tools and its essence in the concept of Industry 4.0 in connection with the preparation for the possibility of the termination of the profession. The detected significance is 0.000 for the Czech Republic and Germany (which is less than the maximum acceptable value of 0.05). The strength of this dependence is given by the contingency coefficient of 0.504 for the Czech Republic and 0.575 for Germany (forces are medium for both countries);
- Knowledge of the concept of independent robots and its essence in the concept of Industry 4.0 in connection with the preparation for the possibility of the demise of the profession. The detected significance is 0.126 for the Czech Republic and 0.000 for Germany (which is less than the maximum acceptable value of 0.05). The strength of this dependence is given by the contingency coefficient of 0.216 for the Czech Republic and 0.606 for Germany (acceptable is a force for Germany that is medium–high);
- Knowledge of the concept of cobots and its essence in the concept of Industry 4.0 in connection with the preparation for the possibility of the termination of the profession. The detected significance is 0.000 for the Czech Republic and Germany (which is less than the maximum acceptable value of 0.05). The strength of this dependence is given by the contingency coefficient of 0.477 for the Czech Republic and 0.656 for Germany (force for the Czech Republic is medium and for Germany is medium–high).

The achieved results clearly show that in case of knowledge of Industry 4.0 and used tools with elements of robotics and automation (Internet of Things, Internet services, cloud tools, stand-alone robots, cobots), workers in engineering companies (within industry section 28.41 Manufacture of machine tools) expect changes. In the functioning of their professions and at the same time with these changes, they perceive a higher risk of the demise of their profession.

In the Czech Republic, the consequences of the introduction of elements of Industry 4.0 are expected in the form of a further increase in differences between individual regions; rich regions (especially Prague and Central Bohemia) and poorer regions (northwestern Bohemia). However, the current situation creates opportunities for all Czech companies [53]. In the case of the introduction of automation and digitization in a company in the EU, not only job losses and redundancies are expected, but also the creation of new jobs as a real response to the introduction. Restructuring in individual industrial branches will be crucial, namely in most industrial European regions, i.e., both in the Czech Republic and Germany [54,55].

Table 2. Gained results for sub-hypotheses H2—preparedness to termination.

Czech Republic				Germany			
$H2C_A$	Knowledge of Industry 4.0	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	87.066 0.000 0.485 0.000	**$H2N_A$**	Knowledge of Industry 4.0	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	373.085 0.000 0.634 0.000
$H2C_B$	Knowledge of the Internet of Things	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	151.597 0.000 0.591 0.000	**$H2N_B$**	Knowledge of the Internet of Things	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	231.831 0.000 0.543 0.000
$H2C_C$	Knowledge of Internet Services	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	150.967 0.000 0.590 0.000	**$H2N_C$**	Knowledge of Internet Services	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	204.571 0.000 0.519 0.000
$H2C_D$	Knowledge of cloud tools	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	96.348 0.000 0.504 0.000	**$H2N_D$**	Knowledge of cloud tools	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	273.616 0.000 0.575 0.000
$H2C_E$	Knowledge of stand-alone robots	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	13.899 0.126 0.216 0.050	**$H2N_E$**	Knowledge of stand-alone robots	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	320.725 0.000 0.606 0.000
$H2C_F$	Knowledge of cobots	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	83.172 0.000 0.477 0.000	**$H2N_F$**	Knowledge of cobots	*Value* *Significance* *Cont.coef.* *Kendaull's tau*	418.294 0.000 0.656 0.000

Own work.

A similar approach for verification was adapted to hypothesis 3, which was defined as "Expected changes and preparedness for professions forfeiture are depending on potential job changes". For the verification, it has to be modified into statistical form. If we contemplate a situation with a 95% level of significance and gained error level is over 0.05 value, then we must reject alternative hypothesis H_1 (the connection between variables exists), and we have to accept null hypothesis H_0 (the connection between variables does not exist). The significance value reflects minimal merit to reject the alternative hypothesis and represents the minimum value from which the alternative hypothesis of the existence of dependence is rejected. If the relation $\alpha' \leq \alpha$ holds, the null hypothesis H_0 is rejected. Conversely, if the relation $\alpha' \geq \alpha$ holds, the null hypothesis H_0 is accepted. Given the results obtained for Pearson's chi-square significance, it can be stated that there is a relationship between these variables for companies in the Czech Republic and Germany. The intensity of this dependence is then expressed by the value of the contingency coefficient:

- $H2_A$: expectations of a change in the profession in connection with Industry 4.0 and a potential change in employment. The observed significance is 0.000 for the Czech Republic and Germany (which is less than the maximum acceptable value of 0.05). The strength of this dependence is given by the contingency coefficient of 0.343 for the Czech Republic and 0.370 for Germany (forces are medium-low for both countries);
- $H2_B$: preparation for the possibility of the termination of the profession in connection with Industry 4.0 is not closely dependent on the potential for a change of employment. The observed significance is 0.000 for the Czech Republic and Germany (which is less than the maximum acceptable value of 0.05). The strength of this dependence is given

by the contingency coefficient of 0.486 for the Czech Republic and 0.518 for Germany (forces are medium for both countries).

All gained results are mentioned in Table 3. It also includes values with the positive (acceptable) and negative (non-acceptable) significance of the relationship. At the same time, Table 3 includes an evaluation of gained significance by Kendaull's tau rate.

Table 3. Gained results for sub-hypotheses H3.

		Czech Republic	Germany
Expectations of a change in the profession in connection with Industry 4.0 and a potential change in employment ($H3_A$)	*Value*	37.688	88.092
	Significance	0.000	0.000
	Cont.coef.	0.343	0.370
	Kendaull's tau	0.037	0.042
Preparation for the possibility of the termination of the profession in connection with Industry 4.0 is not closely dependent on the potential for change of employment ($H3_B$)	*Value*	87.286	202.770
	Significance	0.000	0.000
	Cont.coef.	0.486	0.518
	Kendaull's tau	0.002	0.019

Own work.

The whole concept of Industry 4.0 is perceived as a new opportunity for all companies, not just industrial ones. It is necessary to perceive it as an opportunity, as its introduction into the corporate environment will have a strong effect on the competitive environment and, at the same time, affect the structure of the labor market. The reason is not only a stronger interconnection of individual companies in the economy but also sub-business areas into a complex virtual environment, which will achieve the concept of a global smart factory [31,45,56]. Following the introduction of Industry 4.0 elements, which can be considered tools to increase the innovation potential of companies, significant impacts in the area of human resources are expected. As a mitigation tool, it is necessary to focus on staff training to strengthen existing skills, but also to provide expertise and qualifications in new areas of the worker, thus achieving a new job position. A certain problem can be traced in the partial department of theoretical training and practical teaching, which causes a partial disproportion in the labor market [9]. However, Industry 4.0 cannot be understood only as a change in the technologies used in the company at the time but primarily as a way of setting the minds of all employees [11,57].

5. Conclusions

Industry 4.0 and its components can be considered significant factors that strongly influence the business environment, both internal and external. As part of the questionnaire survey, employees of engineering companies in the Czech Republic and Germany were interviewed. Each economic environment has a different characteristic in terms of the level of knowledge required of workers. Due to the level of use of individual elements, individual elements dominate in German companies compared to Czech ones. The average rate of use is higher in the case of digitization compared to automation and robotization, both in the Czech Republic and Germany. Digitization tasks are usually easier to implement compared to automation and robotization.

Workers perceive the need to use modern technologies in their daily activities in a different way, precisely due to the operation of their company. Workers in German companies are affected more strongly by modern technology due to the level of technology use. In general, they have broader knowledge about new technologies, which leads them to lower their fear of new challenges according to the technologies and comparison to workers in Czech companies. However, in both countries, there is relevant dependence between Industry 4.0 (and its parts) and knowledge. At the same time, there are different expectations in each country. In Germany, the expectation of all groups is almost similar. In the Czech Republic, there is an obvious difference between all individual groups (see Figure 3).

Based on the answers of the respondents (ordinary workers), the moderate influence of modern technologies on daily activities prevails in Czech companies (64.7%), while the strong and maximum influence is 19.5%. In contrast, modern technologies have a significant positive effect on workers in German companies (90.2%). For the use of modern technologies in engineering, their knowledge and skills in working with a computer are necessary. Due to the level of technology used, German workers have greater requirements for the use of computers compared to Czech workers. German workers use computers in 98.7% of their activities, and Czech workers only 56.2%. The use of robots is also an integral part of working with computers. Even in this area, German companies are better off (use of robots in 97.7% of cases) compared to Czech companies (32.5%). One of the reasons is precisely the technological level of equipment of Czech companies. However, even with older technological equipment, it is necessary to perceive Czech companies as important players in the industry. Individual respondents see the adequate use of new technologies in the surveyed companies as important for achieving efficiency in production processes. The meaning is perceived strongly positively in Germany (95.5%). In Czech companies, this meaning is understood positively by only 48.4% of respondents. In the Czech Republic, the introduction of new technologies is generally viewed very skeptically, with no vision of future potential.

Modern technologies currently offer a wide range of functions that make work easier [9,44,45]. The ability to diagnose errors, repair options, and configuration are considered essential functions. Knowledge of the possibility of diagnostics is widespread in companies (Germany: 91.1%; Czech Republic: 72.9%) thanks to the possibility of using manuals, where the codes of all considered errors are given, and the worker can orientate himself much more quickly when identifying a specific error. However, they do not know the self-repair capabilities of the machines, and it is almost always necessary to provide service repairs if necessary. However, it is possible to consider the set auto-calibration function as self-repair, which is specific to the machine in use. The possibility of configuring the machine is then determined by the type of work on the machine. The setting is usually in such a form that the worker loads the relevant program, and the machine sets and calibrates itself.

As a rule, the level of implementation of the elements of Industry 4.0 is carried out with the knowledge of the workers. Due to the main elements of Industry 4.0 (digitalization, automation, robotization), it is possible to introduce individual activities with the knowledge of workers, but also with the possibility of not meeting the implementation. Workers in Czech engineering companies have not encountered the situation of replacing a worker at all as a result of the introduction of Industry 4.0, except for two workplaces, a welding shop and a press shop. In these workplaces, the level of encounter with compensation is 98.2% in the welding shop and 95.8% in the press shop. In the case of the situation in the warehouse and assembly, the numbers of respondents who have encountered the replacement of a worker are more or less equal. On the side of workers in German companies, there are different experiences of workers who have encountered the replacement of man by machine. Paint shops (59.9%) and assembly (70.0%) workplaces have a slight predominance when a worker has met a replacement. On the non-replacement side, the administrative workplace has a slight predominance (65.2%). Meetings with a replacement then prevail in the press shop (97.7%), warehouse (90.1%), and assembly workplaces (70.0%).

The importance of all aspects that Industry 4.0 brings to society can be considered so fundamental that changes are expected in all areas of human life. As a result of the introduction of all aspects, a complex and automated system will be created, into which a person will enter a minimum of cases (autonomous systems will perform everything) and, as a rule, only check or correct the settings—this will require very sophisticated knowledge and skills [20,58]. As the requirements for professional knowledge increase, there will be a certain gradation when highly qualified individuals are unusually strongly sought after in the labor market. On the contrary, individuals with low or no qualifications who perform simple and repetitive activities in the current production environment will be a strongly threatened group. For the reasons mentioned, there will be pressure on all educational institutions (schools, educational and counseling centers, etc.) to adapt educational programs as much as possible because of these pressures and requirements. However, these changes may not be sufficient because the advent of automated systems and technologies will reduce the need for human labor in the long term, regardless of the location of the state and its current economic maturity, and support global business activities [39,40,59–68].

As the main limitation of the paper, consider the authors' time and geographical perspectives. For a relevant evaluation of the possible influences and impacts on the company during the implementation of Industry 4.0, it would be appropriate to select engineering companies that operate in all member states of the European Union. At the same time, cultural differences and perceptions, including any language barrier, could be considered a strong barrier. One of the key areas is how the company should prepare its personal environment for potential threats from Industry 4.0 implementation is preparing future employees (students) in the informatics field [64–66]. The main problem of the Industry 4.0 is the lack of relevant staff because of various changes, especially for the maintenance of assembly lines, robots, and cobots. By implementation of individual parts of Industry 4.0 will be replaced routine activities on the way to achieve higher productivity. In addition, companies have to focus on all types of activities to survive in the market [65]. The preparedness of future employees in new areas in companies should be met by participation with high schools, colleges, and universities [24,30,44,55,67–69].

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