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INNOVATIONS IN WORKFORCE MANAGEMENT: CHALLENGES IN THE FOURTH INDUSTRIAL REVOLUTION

Abstract. *The radical technological changes in business models associated with the fourth industrial revolution (4IR) naturally change workforce requirements and approach to workforce management. To deal with the workforce management challenges of the 4IR, employers should know requirements and expectations of the potential workforce to be able to apply effective and efficient strategies, policies, and practices on workforce management to ensure the organization has quality employees it needs. The article aims to present the main findings of the authors' questionnaire survey on requirements and expectations of Czech employees associated with the fourth industrial revolution and discuss the current workforce management challenges in developing attractive career opportunities. The authors' questionnaire survey was carried out from September to December 2019. The respondents included Czech male and female employees of different professions and different generations. The answers were obtained from 168 respondents. The data analysis methods included the calculation of relative frequencies and the evaluation of the dependence of responses on gender and generation of respondents using contingency tables and chi-square tests of independence. The findings show that respondents are familiar with the 4IR, and they are not concerned about losing their jobs due to the development of digitization, automation, or robotization; however, they are aware of the fact that their knowledge, skills, and abilities determine their employability in the 4IR. On the other hand, they have relatively high job expectations, which could reduce their employability. Therefore, employers should learn how to know the requirements and expectations of the potential workforce to be able to develop attractive career opportunities.*

Keywords: Czech Republic, employee expectations, employment opportunities, human resource management, industry 4.0, working conditions.

Introduction. The fourth industrial revolution (4IR) is characterized by a progressive and pervasive application of interdependent digital technologies and a rise of smart industrial businesses (Muscio and Ciffolilli, 2020). The application of digital technologies offers new values and services to customers and businesses, but at the same time, it causes significant changes in all industrial sectors and businesses (Paulo et al., 2019).

The implementation of digital technologies in industrial businesses has a far-reaching impact on industrial value creation. However, the practical relevance of digital technologies implies that it is essential to understand the underlying dynamics of their implementation as well as their opportunities and challenges for industrial businesses (Muller and Kiel, 2018). The successful transformation of the 4IR concepts into practice is possible only about the external and internal conditions of specific industrial businesses (Lass and Gronau, 2020).

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From the perspective of the Czech Republic, as a traditional industrial country, the implementation of digital technologies in industrial businesses associated with the fourth industrial revolution is a great opportunity and a challenge. In the Czech Republic, examples of the implementation of the 4IR concepts are observed in many industries; however, the implementation of digital technologies is the fastest in the automotive, electrotechnical, pharmaceutical, or chemical-technological industry (Adamek, 2018). However, the fourth industrial revolution also brings some problems in the labor market, especially a severe shortage of quality employees (Kostalova and Bednarikova, 2019). Today's job applicants must demonstrate solid professional and personal knowledge, skills, and abilities for successful performance in the organization. However, there is a shortage of such job applicants in today's Czech labor market. Although many job applicants do not meet the job requirements, their job and career expectations are relatively high (Safrankova and Sikyr, 2017).

The article aims to present the main findings of the authors' questionnaire survey on requirements and expectations of Czech employees associated with the development of the fourth industrial revolution and discuss the current workforce management challenges in developing attractive career opportunities.

The article includes four parts. The first part – literature review – summarizes the findings of earlier studies on the concept of the fourth industrial revolution and the impact of the fourth industrial revolution on the workforce. The second part – methodology and research methods – describes methods of the authors' questionnaire survey on requirements and expectations of Czech employees associated with the development of the fourth industrial revolution. The third part – results – presents and discusses the main findings of the authors' questionnaire survey focused on the requirements and expectations of Czech employees associated with the development of the fourth industrial revolution. The fourth part – conclusions – summarizes the article, includes implications for practice, and defines research limitations and suggestions for future research.

Literature Review. The fourth industrial revolution (4IR) is the environment in which progressive digital technologies are radically affecting and changing the way people live and work (Dean and Spoehr, 2018). The 4IR is based on the digitalization of business processes and activities (Pekerşen & Tugay, 2020; Sotnyk et al., 2020), gathering and analyzing data across machines and transformation of businesses into smart and sustainable ones (Habanik et al., 2019). Through digitalization, the business processes and activities are getting evolved, and accurate results are being produced, which in turn helps to increase productivity (Sanghavi et al., 2019). However, digital technologies are not only a tool for increasing the productivity of the economy but also a driver of the technological development of the economy (Gera and Singh, 2019).

The application of digital technologies drives changes in traditional business models when linear value chains are destroyed and replaced by value networks. This happens because customers become part of the value chain, which changes traditional relationships among producers, traders, and customers (Botha, 2019). It is also expected that the 4IR will be capable of functioning as a new alternative to enhance the quality of the environment. The environmental industry and environmental technologies may be vital economic factors in next-generation society (Choi et al., 2019). On the other hand, 4IR forces people to rethink their approaches to work and life. In these processes, education plays a unique role because it promises to prepare the coming generations for the challenges ahead and transform society for the better (Scepanovic, 2019).

The revolutionary technological advancement associated with the 4IR naturally affects all industries and businesses (Postelnicu and Calea, 2019), and this revolution brings along significant changes in labor markets (Habanik et al., 2019). The introduction of digital technologies in industrial businesses is evoking profound changes in their work systems (Fedulova et al., 2018). It is estimated that the emerging changes will affect both the overall performance of work systems and the well-being of people working in and interacting with the work systems (Kadir and Broberg, 2020). Increasing automation and computerization

lead to changes in human work (Becker and Stern, 2016).

The future industrial businesses will provide less easy and repetitive but more advanced and complex tasks (Becker and Stern, 2016). The application of digital technologies encourages decentralization and increases the interaction between humans and machines (Barata et al., 2019). Also, many jobs are rapidly disappearing because their tasks are automated, which applies both to low-skilled manual and routine jobs and increasingly to medium-skilled specialized jobs and even high-skilled complex jobs (Marengo, 2019). From the perspective of workforce management challenges in the fourth industrial revolution, the competition in recruiting and retaining talented people together with the uncertainty of employees about what they will face and obtain in the course of working for employers are two significant problems. Employers should make their employees satisfied and pleased with their career opportunities. This satisfaction and pleasure are hoped to be critical factors in motivating employees to perform their jobs and meet the objectives of the business (Nangoy et al., 2020).

The competition in recruiting and retaining talented people generally arises from a severe shortage of quality employees on the labor market (Kostalova and Bednarikova, 2019). The shortage of skilled people willing to work in industrial businesses supports, but at the same time limits the introduction of digital technologies in industrial companies (Pardi, 2019). Improving this state would require changes in the education system and the cooperation between employers and educational institutions (Safrankova and Sikyr, 2017). The uncertainty about career opportunities generally arises from potential occupational health and safety problems. The 4IR brings nonstandard career opportunities. The increasing application of digital technologies can lead to new forms of diseases and accidents (Min et al., 2019).

Methodology and research methods. Achieving the aim of the article is based on the analysis of earlier studies on the workforce management practice and the results of the authors' questionnaire survey on requirements and expectations of Czech employees associated with the development of the fourth industrial revolution. The survey was carried out by authors (Jana Marie Safrankova, Martin Sikyr, and Renata Skypalova) from September to December 2019. The questionnaire applied included 18 multiple-choice questions focused on employee requirements and expectations associated with the fourth industrial revolution. The respondents included Czech male and female employees of different professions and different generations. The answers were obtained from 168 respondents. The respondents were characterized by gender (32% male, 68% female) and generation (37% generation X: 1965–1980, 25% generation Y: 1981–1994, and 38% generation Z: 1995–2010). The data analysis methods included both the calculation of relative frequencies (as a share from the total number of respondents) and the evaluation of the dependence of responses on gender (male and female respondents) and generation (respondents of generation X: 1965–1980, respondents of generation Y: 1981–1994, and respondents of generation Z: 1995–2010). The evaluation was conducted by developing contingency tables and performing chi-square tests of independence.

By the aim of the survey, six hypotheses concerning the requirements and expectations of respondents associated with the development of the fourth industrial revolution were tested. The hypotheses tested were as follows: 1) there is no difference in responses depending on the gender of respondents regarding the concern about losing their jobs due to the development of digitization, automation or robotization; 2) there is no difference in responses depending on the gender of respondents regarding more chances to meet the challenges of the 4IR as a result of higher education; 3) there is no difference in responses depending on the gender of respondents regarding the desire to be a manager; 4) there is no difference in responses depending on the generation of respondents regarding the desire to work in the place of residence; 5) there is no difference in responses depending on the generation of respondents regarding the acceptable gross monthly income, and 6) there is no difference in responses depending on the generation of respondents regarding the motivation to change a job because of the offer of benefits.

The procedure of the chi-square tests of independence included six steps:

- 1) formulation of the null (H_0) and alternative (H_A) hypothesis;
- 2) selection of a level of significance α ;
- 3) calculation of the chi-square statistic

$$\chi^2 = \sum \left[\frac{(O_{r,c} - E_{r,c})^2}{E_{r,c}} \right] \quad (1)$$

where O is observed frequencies, E is expected rates, r is the number of rows in the contingency table, and c is the number of columns in the contingency table;

- 4) calculation of the degrees of freedom

$$f = (r-1) \times (c-1); \quad (2)$$

- 5) selection of the critical chi-square value $\chi^2_{\alpha}(f)$;

6) comparison of the chi-square statistic χ^2 to the critical chi-square value $\chi^2_{\alpha}(f)$ and acceptance or rejection of the null hypothesis.

Results. In the case of general awareness of the concept of the fourth industrial revolution (4IR), 89% of respondents agreed that they know the idea. In this context, respondents stated that this concept is mainly characterized by automation of production (82%), robotics (74%), or application of new technologies (68%). When it comes to the question of whether respondents are concerned about losing their jobs due to the development of digitization, automation, or robotization, 6% of them stated yes, 80% of them reported no, and 14% of them reported don't know. There was no significant difference in responses depending on the gender of respondents ($p > 0.05$). The null hypothesis was tested that there is no difference in responses depending on the gender of respondents regarding the concern about losing their jobs due to the development of digitization, automation, or robotization (see Table 1). Since the test statistics were lower than the critical value, the null hypothesis was not rejected.

Table 1. Are you concerned about losing your job due to the development of digitization, automation, or robotization?

Gender	Yes	No	Don't know	Σ
Male respondents	2* (3.21)**	48 (43.07)	4 (7.71)	54
Female respondents	8 (6.79)	86 (90.93)	20 (16.29)	114
Σ	10	134	24	168

*observed frequencies (O), ** expected frequencies (E)

H_0 : There is no difference in responses depending on the gender of respondents regarding the concern about losing their jobs due to the development of digitization, automation, or robotization. H_A : There is a difference in responses depending on the gender of respondents regarding the concern about losing their jobs due to the development of digitization, automation, or robotization.

Level of significance $\alpha = 0.05$; Chi square statistic $\chi^2 = \sum \left[\frac{(O_{r,c} - E_{r,c})^2}{E_{r,c}} \right] = 4.143$

Degrees of freedom (f): $(r-1) \times (c-1) = 2$; Critical chi-square value $\chi^2_{0.05}(2) = 5.991$

r – the number of rows in the contingency table, c – the number of columns in the contingency table

Sources: developed by the authors.

When it comes to the question of whether respondents can imagine that machines or robots could replace some people in their organization, 45% of them stated yes, 42% of them reported no, and 13% of them reported don't know.

When it comes to the question to what extent information and communication technologies influence daily work activities of respondents, 52% of them stated maximum, 36% of them stated average, and 12% of them indicated minimum. Similarly, when it comes to the question to what extent computer work is part of daily work activities of respondents, 76% of them stated maximum, 17% of them stated average, and

7% of them indicated minimum. In the context of computer work, respondents indicated that usually use a word processor (99%), a spreadsheet (93%), an email client (81%), or a presentation maker (76%).

When it comes to the question of whether the employer of respondents invests in digitization, automation, or robotization, 47% of them stated yes, 39% of them said no, and 14% of them stated don't know. Similarly, when it comes to the question of whether the employer of respondents invests in their education in connection with the application of information and communication technologies, 40% of them said yes, 42% of them said no, and 18% of them said they don't know.

The results of the authors' questionnaire survey showed that information and communication technologies are a standard part of workplaces and that respondents usually use them to carry out their daily work activities. However, to meet the challenges of digitization, automation, or robotization, they need to develop their professional skills continually. According to respondents, the most critical skills necessary for meeting the challenges of the 4IR include communication skills (84%), solving-problems skills (84%), implementation skills (76%), learning skills (68%), or teamwork skills (61%). On the other hand, respondents showed relatively high job expectations. The respondents' job expectations include self-fulfillment (87%), meaningful work (78%), professional development (68%), favorable environment (68%), fair wages (67%), friendly team (65%), or professional management (61%).

In the context of employability, 82% of respondents agreed that higher education gives them more chances to meet the challenges of the 4IR. There was a significant difference in responses depending on the gender of respondents ($p < 0.05$). The null hypothesis was tested that there is no difference in answers depending on the gender of respondents regarding more chances to meet the challenges of the 4IR as a result of higher education (see Table 2). Since the test statistics were higher than the critical value, the null hypothesis was rejected in favor of the alternative hypothesis. However, 52% of respondents stated that they see their chances in today's labor market as a medium. This may be due to uncertainty regarding career opportunities.

Table 2. Do you think that higher education gives you more chances to meet the challenges of the 4IR?

Gender	Yes	No	Σ
Male respondents	36* (14.24)**	18 (13.76)	54
Female respondents	102 (34.08)	12 (32.92)	114
Σ	138	30	168

*observed frequencies (O), ** expected frequencies (E)

H₀: There is no difference in responses depending on the gender of respondents regarding more chances to meet the challenges of the 4IR as a result of higher education. H_A: There is a difference in responses depending on the gender of respondents regarding more chances to meet the challenges of the 4IR as a result of higher education.

Level of significance $\alpha = 0.05$; Chi square statistic $\chi^2 = \sum \left[\frac{(O_{r,c} - E_{r,c})^2}{E_{r,c}} \right] = 12.994$

Degrees of freedom (f): $(r-1) \times (c-1) = 1$; Critical chi-square value $\chi^2_{0,05}(1) = 3.841$

r – the number of rows in the contingency table, c – the number of columns in the contingency table

Source: developed by the authors.

When it comes to the question of whether respondents want to be managers (manage people), 69% of them stated yes, 7% of them said no, and 24% of them stated don't know yet. There was no significant difference in responses depending on the gender of respondents ($p > 0.05$). The null hypothesis was tested that there is no difference in answers depending on the gender of respondents regarding the desire

to be a manager (see Table 3). Since the test statistics were lower than the critical value, the null hypothesis was not rejected.

Table 3. Do you want to be a manager?

Gender	Yes	No	Don't know yet	Σ
Male respondents	42* (37.29)**	4 (3.86)	8 (12.86)	54
Female respondents	74 (78.71)	8 (8.14)	32 (27.14)	114
Σ	116	12	40	168

*observed frequencies (O), ** expected frequencies (E)

H₀: There is no difference in responses depending on the gender of respondents regarding the desire to be a manager. H_A: There is a difference in responses depending on the gender of respondents regarding the desire to be a manager.

Level of significance $\alpha = 0.05$; Chi square statistic $\chi^2 = \sum \left[\frac{(O_{r,c} - E_{r,c})^2}{E_{r,c}} \right] = 3.590$

Degrees of freedom (f): $(r-1) \times (c-1) = 2$; Critical chi-square value $\chi^2_{0.05}(2) = 5.991$

r – the number of rows in the contingency table, c – the number of columns in the contingency table

Source: developed by the authors.

An interesting problem associated with working conditions is the need to commute to work. When it comes to the question of whether respondents want to work at their place of residence, 51% of them stated yes, 19% of them said no, and 30% of them stated don't know yet. There was a significant difference in responses depending on the generation of respondents ($p < 0.05$). The null hypothesis was tested that there is no difference in answers depending on the production of respondents regarding the desire to work in the place of residence (see Table 4). Since the test statistics were higher than the critical value, the null hypothesis was rejected in favor of the alternative hypothesis.

Table 4. Do you want to work at your place of residence?

Generation	Yes	No	Don't know yet	Σ
X: 1965–1980	42* (31.74)**	10 (11.81)	10 (18.45)	62
Y: 1981–1994	28 (21.50)	6 (8.00)	8 (12.50)	42
Z: 1995–2010	16 (32.76)	16 (12.19)	32 (19.05)	64
Σ	86	32	50	168

*observed frequencies (O), ** expected frequencies (E)

H₀: There is no difference in responses depending on the generation of respondents regarding the desire to work in the place of residence. H_A: There is a difference in responses depending on the generation of respondents regarding the desire to work in the area of the house.

Level of significance $\alpha = 0.05$; Chi square statistic $\chi^2 = \sum \left[\frac{(O_{r,c} - E_{r,c})^2}{E_{r,c}} \right] = 30.126$

Degrees of freedom (f): $(r-1) \times (c-1) = 4$; Critical chi-square value $\chi^2_{0.05}(4) = 9.488$

r – the number of rows in the contingency table, c – the number of columns in the contingency table

Source: developed by the authors.

When it comes to the question of what gross monthly income respondents consider acceptable, 59% of them stated EUR 1,550 and more, 27% of them said EUR 1,150-1,500, and 14% of them told EUR 750-1,100. In Q3 2019, the average gross monthly nominal wage was approximately EUR 1,300 (CZSO, 2019).

There was no significant difference in responses depending on the gender of respondents ($p > 0.05$), but there was a significant difference in answers depending on the generation of respondents ($p < 0.05$). The null hypothesis was tested that there is no difference in responses depending on the generation of respondents regarding the acceptable gross monthly income (see Table 5). Since the test statistics were higher than the critical value, the null hypothesis was rejected in favor of the alternative hypothesis.

Table 5. What gross monthly income do you consider acceptable?

Generation	EUR 750–1,100	EUR 1,150–1,500	EUR 1,550 and more	Σ
X: 1965–1980	4* (8.86)**	10 (16.98)	48 (36.17)	62
Y: 1981–1994	4 (6.00)	12 (11.50)	26 (24.50)	42
Z: 1995–2010	16 (9.14)	24 (17.52)	24 (37.33)	64
Σ	24	46	98	168

*observed frequencies (O), ** expected frequencies (E)

H₀: There is no difference in responses depending on the generation of respondents regarding the acceptable gross monthly income. H_A: There is a difference in responses depending on the generation of respondents regarding adequate gross monthly income.

Level of significance $\alpha = 0.05$; Chi square statistic $\chi^2 = \sum \left[\frac{(O_{r,c} - E_{r,c})^2}{E_{r,c}} \right] = 22.481$

Degrees of freedom (f): $(r - 1) \times (c - 1) = 4$; Critical chi-square value $\chi^2_{0.05(4)} = 9.488$

r – the number of rows in the contingency table, c – the number of columns in the contingency table

Source: developed by the authors.

Besides fair wages, employees and job seekers often expect attractive benefits. When it comes to the question of what benefits respondents expect and consider to be motivating, they stated sick-days (77%), other vacations (72%), pension/life insurance contributions (61%), education contributions (60%), or meal vouchers (52%).

Table 6. Would you change a job because of the offer of benefits?

Generation	Yes	No	Σ
X: 1965–1980	42* (51.67)**	20 (10.33)	62
Y: 1981–1994	38 (35.00)	4 (7.00)	42
Z: 1995–2010	60 (53.33)	4 (10.67)	64
Σ	140	28	168

*observed frequencies (O), ** expected frequencies (E)

H₀: There is no difference in responses depending on the generation of respondents regarding the motivation to change a job because of the offer of benefits. H_A: There is a difference in responses depending on the generation of respondents regarding the motivation to change a job because of the offer of benefits.

Level of significance $\alpha = 0.05$; Chi square statistic $\chi^2 = \sum \left[\frac{(O_{r,c} - E_{r,c})^2}{E_{r,c}} \right] = 17.394$

Degrees of freedom (f): $(r - 1) \times (c - 1) = 2$; Critical chi-square value $\chi^2_{0.05(2)} = 5.991$

r – the number of rows in the contingency table, c – the number of columns in the contingency table

Source: developed by the authors.

When it comes to the question of whether the offer of benefits could motivate respondents to change their jobs, 83% of them stated yes, and only 17% of them said no. There was no significant difference in responses depending on the gender of respondents ($p > 0.05$), but there was a significant difference in

responses depending on the generation of respondents ($p < 0.05$). The null hypothesis was tested that there is no difference in answers depending on the generation of respondents regarding the motivation to change a job because of the offer of benefits (see Table 6). Since the test statistics were higher than the critical value, the null hypothesis was rejected in favor of the alternative hypothesis.

Conclusions. The authors' questionnaire survey on requirements and expectations of Czech employees associated with the fourth industrial revolution (4IR) showed that male and female respondents of different professions and different generations are familiar with the 4IR concept and that information and communication technologies are a standard part of their workplaces. In contrast, respondents frequently use them to carry out their daily work activities.

Respondents are not concerned about losing their jobs due to the development of digitization, automation, or robotization. However, they are aware of the fact that their knowledge, skills, and abilities determine their employability in the 4IR. On the other hand, respondents have relatively high job expectations, including self-fulfillment, meaningful work, professional development, favorable environment, fair wages, attractive benefits, friendly team, or professional management. Failure to meet all these expectations could lead to dissatisfaction and limited employability of respondents. Respondents, respectively, employees and job seekers in general, should be ready to continually develop their professional skills to meet the challenges of the 4IR.

The results support the suggestion that employers should learn how to know the requirements and expectations of the potential workforce to be able to develop attractive career opportunities. Employers should improve their understanding of specific needs and expectations of employees and job seekers and develop attractive career opportunities for them to motivate them to perform their jobs and meet objectives of the business successfully.

The focus on the Czech labor market and the relatively low number of respondents limit general conclusions. However, the current results are worth attention from business managers and HR specialists who are responsible for workforce management in different organizations. The present results can be the starting point for further research on workforce management in the 4IR.

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Інноваційні підходи до управління персоналом: вплив четвертої промислової революції

Ця стаття узагальнює аргументи та контраргументи в межах наукової дискусії з питання особливостей інноваційного процесу та нововведень управління персоналом, проблем розробки та впровадження інноваційних технологій в управління персоналом. Систематизація літературних джерел та підходів до вирішення проблеми управління персоналом засвідчила, що трудова діяльність сучасного працівника внаслідок дії четвертої промислової революції набуває все більш ядро вираженої специфіки, яку необхідно враховувати при впровадженні в практику кадрових інновацій у відповідності з поточними і стратегічними цілями підприємств. Актуальність вирішення даної наукової проблеми продиктовано необхідністю вдосконалення стратегії, принципів та практики управління персоналом в умовах четвертої промислової революції. Основною метою проведеного дослідження є встановлення специфіки трудової

діяльності чеських працівників, їх вимоги та очікування спричинених четвертою промисловою революцією. У статті представлено результати емпіричного аналізу опитування 168 респондентів, чоловіки та жінки різних вікових та професійних груп, з вересня по грудень 2019 року. Методичним інструментарієм проведеного дослідження стали методи відносних частот та оцінки залежності відповідей респондентів на основі факторних таблиць та критерію незалежності χ^2 -квадрат. Отримані результати дослідження свідчать, що процеси діджиталізації, автоматизації та роботизації не мають статистично значимого впливу на переживання працівників з приводу можливого ризику втрати робочого місця. Однак, переважна більшість респондентів усвідомлюють, що четверта промислова революція висуває нові вимоги до рівня знань, вмій та навичок, необхідних для працевлаштування. Дослідження емпірично підтверджує та теоретично доводить, що розуміння працівників майбутніх викликів пов'язаних з впливом четвертої промислової революції дозволяють впроваджувати на підприємствах сучасні стратегії управління персоналом. Результати проведеного дослідження можуть бути корисними для підприємств при впровадженні інноваційних підходів щодо управління персоналом, зокрема: пошуку та найму працівників, розвитку їх кар'єри, створення корпоративної культури тощо.

Ключові слова: Чеська Республіка, очікування працівників, можливості працевлаштування, управління трудовими ресурсами, індустрія 4.0, робоче середовище.

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