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Management and Organization of Human Resources in Science and Technology of the Republic of Serbia

Olivera Milutinović¹ , Slavica Anđelić¹ , Dušan Garabinović^{2*} , Momčilo Bajac¹ 

¹University "Union – Nikola Tesla", Faculty of Management, Sremski Karlovci, Serbia,
e-mail: olivera.milutinovic@famns.edu.rs; slavica.andjelic@famns.edu.rs; momcilo.bajac@famns.edu.rs

²Higher Business School of Vocational Studies "Prof. dr Radomir Bojković", Kruševac, Serbia,
e-mail: dusan.garabinovic.032@gmail.com

Abstract: The subject of this paper is human resources in the field of science and technology in the Republic of Serbia. The aim is to establish the state and tendencies regarding the number and structure of human resources in the mentioned field. Accordingly, several research questions were defined. Open data (2018-2021) of the Statistical Office of the Republic of Serbia were used. The results showed that the average number of employees who have either higher education or are employed in the field of science and technology was 991.9 thousand and on average their number was growing. The majority were women, whose number and share increased on average. The average number of employees who have higher education and are employed in the field of science and technology was 501.4 thousand and their number was growing on average, including people of both genders. The majority were women, whose share was constant with a tendency to minimal decrease. The average number of employees aged 15-74 who are employed in the field of science and technology was 731.2 thousand and on average their number was growing, including persons of both genders. The majority were women, whose share was constant with a tendency to minimal increase. The most important sector in the field of science and technology was education. It is concluded that there are positive tendencies regarding the number of human resources in the field of science and technology in Serbia, especially when it comes to women.

Keywords: management, organization, human resources, science, technology.

Introduction

Human resources (*HR*) represent one of the most important success factors in the modern business world. Without people, no organization functions regardless of its size, as well as its other specifics. The reason for the above is that people are the basic elements of the organization, both in executive and management positions. They are the basis of both changing existing and developing completely new occupations. The role of human resources is indisputable in the field of science and technology, especially if viewed from the aspect of innovation and higher education. Adequate management of human resources is necessary precisely because of their importance. Human resource management (*HRM*) is "the field of study and practice that focuses on people in organizations" (Stewart and Brown, 2020, p. 4). Its roles include both people and processes (Stewart and Brown, 2020, p. 4).

Management and organization of human resources in science and technology are elements that drive all other factors of the socio-economic system, primarily due to innovations created by science and technology. Management in science is related to management in education, especially in higher education. Accordingly, the term management in science and technology can be explained using the definition of management in education (Šormaz et al., 2019), partially modified and adapted. Therefore, management in science includes personnel who perform management activities of scientific institutions and organizations. Modern technologies are increasingly important in human resource management (Vrontis et al., 2022). Based on the above, and in accordance with the topic of this paper, the conclusion is that human resources management is important in the field of technology, but technology is also important in the field of human resources management.

*Corresponding author: dusan.garabinovic.032@gmail.com



Science in Serbia is not a recent phenomenon. Its development can be traced from the period of the Middle Ages, through the period of stagnation (17th and 18th centuries), and up to the beginnings of modern science in Serbia, closely related to the gradual development of statehood (at the end of the 18th and during the 19th century) (Ivković and Maksimović, 2023). Nowadays, in Serbia, the policies of encouraging science and research follow world trends, and corresponding goals have been set in accordance with these trends. There are also certain activities accompanied by financial investments. During the previous decade, the set goals were partially achieved, and at the same time there was constant, but still slight progress in the sphere of the scientific research system. However, there is a constant lag in the analyzed indicators in relation to the member states of the European Union (EU). The small number of scientists engaged in the economy is perhaps one of the main problems. The above situation can be seen both as a cause and as a consequence of insufficient cooperation and connection between science and business (Stančetić and Tmušić, 2023). In contrast to the mentioned situation, it is undeniable that Serbia has opportunities for successful cooperation between science and business, but these opportunities are currently not sufficiently utilized. One of the reasons for the above is the orientation of people from the scientific and research field almost entirely towards scientific work (Stošić et al., 2019).

The analysis of innovative organizational design in scientific and research organizations in Serbia showed that “external and internal environment, project portfolio, resources, monitoring and methods and techniques influence organizational design”, but also that these are important elements of strategic project management (Mosurović et al., 2023). Special attention should be paid to them in the further development of science and technology in Serbia.

The four strategies are among the most significant documents in the field of science and technological development in Serbia. The mentioned strategies refer to: a) scientific and technological development (Government of the Republic of Serbia, 2021b), b) startup ecosystems (Government of the Republic of Serbia, 2021a), c) smart specialization (Government of the Republic of Serbia, 2020) and d) artificial intelligence (Government of the Republic of Serbia, 2019).

The topic that attracts special attention is the position of women, first in education, and then in employment in the field of “Science, Technology, Engineering, and Mathematics” (STEM). There are many problems and challenges that women workers in the field of science and technology face on a daily basis. Among others, these can be problems with working hours, opportunities for further development and professional voice, the period during and after pregnancy, etc. (Wang et al., 2023). Both personal and environmental characteristics affect the professional career of women in the STEM field, and at the same time many challenges arise – organizational culture based on gender, stereotypes, work-private life balance, etc. (Makarem and Wang, 2020). Many women have left a great impact in the sphere of science and technology, but there are still efforts to involve as many women as possible in the STEM field where their number is at best constant (Bauer et al., 2020). The conclusion is that in certain parts of the world, gender can be one of the important factors of inclusion and success in the field of science and technology. When it comes to the situation in Serbia, Lazarević-Moravčević et al. (2023) conclude that there is gender inequality in scientific and research activity, whereby the gender segregation present in education is also transferred to the sphere of science, with the simultaneous existence of vertical gender segregation.

The subject of the paper is human resources in the field of science and technology in the Republic of Serbia. The aim is to establish the state and tendencies regarding the number and structure of human resources in the field of science and technology in the Republic of Serbia. Several research questions have been defined based on the subject and objective:

1. What is the current situation and what are the trends regarding the number of employees who have completed higher education and/or are employed in the field of science and technology in Serbia?
2. What is the current situation and what are the trends regarding the gender structure of employees who have completed higher education and/or are employed in the field of science and technology in Serbia?
3. What is the current situation and what are the trends regarding the number of employed persons in the field of science and technology in Serbia?
4. What is the current situation and what are the trends regarding the gender structure of employees in the field of science and technology in Serbia?
5. What is the current situation and what are the trends regarding the structure of employees in the field

of science and technology according to the sectors of activity in Serbia?

A business venture in the field of science and technology can be seen as “a ship in a great sea that, regardless of its size, the winds and waves that hinder it, tries to find its right path, tries to maintain the course that leads it to the desired goal, but it is possible only if the captain and all crew members are united in their decision – there is no giving up” (Garabinović, 2017, p. 445). Answers to the above questions help to better understand the structure of employees in the field of science and technology in the Republic of Serbia, which is the basis for future improvements in human resources management in this field.

Materials and Methods

The analysis is based on the use of open data. Open data is data that can be viewed from two aspects. According to the first point of view, i.e. the broader point of view, open data is “open” to the public, i.e. it is publicly available. In accordance with the stated point of view, open data are data in any format if they meet the condition of availability to the public. According to the second point of view, i.e. a narrower and stricter point of view, open data is data that, as in the first point of view, meets the condition of public availability, but unlike the first point of view, the format of the data is of great importance. In accordance with the stated point of view, open data is publicly available data that can be downloaded in a format suitable for direct processing in appropriate application programs. One of the main specificities of open data is “machine readability”. It implies that certain data can be (automatically) processed and then analyzed using some software (Blagojević et al., 2020). Among the specialized portals in Serbia, the most important are data.gov.rs and data.stat.gov.rs. Some of the formats in which data can mainly be downloaded are JSON, CSV, XML, SDMX, SDMX DSD, Excel and others.

Data for “Human resources in science and technology (HRST)” are available in the open data base of the Statistical Office of the Republic of Serbia in the field of “Science, technology and innovations”. Appropriate data available for gender and other significant categories for the period 2018-2021 were extracted from the aforementioned database (Statistical Office of the Republic of Serbia, 2022a, 2022b, 2022c, 2022d).

Results and Discussions

The number of employed persons aged 15 to 74, who meet the condition that they either have completed higher education or are employed in the field of science and technology in the other analyzed years (2019, 2020 and 2021) was higher compared to 2018 (Table 1). The highest growth was in 2021 (4.8%), when this indicator had its maximum value. Analyzing the annual data for this indicator compared to the previous year, it can be seen that in 2019 there was an increase compared to 2018. After that, there was a decrease in 2020. In 2021, there was the highest growth compared to the previous year (3.4%). Looking at the analyzed indicator by gender, there are certain differences that are explained in more detail below.

Table 1. Number of “employed persons aged 15-74 who have either completed tertiary education or are employed in the field of science and technology” by gender (authors’ calculations – [Statistical Office of the Republic of Serbia, 2022a](#))

	Year	Number (in thousands)	Change compared to			
			the base year		the previous year	
			No.	%	No.	%
Total	2018	972.2	-	-	-	-
	2019	991.1	18.9	1.9	18.9	1.9
	2020	985.2	13.0	1.3	-5.9	-0.6
	2021	1019.0	46.8	4.8	33.8	3.4
Male	2018	456.0	-	-	-	-
	2019	452.5	-3.5	-0.8	-3.5	-0.8
	2020	448.5	-7.5	-1.6	-4.0	-0.9
	2021	466.4	10.4	2.3	17.9	4.0
Female	2018	516.2	-	-	-	-
	2019	538.6	22.4	4.3	22.4	4.3
	2020	536.7	20.5	4.0	-1.9	-0.4
	2021	552.6	36.4	7.1	15.9	3.0

The number of employed men was lower in 2019 and 2020 compared to 2018. Both the largest decrease (-1.6%) and the minimum value were in 2020. In 2021, the highest growth (2.3%) and maximum value was recorded. Analyzing the annual data for this indicator compared to the previous year, it is noted that a decrease was recorded in 2019 and 2020. After that, the year 2021 saw the highest growth compared to the previous year (4.0%).

The number of employed women in the other analyzed years (2019, 2020 and 2021) was higher compared to 2018. The highest growth was in 2021 (7.1%), and in the same year this indicator had its maximum value. Analyzing the annual data for this indicator compared to the previous year, it is noted that in 2019, compared to 2018, there was the highest growth (4.3%). After that, in 2020 there was a decrease, and in 2021 there was a renewed growth.

Women made up the majority of “employed persons aged 15-74 who have completed higher education or are employed in the field of science and technology during all analyzed years (Table 2). The share of women compared to 2018 was higher in all other observed years. The largest increase compared to the base year was in 2020. Comparing each year with its previous year, it was found that the only decrease was in 2021. The lowest share of women was in 2018, and the highest in 2020. The share of men has opposite tendencies.

Table 2. Percentage of “employed persons aged 15-74 who have either completed tertiary education or are employed in the field of science and technology” by gender (authors’ calculations – [Statistical Office of the Republic of Serbia, 2022a](#))

	Year	%	Change compared to	
			the base year	the previous year
Male	2018	46.9	-	-
	2019	45.7	-1.2	-1.2
	2020	45.5	-1.4	-0.1
	2021	45.8	-1.1	0.2
Female	2018	53.1	-	-
	2019	54.3	1.2	1.2
	2020	54.5	1.4	0.1
	2021	54.2	1.1	-0.2

In the period 2018-2021, the average annual number of employed persons aged 15-74 who have completed higher education or are employed in the field of science and technology was 991.9 thousand. The average annual change compared to the base year was 26.2 thousand, i.e. 2.7%. The average annual change compared to the previous year was 15.6 thousand, i.e. 1.6%. Below are the data for both women and men. Below is the data on the analyzed category of employees by gender.

There were on average 455.9 thousand men. The average annual change compared to the base year was -0.2 thousand, i.e. 0.0%. The average annual change compared to the previous year was 3.5 thousand, i.e. 0.8%.

There were on average 536.0 thousand women. The average annual change compared to the base year was 26.4 thousand, i.e. 5.1%. The average annual change compared to the previous year was 12.1 thousand, i.e. 2.3%.

The average share of women was 54.0%, and men 46.0%. The average change in the percentage of women compared to the base year was 1.3, or 0.4 compared to the previous year.

The number of persons aged 15 to 74 who have completed higher education and are employed in the field of science and technology in the other analyzed years (2019, 2020 and 2021) was higher compared to 2018 (Table 3). The highest growth was in 2021 (6.0%) and in the same year this indicator had its maximum value. Analyzing the annual data for this indicator in comparison with the previous year, it is noted that there was an increase in 2019 compared to 2018. After that, there was a decrease in 2020. In 2021, the highest growth compared to the previous year was recorded (5.2%). Looking at the analyzed indicator by gender, there are certain differences that are explained in more detail below.

Table 3. Number of "employed persons aged 15-74 who have completed tertiary education and are employed in the field of science and technology" by gender (authors' calculations – [Statistical Office of the Republic of Serbia, 2022b](#))

	Year	Number (in thousands)	Change compared to			
			the base year		the previous year	
			No.	%	No.	%
Total	2018	491.6	-	-	-	-
	2019	497.1	5.5	1.1	5.5	1.1
	2020	495.5	3.9	0.8	-1.6	-0.3
	2021	521.2	29.6	6.0	25.7	5.2
Male	2018	209.0	-	-	-	-
	2019	210.4	1.4	0.7	1.4	0.7
	2020	207.5	-1.5	-0.7	-2.9	-1.4
	2021	225.3	16.3	7.8	17.8	8.6
Female	2018	282.6	-	-	-	-
	2019	286.7	4.1	1.5	4.1	1.5
	2020	288.0	5.4	1.9	1.3	0.5
	2021	295.9	13.3	4.7	7.9	2.7

The number of employed men was lower only in 2020 compared to 2018. Both the largest decrease (-0.7%) and the minimum value were in 2020. Both the highest growth (7.8%) and the maximum value were in 2021. Analyzing the annual data for this indicator in comparison with the previous year, it is noted that only in 2020 a decrease was recorded (-1.4%). After that, the year 2021 saw the highest growth compared to the previous year (8.6%).

The number of employed women in the other analyzed years (2019, 2020 and 2021) was higher compared to 2018. The highest growth was in 2021 (4.7%) and in the same year this indicator had its maximum value. Analyzing the annual data for this indicator in relation to the previous year, it is noted that there was constant growth. The highest growth was in 2021 (2.7%).

Women made up the majority of persons aged 15-74 who have completed higher education and are employed in the field of science and technology during all analyzed years (Table 4). The share of women compared to 2018 decreased only in 2021 (-0.7%). The largest increase compared to the base year was

in 2020 (0.6%). Comparing each year with its previous year, the only decrease was in 2021 (-1.4%). The lowest share of women was in 2021, and the highest in 2020. The share of men has opposite tendencies.

Table 4. Percentage of “employed persons aged 15-74 who have completed tertiary education and are employed in the field of science and technology” by gender (authors’ calculations – [Statistical Office of the Republic of Serbia, 2022b](#))

	Year	%	Change compared to	
			the base year	the previous year
Male	2018	42.5	-	-
	2019	42.3	-0.2	-0.2
	2020	41.9	-0.6	-0.4
	2021	43.2	0.7	1.4
Female	2018	57.5	-	-
	2019	57.7	0.2	0.2
	2020	58.1	0.6	0.4
	2021	56.8	-0.7	-1.4

In the period 2018-2021, the average annual number of employed persons aged 15-74 who have completed higher education and are employed in the field of science and technology was 501.4 thousand. The average annual change compared to the base year was 13.0 thousand, i.e. 2.6%. The average annual change compared to the previous year was 9.9 thousand, i.e. 2.0%. Below is the data on the analyzed category of employees by gender.

There were 213.1 thousand men on average. The average annual change compared to the base year was 5.4 thousand, i.e. 2.6%. The average annual change compared to the previous year was 5.4 thousand, i.e. 2.6%.

There were on average 288.3 thousand women. The average annual change compared to the base year was 7.6 thousand, i.e. 2.7%. The average annual change compared to the previous year was 4.4 thousand, i.e. 1.5%.

The average share of women was 57.5%, and men 42.5%. The average change in the percentage of women compared to the base year was 0.0, or -0.2 compared to the previous year.

The number of employed persons aged 15 to 74 who are employed in the field of science and technology was lower (-0.1%) only in 2022 compared to 2018 (Table 5). The highest growth was in 2021 (4.1%) and in the same year this indicator had its maximum value. Analyzing the annual data for this indicator in comparison with the previous year, it is noted that there was an increase in 2019 compared to 2018. After that, there was a decrease in 2020. The highest growth compared to the previous year was in 2021 (4.2%). Looking at the analyzed indicator by gender, there are certain differences that are explained in more detail below.

Table 5. Number of “employed persons aged 15-74 that are employed in the fields of science and technology” by gender (authors’ calculations – [Statistical Office of the Republic of Serbia, 2022c](#))

	Year	Number (in thousands)	Change compared to			
			the base year		the previous year	
			No.	%	No.	%
Total	2018	723.0	-	-	-	-
	2019	726.8	3.8	0.5	3.8	0.5
	2020	722.4	-0.6	-0.1	-4.4	-0.6
	2021	752.5	29.5	4.1	30.1	4.2
Male	2018	324.3	-	-	-	-
	2019	320.5	-3.8	-1.2	-3.8	-1.2
	2020	316.8	-7.5	-2.3	-3.7	-1.2
	2021	338.0	13.7	4.2	21.2	6.7
Female	2018	398.7	-	-	-	-
	2019	406.3	7.6	1.9	7.6	1.9
	2020	405.6	6.9	1.7	-0.7	-0.2
	2021	414.5	15.8	4.0	8.9	2.2

The number of employed men was higher only in 2021 compared to 2018, and the maximum value was recorded in the same year. Both the largest decrease (-7.5%) and the minimum value were in 2020. Analyzing the annual data for this indicator compared to the previous year, it is noted that the increase was only in 2021 (6.7%).

The number of women in the other analyzed years (2019, 2020 and 2021) was higher compared to 2018. The highest growth was in 2021 (4.0%) and in that year this indicator had its maximum value. Analyzing the annual data for this indicator compared to the previous year, it is noted that the decrease was only in 2020 (-0.2%). The highest growth was in 2021 (2.2%).

Women made up the majority of employed persons aged 15-74 who are employed in the field of science and technology (Table 6). The share of women compared to 2018 decreased only in 2021. The largest increase compared to the base year was in 2020. Comparing each year to its previous year, the only decrease was in 2021. The lowest share of women was in 2018 and 2021, and the highest in 2020. The share of men has opposite tendencies.

Table 6. Percentage of employed persons aged 15-74 that are employed in the fields of science and technology by gender (authors’ calculations – [Statistical Office of the Republic of Serbia, 2022c](#))

	Year	%	Change compared to	
			the base year	the previous year
Male	2018	44.9	-	-
	2019	44.1	-0.8	-0.8
	2020	43.9	-1.0	-0.2
	2021	44.9	0.1	1.1
Female	2018	55.1	-	-
	2019	55.9	0.8	0.8
	2020	56.1	1.0	0.2
	2021	55.1	-0.1	-1.1

In the period 2018-2021, the average annual number of employed persons aged 15-74 who are employed in the field of science and technology was 731.2 thousand. The average annual change compared to the base year was 10.9 thousand, i.e. 1.5%. The average annual change compared to the previous year was 9.8 thousand, i.e. 1.4%. Below is the data on the analyzed category of employees by gender.

There were 324.9 thousand men on average. The average annual change compared to the base year was 0.8 thousand, i.e. 0.2%. The average annual change compared to the previous year was 4.6 thousand, i.e. 1.5%.

There were 406.3 thousand women on average. The average annual change compared to the base year was 10.1 thousand, i.e. 2.5%. The average annual change compared to the previous year was 5.3 thousand, i.e. 1.3%.

The average share of women was 55.6%, and men 44.4%. The average change in the percentage of women compared to the base year was 0.6, or 0.0 compared to the previous year.

In Serbia, it is possible to single out several subfields within science and technology. Their significance is different in terms of the number of employees. The letter designations listed in Figure 1 are used instead of the full names of the activity sectors in the following text.

Science and technology																				
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
Agriculture, forestry and fishing	Mining and quarrying	Manufacturing	Electricity, gas, steam and air conditioning supply	Water supply, sewerage, waste management and remediation activities	Construction	Wholesale and retail trade; repair of motor vehicles and motorcycles	Transportation and storage	Accommodation and food service activities	Information and communication	Financial and insurance activities	Real estate activities	Professional, scientific and technical activities	Administrative and support service activities	Public administration and defence, compulsory social security	Education	Human health and social work activities	Arts, entertainment and recreation	Other service activities	Activities of households as employers, undifferentiated goods- and services-producing activities of households for own use	Activities of extraterritorial organisations and bodies

Figure 1. Sectors of activity in the field of science and technology (authors based on – [Statistical Office of the Republic of Serbia, 2022d](#))

In all the years covered by this analysis, three sectors occupy the first three places when it comes to employed persons aged 15-74 who are employed in the field of science and technology (Table 7):

1. Education,
2. Human health and social work activities,
3. Manufacturing.

Table 7 . Number and percentage of “employed persons aged 15-74 that are employed in the field of science and technology by sectors of activity in which they work” (authors’ calculations – [Statistical Office of the Republic of Serbia, 2022d](#))

	Year	Number (in thou- sands)	Change compared to				%	Change compared to	
			the base year		the previous year			the base year	the previous year
			No.	%	No.	%			
A	2018	5.3	-	-	-	-	0.7	-	-
	2019	5.9	0.6	11.3	0.6	11.3	0.8	0.1	0.1
	2020	6.7	1.4	26.4	0.8	13.6	0.9	0.2	0.1
	2021	5.9	0.6	11.3	-0.8	-11.9	0.8	0.1	-0.1
B	2018	7.8	-	-	-	-	1.1	-	-
	2019	7.1	-0.7	-9.0	-0.7	-9.0	1.0	-0.1	-0.1
	2020	8.1	0.3	3.8	1.0	14.1	1.1	0.0	0.1
	2021	7.4	-0.4	-5.1	-0.7	-8.6	1.0	-0.1	-0.1
C	2018	77.5	-	-	-	-	10.7	-	-
	2019	79.1	1.6	2.1	1.6	2.1	10.9	0.2	0.2
	2020	78.9	1.4	1.8	-0.2	-0.3	10.9	0.2	0.0
	2021	83.6	6.1	7.9	4.7	6.0	11.1	0.4	0.2
D	2018	13.4	-	-	-	-	1.9	-	-
	2019	12.6	-0.8	-6.0	-0.8	-6.0	1.7	-0.1	-0.1
	2020	11.7	-1.7	-12.7	-0.9	-7.1	1.6	-0.2	-0.1
	2021	9.8	-3.6	-26.9	-1.9	-16.2	1.3	-0.6	-0.3
E	2018	11.2	-	-	-	-	1.5	-	-
	2019	11.1	-0.1	-0.9	-0.1	-0.9	1.5	0.0	0.0
	2020	7.4	-3.8	-33.9	-3.7	-33.3	1.0	-0.5	-0.5
	2021	7.2	-4.0	-35.7	-0.2	-2.7	1.0	-0.6	-0.1
F	2018	16.3	-	-	-	-	2.3	-	-
	2019	20.5	4.2	25.8	4.2	25.8	2.8	0.6	0.6
	2020	22.5	6.2	38.0	2.0	9.8	3.1	0.9	0.3
	2021	25.1	8.8	54.0	2.6	11.6	3.3	1.1	0.2
G	2018	54.6	-	-	-	-	7.6	-	-
	2019	55.3	0.7	1.3	0.7	1.3	7.6	0.1	0.1
	2020	57.0	2.4	4.4	1.7	3.1	7.9	0.3	0.3
	2021	62.3	7.7	14.1	5.3	9.3	8.3	0.7	0.4
H	2018	21.0	-	-	-	-	2.9	-	-
	2019	21.1	0.1	0.5	0.1	0.5	2.9	0.0	0.0
	2020	15.6	-5.4	-25.7	-5.5	-26.1	2.2	-0.7	-0.7
	2021	17.4	-3.6	-17.1	1.8	11.5	2.3	-0.6	0.2
I	2018	7.9	-	-	-	-	1.1	-	-
	2019	5.8	-2.1	-26.6	-2.1	-26.6	0.8	-0.3	-0.3
	2020	4.1	-3.8	-48.1	-1.7	-29.3	0.6	-0.5	-0.2
	2021	5.5	-2.4	-30.4	1.4	34.1	0.7	-0.4	0.2
J	2018	53.7	-	-	-	-	7.4	-	-
	2019	54.5	0.8	1.5	0.8	1.5	7.5	0.1	0.1
	2020	62.5	8.8	16.4	8.0	14.7	8.7	1.2	1.2
	2021	78.2	24.5	45.6	15.7	25.1	10.4	3.0	1.7

	Year	Number (in thousands)	Change compared to				%	Change compared to	
			the base year		the previous year			the base year	the previous year
			No.	%	No.	%			
K	2018	22.6	-	-	-	-	3.1	-	-
	2019	25.6	3.0	13.3	3.0	13.3	3.5	0.4	0.4
	2020	24.7	2.1	9.3	-0.9	-3.5	3.4	0.3	-0.1
	2021	18.4	-4.2	-18.6	-6.3	-25.5	2.4	-0.7	-1.0
L	2018	2.2	-	-	-	-	0.3	-	-
	2019	3.1	0.9	40.9	0.9	40.9	0.4	0.1	0.1
	2020	1.5	-0.7	-31.8	-1.6	-51.6	0.2	-0.1	-0.2
	2021	2.7	0.5	22.7	1.2	80.0	0.4	0.1	0.2
M	2018	77.2	-	-	-	-	10.7	-	-
	2019	68.2	-9.0	-11.7	-9.0	-11.7	9.4	-1.3	-1.3
	2020	66.0	-11.2	-14.5	-2.2	-3.2	9.1	-1.5	-0.2
	2021	75.4	-1.8	-2.3	9.4	14.2	10.0	-0.7	0.9
N	2018	7.7	-	-	-	-	1.1	-	-
	2019	6.9	-0.8	-10.4	-0.8	-10.4	0.9	-0.1	-0.1
	2020	9.5	1.8	23.4	2.6	37.7	1.3	0.3	0.4
	2021	11.2	3.5	45.5	1.7	17.9	1.5	0.4	0.2
O	2018	61.0	-	-	-	-	8.4	-	-
	2019	62.3	1.3	2.1	1.3	2.1	8.6	0.1	0.1
	2020	58.5	-2.5	-4.1	-3.8	-6.1	8.1	-0.3	-0.5
	2021	58.0	-3.0	-4.9	-0.5	-0.9	7.7	-0.7	-0.4
P	2018	132.8	-	-	-	-	18.4	-	-
	2019	135.3	2.5	1.9	2.5	1.9	18.6	0.2	0.2
	2020	135.9	3.1	2.3	0.6	0.4	18.8	0.4	0.2
	2021	129.0	-3.8	-2.9	-6.9	-5.1	17.1	-1.2	-1.7
Q	2018	114.9	-	-	-	-	15.9	-	-
	2019	116.2	1.3	1.1	1.3	1.1	16.0	0.1	0.1
	2020	117.2	2.3	2.0	1.0	0.9	16.2	0.3	0.2
	2021	120.5	5.6	4.9	3.3	2.8	16.0	0.1	-0.2
R	2018	25.2	-	-	-	-	3.5	-	-
	2019	28.0	2.8	11.1	2.8	11.1	3.9	0.4	0.4
	2020	24.5	-0.7	-2.8	-3.5	-12.5	3.4	-0.1	-0.5
	2021	25.5	0.3	1.2	1.0	4.1	3.4	-0.1	0.0
S	2018	9.8	-	-	-	-	1.4	-	-
	2019	7.7	-2.1	-21.4	-2.1	-21.4	1.1	-0.3	-0.3
	2020	9.6	-0.2	-2.0	1.9	24.7	1.3	0.0	0.3
	2021	9.3	-0.5	-5.1	-0.3	-3.1	1.2	-0.1	-0.1
T	2018	0.0	-	-	-	-	0.0	-	-
	2019	0.0	0.0	-	0.0	-	0.0	0.0	0.0
	2020	0.0	0.0	-	0.0	-	0.0	0.0	0.0
	2021	0.0	0.0	-	0.0	-	0.0	0.0	0.0
U	2018	1.0	-	-	-	-	0.1	-	-
	2019	0.0	-1.0	-100.0	-1.0	-100.0	0.0	-0.1	-0.1
	2020	0.0	-1.0	-100.0	0.0	-	0.0	-0.1	0.0
	2021	0.0	-1.0	-100.0	0.0	-	0.0	-0.1	0.0

In order to obtain data more suitable for mutual comparison of activity sectors, average values were calculated (Table 8).

Table 8. Average number and percentage of “employed persons aged 15-74 that are employed in the field of science and technology by sectors of activity in which they work” (authors’ calculations – [Statistical Office of the Republic of Serbia, 2022d](#))

	Number (in thou- sands)	Change compared to				%	Change compared to	
		the base year		the previous year			the base year	the previous year
		No.	%	No.	%			
A	6.0	0.9	16.4	0.2	4.3	0.8	0.1	0.0
B	7.6	-0.3	-3.4	-0.1	-1.2	1.0	-0.1	0.0
C	79.8	3.0	3.9	2.0	2.6	10.9	0.3	0.1
D	11.9	-2.0	-15.2	-1.2	-9.8	1.6	-0.3	-0.2
E	9.2	-2.6	-23.5	-1.3	-12.3	1.3	-0.4	-0.2
F	21.1	6.4	39.3	2.9	15.7	2.9	0.8	0.4
G	57.3	3.6	6.6	2.6	4.6	7.8	0.4	0.2
H	18.8	-3.0	-14.1	-1.2	-4.7	2.6	-0.4	-0.2
I	5.8	-2.8	-35.0	-0.8	-7.2	0.8	-0.4	-0.1
J	62.2	11.4	21.2	8.2	13.8	8.5	1.4	1.0
K	22.8	0.3	1.3	-1.4	-5.2	3.1	0.0	-0.2
L	2.4	0.2	10.6	0.2	23.1	0.3	0.0	0.0
M	71.7	-7.3	-9.5	-0.6	-0.2	9.8	-1.2	-0.2
N	8.8	1.5	19.5	1.2	15.1	1.2	0.2	0.1
O	60.0	-1.4	-2.3	-1.0	-1.6	8.2	-0.3	-0.2
P	133.3	0.6	0.5	-1.3	-0.9	18.2	-0.2	-0.4
Q	117.2	3.1	2.7	1.9	1.6	16.0	0.2	0.0
R	25.8	0.8	3.2	0.1	0.9	3.5	0.1	0.0
S	9.1	-0.9	-9.5	-0.2	0.0	1.2	-0.1	0.0
T	0.0	0.0	-	0.0	-	0.0	0.0	0.0
U	0.3	-1.0	-100.0	-0.3	-	0.0	-0.1	0.0

Average growth trends in the number of employees in relation to both the base year and the previous year were seen in sectors A, C, F, G, I, L, N, Q and R, and in relation to the base year in sectors K and P. The average changes in the share of sectors were not were large, which is best indicated by the fact that sector J had the biggest change in relation to both the base (1.4) and the previous year (1.0).

Conclusions

Management in science and technology includes a wide range of activities, but also requires a wide range of expertise and knowledge. One of the undeniable characteristics of modern business is volatility. Changes in the environment disturb the established practice and require a reaction. The best managers act with their decisions not only reactively, but primarily proactively, creating changes that others need to respond to. Changes have become everyday, as have the challenges that changes bring. Human resources in science and technology are a key element of success, because the development of this field, despite numerous technological advances, especially in the field of artificial intelligence, cannot be achieved without the participation of people as carriers of “natural human intelligence” and as creators of change. It is precisely for this reason that it is necessary to monitor trends related to employees. Only with an insight into the real situation can optimal decisions be made aimed at solving problems, improving business performance and overall success.

The analysis performed in this paper provides data on the state and dynamics of human resources in the field of science and technology in the Republic of Serbia. These data are the starting point for the

further development of human resources management in the field of science and technology. Differentiation according to gender and sector of activity is particularly significant.

The results show that the number of employees who have either higher education or are employed in the field of science and technology has grown on average. The majority were women. Their number and share on average grew.

The number of employees who have higher education and are employed in the field of science and technology has grown on average. The above applies to both women and men. The majority in this category were women, but their average percentage participation was at approximately the same level with a minimal tendency to decrease.

The number of employees aged 15-74 who are employed in the field of science and technology has grown on average. The above applies to both women and men. The majority in the mentioned category were women. Their share can be described as stable with a tendency of minimal increase.

According to the criterion of the number of employees, education was the most important scientific and technological sector of activity. Changes in the number of employees by individual scientific and technological sectors were present, but the average change in their percentage participation was small.

Through the conducted analyzes and consideration of the obtained results, the subject and aim of the paper were achieved and at the same time answers were given to the research questions. The general conclusion is the existence of positive tendencies regarding the number of human resources in the field of science and technology in Serbia. The aforementioned tendencies are particularly significant when it comes to the position of women in science and technology.

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Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Conceptualization, O.M., S.A., D.G. and M.B.; methodology, O.M., S.A., D.G. and M.B.; formal analysis, O.M., S.A., D.G. and M.B.; writing—original draft preparation, O.M., S.A., D.G. and M.B.; writing—review and editing, O.M., S.A., D.G. and M.B. All authors have read and agreed to the published version of the manuscript.

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