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# WORK 4.0 COMPETENCIES IN THE FEMALE OPTICS

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**Abstract**

*Recently, the research in Industry 4.0 has been focused not only on the technological aspects of Industry 4.0, but also on the wellbeing of the workers and their autonomy and job satisfaction. In this paper, specific requirements related to Industry 4.0 implementation are reflected with regard to female element. Based on the analysis of the key challenges of the Industry 4.0 development, specific challenges in human capital of women are pointed out, such as e.g. the social skills, maintenance of non-routine jobs, and support to adaptation to Industry 4.0. The aim of the paper is to analyse if women in Slovakia are prepared for the of Industry 4.0 development in terms of digital access, digital literacy and digital attitudes (patterns of digital participation).*

**Key words**

*Industry 4.0, human capital, women in the labour market, digital literacy*

## INTRODUCTION

Changes in the labour market structure, which have been due to technological innovations within the Industry 4.0 concept, drew our attention to specific changes in human capital. The term of Work 4.0 has been introduced to capture the changes in the human capital content, that reflect the key characteristics of work tasks and forms of the work organization in relation to the Industry 4.0 requirements.

We can see the scientific literature focuses not only on the technological aspects of Industry 4.0, but gradually it rather shifts more to the wellbeing and autonomy of workers and their satisfaction in the process. We believe that the human resource optic is to be applied in order to emphasize the changes in human capital which were due to the Industry 4.0 implementation. In collaboration across disciplines, it opens up the space for asking the question of how to achieve the best conditions for cooperation of humans and robots within the Human-Robot

Collaboration in hybrid teams, and how the introduction of Industry 4.0 influences the development of human capital and its implementation in the labour market.

In this article, the attention is concentrated on the female optic within the Industry 4.0 development in the field of digital literacy development of women and the attitudes towards working with robots. What are the possibilities that the Industry 4.0 development may enhance the women's human capital, and how could women contribute to sustainability and development of the Industry 4.0 concept?

## STRUCTURAL AND ORGANIZATIONAL FACTORS OF THE HUMAN CAPITAL DEVELOPMENT OF INDUSTRY 4.0

Women have been considered to be the favoured workforce in the context of the information society development (Castells, 2000). The gender-based limitations of the history will fast become outmoded, and companies in the future will eliminate gender-stereotypes, allowing them to innovate and grow (Funna, 2018). Industry 4.0 influences the labour market – it contributes to the emergence of new skills and professions, and also opens up new opportunities, especially for women (Ryazantseva, 2017). Owing to the raise of education level and shift towards the service economy, women have become the important part of the labour market structure. Positive effects of engaging women on the labour market (utilisation of women's abilities and potential) is connected also with some negative impacts such as the "phenomenon of over-feminized" education (deficit of male pattern), a lower birth rate, a crisis of traditional relationships and values, including fears of the extinction of a traditional family" (Džbánková, Z. 2017, p. 359). Several authors believe the fourth industrial revolution is poised "to reverse the gender stereotypes created by the first [industrial revolution], putting the emphasis back on human talent with ingenuity and creativity, not on traditionally masculine skillsets (Funna, 2018).

Digitisation has transformed the character of the labour market and shaped political participation, while impacting the future of work as well as other features. According to the European Institute for Gender Equality, this all also provides opportunities to mark gender inequalities that affect women and men in different ways. The European Institute for Gender Equality presents some observations in the factsheet, from work on the gender aspects of digitisation. "While male domination in STEM jobs and ICT in particular is a consequence of gender stereotyping, it further reinforces the ideas about femininity and masculinity, and the roles of women and men within society. Furthermore, the lack of women in the science and technology development exacerbates gender bias in technology itself" (Eige, 2018, p. 2).

The concept of Work 4.0 that reflects the key features of work tasks and forms of work organization in relation to the Industry 4.0 requirements can be analysed deeper in the optics of gender differences in human capital development. There are a number of studies showing that women are less represented in the digital sector. Women also use ICT less, since they have less confidence in the use of technology in general. According to one of these studies, advanced digital skills help increase productivity, increase chances of finding a job, and help balance personal and professional life, the key issue for adult women. (Axess, 2017) Similarly, EIGE (2018) points out the gender digital paths: whereas 92% of girls and 93% of boys at the age of 16 – 24 are skilled enough in using digital technologies in their daily lives, only 63% of girls and 73% of boys feel confident about their digital skills (Eige, 2018).

As stated by Džbánková (2017, p. 360), there are several key benefits that Industry 4.0 in the female optic, as "a) digitization may offer opportunities for more equal participation of women in the labour market, in financial markets and in business, b) women appear to face lower risks in replacing them by a machine compared to men's workforce, c) the often-

highlighted social skills of women also represent a comparative advantage in the digital age, especially when complemented by higher education and advanced digital literacy".

Structural labour market trends with regard to the Industry 4.0 development favorise not only human-robot collaboration for future, but also the maintenance of non-routine jobs that are based on non-codifiable skills. For example, the set of skills of engineers involves also communication skills in the current competitive economics (Bozić, Pintarić, 2018). Thus, communication skills are expected to be part of the human-intensive work tasks as well as computer-intensive work tasks for the future.

There are several differences in the field of the innovation adoption with regard to gender according to managerial theories. As cited by the studies in the field of information system, general attitudes towards technology can act as an indicator of a person's willingness to adopt technology, beside the factors of anticipated competence to use it, aesthetics and user's prior experience with technology (Peters et al.) As managing working in hybrid human-robot work teams belongs to the key challenges of the Industry 4.0 development, data in the field of Human-Robot collaboration are a valuable source of information. According to Velšic (2018), women seem to be slightly more "unsure" of their reaction to robot as a working partner (colleague). When asked: "Imagine a situation where you will have to communicate with a robot in human language. How would you treat it?" slightly more women than men could not determine their behaviour in this situation, with slightly more men than women (64, 60%) saying that they would act as a machine, while 8% of men and 7% of women would approach the robot as a human partner. Similarly, for slightly more men as women (29% compared to 25%), it would be acceptable to follow the robot's instructions, e.g. during transport or control. Although, as stated by the author, there are no significant differences between men and women regarding the ideas of robotic design so far (robotic or humanoid), more data are needed based on real working experience in mixed work teams. However, personalization in design can act as a fruitful way in managing the optimal Human-Robot cooperation.

## HOW ARE WOMEN READY FOR INDUSTRY 4.0 WITH REGARD TO DIGITAL ACESS, DIGITAL LITERACY AND PATTRERNS OF DIGITAL PARTICIPATION?

According to the EU statistics, Europeans have the right infrastructure, but they do not have the digital skills they need to take full advantage of digital transformation (Axess, 2017). Significant differences in the importance of the digital skills in relation to the work position could be explained in the frame of the overlapping online and offline activities, by the differences in requirements that emerge within a social structure. Based on the data of PIAAC and PISA studies, it appears that gender gaps in literacy are closing with the age, while differences in numeracy between men and women persist. One of the explanations is that men are also much more likely than women to pursue careers in the fields that require more intensive use of numeracy skills – which may explain why they tend to retain or increase their advantage in numeracy. Arguably, reading is a transversal skill that is practiced across a wide range of occupations, so that men may have more opportunities to practice their reading skills than women do.

As regard to digital literacy, gender is a less significant factor of digital gap in Slovakia to compare education or region. The main differences between women and men lie in the level of hardware skills (Kokles et al. 2017, Velšic, 2018). According to Kokles et al. (2017, p. 184), gender as a factor differentiates digital literacy in the level of hardware skills as work with computer (desktop, notebook, laptop), installation of additional devices and telephony via Internet (VoIP) with men reaching significantly higher level in examined cases. In case of indicator work with the Internet and sending and receiving emails, statistical significance was not shown.

The PIAAC study focused on qualitative assessment of the different competences, including digital competences and the ability to use them in practice. Slovakia is one of the countries with the slightest difference in literacy, numeracy and ability to solve problems in a technologically rich environment, similar to e.g. Poland and Estonia. The Survey of Adult Skills shows small gender differences in literacy proficiency with 2 p.p. in OECD in average, however, wider gender gaps were observed in numeracy. In 2018, in the Central and Eastern European countries of Estonia, Lithuania, Poland, Slovenia and the Slovak Republic, gender differences in numeracy proficiency were low, with 2 p.p. in case of Slovakia, to compare 12 p.p. in the OECD countries. Not only in Slovakia, but also in general, gender differences in proficiency in problem solving in technology-rich environments are small, with men having a slight advantage over women. In Slovakia, mean level of the ability to solve problems on technology rich environment is lower with 26.5% of men and 24.8% of women, compared to OECD. However, the gender gap according to the indicator is lower as in the OECD countries, where gender gap reached 4 p.p. in case of problem solving in technology rich environment with 31.7% men at the mean level to compare 27.7% of women, while in case of Slovakia gender gap reached 1.8 p.p.

According to the Women in the Digital Age study, there are differences in digital skills within EU 28 countries, with 12.9% gap, when digital skills above the basic skills are considered (p. 55). Still, there is a 6% digital gap in basic skills between men and women over 55 years in EU 28.

With regard to the findings of the studies, in Slovakia, women are ready to work within technologically rich environment as well as men are, and there are no significant differences in literacy, numeracy or ability to solve problems in technologically rich environment in gender optics. In the field of digital access, as shown, men spend more time on the Internet than women.

However, various studies show that the significant differences between men and women appear in “informatics self-consciousness”, motivation, attitudes towards studying ICT-related fields and work in digital sector. The data point to external factors, such as lack of examples in women participation in ICT and difficulties in work-life balance. Preferences of other activities and types of work and possible cultural patterns and stereotypes in women participation in digital work should be taken into account as well (Women in Digital Age, 2018).

Differences in gender optics appear also in adaptation to digital technologies in a group of 18-29 years old, while the majority of women acquire digital skills at school (42%), compared to the men who acquire digital skills in an informal environment, with the help of friends and self-study (67%). Women rely more on the family (43%) and the work environment (26%) more than men in adapting to the ICT technologies. Approximately similar proportions of men and women (24%, 25%) acquire computer digital skills in computer after-school lessons (Velšic, 2019).

The data show gender differences in the attitudes towards technology and digitization when women are more concerned with the impact of technology on the future of the work. Women have less positive view then men regarding the impact of robots and artificial intelligence on daily life, when 64% of women agree that robots might help perform daily tasks, compared to 72% of men. More women than men would feel uncomfortable when being assisted by robots in specific actions, as for example in medical operation performed by robot, having a robot assistance at work, having a robot providing a companion, receiving goods delivered by drone or robot or travelling in a driverless car (Velšic, 2019, p. 94).

The most common preventive measures to overcome barriers for women in the digital sectors are: role models, training, reformed ICT formal education, mentoring, facilitating access to study, increased women confidence in digital innovation, networking and facilitating access to study. Based on the cases analysed in the Women in digital age study - it seems that initiatives as "convincing" women to opt for STEM careers, awareness campaigns and direct

communication are less effective than those aimed at adapting content and the ways in which this content is transmitted. The example is "launching the new introductory course, with subjects adapted to the computing levels of the students, and modifying the curriculum, with more appealing content descriptions and with a greater hands-on approach, stressing the usefulness of computing and its real-world applications" (p. 34). Introductory courses can help equalize skill levels and reduce the possible confidence gap. Also, helping to balance personal and working life and childcare support can be useful tool especially for students and professors.

These measures could improve also the situation on the labour market. The data of the workers with tertiary education with digital jobs by the age and gender show, that among man, in the age group under 30, the share of men in digital jobs raised from 16,9% in 2011 to 17,3% in 2015, in the age from 30 to 49 from 15,3% to 16,6% and the share of men in digital jobs in raised from 10% to 12% in the age group 45 and older. However, among women, the share of female workers remined the same in the younger groups with 4,7% women under 30 in digital jobs in 2011 and 2015 and 4.6% in the age 30-44 years.

The older workers - both men and women - may have the potential of greater labour market participation in the ICT sector. As compared to 2011, the proportion of older women who left the digital job in that year fell from 15% to 7%, while the decline in the number of women who have left their jobs in the digital sector appears only in the age group over 55. According to OECD Study PIAAC, the share female workers with tertiary education in ICT jobs raised from 2,6% in 2011 to 3,2% in 2015 in the age group over 45. Similarly, even for older men, there is a decline in leaving the IT sector.

In view of the projected developments in the age digital divide, a possible shift in the age structure of digital workers for the future can be estimated. However, the data documenting the increase in the share of digital workers in older age groups should also be monitored in view of the decrease in the number of students in the IT field in 2015 compared to 2011. The decrease in this area is the reason for the analysis of support for the choice of IT tertiary education and improvement of the conditions of study in this field for the future.

## WOMEN IN ICT SECTOR AND INFORMATION STUDIES

However, based on evidence of a study Women in a Digital Age, there are signs of increasing a gender gap in the digital sector (Women in a Digital Age, 2018), declared by decrease in number of women taking up ICT related higher education when compared to 2011. According to WID indicator (Women in Digital) that compares 13 indicators in the areas of Internet use, Internet user skills as well as specialist skills and employment, there are significant differences in all indicators between men and women, especially in ICT education and employment and entrepreneurship.

In European Union, 57% of tertiary graduates are women, wit 24,9% graduated in ICT - related fields. The negative trend in number of people with ICT related education is observed for both genders but the gap between men and women has increased. If only those with tertiary studies are considered, the figures are higher but the downward trend still persists: 5.8% of university students in 2011 were in the ICT-related field compared to 5.4% in 2015 (Women in a Digital Age, 2018, p. 30).

The biggest difference between the number of men and the number of women graduating in ICT fields have been found in Malta and Finland, in relative terms the gaps are widest in Belgium, Slovakia, Luxembourg and Lithuania, where the number of male ICT graduates is more than 10 times higher than of females.

However, very few women enter that sector for their career: "…females currently make up 13% of tertiary graduates in ICT-related fields that are working in digital jobs, which is a

negative change from 15% of graduates only four years earlier" (Women in a Digital Age, 2018, p. 40).

There are several arguments about the gender gap between men and women in the field of ICT work participation, as e.g. basic and advanced digital skill gap between men and women, attitudes towards technology and digitization and stronger undermining of their own capabilities and skills by women. Even if there is no gender digital gap in EU 28 when considered basic digital skills, the influence of the age is significant. The factor of the age is significant when considering gender digital gap, as "girls under 24 surpass their male counterparts, while in the other age groups a gender gap negatively affecting women still persists (p. 11). When it comes to basic skills, there is no gap among those under 55 years old, but there is a gap at 6 pp. difference between men and women over the age of 55.

In Slovakia, the share of women in the total number of students in informatics and related fields reaches 20%. In practice, the ration of men and women within ICT specialists is 87,7 to 12,3% (Velšic, 2019, p. 2). Data collected in representative survey on a sample of young women in the age of 14-17 years point to different perception of ICT in girls who choose to study ICT as compared to those that ICT to study is supported by data on features that the relevant groups of girls appreciate in the field of ICT. The attractiveness of self-realization and creativity in the ICT area is more pronounced for those who decide to study ICT compared to those who do not want to study ICT (46% and 4% respectively). Similarly, more girls who are determined to study ICT declare interest in new technologies (23%) and appreciation of the widespread use of ICT (23%) compared to those who do not want to study ICT (9% and 10% respectively). For girls who are not interested in studying this field, ICT is particularly attractive as a means of communication and contact with people (53% compared to 23% for those who choose to study ICT) and information gathering (33% to 23%).

Taking into relatively broad proportion of girls who are considering CT but ultimately do not choose the ICT field of study (39%) - not only because of lack of interest, but also because of concerns about excessive demands and poor motivation to study - the author of the study estimates the potential of girls to study and work in the IT field in Slovakia at 20% (Velšic, 2019, p. 18). According to the study, interest in working in the digital field can be expected for girls with a relatively good level of digital skills and for girls with a great benefit. Similarly, correlations with computer confidence can be identified in girls interested in working in the field. The European study (Eige, 2018) points out low self-confidence among girls which goes hand in hand with lower aspirations of engaging in digital jobs. In EU countries – Bulgaria, Estonia, Malta and Romania – very low percentage (between 1% and 3%) teenage girls express an interest in working as an information and communications technology professional at the age of 30. In other EU countries is notes also almost no interest. "In contrast, between 3% and 15% of teenage boys across the EU aspire to become ICT professionals." (Eige, 2018, p. 1)

According to the information obtained from some STU faculties, the trend of choosing the study of computer science has an increasing tendency, but we can see very low proportion of woman. The table shows the numbers of male and female students of study´s programs in computer science and automation from some faculties of Slovak University of Technology in Bratislava: The Faculty of Mechanical Engineering, The Faculty of Electrical Engineering and Information Technology, The Faculty of Informatics and Information Technologies, The Faculty of Materials Science and Technology and The Faculty of Chemical and Food Technology acquired in the last 3 years.

| **Table 1** Number of enrolled students by 31Nov. for the past three years at the Slovak University of Technology in Bratislava – Computer Science and Automation study programmes | | | | | | |
|---|---|---|---|---|---|---|
| | **31/10/2019** | | **31/10/2018** | | **31/10/2017** | |
| | **Together** | **Women** | **Together** | **Women** | **Together** | **Women** |
| **Bachelor´s Degree** | 1858 | 243 | 1758 | 224 | 1653 | 193 |
| **Master´s Degree** | 452 | 51 | 403 | 42 | 434 | 41 |

Science, technology, engineering and mathematics are the most gender-segregated subjects in the education system and over the past ten years, the number of women graduates in these subjects in the EU has decreased (from 23% to 22%). "This gender division is mirrored in the labour market, where the share of women in STEM occupations is 14%, with almost no change over the past decade." (Eige, 2018, p. 1) In Slovakia there is an effort to motivate girls to study computer science. The aim of website "Aj ty v IT" (You too in IT) is to attract more young girls into IT study and bring them information about possibilities they have in IT sector. The "Aj Ty v IT" portal informs girls, their parents, and the public about importance and positive impact of having women in IT, they can find information and sign up events and workshops that are happening in their region. (www.ajtyvit, 2020)

## DISCUSSION ON RESULTS

There are several initiatives to support women participation in digital sector and ICT studies presenting benefits of working in IT, as e.g. in the field of work-life balance and distance work. In generally, the attitudes towards working in IT sector can be influences by patterns of women successfully participating in IT labour market and by analysis of curriculum of ICT fields of study with the emphasis of practical use of knowledge. The successful example of this efforts support the findings in the structure of digital gender gap that is based merely on differences in attitudes towards digital technologies and "informatics self-consciousness" of women.

Although the strategic concepts of the Ministry of Education of the SR reflect the need for the application of ICT in education (Action Plans), relatively little emphasis is given to the use of ICT at higher educational levels. The need to make ICT elements accessible to higher education in line with Industry 4.0's needs is a specific area that deserves special attention. We propose to develop an Education 4.0 strategy with a view to higher education, with the aim of promoting the use of Virtual Reality, Augmented reality, Teaching factory and other tools to connect the virtual and real world, academia and industry and - if possible - with regard to support women choice for ICT studies.

## CONCLUSION

The key gender differences in digital literacy in the EU are related to age, level of digital competencies and attitudes towards work in IT sector. The digital age gap has not yet closed and it also has an impact on gender comparisons. In the area of basic digital literacy, age and gender act as a differentiating factor with the difference in digital literacy especially among older women, persisting in the age group over 55 with the 6% difference in the level of basic digital skills, compared to men over 55.

In general, in the level of the basic digital skills, the gender digital gap can be marked as close, however, there can be 12. 9% digital gap identified above the basic level of digital skills (Women in a Digital age, 2018, p. 54). However, when considering advanced digital skills, girls under 24 surpass their male counterparts, while in the other age groups, a gender gap negatively affecting women still exists (Women in a Digital age, 2018, p. 11).

Key differences in the current share of women working in ICT sector is connected with several factors, such as difficulties with work-life balancing, lack of role models in sector, psychical barriers, lack of "digital self-confidence", and possible cultural stereotypes in division of labour. Based on empirical data on digital literacy, women and men in Slovakia are similarly ready to the Industry 4.0 adaptation with no significant differences in literacy, numeracy or ability to solve problems in technologically rich environment in gender optic (PIAAC study). The older workers - both men and women - may have the potential of greater labour market participation in the ICT sector. In view of the projected developments in the age digital divide and with regard to raise of female workers with tertiary education in ICT and decline in leaving IT sector in a group over 55 years, a possible shift in the age structure of digital workers for the future can be estimated.

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