



*The 18<sup>th</sup> International Scientific Conference*  
**“DEFENSE RESOURCES MANAGEMENT  
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**ASPECTS CONCERNING THE EMPLOYED PERSONS WITH ICT  
EDUCATION IN EU COUNTRIES**

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***Abstract:***

Nowadays is mandatory to have at least a basic ICT education in order to perform adequately at your workplace. In this paper we have analyzed the situation of the employed persons with ICT education in EU countries enterprises. The ICT education statistics are part of the ICT training domain, which is one of the domains in the wider concept of Digital skills. ICT education indicators are based on the EU Labour Force Survey (EU-LFS) microdata

*Key words: index; indicator; evolution; ICT education; EU-27; Romania*

**1. Introduction**

The indicators that we have analyzed in this paper refer to the persons with ICT education in EU member countries. In the tables below the countries are presented using the two letters abbreviation, as follows: EU-27 (European Union 27 countries), AT (Austria), BE (Belgium), BG (Bulgaria), CY (Cyprus), CZ (Czechia), DE (Germany), DK (Denmark), EE (Estonia), EL (Greece), ES (Spain), FI (Finland) FR (France), HR (Croatia), HU (Hungary), IE (Ireland), IT (Italy), LT (Lithuania), LU (Luxembourg), LV (Latvia), MT (Malta), NL (Netherlands), PL (Poland), PT (Portugal), RO (Romania), SE (Sweden), SI (Slovenia), SK (Slovakia).

**2. Analysis**

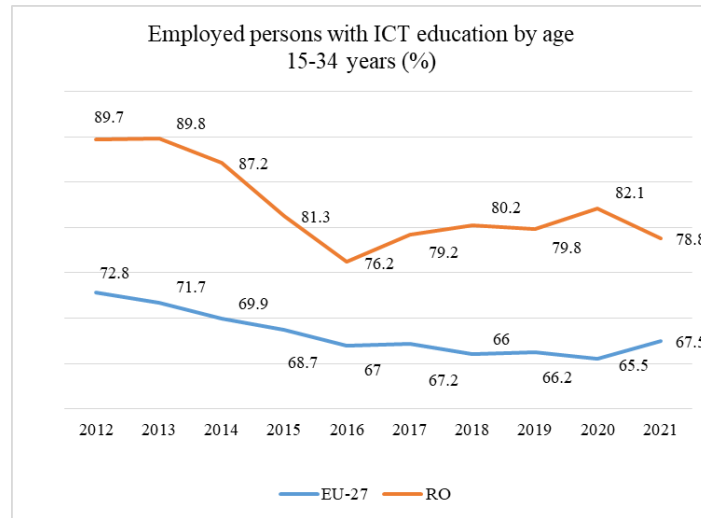
**2.1. First indicator**

The first indicator analyzed was the *Employed persons with ICT education by age*. The delimitation of age is made in two intervals: 15-34 years and 35-74 years. As we can see in Figure 1 below the evolution of those persons (15-34 years) has a descending trend in Romania and also as an average in EU-27.



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**Fig. 1** The evolution of employed persons with ICT education by age 15-34 years (%)

In Tables 1a to 1d we have selected the minimum value and the maximum value of the indicator in each of the 27 countries in EU. Out of those values the maximum one is in Lithuania (90.5% in 2014) and the minimum one is in Finland (37.8% in 2017).

Country	EU-27	AT	BE	BG	CY	CZ	DE
MIN year	65.5 2020	56.9 2018	68.3 2017	64.7 2021	69.5 2018	70.6 2018	60.2 2020
MAX year	72.8 2012	73.8 2012	78.1 2012	86.8 2016	80.1 2012	89.2 2012	68.3 2012

**Table 1a** Employed persons with ICT education by age – 15-34 years (EU-27 – DE)

Country	DK	EE	EL	ES	FI	FR	HR
MIN year	50.8 2015	68.7 2019	61.9 2020	59.5 2021	37.8 2017	58.9 2020	79.9 2016
MAX year	67.9 2020	83.3 2013	82.3 2014	70.4 2014	57.7 2012	71.5 2021	87.8 2012

**Table 1b** Employed persons with ICT education by age – 15-34 years (DK – HR)

Country	HU	IE	IT	LT	LU	LV	MT
MIN year	68.3 2014	52.6 2018	70.1 2013	67 2020	52 2014	63.6 2015	76.9 2021
MAX year	82.3 2012	60.9 2021	78 2019	90.5 2014	72.6 2016	89.4 2016	89.8 2016

**Table 1c** Employed persons with ICT education by age – 15-34 years (HU – MT)



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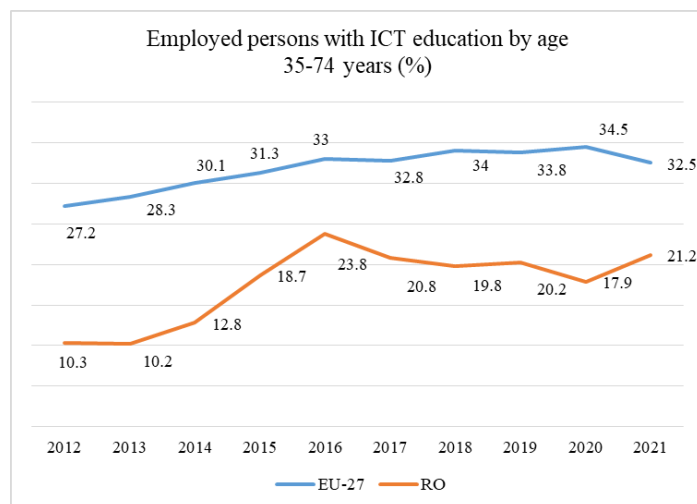
Country	NL	PL	PT	RO	SE	SI	SK
MIN year	60.4 2019	67.5 2019	70 2016	76.2 2016	47.8 2014	58.1 2014	77.1 2015
MAX year	72.4 2012	79.9 2012	82.7 2012	89.8 2013	63.1 2020	78.8 2019	86.6 2013

**Table 1d** Employed persons with ICT education by age – 15-34 years  
(NL – SK)

Next we made a ranking of the values in descending order of the indicator in 2012 and in 2021 – first and last years of available data. In 2012 Austria is ranking 15, Belgium 12, Bulgaria 11, Cyprus 9, Czechia 2, Germany 20, Denmark 26, Estonia 14, Greece 8, Spain 19, Finland 25, France 21, Croatia 3, Hungary 7, Ireland 24, Italy 16, Lithuania 13, Luxembourg 22, Latvia 17, Malta 5, Netherlands 18, Poland 10, Portugal 6, Romania 1, Sweden 27, Slovenia 23, Slovakia 4. So Romania had the highest value of the indicator in 2012 (89.7%).

In 2021 the ranking was as follows: Austria 23, Belgium 14, Bulgaria 19, Cyprus 9, Czechia 5, Germany 21, Denmark 18, Estonia 8, Greece 20, Spain 25, Finland 27, France 12, Croatia 2, Hungary 16, Ireland 22, Italy 7, Lithuania 13, Luxembourg 26, Latvia 10, Malta 6, Netherlands 17, Poland 15, Portugal 4, Romania 3, Sweden 24, Slovenia 11, Slovakia 1. The value for the indicator in 2021 in Romania was 78.8%.

The second part of the analysis of the evolution of employed persons with ICT education by age refers to the interval 35-74 years. As we can observe in Figure 2 below, we have an ascending trend of this indicator in Romania and also in EU-27 index.



**Fig. 2** The evolution of employed persons with ICT education by age  
35-74 years (%)

In Tables 2a to 2d we have selected the minimum value and the maximum value of the indicator in each of the 27 countries in EU. Out of those values the maximum one is in Finland (62.2% in 2017) and the minimum one is in Malta (10.2% in 2016).



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Country	EU-27	AT	BE	BG	CY	CZ	DE
MIN	27.2 2012	26.2 2012	21.9 2012	20.8 2016	19.9 2012	10.8 2012	31.7 2012
MAX	34.5 2020	43.1 2018	31.7 2017	35.3 2021	30.5 2018	29.4 2018	39.8 2020

**Table 2a** Employed persons with ICT education by age – 35-74 years  
(EU-27 – DE)

Country	DK	EE	EL	ES	FI	FR	HR
MIN	32.1 2020	16.7 2013	17.7 2014	29.6 2014	42.3 2012	28.5 2021	12.2 2012
MAX	49.2 2015	31.3 2019	38.1 2020	40.5 2021	62.2 2017	41.1 2020	20.1 2016

**Table 2b** Employed persons with ICT education by age – 35-74 years  
(DK – HR)

Country	HU	IE	IT	LT	LU	LV	MT
MIN	17.7 2012	39.1 2021	22 2019	13.7 2013	27.4 2016	21.4 2016	10.2 2016
MAX	31.7 2014	47.4 2018	29.9 2013	33 2020	48 2014	36.4 2015	23.1 2021

**Table 2c** Employed persons with ICT education by age – 35-74 years  
(HU – MT)

Country	NL	PL	PT	RO	SE	SI	SK
MIN	27.6 2012	20.1 2012	17.3 2012	10.2 2013	36.9 2020	21.2 2019	13.4 2013
MAX	39.6 2019	32.5 2019	30 2016	23.8 2016	52.2 2014	41.9 2014	22.9 2015

**Table 2d** Employed persons with ICT education by age – 35-74 years  
(NL – SK)

For the ranking of the values in 2012 we have missing data in Bulgaria, Lithuania, Latvia, and Slovakia. Also in 2021 for Latvia and Slovakia.

The rest of the countries are ranking in 2012 as follows: Austria 12, Belgium 14, Cyprus 16, Czechia 22, Germany 8, Denmark 2, Estonia 13, Greece 17, Spain 9, Finland 3, France 7, Croatia 21, Hungary 18, Ireland 4, Italy 11, Luxembourg 6, Malta 19, Netherlands 10, Poland 15, Portugal 20, Romania 23, Sweden 1, Slovenia 5. The value for the indicator in 2012 in Romania was 10.3%.

In 2021 the ranking was: Austria 5, Belgium 14, Bulgaria 9, Cyprus 18, Czechia 21, Germany 7, Denmark 10, Estonia 19, Greece 8, Spain 3, Finland 1, France 16, Croatia 25, Hungary 12, Ireland 6, Italy 20, Lithuania 15, Luxembourg 2, Malta 22, Netherlands 11, Poland 13, Portugal 23, Romania 24, Sweden 4, Slovenia 17. The value for the indicator in 2021 in Romania was 21.2%.



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**2.2. The second indicator**

The second indicator analyzed was the *Employed persons with ICT education by educational attainment level*. We have 2 parts also for this indicator: Levels 3 and 4 on the first part and Levels 5-8 on the second part.

Concerning the Levels 3 and 4 the trend was abruptly descending in Romania and slowly descending for the EU-27 composite index.

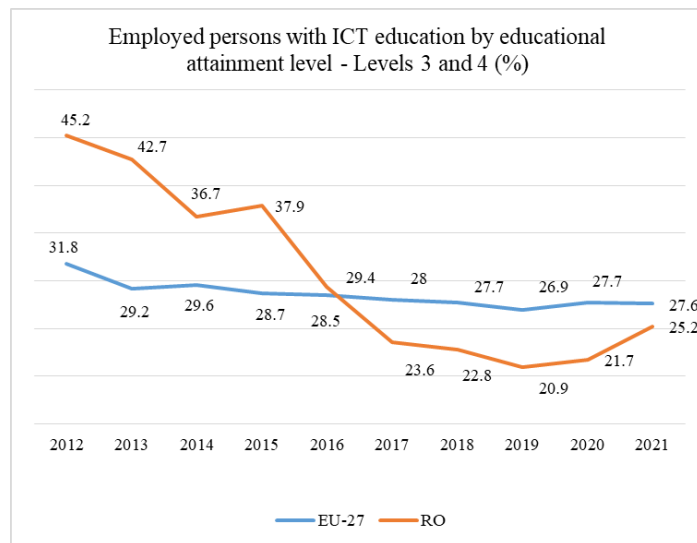


Fig. 3 The evolution of employed persons with ICT education by educational attainment level – levels 3 and 4 (%)

In Tables 3a to 3d we have selected the minimum value and the maximum value of the indicator in each of the 27 countries in EU. Out of those values the maximum one is in Portugal (75.5% in 2017) and the minimum one is in Spain and Lithuania (6.3% in 2013 and 6.3% in 2020 respectively). We have missing data in Bulgaria and France.

Country	EU-27	AT	BE	BG	CY	CZ	DE
MIN year	26.9 2019	10.4 2016	11.7 2021	:	7.5 2021	25 2013	33.4 2020
MAX year	31.8 2012	27.9 2012	19.8 2020	:	14.6 2015	40.9 2012	40.6 2014

**Table 3a** Employed persons with ICT education by educational attainment level – Levels 3 and 4 (EU-27 – DE)

Country	DK	EE	EL	ES	FI	FR	HR
MIN year	10.8 2015	33 2018	25.3 2020	6.3 2013	18.9 2019	:	39.1 2013
MAX year	56.2 2020	44.3 2016	47.2 2012	12.1 2018	44.3 2012	:	51.8 2019

**Table 3b** Employed persons with ICT education by educational attainment level –



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Levels 3 and 4 (DK – HR)

Country	HU	IE	IT	LT	LU	LV	MT
MIN year	33.2 2015	10.5 2016	62.7 2017	6.3 2020	11.9 2020	10.6 2019	31.5 2021
MAX year	45.3 2012	15.2 2014	72.4 2012	12.7 2016	25.7 2013	36.7 2018	48.6 2013

**Table 3c** Employed persons with ICT education by educational attainment level – Levels 3 and 4 (HU – MT)

Country	NL	PL	PT	RO	SE	SI	SK
MIN year	34.3 2013	30.9 2014	60.4 2021	20.9 2019	14.1 2021	9.2 2014	21.6 2015
MAX year	43.3 2014	43.9 2021	75.5 2017	45.2 2012	20.8 2013	39.4 2017	33.6 2016

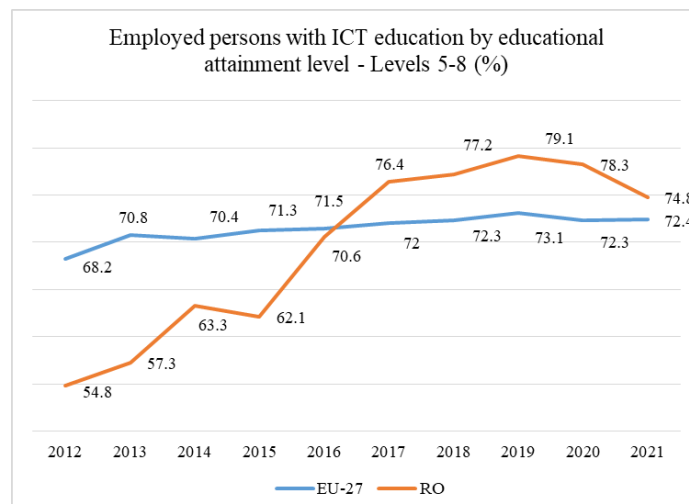
**Table 3d** Employed persons with ICT education by educational attainment level – Levels 3 and 4 (NL – SK)

For the ranking of the values in 2012 we have missing data in Bulgaria, Cyprus, France, Lithuania, and Latvia. Also in 2021 for Bulgaria, Denmark, France, and Latvia.

The rest of the countries are ranking in 2012 as follows: Austria 15, Belgium 20, Czechia 8, Germany 9, Denmark 16, Estonia 13, Greece 3, Spain 22, Finland 7, Croatia 6, Hungary 4, Ireland 21, Italy 1, Luxembourg 17, Malta 10, Netherlands 12, Poland 11, Portugal 2, Romania 5, Sweden 18, Slovenia 19, and Slovakia 14. The value for the indicator in 2012 in Romania was 10.3%.

In 2021 the ranking was: Austria 16, Belgium 20, Cyprus 23, Czechia 10, Germany 9, Estonia 5, Greece 14, Spain 19, Finland 13, Croatia 4, Hungary 8, Ireland 21, Italy 1, Lithuania 22, Luxembourg 17, Malta 11, Netherlands 6, Poland 3, Portugal 2, Romania 15, Sweden 18, Slovenia 7, and Slovakia 12. The value for the indicator in 2021 in Romania was 25.2%.

The second part of the analysis of the evolution of employed persons with ICT education by educational attainment level refers to the Levels 5-8. As we can observe in Figure 4 below, we have an ascending trend of this indicator in Romania and also in EU-27 index, but more moderately.





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Fig. 4 The evolution of employed persons with ICT education by educational attainment level – levels 5-8 (%)

In Tables 4a to 4d we have selected the minimum value and the maximum value of the indicator in each of the 27 countries in EU. Out of those values the maximum one is in France (99.3% in 2015) and the minimum one is in Portugal (24.5% in 2017).

Country	EU-27	AT	BE	BG	CY	CZ	DE
MIN year	68.2 2012	72.1 2012	80.2 2020	71.5 2012	85.4 2015	59.1 2012	59.4 2014
MAX year	73.1 2019	89.6 2016	88.3 2021	95 2014	96.9 2019	75 2013	66.6 2021

**Table 4a** Employed persons with ICT education by educational attainment level – Levels 5-8 (EU-27 – DE)

Country	DK	EE	EL	ES	FI	FR	HR
MIN year	43.8 2020	55.7 2016	52.8 2012	87.9 2018	55.7 2012	95.7 2014	48.2 2019
MAX year	95.6 2021	67 2018	74.7 2020	93.7 2013	81.1 2019	99.3 2015	60.9 2020

**Table 4b** Employed persons with ICT education by educational attainment level – Levels 5-8 (DK – HR)

Country	HU	IE	IT	LT	LU	LV	MT
MIN year	54.7 2012	84.8 2014	27.6 2012	87.3 2016	74.3 2013	63.3 2018	51.4 2013
MAX year	66.8 2015	89.5 2016	37.3 2017	93.7 2020	88.1 2020	89.4 2019	68.5 2021

**Table 4c** Employed persons with ICT education by educational attainment level – Levels 5-8 (HU – MT)

Country	NL	PL	PT	RO	SE	SI	SK
MIN year	56.7 2014	56.1 2021	24.5 2017	54.8 2012	79.2 2013	60.6 2017	66.4 2016
MAX year	65.7 2013	69.1 2014	39.6 2021	79.1 2019	85.9 2021	90.8 2014	78.4 2015

**Table 4d** Employed persons with ICT education by educational attainment level – Levels 5-8 (NL – SK)

In 2012 Austria is ranking 12, Belgium 6, Bulgaria 13, Cyprus 2, Czechia 20, Germany 19, Denmark 11, Estonia 15, Greece 25, Spain 3, Finland 21, France 1, Croatia 22, Hungary 24, Ireland 5, Italy 27, Lithuania 4, Luxembourg 9, Latvia 10, Malta 18, Netherlands 16, Poland 17, Portugal 26, Romania 23, Sweden 8, Slovenia 7, Slovakia 14. Romania had the value of this indicator in 2012 54.8%.



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In 2021 the ranking was as follows: Austria 11, Belgium 7, Bulgaria 3, Cyprus 4, Czechia 18, Germany 19, Denmark 2, Estonia 23, Greece 14, Spain 8, Finland 15, France 1, Croatia 24, Hungary 20, Ireland 6, Italy 27, Lithuania 5, Luxembourg 12, Latvia 10, Malta 17, Netherlands 22, Poland 25, Portugal 26, Romania 13, Sweden 9, Slovenia 21, Slovakia 16. The value for the indicator in 2021 in Romania was 74.8%.

**2.3. The third indicator**

The third indicator analyzed was the *Employed and unemployed persons with ICT education*. We refer in this paper only to the employed persons. As we can observe in Figure 5 below, the trend for Romania and EU-27 is ascending.

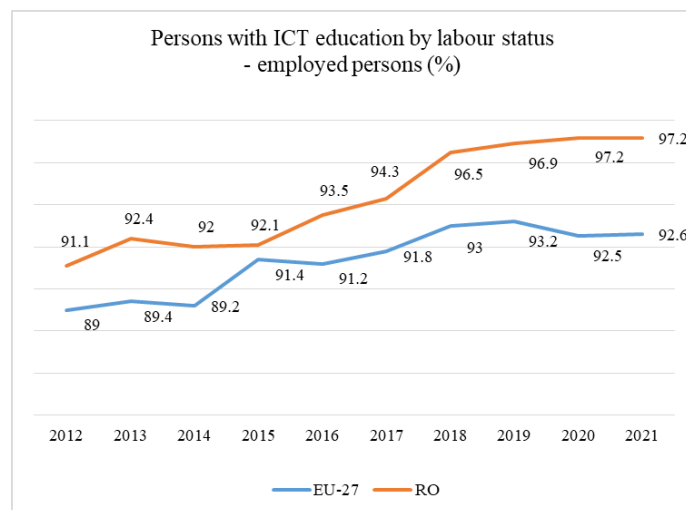


Fig. 5 The evolution of employed persons with ICT education (%)

In Tables 5a to 5d we have selected the minimum value and the maximum value of the indicator in each of the 27 countries in EU. Out of those values the maximum one is in Czechia (100% in 2017) and the minimum one is in Greece (62.6% in 2013).

Country	EU-27	AT	BE	BG	CY	CZ	DE
MIN year	89 2012	91 2016	89.7 2020	93.4 2013	81.7 2014	93 2014	96.2 2014
MAX year	93.2 2019	97.5 2019	97.3 2021	98.6 2017	96.7 2019	100 2017	97.4 2018

**Table 5a** Persons with ICT education by labour status – employed persons (EU-27 – DE)

Country	DK	EE	EL	ES	FI	FR	HR
MIN year	90.4 2017	89.3 2013	62.6 2013	77.5 2012	85.1 2015	88.7 2014	79.2 2015
MAX year	95.9 2019	96.9 2019	80.5 2021	89 2018	93 2018	95.3 2016	94.8 2020

**Table 5b** Persons with ICT education by labour status – employed persons





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(DK – HR)

Country	HU	IE	IT	LT	LU	LV	MT
MIN year	89.7 2012	84.1 2012	82.3 2014	94 2017	92.7 2012	81.1 2012	94.4 2014
MAX year	97.1 2018	93.8 2020	87 2020	98.1 2019	97.3 2019	99.2 2019	99.5 2015

**Table 5c** Persons with ICT education by labour status – employed persons  
(HU – MT)

Country	NL	PL	PT	RO	SE	SI	SK
MIN year	92.4 2014	90.3 2013	76.7 2013	91.1 2012	92.2 2020	84.4 2016	87 2012
MAX year	97.7 2019	97.2 2019	93.2 2020	97.2 2021	94.4 2018	96.9 2017	97 2021

**Table 5d** Persons with ICT education by labour status – employed persons  
(NL – SK)

In 2012 Austria is ranking 11, Belgium 5, Bulgaria 8, Cyprus 18, Czechia 3, Germany 1, Denmark 16, Estonia 13, Greece 27, Spain 26, Finland 17, France 9, Croatia 20, Hungary 19, Ireland 22, Italy 23, Lithuania 2, Luxembourg 12, Latvia 24, Malta 4, Netherlands 6, Poland 14, Portugal 25, Romania 15, Sweden 7, Slovenia 10, Slovakia 21. Romania had the value of this indicator in 2012 91.1%.

In 2021 the ranking was as follows: Austria 15, Belgium 3, Bulgaria 9, Cyprus 14, Czechia 1, Germany 5, Denmark 18, Estonia 8, Greece 27, Spain 26, Finland 23, France 21, Croatia 22, Hungary 7, Ireland 19, Italy 25, Lithuania 16, Luxembourg 10, Latvia 20, Malta 2, Netherlands 11, Poland 12, Portugal 24, Romania 4, Sweden 17, Slovenia 13, Slovakia 6. The value for the indicator in 2021 in Romania was 97.2%.

#### **2.4. The fourth indicator**

The fourth and last indicator analyzed was the *Employed persons with ICT education by sex*. In the Figure 6 below we can observe the slightly ascending trend for Romania and Eu-27.



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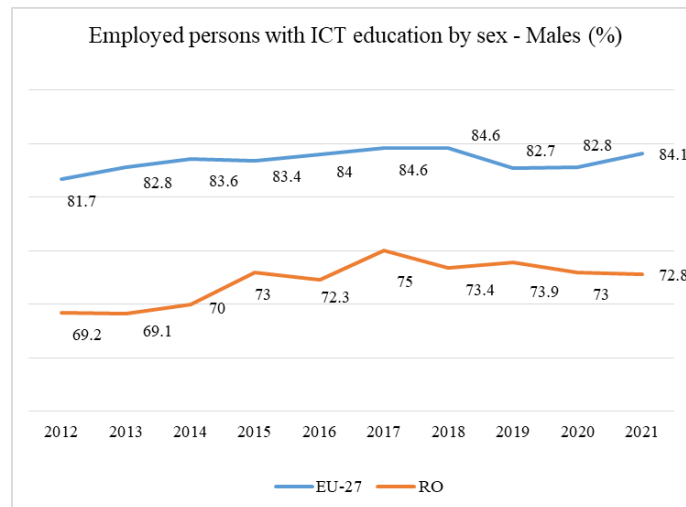


Fig. 6 The evolution of males with ICT education (%)

In Tables 6a to 6d we have selected the minimum value and the maximum value of the indicator in each of the 27 countries in EU. Out of those values the maximum one is in Slovenia (97.6% in 2012) and the minimum one is in Cyprus (60.7% in 2012).

Country	EU-27	AT	BE	BG	CY	CZ	DE
MIN year	81.7 2012	75 2019	85.4 2017	63.4 2021	60.7 2012	86.9 2013	85.2 2021
MAX year	84.6 2018	90.7 2014	92.6 2018	78.6 2013	77.1 2017	96.3 2012	86.7 2015

**Table 6a** Employed persons with ICT education by sex – Males (EU-27 – DE)

Country	DK	EE	EL	ES	FI	FR	HR
MIN year	67.1 2020	66.3 2012	62.7 2012	76.7 2015	66.9 2014	77.7 2019	75.3 2013
MAX year	87 2017	83.5 2016	78.5 2018	82.6 2013	85.9 2020	89.7 2021	93.9 2016

**Table 6b** Employed persons with ICT education by sex – Males (DK – HR)

Country	HU	IE	IT	LT	LU	LV	MT
MIN year	82.9 2020	64.8 2012	75.1 2012	75.7 2012	76.4 2019	63.5 2013	77 2018
MAX year	90.4 2017	79.9 2021	84 2019	90.7 2015	91.4 2014	93.6 2020	86.3 2013

**Table 6c** Employed persons with ICT education by sex – Males (HU – MT)



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Country	NL	PL	PT	RO	SE	SI	SK
MIN year	82.4 2013	83.7 2012	75.7 2015	69.1 2013	73.3 2012	80 2019	76.7 2012
MAX year	89 2016	90.4 2018	85.1 2018	75 2017	78.1 2018	97.6 2012	91.2 2015

**Table 6d** Employed persons with ICT education by sex – Males  
(NL – SK)

In 2012 Austria is ranking 9, Belgium 5, Bulgaria 21, Cyprus 27, Czechia 2, Germany 6, Denmark 12, Estonia 23, Greece 26, Spain 13, Finland 19, France 11, Croatia 15, Hungary 8, Ireland 25, Italy 18, Lithuania 16, Luxembourg 3, Latvia 24, Malta 7, Netherlands 4, Poland 10, Portugal 17, Romania 22, Sweden 20, Slovenia 1, Slovakia 14. Romania had the value of this indicator in 2012 69.2%.

In 2021 the ranking was as follows: Austria 9, Belgium 4, Bulgaria 27, Cyprus 23, Czechia 1, Germany 10, Denmark 25, Estonia 13, Greece 26, Spain 14, Finland 19, France 3, Croatia 20, Hungary 8, Ireland 18, Italy 15, Lithuania 11, Luxembourg 21, Latvia 12, Malta 17, Netherlands 7, Poland 5, Portugal 16, Romania 24, Sweden 22, Slovenia 2, Slovakia 6. The value for the indicator in 2021 in Romania was 72.8%.

### 3. Conclusions

In Romania the employed persons with ICT education represented in 2021 97.2% out of the total employed persons. The highest value from the EU member countries was in Czechia (99.4%).

If we look at the employed persons with ICT education by age we observe that the majority of them (78.8%) were between 15 and 34 years old. In Slovakia we had 82.4% - the highest value.

Concerning the employed persons with ICT education by educational attainment level we had in 2021 74.8% at levels 5-8, which represent a 20% increase compared to 2012. In France these persons represented in 2021 96%.

In 2021 72.8% out of the employed persons with ICT education were males and only 27.2% were females. In Czechia 92.6% were males – the highest disequilibrium between sexes.

The measurement of this 4 indicators supports the implementation of one of the 6 priorities for the period 2019-2024 – *A Europe fit for the digital age*.

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