

THE ROLE OF WOMEN IN THE CREATION OF KNOWLEDGE FOR THE FOURTH INDUSTRIAL REVOLUTION

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Abstract: *Talent and technology together will determine how the Fourth Industrial Revolution can be harnessed to deliver sustainable economic growth and innumerable benefits to society. In this paper we will try to examine the opportunities and challenges of information-communication technologies (ICT) and Internet for women population from the gender gap perspective. It is evident that technological change has a significant impact on job creation and displacement, skills gaps, education and gender gaps. Preparing talent for this new world will be the key for full use of ICT potentials for development purposes. This will require breaking down old relations between education systems and labour markets, agile approaches to regulation, new forms of public-private collaboration, and new norms and values granting equal gender possibilities.*

Key words: *Information-communication technologies, gender, equality, knowledge, development.*

1. INTRODUCTION

The world is witnessing today the increasing proliferation of technology and its effects on advancing global prosperity. As ICT-fuelled digital economy is taking off in an exponential way, it is recognized that we are facing with the beginning of a Fourth Industrial Revolution that will fundamentally change the way we live, work, and relate to one another.

This Revolution is characterized by the high speed of developments, disruption across all major industries, and the ICT impact on entire systems of production, management, and governance. The future holds an even higher potential for human development as the full effects of new technologies such as the Internet of Things, artificial intelligence, 3-D Printing, and quantum computing unfold [1]. In order to be able to manage development, ICT potentials, the world has to ensure that women, as one half of the global population, are equally integrated both as beneficiaries and shapers of knowledge, technology and resources for the Fourth Industrial Revolution.

2. ICT AND INTERNET USE FROM THE GENDER GAP PERSPECTIVE

As is usually the case with technology, information technology is gender neutral. However, there are gender dimensions in terms of ICT access and use that can hinder progress towards

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gender equality. There is a pervasive gender divide in Internet use by men and women. According to the latest figures published by ITU in 2017 the global Internet penetration rate for men stands at 50,9% compared to 44,9% for women. The proportion of women using the Internet is 11,6% lower than the proportion of men using the Internet worldwide. The gender gap is currently more pronounced in developing countries, where 16,1% fewer women than men use the Internet, compared with 2,8% fewer women than men in the developed world (Table 1). While the gender gap has narrowed in most regions since 2013, it has widened in Africa. In Africa, the proportion of women using the Internet is 25% lower than the proportion of men using the Internet. In LDCs, only one out of seven women is using the Internet compared with one out of five men [2].

	Internet penetration rate*		Internet user gender gap**	
	Men	Women	2013.	2017.
WORLD	50,9	44,9	11,0	11,6
Developed	82,2	79,9	5,8	2,8
Developing	44,7	37,5	15,8	16,1
LDC	21,2	14,1	29,9	32,9
REGIONS				
Africa	24,9	18,6	20,7	25,3
Arab States	47,7	39,4	19,2	17,3
Asia&Pacific	47,9	39,4	17,4	17,1
The Americas	65,5	66,7	-0,4	-2,6
CIS	69,8	65,8	7,5	5,8
Europe	82,9	76,3	9,4	7,9

* Penetration rates in this chart refer to the number of women/men that use the Internet, as a percentage of the respective total female/male population

** The gender gap represents the difference between the Internet user penetration rates for males and females relative to the Internet user penetration rate for males, expressed as a percentage.

Table 1: International penetration rate by man and woman in 2017

Source: [2].

Huyer, Hafkin, Ertl & Dryburgh note that women's rate of Internet access does not always increase in tandem with national rates of Internet penetration, and the high overall ICT penetration does not guarantee equitable access by gender [3]. The fewer women access and use of the Internet and ICT is a direct result of their unfavourable conditions with respect to employment, education and income. Gaps in wages and therefore gaps in purchasing power are major determinants of the different abilities of men and women to access ICTs [4].

There is no single ICT or Internet gender gap, there are several. Bimber (2000) noted two Internet gender gaps for the United States, one with access to the Internet, and the other is the difference in the use of the Internet among those men and women [who are already equipped] with access [5]. For example, consistent and measurable gender gaps are observed in the use of e-commerce and the use of smartphones, with consistently higher proportions of men choosing to purchase and use these services than women [4].

Access is especially important in relation to the right to communicate. According to Broadband Commission data, women worldwide are, on average, 21% less likely to own a mobile phone, representing a gender gap of 300 million, equating to \$13 billion in potential missed revenues for the mobile sector [4]. Even when women own a mobile phone, they are far less likely than men to use it, especially when it comes to the more transformational services like mobile

Internet and mobile money services. The key barriers to women's mobile access include costs, culture, technical literacy and perceptions of value.

According to analysis in developing countries, every 10 % increase in access to broadband translated to a 1,38 % growth in the gross domestic product (GDP). This means that bringing an additional 600 million women and girls online could boost global GDP by as much as \$18 billion. In this respect, in March 2013, the *ITU/UNESCO Broadband Commission for Digital Development* endorsed a fifth broadband advocacy target, calling for gender equality in access to broadband by 2020 [6].

3. WOMEN IN ICT EDUCATION AND EMPLOYMENT

Two factors highly determine the contribution of women to the economic development process under the Fourth Industrial Revolution and those are women's technical education and their participation in science and technology (S&T) professions. Available data clearly indicate differences in access to education and employment opportunities in ICTs for women.

Education - Globalization, digital technologies and new ways of working puts a high premium on workers with skills and qualifications in science and technology, workers historically less likely to be women. Women are vastly underrepresented in these subjects at the secondary and tertiary education levels and in the overall technical workforce [7]. Although more governments are collecting data on the use of ICTs in public education, it is still not possible to obtain data on the number of men and women studying ICTs and computer science in most countries and in nearly all developing countries. All the same, the data that are available indicate consistently low participation by women and girls in S&T education [7].

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graduated in 1982 at the University of Belgrade, Faculty for Economics in International Economy and obtained a PhD at the same University. She worked as senior research fellow with the Institute of Economic Sciences in Belgrade. Scientific adviser degree, she obtained in 2008. Marijana Vidas-Bubanja has been working as professor of Faculty for Trade and Banking, Alpha University, Belgrade and of Belgrade Business School since 2004. Besides topics in International Economy in her work, dr Vidas-Bubanja deals with development aspects of eEconomy, information society, economic impacts of e-business practices, etc. In period (February 2000-February 2002) she was eEnvoy for Serbia in the eSEEurope Initiative under the II Table of the Stability Pact for SEE. The Chair of the same Initiative was since February 2002 up to October 2007. Dr Vidas-Bubanja participated and coordinated creation of two basic documents for information society development in SEE - eSEE Agenda in 2002 and eSEE Agenda+ in 2007. She is author or coauthor of 5 books and more than 100 articles in country and abroad.



Despite the growth of female tertiary graduates in science over the past few years, women still engage in different fields of study than men and remain under-represented in science and technology fields in all EU Member States. Across the EU-28, the second most common field of education was engineering, manufacturing and construction-related studies which accounted for 15,7% of all tertiary education students. In this field, three quarters of the students were male [8]. At the postgraduate level, the share of women in S&T fields declines further and yet again in the transition to the workplace. In 2012 women accounted for 47% of top-level graduates and in 2013 they held only 35,5% of total research positions in EU [9].

Few data are available also in the area on women's participation in computer science and engineering research especially in the developing countries. However, existed data indicate the low participation of women in higher-skilled, higher-ranking, and higher-paid positions in ICT research and development [10].

Employment - Disadvantages in education translate into lack of access to skills and limited opportunities in the labour market. Female participation in the labour force and employment rates are affected heavily by economic, social and cultural issues and care work distributions in the home. In 2015 the global labour force participation rate was 50% for women, but 77% for men. Worldwide in 2015, 72 % of working-age (ages 15 and older) men were employed compared with only 47% of women. Achieving higher engagement in paid work confers multiple benefits not just to women, but to societies and economies at large. It is well recognized that a higher female labour force participation rate boosts economic growth. For example, raising the rate in Japan from the current 66% to 80% (still 5% lower than the male participation rate) could boost the country's output 13 percent [7].

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is a full-time professor at the Faculty of Economics, IT Management and Creative Production, Metropolitan University in Belgrade. She graduated, got her master degree and obtained a PhD at the Faculty of Economics, University of Belgrade in the field of international economics. She speaks English and German. Snežana is the author of monographs and textbooks in the field of international economics, as well as over hundreds of professional and scientific papers. She teaches International Economics, International Economic Relations and International Business. In the period from 2003 to 2015 she was at the position of the Vice Dean for Education at FEFA Faculty. In the same time, dr Popovčić-Avrić holds classes from Economics at the Faculty of Electrical Engineering, University of Belgrade. She also worked at the Institute for Market Research and Institute of Economic Sciences in Belgrade. Snežana led numerous projects in the field of international trade, research of macroeconomic economic trends and economic trends in the country and abroad, as well as market product research and assessment of the justification of investments.



In particular, the participation of women in ICT design and development is generally low. Available data show a progressive decline of the number of women in ICT-related employment at increasing levels of complexity. Many women operate computers, largely for word processing and related office programs and for data entry. Many fewer are programmers and systems analysts. The least number of women are in software and hardware engineering in North America, Europe, and Asia [11].

As a growing sector of the EU economy, ICT in 2014 accounted for 4,2% of the EU's GDP. This sector creates 120.000 new jobs every year, with expectations that by 2020, the EU will lack 900.000 skilled ICT workers. Women made only 16,7% of the nearly 8,2 million employed as ICT specialists in the EU in 2016. Also, women only take up 19% of managerial position in ICT whereas the average for other sectors is 45% [12].

Women are underrepresented in senior business management globally. They hold only 22% of senior leadership positions, and 32 % of businesses do not have any female senior managers, with regional variation ranges from 8% in Japan to 40% in the Russian Federation. Women hold only 19% of senior technology roles. The situation is even starker at the top of enterprises, with only 9 % of companies having a female chief executive officer in 2014 [7].

3. DIGITAL DEVELOPMENT IN SERBIA AND THE IMPACT OF GENDER UNEQUALITY

For a small country in transition like Serbia, digital economy is great development opportunity and in this respect, all available human and knowledge resources should be used for its realization. This includes women's potentials as well, as according to Census from 2011 53,2% of the population in Serbia were women [13]. This number indicates that women present half of human potential for the development in Serbia that should be properly used. In reality gender equality in Serbia has not yet been reached and women continue to face a number of problems in attempting to exercise their capabilities and their guaranteed rights. The same is true for the digital gender perspective.

The data from the Statistical office of the Republic of Serbia show that in 2017 there were 3.616.000 persons using *computers* in the last three months, 72,2% of men and 63,4% of women. Over 3.750.000 persons in Serbia in 2017 used *Internet* in last three months, and the relation between men and women was similar, 73,7% of men and 67,4% of women. Over 90% of men and women in Serbia used mobile phones in 2017 [14].

Use of	Computer		Internet		Mobile phone	
Age	Male	Female	Male	Female	Male	Female
16-24	96,9	93,9	98,7	97,3	98,6	97,2
25-54	85,7	80,4	87,5	85,1	97,3	98,4
55-74	39,3	28,2	40,3	31,6	84,2	81,2

Table 2: Use of computers, internet and mobile phones in Serbia in 2017, by gender and age groups
Source: [14].

Use of computer and Internet in Serbia is statistically significantly correlated with household monthly income, age, level of education and profession. Women in rural areas, with lower monthly income, lower secondary education, and older than 50, are less likely to be ICT users in Serbia.

When online, Serbian women use internet differently than men. They are more active on social media and in using e-mail as internet service, but in all other online activities, especially more sophisticated one, they are less active than men (Table 3).

Different Internet use	Male	Female
Sending/receiving e-mails	83.3%	76.1%
Social networks participation	67.9%	71.1%
Reading and downloading online newspapers and magazines	61.5%	59.2%
Searching for information about goods and services	56.4%	50.0%
Searching for information related to education, courses	52.6%	51.8%
Services related to traveling	44.9%	40.4%
Software download	39.1%	17.9%
Searching for information related to health	36.5%	47.2%
Searching for job and job applications	35.9%	24.3%
Selling goods and services online	29.5%	15.1%
Internet payments	25.6%	11.9%
Participation in professional networks	24.4%	13.3%

Gambling	21.8%	3.7%
Online courses	12.8%	9.6%

Table 3: Different ICT use by gender in Serbia

Source: [15].

These results of the different Internet use are correlated with the fact that in the Republic of Serbia, 34,2% of persons aged 15 and over are computer literate. Observed by sex, among computer literate persons the share of men and women is almost equal (50,4% of men and 49,6% of women), while among illiterate persons the share of women is higher than that of men (54% and 46% respectively) [13].

Education is very attractive to women in Serbia but not so much in science and informatics. In fact, the number of students in technical areas in Serbia is rising, but in 2012/13 school year they are still representing less than 20% of the Serbian student's population, and only 15,5% out of the total number of graduates [16]. Women in Serbia are underrepresented in the field of the science and engineering in education. During the period 2009-2013 around 23% of all graduate students at Electrical engineering faculty in Belgrade were women and 77% were men [17].

Iva Bubanja is a PhD student at Faculty of political sciences, University of Belgrade in the field of culture and media. She works as a teaching assistant at Belgrade business school and holds classes from Business communication and Sociology. Topic of her master thesis deals with the commercials in Belgrade daily press. For a few years now, she is interested in researching the new concepts in marketing and propaganda with a large focus on the digital sphere. She is an author of scientific papers in domestic and international magazines. Iva also worked as a journalist and was active in non-governmental organizations that stand for equality and human rights.



Serbian IT industry itself employed 17.711 workers in 2013 but women are underrepresented either as ICT workers, or ICT experts. Inequality between men and women persists, especially in the highest corporate positions and in academia as well [16].

Activities are needed for the all levels in the Serbian economy for the rising awareness about gender equality in ICT use, and for the elimination of stereotypes that women are less competent and capable to use ICT and to work in IT sector.

4. CONCLUSION

Performed analysis confirms that digital gender divide persist in the world and is more pronounced in less developed countries. Closing the digital divide is a pressing concern and it is a significant opportunity for growth in today's digital economy. All stakeholders, including governments, policymakers, industry stakeholders and operators must work together to give women equal access to information and communication technologies. Especially governments and enterprises need to be more proactive in helping women thrive in the ICT workforce.

On one side, women's and girls' empowerment in ICT is essential to expand economic growth and promote social development under the dynamic and technology intensive environment. The full participation of women in labour forces would add percentage points to most national growth rates double digits in many cases. On the other side, ICTs are very useful for women. ICTs have potentials to increase women's capacity to cope with the requirement of modern,

demanding life more efficiently, and at the same time, ICTs enable women to transform the conditions of life and work and assert alternative gender roles.

In Serbia as a country where a little over 50% of the population is female, it is crucial for women to shape our country's future in the engineering industry alongside men. The rising number of men and women are using the Internet, but gender gap still exists on the level around 5%-7%. Positive trends are noticed concerning younger age groups where women exceed men concerning the use of computer, internet or mobile phones.

Data indicates that while Serbian women actively participate in developing the information society and digital economy, both as users and producers of information services, still there is a gender imbalance in the ICT industry workplace. Women are underrepresented in ICT business sector occupying small number of corporate positions in the ICT sector.

Serbia needs innovative strategies to advance gender equality, focusing in three areas: 1) ACCESS - Achieve equal access to digital technology for women and girls; 2) SKILLS - Empower women and girls with the skills to become ICT creators; 3) LEADERS - Promote women as ICT leaders and entrepreneurs. Special attention should be placed on creating the platform for advancing women's meaningful engagement with ICTs and their role as decision-makers and producers in the technology sector.

On the global level, digital gender equality and gender empowerment is clearly recognized in the United Nations Sustainable Development Goals (SDGs), and in particular SDG 5, "Achieve gender equality and empower all women and girls". Global Partnership to Ensure Gender Equality in the Digital Age that brings together all relevant stakeholders was launched during the UN General Assembly in September 2016.

The use of ICTs by women and men reflects to a large extent the wider socio-cultural and economic context within which the technologies are produced and used. Gender and technology should be viewed as evolving and changeable. The holistic strategy focused on transforming the company culture and mindset is essential to cultivating wider change. It is equally important to continue studying, document and analyze the situation of women in ICT, specially in developing countries where the lack of gender sensitive data prevent reaching right conclusions and creating adequate strategies.

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