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UNDER PRESSURE: ROMANIA`S LABOUR MARKET REVIEW.

LANDMARKS OF LABOUR SHORTAGES

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UNDER PRESSURE: ROMANIA`S LABOUR MARKET REVIEW. LANDMARKS OF LABOUR SHORTAGES[*]

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Abstract: *In recent years, the labour market in Romania became more and more tense, with growing labour shortages affecting the development of many important sectors. This paper is focusing on the labour market imbalances, specifying the main landmarks of labour shortages and highlighting their conditions of emergence and the generating factors for each type of their manifestation. Even if some imbalances has been reported long before, the existence and persistence of quantitative and qualitative labour shortages in Romania became obvious only recently, also under the circumstances of the warning signals of academia and business environment. Among the causes of this growing labour shortages and mismatches are the unfavourable demographic trends, the massive external migration of the skilled and high skilled labour force, the low level of the participation rate, the high inactivity rate, the quantitative and qualitative discrepancies between the supply of the education system and the real needs of the labour market, the size of undeclared work that continues to distort the labour market, the lack of cooperation between employers and institutions with responsibilities in the field employment and professional training of adults. The case study conducted on the IT&C sector, a growing sector in Romania, led to the conclusion that, despite its was claimed by the decision makers as strategic priority, the labour shortages in the sector remains high, being likely to maintain in the near future in the absence of promoting adequate support measures. Under the circumstances of Coronavirus global outbreak early 2020, the effects on the labour market in Romania are difficult to predict, the quantitative and qualitative shortages alleviation depending on the ability of the authorities to manage the crisis and to find the right responses, including by redirecting the returned migrant workers towards the domestic labour market.*

Keywords: *demographic demographic trends, population aging, emigration, demographic and economic dependency ratio, labour market demand and supply, labour market tensions, internal mobility, labour shortages*

JEL: *E60, F22, F66, I20, J08, J10, J21, J23, J61*

1. Introduction

Although no consensus was reached between different authors in the academic literature or the international institutions regarding a single definition of the labour shortage (Blank and Stigler, 1957; Franke and Sobel, 1970; OECD, 2003; Anderson and Ruhs, 2010; Barnow, Trutko and Piatak, 2013; European Parliament, 2015 a.o.) most of these refer to this situation in terms a labour market imbalance, where the demand exceeds the supply and the available workers are insufficient in relation to the needs, as number and/or qualification.

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The occurrence of labour shortage is a serious cause for decision makers concerns, because these can lead to macroeconomic and financial imbalances, due to the loss of potential output and a suboptimal use of available labour, as well as adverse effects at micro and mesoeconomic levels, affecting the business environment and the development prospects of companies, including social ones. The existence and persistence of quantitative and qualitative deficits of labour force in Romania seem obvious today, but the risk of such imbalances has been reported long before.

In this second part of the study, the issue of the labour market is presented from the point of view of the labour shortages, highlighting their conditions of manifestation and the generating factors, trying to identify their main benchmarks in order to elaborate the most appropriate policies and to adopt the best practices for their management and mitigation.

The quantitative labour shortages are generated by factors related to the decline of the working age population (caused by emigration and the decline in the natural increase), decreases in the participation rate (inactivity of marginal groups, early retirement and the obsolescence of the skills of older workers, other groups with risk of inactivity), increases in aggregate demand for labour (increasing demand for goods and services, increasing demand due to aging population, changes in tastes and preferences of consumers), but also to the geographical discrepancies and mismatches.

Regarding the qualitative labour shortages, among the decisive factors that generate them are the skill mismatches (against technological changes, shifts at sectoral and professional level, rigidity of recruitment, increased demand for replacement and incorrect educational options of young people), the discrepancy between preferences of the persons searching for a job and the conditions of the offered jobs (from the perspective of the working conditions, the social status of the job), as well as the information mismatch.

The statistical analysis regarding the transition from school to active life in Romania focuses on quantitative and qualitative inconsistencies regarding the occupational and territorial structure and the current and prospective demands of the labour market, as well as the data and information regarding vacancies, respectively from the National Institute of Statistics, the public institutions empowered in the field of labour (National Agency for Employment - ANOFM), the recruitment services of companies and / or specialized private agencies.

At the end of this part, a case study on the IT&C sector is presented, analysing the main indicators of the sector and designing a labour supply and demand forecast, as well as three scenarios of possible evolution of the software and information technology services, trying to identify if there is a labour shortage in this field and the related inadequacies of the education system regarding the training of specialists on the accreditations required on this market, including in territorial profile.

2. Growing pressures on the labour market in Romania

The labour market in Romania became more and more tight in recent years, growing labour shortages being felt in many sectors of the economy. Some of the labour market imbalances have been reported long before, but their extension and persistence tend to prove systemic considering the warning signals of international organizations and academia, also based on the reactions from the business environment, trade unions and authorities.

2.1. Warnings from academia and international organizations

As far back as 2008, a report on the Reprofessionalisation of Romania[1], published in the European Union post-accession euphoria, and at a time when the economic and financial crisis had not bitten yet into the Romanian economy, cautioned for the need of urgent action to tackle **the**

[1] Published under the aegis of the Institute for Innovation and Development Projects (Institutul de Proiecte pentru Inovație și Dezvoltare - IPID), and coordinated by Călin Georgescu, Mircea Malița.

issue of human resources, **by strategic measures aiming far ahead**, failing which, the jeopardy for the sustainable development of Romania would be hard to assess. It was a time when neither the policy makers, nor the business environment, or the Romanians as a whole, were prepared to understand and address.

Another sign of alarm came when the results of the population census of October 2011 were published. We suddenly discovered that this country's population had shrunk to 19.6 mil. persons, a loss of 2.6 mil. people since the census of 2002. In a study titled *Our Demographic Drama. Romania's Population in the October 2011 Census*[2], Professor Vasile Gheţău noted that Romania's population had reached 19 mil. inhabitants in 1965 (the loss of population that had started in 1992 bringing the country back to the population size of 1965), and that **the fast loss of population was being caused by the combined effects of emigration and negative demographic growth** (deaths outnumbering births).

Professor Gheţău's estimation, corroborated by other experts, both Romanian and foreign, also sustained by Eurostat forecasts, indicate that, if current trends persist, Romania's population might drop to 16 mil inhabitant by 2050.

UN data show that, in the past 10 years, 3.4 mil Romanian citizens settled abroad. INS data add more statistic details: 65% of the Romanian émigrés are in the 20 to 45 years' age segment, and 14.5% of them come from the age segment 46 to 59 years, which means that 80% of the Romanians seeking better life in other countries are part of the country's active population.

As at 2011, Romanians accounted for the majority of the foreign settlers in Italy (1.2 mil persons), coming second among other intra-EU immigrants in Italy. In Spain, they amounted to 768.6 thou' persons, which placed them third among foreign communities in the Iberian country. The same year, the Romanian immigrants in Germany numbered 449.9 thou persons (seventh largest community).[3]

A more recent statistic, at 1 January 2018, carries a chart showing the distribution of non-residents in each EU member state, and their numerical classification by state of origin: Romanian citizens come first in Italy, with 1.17 mil persons (23% of total non-residents), in Spain, with 683.8 thou persons (15.5% of all non-residents), and in Hungary, with 24.0 thou' persons (15.9% of total non-residents).

Citizens of Romanian origin come 4th in number in Slovakia, with 6.3 thou' immigrants (9.0% of total non-residents), in UK with 333.3 thou' persons (5.5% of total non-residents), in Portugal with 30.4 thou' persons and 7.7% of all non-residents, in Ireland – 29.3 thou' Romanian immigrants, and 5.2% of all non-residents, in Denmark – 25.3 thou' persons, and 5.2% of total non-residents, and they hold place no. 5 in Germany, with 507.1 thou' persons (respectively 5.5%), Austria (92.1 thou' persons and 6.9% of total), and in Belgium, with 79.8 thou' persons and 5.9% of total non-residents).

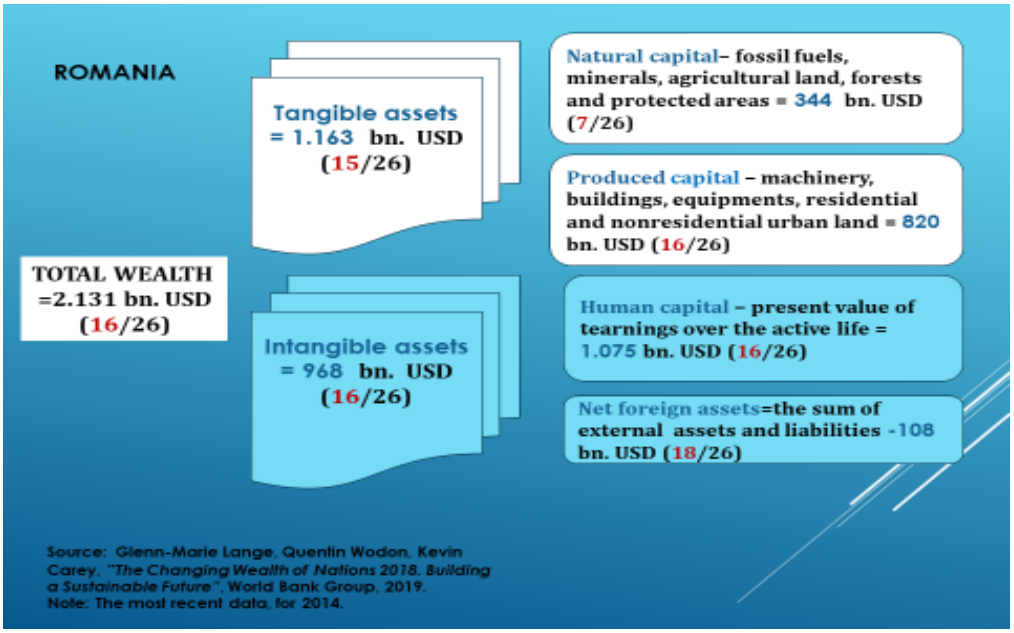
If, in an initial stage, from an economic perspective, intangible assets were "priceless", not being formalized in mathematical functions that aimed to evaluate the contribution of production factors in the creation of wealth, in the more recent economic studies (Georgieva, 2010; Roth and Thum, 2010; Alistair, 2011; Dutz et al., 2012; Chen, 2017; WIPO, 2017; Fassio et al., 2019; Lange et al., 2019 a.o.) they appear as essential assets in the equation of nations wealth and considered the fourth factor of production.

Despite many attempts, the incomplete statistical information and the delay with which they become available affect our ability to make judgments on the present value of tangible and intangible assets, the contribution of each category to the creation of national wealth in Romania.

[2] Editura Compania [Publishing House], 2012.
[3] "People in the EU: who are we and how do we live", Eurostat Statistical book, 2015 edition.

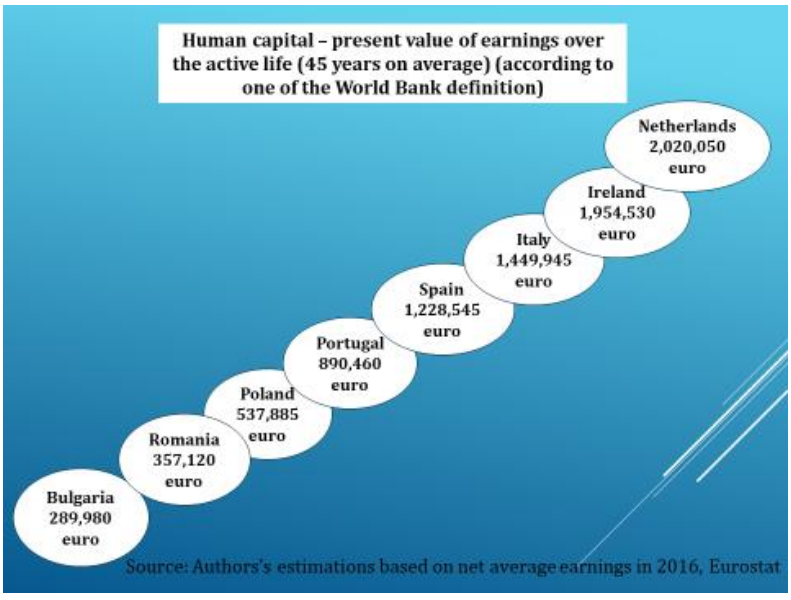
The latest information on Romania is provided by the World Bank[4] in a report published in 2018 and refers to 2014. Among the 26 EU Member States for which information is provided, with a nation wealth of US $ 2,131 billion, Romania ranked 16th. In terms of tangible assets Romania ranked 15th and 16th from the point of view of the intangible assets. In terms of natural capital Romania ranks 7th, but 16th and 18th respectively in terms of produced capital, human capital and net foreign assets (**Graph 1**).

Graph 1: The nation wealth estimation for Romania



A possible explanation for the lower share of intangible assets in Romania's national wealth may be due to the World Bank methodology for evaluating human capital, according to the present value of the estimated incomes during the active life (45 years on average (Graph 2).

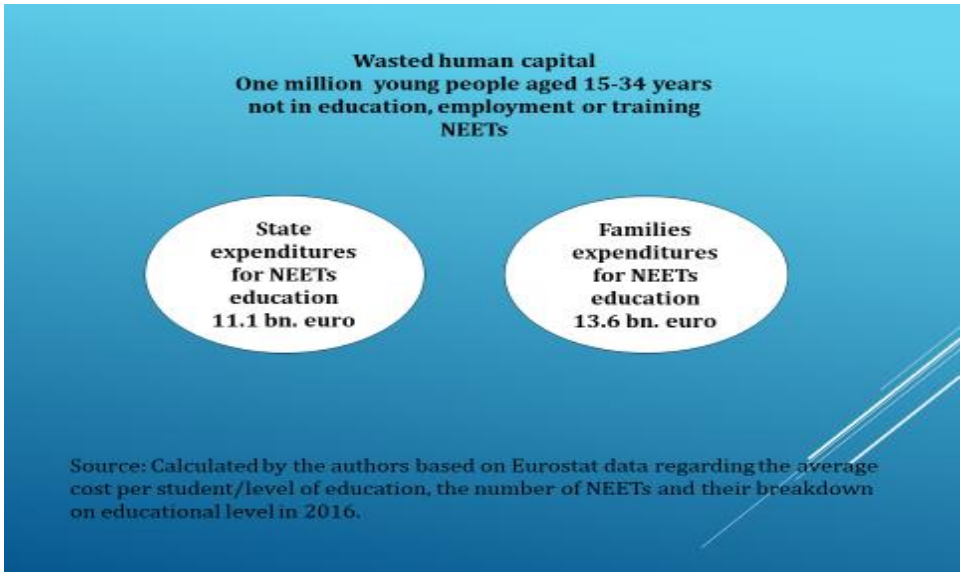
Graph 2: The estimation of incomes during the active life (45 years on average)



[4] Sursa: Glenn-Marie Lange, Quentin Wodon, Kevin Carey, "*The Changing Wealth of Nations 2018. Building a Sustainable Future"*, World Bank Group, 2019.

From another viewpoint, considering the average annual expenses per student and the number of NEETs according to the level of the last graduated school, our estimations, based on Eurostat data, led to the conclusion that, in Romania, for the formation of about 1 million NEETs, the state expenditures for their education amounted to about 11. 1 billion euros, to these about 13.6 billion euros should be added representing the expenditures of the families for the education, resulting a total of 24.7 billion euros the value of the unused human capital. (Graph 3). It is worth mentioning that these estimates do not take into account the contribution to the added value that NEETs would generate if they were integrated into the labour market.

Graph 3: Estimation of expenditures for NEETs education



When the 2016 Romania Country Report was published, the Head of the European Commission Representative Office in Romania, Angela Filote, stated that *We are all aware of Romania's economic growth in the recent years. This is a paradox: Romania is at the top of economic growth in the European Union, and, concomitantly, at the top of the poorest countries. This means that the growth model does not work for the benefit of its citizens.* One of the conclusions of the Report emphasises the threat of poverty, social exclusion, and earning inequities[5] that Romania will continue to be confronted with, and which have been the main causes at the roots of emigration of its citizens to other countries.

Given the uncertainties regarding the timing and size of wage increases in the medium and short term, especially in the case of public sector employees, according to the NBR report on inflation published in November 2018, one of the potential causes of the inflation rate deviation from the projected trajectory comes from the **relatively high degree of tensions in the labour market**, due to the persistent shortages and the lack of qualifications of the available labour force according to the demands of the employers, as well as the high rate of inactivity, the low internal mobility and the high level of emigration[6].

The significant fiscal changes introduced since January 1, 2018 have led to an increased uncertainty in the business environment, with a negative impact on the dynamics of investments and newly created jobs. The accelerated wage growth in recent years, boosted by the increase of the minimum wage, as well as the increase in financing costs, could reduce the profitability of economic actors in certain sectors, with a negative impact on the revenues from the profit taxes.

[5] "Romania Country Report for 2016. Including a comprehensive analysis on preventing and adjusting macroeconomic imbalances ", SWD (2016) 91 final, Bruxelles, 26 February 2016.

[6] National Bank of Romania, *Report on inflation*, November 2018, p. 53.

Some studies and reports prepared by various international institutions with recognized probity, draw attention to some **macroeconomic risks** with effects on the financial stability of Romania, in the medium and short term, with a significant impact on the labour market. Thus, in the Convergence report of the European Commission published in May 2018, a number of challenges and risks facing the Romanian labour market are mentioned, starting from the **unfavourable demographic trends**, likely to manifest in the medium and long term, the **aging population**, the limited internal labour mobility and the continuation of **emigration**, which represents serious obstacles to the potential growth. It is worth noting that, despite recent improvements, the participation rate remains below the EU average. To these, quantitative and qualitative labour shortages, with adverse impact on the quality of the job offer, the undeclared work that continues to distort the labour market, the fact that the minimum wage is set in a discretionary manner, the involvement of the social partners in the elaboration of policies in this area being very limited, are added[7].

According to key indicators of the labour market published in the third Surveillance Report of the European Commission on Romania's Post-Programme monitoring[8], the high growth of the economy in recent years has created **tensions in the labour market**, in the perspective on short and medium term, the further increase in the unit labour cost at the expense of faster wage increases compared to labour productivity leading to losses in competitiveness[9].

On May 23, 2018, the European Commission sent to Romanian authorities three country-specific recommendations on the major actions that need to be taken in 2018 and 2019, two of them directly or indirectly related to the labour market.[10] It was found that, despite the occurrence of quantitative and structural labour shortages, **Romania has substantial reserves of work force that are not used**, such as young people, long-term unemployed, Roma and disabled people, who encounter major difficulties concerning the labour market entry.

Also, although some facilities were provided for increasing mobility, **the impact of active policies on the labour market was very low**, and **the administrative barriers were extremely high**. The public programs of local interest have proved ineffective in trying to ensure the professional reconversion and the qualifications required in the labour market, and the inter-institutional cooperation between the public employment services, as well as between them and the external providers, has been limited. In this context, **the poor performance** of the education system was also highlighted, which contributed to the creation of major discrepancies and inequalities in terms of employment opportunities, affecting the long and very long term prospects of Romania, due to the low level of budgets allocations to this sector. Based on these considerations, the European Commission has recommended, under the circumstances of the social inclusion objective, to improve the social dialogue, to ensure the setting of the minimum wage on objective criteria, respectively through a mechanism to be endorsed by the social partners.

The country report on Romania published in June 2018 by the International Monetary Fund, following the talks with the Romanian authorities regarding Article IV[11], draws attention to the risks of fiscal relaxation and the accentuation of the external deficit, which may have the effect of

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[7] European Commission, *Convergence Report 2018, Technical Annex, Chapter 7 - Romania*, European Economy, Institutional Paper 078, May 2018, p. 117.

[8] The Post-Programme Surveillance on Romania started in 2015, with the main objective of assessing the payment capacity of the country for the reimbursement of EUR 5 bn. provided by the financial assistance in order to support Romani's Balance of payments during the crisis of 2009-2009 and, if necessary, to make recommendations for corrective actions.

[9] European Commission, *Post-Programme Surveillance Report - Romania, Autumn 2017*, DGECFIN, European Economy, Institutional Paper 068, December 2017, p. 5.

[10] European Commission, *Council Recommendation on the 2018 National Reform Programme of Romania*, Brussels, 23.05.2018, COM (2018) 422 final, pp. 4-7.

[11] International Monetary Fund, *Article IV Consultation with Romania*, IMF Country Report no 18/148, June, 2018, p. 21.

lowering investors' confidence, which requires macroeconomic stabilization efforts to improve the business environment, including through the **alleviation of pressures on the labour market.**

2.2. Reactions from the business environment, authorities, trade unions

It was quite a number of years ago when the first reactions to the growing deficit of labour appeared in the media. The alarm was triggered by the trade unions in the public sector, particularly from the health sector, depleted of personnel as cohorts of physicians, first, and then qualified nursing staff, were leaving.[12]

The business environment that first started worrying about the looming **labour shortage** was in the better developed regions of Romania (West, North-West, Centre), and, in general, when important foreign investment initiatives, generating a significant number of jobs, stumbled over the lack of highly qualified workers.

The initial foreign investors' advantage of paying low salaries to Romanians in Romania slowly turned against those planning to bring their money into the Romanian economy, when, after two decades in a row, the qualified workforce had left Romania for better pay in other EU and non-EU labour markets. [13]

In recent years, the issue of labour deficit in Romania has extended to all segments of labour, including persons with medium skills and unskilled labourers.

Representatives of central and local administration, employers in all industries, and recruiting companies are now talking about the tremendous shortage of labour, both in respect of quantity and quality, and about the pressing need for strategies to correct the labour deficits affecting the Romanian economy.

In December 2016, the president of the Association of Professionals in Business Process Management mentioned an estimated labour deficit of 50,000 persons in **the IT sector**, an economic branch viewed both then and now as an industry of primordial importance for Romania.

In November 2017, the Romanian Minister of Labour stated that *"Romania was ailing from a considerable deficit of labour force in the sectors of IT, health, construction, agriculture, and that the Romanian citizens that have left for other countries to work, some of them, in these very types of jobs, should be brought back home (...). The market demand is so high, that if tomorrow schools were to supply 12,000 IT graduates all at once, they would be absorbed by the market within a week."*

Mediafax, in a business analysis of the previous year, published in January 2018, described the year 2017 as the epitome of the labour crisis. The article points to the economic sectors most seriously affected by the lack of workforce: *construction and agriculture, which were joined one after the other, by tourism, retail trade, manufacture of automotive parts and components. The labour shortage in the construction sector threatens to compromise the big infrastructure projects. In agriculture, farm labourers have become increasingly expensive and hard to find. Retail trade went through a flourishing period when new stores were opened, which created a high demand for new employees. Tourism, in its turn, is losing its workers in an exodus that simply cannot be stopped."*

In February 2018, **construction experts** said that to carry on and finalise all the construction projects scheduled for 2018, the industry would need some 600,000 workers, and that, currently, Romania hardly commands half of the required number of construction workers.

The president of ROMPAN Federation told the public news agency Agerpres, in April 2018, that the **milling and bakery industry** was struggling with a deficit of 8,000 persons, and

[12] Luminița Chivu, Constantin Ciutacu, *Romania and the Four Economic Freedoms: From Theory to Practice*, în Economic Dynamics and Sustainable Development – Resources, Factors, Structures and Policies (Proceedings ESPERA 2015, Part 1), Peter Lang Academic Publishing Group, Frankfurt, 2016;

[13] Luminita Chivu, Constantin Ciutacu, Laurențiu Georgescu, *Consequences of Wage Gaps in the European Union*, Procedia Economics and Finance, vol. 22/2015, p 141-147;

pinpointed the causes as being emigration, but also the closing down of the vocational schools that trained workers for this industrial branch.

When the **Tourism Employers Association** convened, in June 2018, the president of HORA estimated that the hotels and restaurant sector in Romania was ailing from a lack of 50,000 workers, despite incentives offered by employers, such as free transport to and from the work place. However, he said, these should be complemented by government measures to stimulate the internal mobility of workforce, or the access to non-EU workers. The Minister of Tourism reinforced the statement above adding, in an interview with HotNews, in August 2018, at the peak of the season, that the deficit of labour was 30% or higher, as estimated by the private touristic operators.

An International Labour Organisation regulation provides that when a sector / industry sustains/registered losses of competencies of more than 20%, the authorities may call a **state of emergency** permitting them to forestall long-term consequences by way of instituting urgent measures. Considering the fact that **Romania has lost, in one decade alone, according to formal and less formal, but credible, estimations, a human capital of 4 to 5 million active persons**, we deem that this is a reason strong enough for the authorities to promote urgent measures.

Observers have noticed that some of the young people, totally demotivated by what they consider to be bleak prospects in this country, start, a few years before graduating school, putting together the papers they need to submit as applicants for admission to universities abroad or for a job, even when such a job is inferior to their level of training.

The severe Coronavirus crisis of Spring 2020 at global scale revealed that certain categories of Romanian emigrants, generally low-skilled or unskilled, are working on the labour markets in other Member States either without legal forms or on the basis of conventions which do not provide them with social protection or the coverage of medical expenses in situations of crisis or difficulties in the labour market. This situation explains, among other things, the massive flow of returned migrants to the country amid this crisis.

Among the consequences of this exodus is the long-term imbalance inflicted upon the social security state budget and the health budget, not to mention the huge losses in human capital, competence and skills.

One cannot deny that the few Romanians who returned home brought along the experience, the knowhow, the intrepid spirit they acquired in their host countries, and can contribute these assets to the welfare of their communities. Similarly, the earnings saved abroad become their investment capital for the construction of new homes or the renovation of existing ones, or just for living better lives.

However, the labour deficit that gives headaches to all those concerned is a threat to the development and the economic growth of some of the sectors: construction, services, the new industry, agriculture, but, no less, education, health, public administration.

Various inquiries in the business environment regarding the issue of **labour shortage** have revealed that the matter **is worsening**.

For example, a 2018 *Study on the Deficit of Talents in Romania*, conducted by Manpower Group, shows that 81% of employers in Romania encounter difficulties in finding suitably qualified workers for their vacancies. The share of employers struggling with the lack of workforce surged from 40% in 2014, to 61% in 2015, and 72% in 2016.

Some of the causes of this accelerated depletion of the labour market are the massive emigration of qualified and highly qualified workforce, the gap between the quality and quantity of the labour force provided by the educational system, and the actual requirements of the labour market, the lack of cooperation between employers, the labour recruitment agencies, and adult training entities.

Eurostat made an experimental analysis based on the comparison between the level of education graduated by labour (ISCED 1999) and occupations (ISCO 2008 3-digit) and it found horizontal discrepancies between the two indicators that go up to 47% in the age group 15-34 years,

and to 31.9% for the age group 25-34 years, in the manufacturing industry and constructions, and up to 45.5% and 46.4% in the services sector.

These findings demonstrate the need for investment in the human capital, for costly measures to stimulate geographic mobility in the labour market, for actions to promote dual education, all of which could stimulate actions towards better employment rates, and higher public spending to encourage employment.

If willing to moderate the adverse factors affecting the labour market, companies operating in Romania, be they domestic or foreign capital based, should support, for the joint interest of the Romanian state and of the private business environment, the public policy initiatives of central and local authorities, in various forms, including public-private partnerships, capable to **stop the deepening of the quantitative and qualitative labour deficits, to normalise the balance between supply and demand on the labour market in respect of occupational coverage and geographic distribution**[14].

3. Types of labour shortage and generating factors

In general, two main types of labour shortages are discussed, respectively **quantitative shortages**, caused by an excess of the aggregate demand, the available workers being insufficient to meet the overall demand, and **qualitative shortages**, which refer to specific shortages of the labour force in terms of qualifications, occupations or sectors, the workers available lacking the skills, preferences or information needed to compensate for it[15].

3.1. Quantitative labour shortages

The quantitative shortage refers to the situation in which the demand for labour is greater than the supply of labour. Compared to a balanced labour market, a shortage of labour force can result either from an increasing demand or from a declining supply. According to the standard economic theory, a labour shortage is supposed to induce an increase in the wage level offered by employers, resulting in a gradual increase in supply and a reduction in demand, until the balance is restored. Therefore, a persistent shortage of labour force is generated either by a rigid level of pay, or by a very slow and inelastic adaptation of the demand and supply of labour. On the other hand, a persistent shortage of labour force can be caused by a succession of shocks of supply and demand.

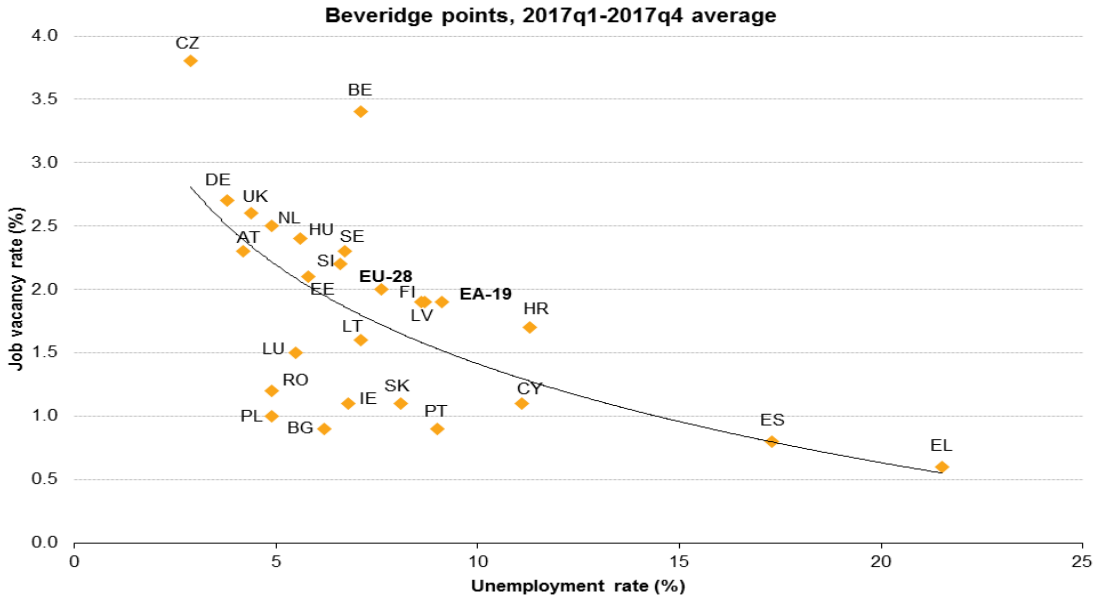
The gap between the demand and the job offer, in general, is expressed in relative terms, using the **labour market tightness** indicator, calculated as a ratio between the vacancy rate and the unemployment rate. In the case of a quantitative shortage, there is a high share of vacancies that are difficult to fill and a low level of unemployment. (*Beveridge curve*).

At the level of the European Union, in 2017, the positioning of the Member States on the Beveridge curve is presented in **Graph 4**, which shows a great diversity of the degree in the intra-EU labour market tightness, from countries where there are high vacancy rates simultaneously with low unemployment rates (Czech Republic) to others, where there was a diametrically opposite situation (Greece).

[14] Luminița Chivu, Simona Poladian, Valeriu Ioan-Franc (coord.), *Convergența economică și monetară a României cu Uniunea Europeană – un demers necesar*, Centrul de Informare și Documentare Economică, București, 2018.

[15] See 7. European Parliament, *Labour market shortages in the European Union*, Directorate General for Internal Policies, Policy Department, IP/A/EMP/ST, PE 542.202, March, 2015, pp. 21-31.

Graph 4: The intra-EU labour market tightness



Source: Eurostat (online data codes: jvs_q_nace2, lfsq_urgan)

eurostat

It should be noted that in Romania there has been a moderate degree of labour market tightness compared to other EU member countries, but, according to the NBR data, it has increased significantly in recent years, respectively from 0.08 in the first quarter of 2012 to 0,26 in the same period of 2018 (**Table 1**).

Table 1

Romania's labour market tightness

Year*	Labour market tightness **
2012	0.08
2013	0.09
2014	0.12
2015	0.14
2016	0.20
2017	0.24
2018	0.26

* Q1 of the years
** Ratio between the vacancy rate and the unemployment rate
Source: National Bank of Romania, The Evolution of economic activity, 2018, Table 2.9.

According to the minutes of the monetary policy meeting of the National Bank of Romania Board on 3 October 2018, the analysis of the situation in the second quarter of this year, revealed the re-amplification of the labour market tightness, the unemployment rate registering a new quarterly decrease and reaching an historical minimum of 4.2% in May, while the vacancy rate increased for the second consecutive quarter. In the context of increasing wage earnings pressures,

in the latter part of 2018, together with the slight improvement of the employment intentions, there has been an exacerbation of the difficulties in recruiting qualified personnel.[16]

3.2. Emergence and causes

On the supply side, the quantitative labour shortages could emerge because of the decline in the number of available workers, due to population aging, emigration and/or the decrease in the participation rate of certain groups. On the demand side, these shortages are due to the increase of the labour demand on account of the economic growth, changes in the consumption patterns and in the relative prices of production factors.

In this context, territorial mismatches may also arise, if a shortage of labour force occurs in one region and, simultaneously, an excess of supply in another region, these being influenced by the lack of geographical mobility. The quantitative labour shortages are characterized by an almost full employment level, under the circumstances when the demand for labour exceeds the supply, existing a general difficulty in finding workers to fill the vacancies in a certain region, EU member state or at EU level.

Further, the main causes generating quantitative labour shortages are presented.

- **The natural decline in the working age population** is due to a low fertility rate and/or decreasing in the last decades, the entry of young people on the labour market being lower than the retirement of older workers. In the circumstances when the activity rates remain the same, this will lead to a decrease in the available labour force, which determines tensions on the labour market, the demand for labour exceeding the related supply. The retirement of baby-boomers (in Romania is the case of "decreței" from the cohort in the 1970s) is likely to lead to the population aging in the next decade and, in the case of many occupations, to a demand for replacement that will be difficult to satisfy from the labour market supply on the internal market[17].

  The decline in the working age population could also happen because of **net emigration**. At intra-EU level, if, one the one hand, the emigration reduces the potential labour shortages in the countries of destination, on the other hand it leads to the decrease in the available labour force in the countries of origin, these countries facing also a "brain drain" phenomenon with an adverse impact on high qualifications workforce supply, which is the case of Romania. The motives that cause people to leave their countries could be related to personal reasons because of poor career prospects, to economic reasons due to low wages and/or lack of jobs, to social reasons because of poor living conditions and/or social insecurity, and also to political reasons caused by political instability and/or a general environment unsecured and corrupted. The emigration of professional from some EU Eastern countries has created serious labour shortages in some essential sectors as the healthcare, which is also the case of Romania.
- **The participation rate decrease** could be generated by the inactivity of certain segments of the labour force, which is more likely in the case of marginal groups, among these more vulnerable being the young people between ages of 15 and 29, who are neither in the field of work, nor in the education or training systems (NEETs). In fact, as it will be shown further in the study, also in the case of Romania, the NEETs represents an important unused human capital and a waste of resources spent for their education, so as they should be considered a priority by the public policies targeting the labour market area and the mitigation of labour shortages. Women and people with disabilities are other socio-demographic groups with a high risk of inactivity, which make necessary measures and incentives that encourage their participation in the labour market.

[16] *Minutes of the monetary policy meeting of the National Bank of Romania Board on 3 October 2018*, NBR, 10 October, 2018.

[17] European Parliament (2015) *Labour market shortages in the European Union*, Directorate General for Internal Policies, Policy Department, IP/A/EMP/ST, PE 542.202, March, p. 23.

The early retirement and/or the loss of jobs by older workers, who become unemployed, could lead to a definitive exit from the labour market, also due to the depreciation of their skills.

- **The increase in the aggregate labour demand** may occur following a rise in the purchasing power of consumers and the changes in consumer composition or tastes. It is important to note that, despite the clear dependence of real income increase on the economic growth, the latter not always lead to an increase in the labour demand, if it is achieved by extending the contribution of the existing workforce, increasing the productivity or the number of working hours. The increase in the aggregate labour demand could emerge also under the circumstances of an aging society, by a higher demand for health products and services. As concerns consumer composition, preferences or tastes, the past experiences showed that their changes, sometimes very fast, led to significant shifts in labour demand. The aggregate labour demand could also increase as a result of rises in the production factors prices (raw materials and machinery), when these are substituted, at least partially, by the labour force.
- **The geographical discrepancies and mismatches between labour supply and demand** can occur when in a certain region there is a shortage of workforce and in another region there is a surplus. In this case, the locations where jobs are available are poorly correlated with the potential employers, under the circumstances of a low level of the workforce geographical mobility, that could be limited by the reluctance of workers to move to other regions, as well as its duration and costs. On the other hand, the interregional mobility of companies, can also be constrained by some factors, among these, the relocation costs.

3.3. Qualitative labour shortages

The qualitative deficit of labour force occurs if the demand for labour in a certain occupation, qualification or sector is greater than the supply of labour in the same occupation, level of qualification, sector. At the aggregate level, in the case of a qualitative shortage, the labour supply and demand could be in balance, but at the same time, a high unemployment rate simultaneously with the partially filling of vacancies can be registered, caused by the qualitative mismatches between the labour offer and the labour market requirements.

3.4. Emergence and causes

The qualitative labour shortages could be generated by:

- **Mismatches regarding the qualification** generated by an imbalance between demand and supply from the point of view of specific qualifications and/or skills, both in terms of their level and the qualification type. These discrepancies may be caused by changes in labour market demand, mainly due to technological changes, and also, on the offer side, changes in supply due to retirements or incorrect options of education and vocational training by the young people. A distinction should be made between the **vertical mismatch**, if the level of education or qualification is lower or higher than the requested one on the labour market and the **horizontal mismatch**, if the type or field of education or qualification is inadequate to the requirements of the job. It also have to be seen if the mismatch relates to the level or field of education or to the qualifications of workers compared to the needs required for their jobs[18]. Eurostat has developed, as an experimental statistics, indicators for the assessment of **vertical mismatches** regarding qualification, calculating the over-qualification rate (OQR) using the number of graduates with tertiary education who are working (ISCED 2011, levels 5-8) and whose occupations (ISCO 2008, groups 4-9) do not require this level of education, according to the formula[19]:

[18] European Parliament (2015) *Labour market shortages in the European Union*, Directorate General for Internal Policies, Policy Department, IP/A/EMP/ST, PE 542.202, March, p. 25.

[19] Eurostat, *Skills mismatch experimental indicators. Methodological note*, Eurostat – Directorate F: Social statistics, 2017.

$$OQR = \frac{\text{Persons employed with ISCED 5−8 and ISCO 4−9}}{\text{Persons employed with ISCED 5−8}} \quad (1)$$

The analysis of the over-qualification rate in the period 2008-2016, on the main economic activities NACE Rev. 2, showed that, unlike most of the EU advanced countries, in the case of Romania, there has been a trend of deepening the vertical mismatches in all these activities, respectively the increase in the share of the workers with higher studies employed in jobs that do not require a tertiary level education, the most significant dimension of these mismatches being registered in the sector of wholesale and retail trade, mentioning that were considered the employed persons in the age group 20-64 years (**Table 2**).

Table 2

Vertical mismatches: the over-qualification rate (%)

NACE Rev. 2	2008	2009	2010	2011	2012	2013	2014	2015	2016
Manufacturing	9.5	10.5	9.6	9.6	11.1	14.8	16.3	16.3	16.5
Construction	7.5	6.5	5.3	8.8	8.6	11.7	12.8	12.8	11.9
Wholesale and retail trade	17.7	23.3	23.0	23.4	29.0	33.3	34.4	34.6	33.6
Transport and warehouses	17.9	20.8	23.9	23.2	26.2	30.2	26.3	30.5	29.1
Professional, scientifical and technical activities	5.3	5.3	4.1	5.4	7.1	8.3	9.2	7.3	8.7
Public administration	8.6	10.8	12.4	16.2	17.6	20.9	21.1	22.5	19.6
Education	1.7	1.9	1.9	2.0	3.3	3.9	2.2	2.8	2.9
Health and public services	3.0	3.3	3.6	4.2	3.8	3.4	3.8	5.8	5.6

Source: Eurostat Experimental Statistics.

In order to evaluate **the horizontal skill mismatches**, in Eurostat experimental statistics, under the hypothesis of congruence between the field of education (FOE) according to ISCED 2011 and the qualifications required for that occupation according to ISCO 2008, the following formula is used:

$$HSMR = 1 - \frac{\text{Persons employed with matching FoE}}{\text{Persons employed}} \quad (2)$$

Based on data from 2014, 2015 and 2016, the experimental indicator was calculated for persons employed in the age group 15-34 years, who graduated at least the secondary education level (ISCED 3-8) and respectively for the persons employed in the age group 25-34 years, which reached the level of tertiary education (ISCED 5-8). In the case of Romania, a tendency of increasing the horizontal skill mismatches for the employed persons in the age group 15-34 years has been recorded, especially in the educational fields with a humanistic and social profile. The interpretation of decreasing skill mismatches in the fields of the technical and engineering sciences should take into account their significant size (in relative figures, share of about 50% or more). In the case of persons employed in the age group 25-34 years who have higher education, the level of horizontal skill mismatches is relatively lower, also showing a tendency to decrease in the last years (**Table 3**).

Table 3

Horizontal skill mismatch rate according to the field of education (%)

Field of education	Age group 15-34 ISCED 2011 3-8			Age group 25-34 ISCED 2011 5-8		
ISCED-F	**2014**	**2015**	**2016**	**2014**	**2015**	**2016**
Education and training	34,8	41,4	41,5	n.a.	n.a.	n.a.
Humanities; languages, arts	52,5	54,9	57,6	33,5	34,4	34,0
Social sciences; business, law	23,8	22,7	24,2	19,5	19,4	19,5
Science; mathematics, computing	74,6	74,7	69,8	49,2	41,2	39,4
Engineering, manufacturing and construction	49,3	49,6	47,0	32,0	33,2	31,9
Agriculture and veterinary	55,0	57,9	58,3	n.a.	n.a.	52,5
Health	15,5	20,3	17,2	n.a.	n.a.	n.a.
Services	46,5	48,4	45,5	53,5	44,5	46,4

n.a. – non available data
Source: Eurostat Experimental Statistics

The emergence of a skill shortage can be one of the consequences of mismatches in terms of qualifications, i.e. a situation where employers in certain sectors cannot find workers who have adequate qualifications and, consequently, jobs are often left unoccupied. However, in this case, employers may decide to hire workers with lower qualifications, but, in certain circumstances, the opposite can also happen, namely that workers have a higher level of education or qualification than is required for their job. In the most of cases, the skill mismatch is related to the salary that the employer offers to the workers, which can arise when the employers fail to recruit personnel having the needed skills from the labour market at the regular rate of pay.

The skill shortage might be both cyclical, during the periods of economic growth significant difficulties in finding the workers that would be needed occurs and structural, as a result of fluctuations in the business cycle when the employment standards are lowered. Thus, in situations where the employment rate is increasing it could happen that, at the same time, significant skill mismatches occur because of the labour market tightness.

The skill mismatch could refer to specific qualification levels, according to the calculations based on the EU labour market survey resulting that more jobs are requiring intermediate qualifications than the available individuals at the corresponding level while for the low-level jobs and low-educated employees the situation is just the opposite[20]. Therefore, the labour market congestion may occur for different reasons, depending on the level of qualification: the skill shortage represents the driving factor of congestion in the case of high-level occupations, while the unattractive working conditions play a greater role at lower levels of qualification. Both demand and supply side factors are associated with the emergence of skill mismatches, including company adjustment delays and wage rigidities, educational system adaptation delays, lack of geographical mobility and imperfect information for students on choosing the right specialization.

The main causes of skill shortages emergence are:

- **Technological changes** can lead to an increase in the demand for skilled labour, a qualification deficit occurring due to the lack of skills required in certain advanced sectors, mainly in high technology production, the education system lagging behind in relation to the new skill requirements on the labour market. Another dysfunction that can be caused by technological changes results from difficulties in professional reconversion of the workforce coming out from declining sectors into growing sectors because of too large skill differences.

[20] CEDEFOP (2014), *Skill mismatch: more than meets the eye*. Briefing note.

- **Changes at sectoral and professional level that creates skill shortages** may be due to the lack of job seekers with an adequate training in the expanding segments of the labour market and/or in growing specific sectors, due to sectoral changes in demand. Looking to the labour market future changes, the main trends show an increasing demand for jobs requiring higher levels of qualification as well as, in the leading and innovative sectors, for high-skilled occupations in advanced manufacturing, which are supposed to create significant bottlenecks and skill shortages in the absence of specific vocational training.
- **Rigidity of recruitment**, another factor causing skill shortages, could result from mismatches between the needed qualifications and human resources policies because of the recruitment poor management by overestimating the candidates and hiring under-skilled workers. Other mismatches leading to skill shortages are between the formal recruitment channels of the companies and the informal strategies used by the people looking for a job, the latter proving in many cases more efficient.
- **Increased replacement demand** can lead to the emergence of skill shortages if the vacancies following the departure of workers due to retirements, temporary withdrawal of women for childbirth or child rearing reasons and occupational mobility are not filled by new workers with adequate skills. Increased replacement demand may arise under the circumstances of a lack of skills updating and/or their becoming obsolete, caused mainly by the aging process. In the medium and long term, shortages are expected in the case of lower skill-intensive sectors and routine occupations, which will expose the companies operating in these sectors to high difficulties in finding the appropriate workers.

➢ **Mismatches regarding the work preferences** could create labour shortages and may arise if the characteristics of the available vacancies, in terms of working conditions and/or the social status of the job, do not correspond to the requirements / preferences of the people looking for a job. This type of shortage refers to the refusal of a working-age person to accept certain jobs, although they would fit their qualification profile and are located in the appropriate geographical region, that leads to an underutilization of the potential workforce. Factors that may cause people to decline job offers could be related to unattractive remuneration, unappropriated working conditions, lack of flexibility of working hours and/or the law status of an associated social stigma, gender stereotype, a poor image for female workers, immigrant workers or ethnic minorities.

➢ **The information mismatch** that creates labour shortages could be the result of a lack of information at the level of the employers and those who are looking for a job, regarding the vacant positions against the candidates for their filling respectively. In this case either the recruitment services of companies are not able to reach their targets or the job search strategies by applicants are not appropriate in order to find the available jobs, none of them receiving the right information about the other. Information inconsistency may also refer to workers currently employed in jobs without correspondence with their level of qualification or skills, and who intend to move toward a better position. In the case of information asymmetries, even if labour shortage does not emerge, the demand could remain unsatisfied due to imperfect information flows, resulting in a labour market lack of transparency.

4. Worrying statistics regarding the transition from school to active life: quantitative and qualitative inconsistencies

As a complement to the indicators analysed above, telling us more about the title issue is a study about the *Access of Youths to the Labour Market*, 2016 (Accesul tinerilor pe piața muncii, anul 2016[21]), published by INS in 2018, which illustrates, comprehensively enough, what happens when young people finish school and try to earn their living.

[21] ” Access of Youths to the Labour Market, 2016”, INS, Bucharest, 2018.

Among the findings of the study are the very low employment rates among youths aged 15-34 years within the next 12 and, respectively, 24 months of school graduation, the precariousness of employment, and the discrepancy between the youths' level of training and the occupation accepted (underused human capital), the significant number of youths with no employment and no school attendance (app 969,320 persons aged 15-34 years), the youths' reluctance to travel long distances between home and work, or to change residence for employment purposes, etc.

The findings above draw their substance from very convincing figures:

- On the average, only 47% of the total number of 4,875 mil. youths aged 15-34 years are in employment within the next 12 months from graduation. The rate grew to 60.9% within the next 12 to 23 months from completing school, and to 73.6% after more than 24 months from graduation;
- Among holders of higher education degrees, in the same age group, employment rates jump from 47.3% for the first 12 months after graduation, to 79.6% for the period of 12 to 23 months from graduation, and to 90.4% for the period beyond the first 24 months after finishing studies; a growing curve of the employment rate can be noticed also among the persons with a medium-level training, but with lower amplitudes than in the higher education segment: 46.8% within the first 12 months, 58.4% within the next 12-23 months from graduation, and 75.1% beyond the first 24 months from graduation;
- In the category of persons with a low level of education, the 50.9% employment rate in the first 12 months from leaving school (which is the highest at all levels of graduation), drops to less than a half in the period of 12-23 months from graduation, and then rises to 59.3% after more than 24 months from graduation;
- Over 91% of the total number of 4,875 mil. young persons aged 15-34 years that were in the focus of this inquiry stated that they never worked during their schooling, 6.0% said they worked without pay, 1.7% worked for pay, and 1.2% worked both with and without pay;
- Of all the young respondents that said they had worked during school, in 63.5% of the cases the professional activities were part of the curriculum (practical work), and 36.5% of the cases the practical work was done outside school time; in the case of young persons in the age group 15-34 years who graduated from comprehensive education and qualifications, the professional practice hours were scheduled outside the curricular schedule, while in the case of students who attended courses in engineering, in various industries or in agricultural, forestry, fishing or veterinary sciences, over 80% of the vocational activities formed part of the school curriculum.
- From the employment perspective, in 2016, the distribution of the total number of 2.5 mil. youths in employment, with ages from 15 to 34 years, was the following: 74.6% of them were on open-ended employment agreements, 1.8% were under fixed-term employment agreements, and 25.4% were non-employees (such as sole proprietors, unpaid family workers, employers); while in the category of graduates of a higher education institution the share of those under a permanent (open-ended) employment agreement was 94.9%, in the category of medium-level graduates, the share of permanent employees was 78.3%, and in the low-education segment, the share was 35.5%, with the balance of 62.3% fitting one of the descriptions of non-employees.
- There was a gap between the level of the graduated schooling and the level of education required by the major group of occupations in which the young person had a job: 30% of the holders of an academic degree were employed for jobs in the major groups 3-9 (specific for medium and lower education graduates), and 10.2% of the medium training graduates were employed in the major occupational group 9 (unskilled labour). This reveals the use of qualified labour for jobs that were inferior to their holders' level of education.
- Of the total number of employees in the age segment 15 - 34 years, 21.1% of them were working in agriculture, 28.5% in manufacturing and construction, and 50.4 in services, with a higher share of academic graduates (79.5%) working in services, and a higher share (55.2) of the low skilled graduates working in agriculture.
- Almost 50% of the young people of ages 15 to 34 stated that they had found the job by direct contact with the employer; 28.8% of them found a job through relatives, friends and other

contacts, 7.0% through advertising, media, websites, etc., and 6.8% through personal job offers from employers; the direct approach of the employer by the job seekers was the most frequent way of finding employment in services (for 52.9% of those working in the sector), and also in the manufacturing and construction sectors (45.2%); while relatives, friends and contacts were instrumental in finding a job for 43.9% of the youths working in agriculture.

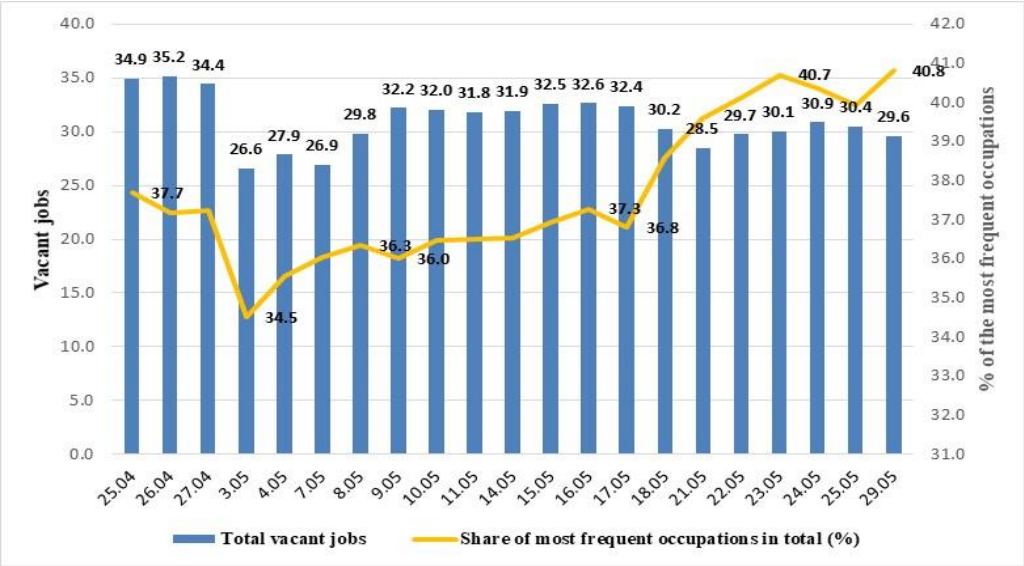
- Approximately 44% of the employees said that their level of education greatly fit the job requirements, 35.3% said the two parameters matched to a certain degree, 13.6% said there was too little compatibility, and 7.1% said that there was none; the share of those claiming that education matched job requirements was higher among those working in services, and higher among those working in urban areas, as against rural areas, in all economic sectors.
- The great majority (96.2%) of the young employees said that they needed not change residence to get their current job.
- Of the echelon of 969,320 youths in the age bracket 15 to 34 who were neither in education, nor in employment (NEET), 465,518 of them (48% of total) were graduates from comprehensive schools and general education programmes, and 232,965 (24%) had graduated from engineering and other technical schools, while a number of 51,026 (5%) had graduated from business, administration, and law schools.
- The overwhelming majority (98%) of the unemployed youths aged 15 to 34 said they had not received any assistance from employment agencies to find a job; 2.3% did receive assistance, and 2% of this narrow segment said that agencies' information and counselling on employment opportunities had been most useful and helpful.
- A large majority of 80% of the youth in the age group 15 to 34 and neither in education, nor in employment said they were unwilling to change residence for the sake of a job; 6.7% were willing to move to another place in Romania, and 13.3% were open to relocating abroad; the most reluctant to changing residence were those in the upper age segment of the group
- Only 35.9% of the NEETs in the age group under scrutiny would accept a job requiring more than an hour to travel from home to work. The percentage is higher (50%) among graduates from health, social care, and services, and only 28.5% among graduates from social sciences, journalism and business schools.
- Of the 3.4 mil. young people who left the system of education before the graduation, 39.1% said that they considered the level completed by then as sufficient, 23.0% said they wanted to start work, 12.8% gave up because they could no longer bear the cost of tuition fees, and 10.9% had family problems. The motivation of being eager to find work was highest among youths in the age bracket 15 to 19 years; only 6.4% left school because they found it too difficult, and 2.8% because the type of studies did not match either their background education or their interests.
- In the year of reference 2016, of the total number of 4,875 mil. young persons in the age group 15-34, 14.5% were holders of an academic degree, 48.2% had a medium level of education, and 37.2% had a low level of education (secondary -forms 5 to 8, primary, or no graduated schooling).
- Approximately 45% of the youths 15 to 34 years of age were trained in comprehensive schools and tuition programmes, 22.4% of them were trained in engineering and manufacturing, and 7.6% had education in business, administration, and law; in the age groups 20 and over, an important share was held by persons trained in social sciences, journalism, and services, distributed as follows: 5.7% in the age group 20 - 24 years, 6.7% in the age group 25 to 29, and 6.9% in the age group 30 - 34 years.

Another important sensor mirroring the vacant jobs are the daily (week days only) press releases of ANOFM, which collects data from its local (county) extensions, and from the public and private employers, who are bound by law to report job vacancies. Our study based its calculations on the INS quarterly vacancy reports, which takes as reference the middle month of every quarter, and corroborated the data therein with the ANOFM releases for the period 25.04 - 29.05.2018. For the purposes hereof, we choose the INS report for Quarter II 2018.

Unlike the INS inquiry, which provides data only on the major occupational groups, the ANOFM data supply details regarding the number of vacant jobs in the most available occupations.

During the time space 25 April – 29 May 2018, the daily number of vacant jobs fluctuated between a maximum of 40.7 thou' and a minimum of 26.6 thou' (**Graph 5**).

Graph 5: Number of vacant jobs (in thousands) and the share of the most available occupations, 25.04 - 29.05.2018

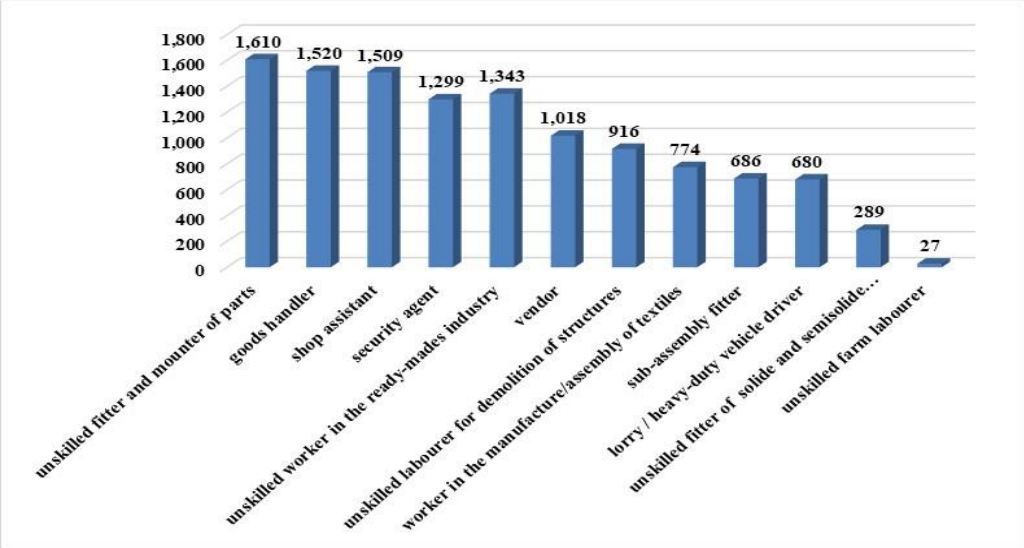


Source: Authors' compilation of ANOFM data.

None of the 12 occupations with the highest number of job vacancies advertised during the reference time period requires higher education, and 5 of them are various types of jobs for unskilled workers. The next abundant job offers are for goods handler, shop assistant, security agent, vendor, textile-factory worker, sub-assembly fitter, lorry / heavy-duty vehicle driver.

In the period 25.04-15.05.2018, the average daily advertised vacancies were 1,610 jobs for unskilled fitter and mounter of parts, 1,520 jobs for goods handlers, 1,509 jobs as shop assistant, 1,299 jobs for security agents, 1,343 jobs as unskilled worker in the ready-mades industry, 1,018 jobs for vendors, etc. (**Graph 6**).

Graph 6: Daily average of vacancies in most available occupations, 25.04-15.05.2018 (number)



Source: Authors' compilation of ANOFM bulletins.

The level of development of a region, the sectoral structure of the local economy, the amount of investment, and the average wage at region level will all shape the configuration of the labour demand, the number of job vacancies, the occupational structure and distribution across the range of economic activities.

The analyses give relevant information deriving from the distribution of jobs in certain economic sectors, by region.

For example, we find that in wholesale and retail trade the number of vacant jobs grew during the period 2008 - Quarter II 2018 from 4,481 to 5,415, by app 20%.

Except for the North-West and South-West regions, where in Quarter II 2018 the vacant jobs were in a smaller number than in 2008, in all the other 6 regions the number of jobs in the trade sector rose.

Bucharest-Ilfov, with some 30% of all jobs in wholesale and retail trade, in Quarter II 2018, was the front runner. Coming second was the North-West Region, which reported 13% of the positions available for employment in this sector, followed by the regions Centre and South-Muntenia, each with an equal share of 12%. The fewest jobs in the sector were available in the South-West Region: 2% of all.

In the production and supply of electricity, steam, gas, hot water, and air conditioning, during the entire period between 2008 and Quarter II 2018, the number of available jobs remained constantly low: 358 in 2008, 67 in 2012, 365 in 2017, and 307 in Quarter II 2018.

With the exception of North-West and South-East, the number of the jobs available in this sector in all the other 6 regions has dropped significantly.

In Quarter II 2018, app. 69% of the unoccupied jobs in the production and supply of electricity, steam, gas, hot water and air conditioning could be found in the North-West Region, and 11% of them in the North-East Region. The fewest of them, 1% of total vacant jobs, were available in the South Region; Bucharest–Ilfov offered 8% of the employment offer in this sector.

The offer of employment in the sector of hotels and catering (HORECA), in Quarter II 2018, was 80% higher than in 2008.

The highest growth was registered in the Centre Region, where the number of vacant jobs in this sector grew 7.5 times. Next came South-East with a four-fold growth, then North-West with a 2.5 times growth, and North-East, where the vacant jobs in hotels and restaurants doubled.

At the opposite extreme were Bucharest-Ilfov, South, and South-West, where the number of jobs in this sector diminished. In Quarter II 2018, almost half of the jobs in hotels and catering were concentrated in the Centre (24.1%) and South-East (24.8%).

Another important share of the vacant jobs in the HORECA sector was available in Bucharest-Ilfov: 18%. While the lowest share was in South-West.

In information and communications, the number of vacant positions grew 4.4 times, from 676 to 2,956, in the reference period 2008 – Quarter II 2018.

The regions with the fewest vacant jobs and the slightest growth of employment opportunities in ICT, in the reference period, were South (25 vacant jobs in 2008, and 38 in Quarter II 2018), and South-West (15 vacant jobs in 2008, and 95 in Quarter II 2018).

In Quarter II 2018, 57.5% of the jobs available in the ICT sector could be found in Bucharest, 13.4% of them in North-West, and only 1.3% in South Muntenia, 3.2% in South-West, and 3.8% in South-East. Centre, North-East, and West featured, in QII 2018, with 6.2-7.6% of the sector's vacant jobs.

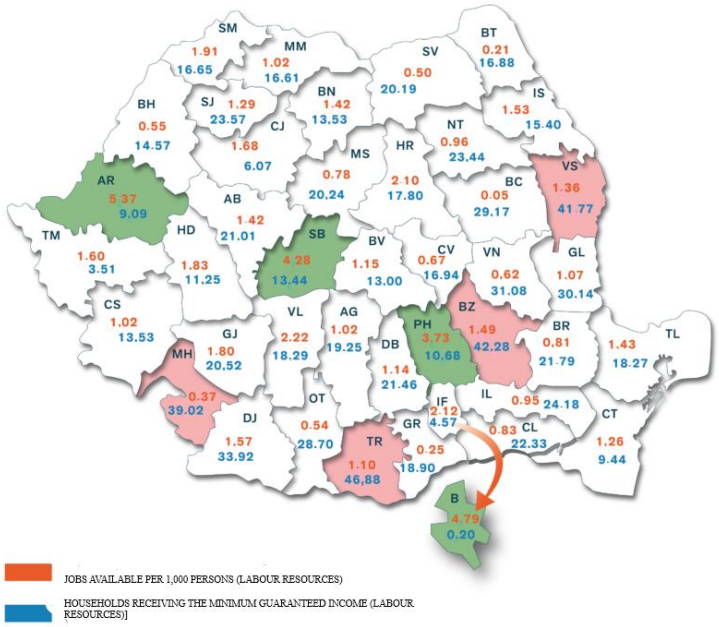
According to ANOFM, in the time span 25.04-15.05.2018, the highest daily average number of vacant jobs were reported from Bucharest, with 5,287 units, followed by Prahova County with 2,931 vacancies, Dolj County with 1,699 jobs (**Graph 7**).

In the period above, the fewest vacant jobs were reported in the counted of Bacău (37), Botoșani and Covasna (73).

Bucharest reported a number of jobs equivalent to the sum of jobs reported by the 17 counties that came last in the classification by this indicator.

The surveys made by the Social Monitor (Monitorul Social) reveal a negative connection between the share of households receiving the minimum guaranteed income and the county rate of vacant jobs. More precisely, where there is a relatively large number of recipients of the minimum guaranteed income, the job offer in such counties is low, while in the counties with fewer families qualifying for this type of income, the job offer is relatively higher. (**Map 1**).

Map 1: Rate of vacant jobs (jobs available at 1,000 persons), and the share of households receiving aid equal the minimum guaranteed income (%), by county, February 2018



Source: Monitorul Social, Friedrich Ebert Stiftung, based on data from the Ministry of Labour and Social Justice (February 2018), and ANOFM (March 2018).

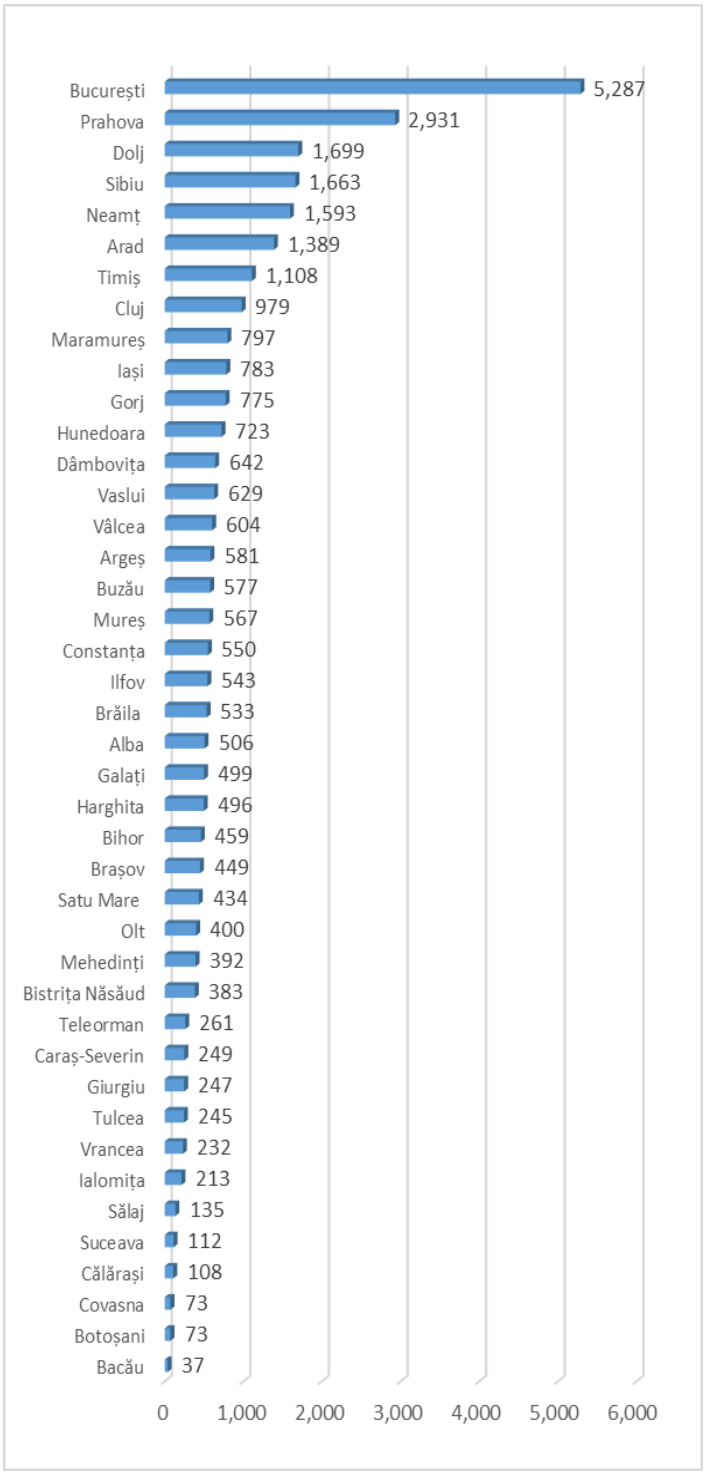
However, the analysis demonstrates that the conclusion of the survey does not corroborate with the assumption that the majority of the beneficiaries of such a welfare policy turn down employment offers. On the contrary, it is much more likely that the limited job supply favours the existence of a greater number of households that need government assistance by way of a financial support equivalent to the minimum guaranteed income.

Similar to the occupational structure, the data about the local distribution of jobs, with the exception of Bucharest, suffers from mismatch between the information provided by INS and the information from ANOFM.

A mere navigation across the Internet sites of labour recruitment agencies reveals an occupational and geographical distribution that is notably different from that advanced by ANOFM. A possible explanation is that private companies resort to the services of the county labour agencies only when they need non-skilled or poorly skilled labour, and that, as a rule, they hire better qualified personnel through their own human resources departments, or with the aid of private recruitment entities.

In addition to collecting the statistic reports on vacant jobs from all county labour agencies, ANOFM **(Graph 7**) also publishes information of job vacancies communicated to them by other European states, via EURES.

Graph 7: Daily average of vacant jobs, by county, during 25.04 - 15.05.2018 (number)



Source: Authors' compilation of ANOFM bulletins.

Looking at the data carried by the ANOFM bulletins regarding the total number of vacant jobs communicated via EURES, during a time span between 25.04 and 27.06.2018, we can see that this fluctuated between a maximum of 1,409 jobs, and a minimum of 993 jobs.

The data available to us for the reference period above regarding the job offers in countries like Germany, The Netherlands, Poland, Malta, The Czech Republic, Belgium, Finland, indicate that jobs requiring a higher qualification are relatively few, but so are the jobs requiring no skills. This can be seen in the first three mostly demanded occupations in each of the states above (**Table 4**).

Table 4

Number of vacant jobs published by EURES for the top 3 occupations in each country, over the period 25.04 - 27.06 2018

	25.04	2.05	9.05	16.05	23.05	30.05	6.06	13.06	20.06	27.06
Germany										
Porter	400	400	400	400						
Luggage forklift operator	200	200	200	200						
Smith	53	53	53	50						
The Netherlands										
Flower bulb sorting and packing operator	50	50	50	50	50	50	50	50	50	50
Machine operators for flower bulbs	50	50	50	50	50	50	50	50	50	50
Warehouse operator									60	60
Poland										
MAG welder	20	20	20	20	20	20	20	20	25	25
Concrete shuttering wood worker	10	10	10	10	10	10	10	10	10	10
Masonry worker	10	10	10	10	10	10	10	10	10	10
Malta										
Bus driver	150									
Industrial machinery operators			10	10	10	10				
Plastic mould operators					5	5	5	5		
Czech Republic										
Forging machine operator	15	15	15	15	15	15	15	15	15	15
CNC machine operator	15	15	15	15	15	15	15	15	15	15
Belgium										
Deboning/meat sorting operator	10									
CNC machine operator /turner	5						1	1	1	1
Packing operator in food industry							10	10	10	10
Finland										
Plumber	10									
Welder	10									
Welding team foreman	2									

Source: Authors' compilation of ANOFM bulletins.

Given the small number of jobs published by EURES, we can assume that most of the Romanians leaving their country have alternative sources of information about the jobs available in other member states. Therefore, the top three types of jobs for which there is a formal demand for labour force from the foreign employers in the above EU countries does not give a comprehensive picture of all vacancies available abroad for the Romanian job seekers.

5. Case study: ICT

The ICT sector is growing at a fast rate in Romania, well above the national average, contributing increasingly more to the GDP creation and international services revenues of BoP

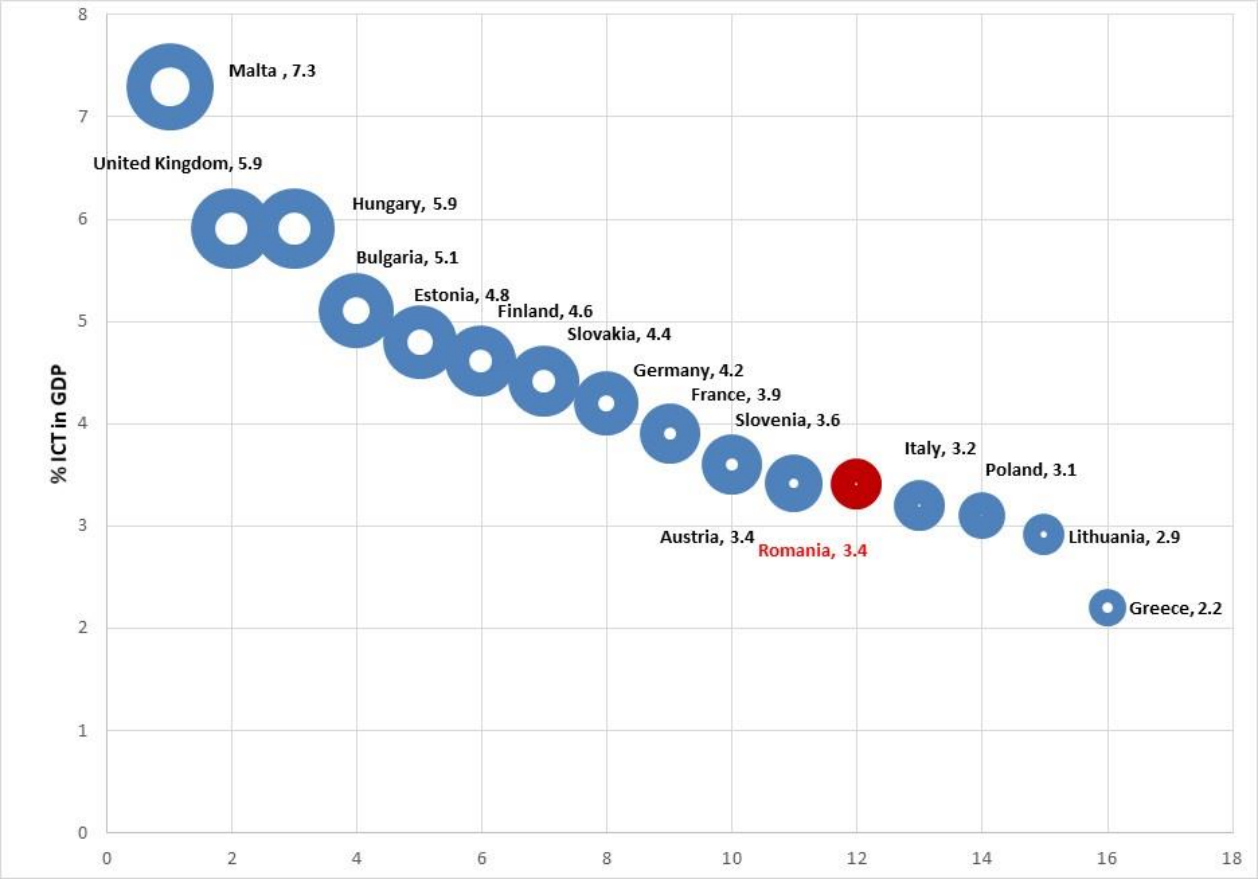
current account. Despite this sector was claimed as strategic priority by the decision makers, the labour shortages in the sector remains high, being likely to maintain in the near future in the absence of promoting adequate support measures. The study case tries to evaluate the current issues that face the ICT sector and its outlook in the coming years.

5.1. Main ICT sector indicators

The information and communications technology[22] (**ICT**) sector is on a fast upward trend in Romania, and tending to speed up at a faster rate than the average growth of the national economy, which is why decision makers have declared it a strategic priority.

Although, in Romania, the added value generated by the ICT sector has been growing at a faster pace than that of other economic sectors, in 2016, the ICT accounted for a share of 3.4% of Romania's GDP, which was lower than that of the same sector in many other European Union countries (**Graph 8**): 7.3% in Malta, 5.9% in UK and Hungary, 5.1% in Bulgaria, and 4.8% in Estonia.

Graph 8: Share of the ICT sector in the gross domestic product (GDP) in some EU member states, 2016 (%)

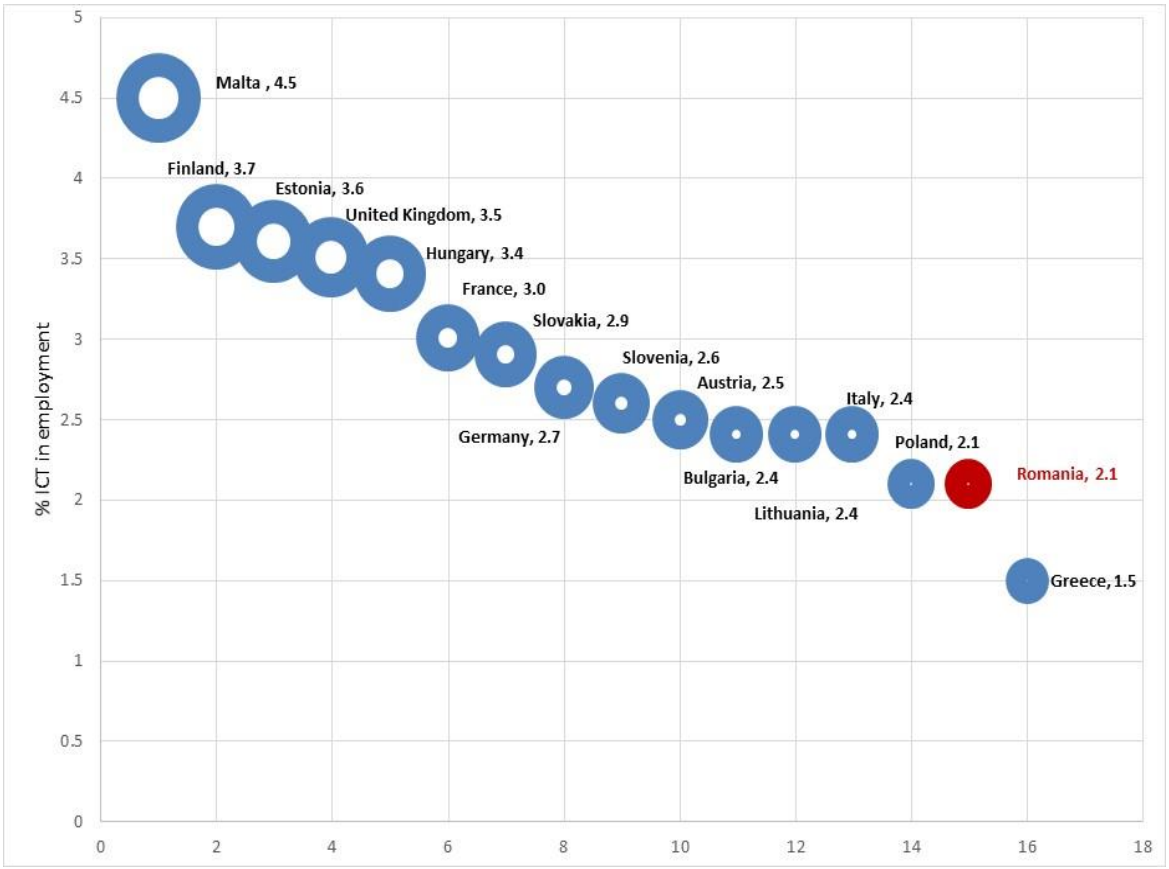


Source: Eurostat data.

The same year, the share of the ICT workers in the total employed population of Romania was 2.1%, compared to 4.5% in Malta, or to the 3% to 4% in Finland, Estonia, UK, Hungary and France (**Graph 9**).

[22] According to the definition accepted by Eurostat, in a broader sense, the information and communications technology (ICT) covers the following activities: manufacture of electronic components, computers and peripherals, communication equipment, electronic commodities, magnetic and optic recording devices; software editing, telecommunications; information technology services; web portal activities; data processing; web page management and related activities; repair of computers and communications equipment.

Graph 9: Share of the ICT sector in total employed population in some EU member states, 2016 (%)



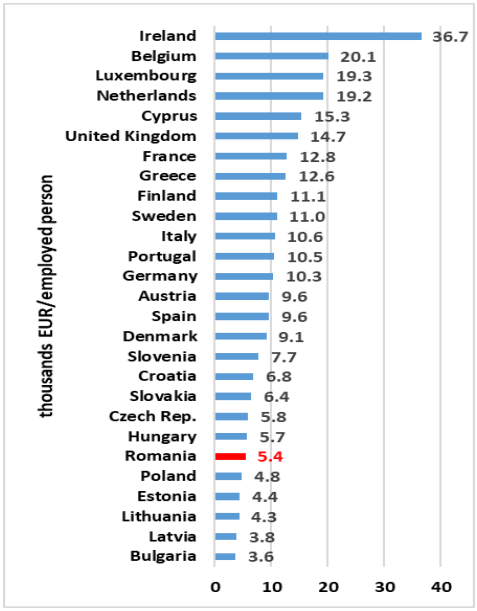
Source: Eurostat data.

The same shares have been reported in the average investment per employed person and the average costs for the personnel, which, in Romania are much below those in other EU member states.

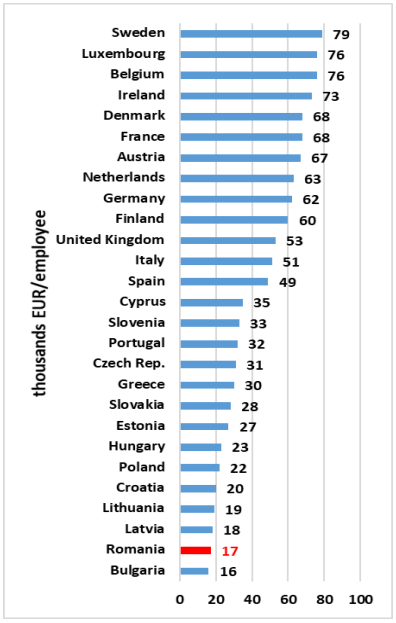
In 2016, for example, the average investment per one employed person in the ICT sector in Romania was 5.4 thou' euro, compared to 36.7 thou' euro in Ireland, 20.1 thou' euro in Belgium, 19.2-19.3 thou' euro in The Netherlands and Luxembourg, and 7.7 thou' euro in Slovenia (**Graph 10**).

In 2016, Romania was last but one in the classification of the EU member states regarding the average personnel costs per one ICT employee, with 17 thou' euro, against 79 thou' euro in Sweden, 33 thou' euro in Slovenia, and 31 thou' euro in The Czech Republic (**Graph 11**).

Graph 10: Average investment per employed person in ICT, 2016



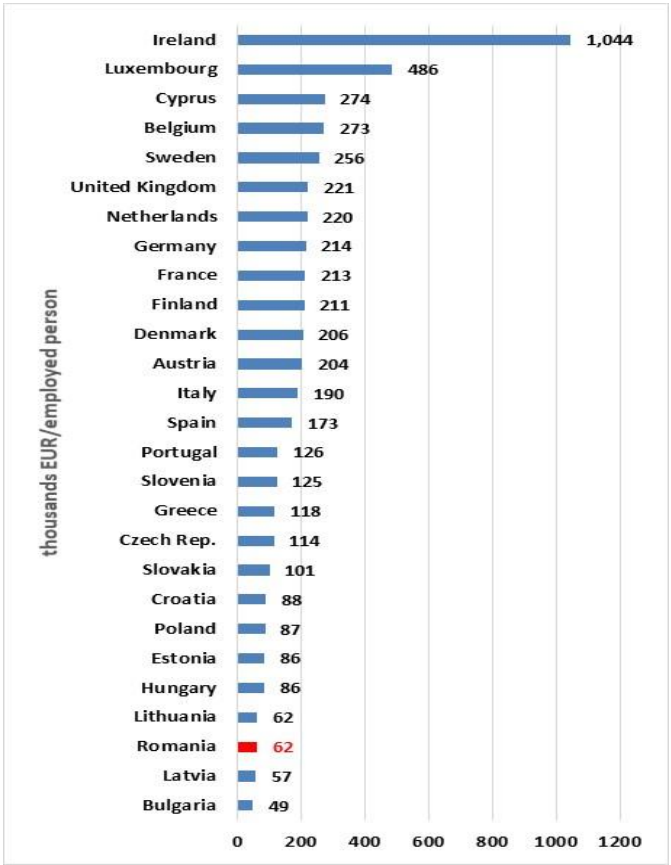
Graph 11: Average expenses for personnel in ICT, 2016



Source: Authors' compilation of Eurostat data.

Labour productivity, as an expression of the average turnover per employee in ICT, was, in Romania, in 2016, 16.8 times lower than in Ireland, 7.8 times lower than in Luxembourg, and almost half of that in Portugal and Slovenia (**Graph 12**).

Graph 12: Labour productivity in ICT - Average turnover per employed person, 2016



Source: Authors' compilation of Eurostat data.

According to the Classification of Activities in the National Economy (CAEN rev. 2), the ICT sector covers the activities listed under entries 58-63, i.e. telecommunications (CAEN code number 61), **information technology activities** (CAEN 62), information technology services (CAEN 63), and other, sector-specific, activities (CAEN 58-60).

We learn from Eurostat that, in 2016, in Romania, the activities fitting the description of the large umbrella of information technology were carried in approximately 19,606 business entities, with a total manpower of 135,830 persons, which means an average of 6.9 persons per business venture (**Table 5**).

Knowing that the average personnel expenses were 17.5 thou' euro, and that the average investment per employed person was approximately 1.7 thou' euro, labour productivity in the sector was about 46.2 thou' euro as average turnover per employed person.

Table 5

Main indicators in Romania's ICT sector, 2016

	UM	Code CAEN 63 Information technology services	Code CAEN 62 Information technology activities	Total
Number of ventures	number	4,510	15,096	19,606
Personnel costs	mil. euro	303	2,080.4	2,383.4
Turnover	mil. euro	1,260.3	5,025.6	6,286.2
Employed population	persons	28,154	107,676	135,830
Labour productivity (turnover/employed person)	thou' euro/ employed pers.	44.8	46.7	46.2
Average number of employees per venture	persons	6.0	7.1	6.9
Average personnel costs per employed person	thou' euro / employed pers.	10.8	19.3	17.5
Average investment per one employed person	thou' euro/ employed pers.	1.7	1.8	1.8

Source: Authors' compilation of Eurostat data.

The development of the ICT sector has been fostered by a growing demand for its services both on the domestic and foreign markets.

A recent study put out by the Software and Services Industry Employers Association (Asociația Patronală a Industriei de Software și Servicii – ANIS) in September 2018, the domestic market for software and IT services had, in 2017, a year on year growth of 2.1%, with a total of 975 mil. euro, and a turnover that had risen by 11% in 2017, from the level reached in 2016. The same professional association estimated that the total revenues generated by the software and IT services would amount to 4.5 bn. euro, up from the 4 bn. revenues in 2017[23].

The revenues of the software and IT services in the global external market in 2017 totalled some 3,025 bn. euro, which accounted for app 75,6% of the whole worth of the IT sector, up by over 14% from 2016. The bulk, 75%, of the revenues obtained in the IT products and services industry came from the European market, and 22% from the US and other non-EU markets.

The revenues of this industry in the Romanian market grew up by 2.1%, from 955 mil. euro in 2016 to 975 de mil. euro in 2017. Of all the revenues generated by the software and IT services for corporate clients, 22% were obtained from manufacturers, 20% from the public sector, 16% from the banking sector, 11% from telecommunications, and 8% each from utilities, trade, and other services operators.

[23] "Software and IT Services in Romania – 2018 Edition", Pierre Audoin Consultants (PAC), 2018.

The top 10 companies in this branch hold app 25% of the market segment. In the top 300 software IT services companies operating in the Romanian market, 40% of them are Romanian-capital companies.

5.2. Prospects of the ICT sector. A forecast

A NBR[24] study published in 2017, on the IT sector, proposes 3 possible scenarios regarding the evolution of the share of the gross value added (GVA) of the information and communications sector in the nominal GDP, subject to the projections until 2025 (according to the forecast made by NBR in its Report on Inflation, dated August 2017), based on the BNR's medium-term analysis and prognosis model (MAPM) for the real GDP, and the nominal GDP. The authors point out, however, that estimations up to a distant future are, inevitably, prone to greater uncertainties than forecasts for 6 to 8 quarters.

The three scenarios are as follows:

- **Scenario No. 1** starts from the premise that the growth of the gross value added in the information and communications sector in the 2017-2025-time segment will continue at the same pace as in 2016, respectively 13.8% real growth, and 15.8 % nominal growth. According to this scenario, with a GDP as estimated with the aid of MAPM until 2025, the share of the ICT in the GDP by that time horizon would reach 12.1%. As such, in 2025 the sector will have a contribution of 1.5 percentage points to the overall economic growth, from 0.7 percentage points in 2016), which translates into a doubling of its share in the GDP (**Table 6**);
- **Scenario No. 2** starts from the premise that, in 2017 – 2025, the gross value added of the ICT sector will increase by the average growth rate of the last five years prior to the Report. That would mean 9.5% real growth, and 12.8% nominal growth. Considering the GDP evolution estimated by the MAPM, the share of the ICT in the GDP would reach 9.6% by 2025. If so, the ICT sector's contribution to the overall growth of the economy would be 0.9 percentage points, from 0.7 percentage points in 2016);
- **Scenario No. 3** starts from the premise that the gross value added in the information and communications sector in the 2017-2025-time segment will grow at a rate representing the average growth of the last 10 years, i.e. 6.6% in real terms, and 12.8% in nominal term. Based on the GDP estimated by the MAPM until 2025, the share of the ICT by that time will be 9.6%. If proven right, the sector's contribution in 2025 to the economy's overall growth will be 0.6 percentage points, from 0.7 percentage points in 2016).

Table 6

Scenarios regarding the prospects of the ICT sector until 2025

Title of scenario: growth of the gross value added (nominal/real) during the period 2017-2025 in the information and communications sector	Share of the GVA of information and communications sector in the GDP, 2025 (%)	Real annual growth rate of GVA in the information and communications sector in 2025 (%)	Contribution of information and communications sector to the growth of the GDP in 2025 (%)
S1: at the rate of 2016	12.1	13.8	1.5
S2: by the average rate of the last 5 years	9.6	9.5	0.9
S3: by the average rate of the last 10 years	9.6	6.6	0.6

Source: Veaceslav Grigoraș, Andrei Tănase, "Studiu al evoluțiilor sectorului IT&C în România", National Bank of Romania, 2017.

[24] Veaceslav Grigoraș, Andrei Tănase, "Studiu al evoluțiilor IT&C in Romania", National Bank of Romania, 2017.

If the analysis of the software and IT services industry is narrowed down to the period 2018-2021, according to the ANIS study quoted above, the size of this market is estimated to grow from 4.5 bn. euro in 2018 to approximately 6.9 bn euro in 2021, which would be a rise by 53% (**Table 7**).

Table 7

Recent trends and forecasts for the software and IT services industry in Romania, by 2021

	2014	2015	2016	2017	2018	2019	2020	2021
Market size (mil. euro)	2,805	3,240	3,605	4,000	4,500	5,145	5,970	6,880
Annual growth rate (%)		15.5	11.3	11.0	12.5	14.3	16.0	15.2
Revenues domestic market (mil. euro)	950	990	955	975	1,045	1,145	1,245	1,360
Annual growth rate of the domestic market (%)		4.2	-3.5	2.1	7.2	9.6	8.7	9.2
Revenues from external markets (mil. euro)	1,855	2,250	2,650	3,025	3,455	4,000	4,725	5,520
Annual growth rate of the domestic market (%)		21.3	17.8	14.2	14.2	15.8	18.1	16.8

Source: ANIS data.

5.2.1. Structure of the labour force in the ICT sector

The same study shows that, in 2017, the total number of full-time contractual workers in the software and IT services was 89,850 trained employees, up by 7.5% from 2016. The great majority of them, 88.6%, hold technical positions. The others work in non-technical departments.

In 2017, almost 75% of the workers in the IT sector were employed by foreign capital ventures. Most of them, 81%, were employees of the top 5 IT companies. IT workers accounted for 87% of the top 10 companies, and represented 85% of the personnel in the top 50 companies (**Table 8**).

Table 8

Distribution of software and IT services workers by category of companies, and by source of capital, in 2017

	Romanian capital ventures (%)	Foreign capital ventures (%)
Total sector	25	75
Top 5 companies	19	81
Top 10 companies	13	87
Top 50 companies	15	85

Source: ANIS data.

The records of the Labour Inspectorate (Inspectia Muncii – IM) indicate that, in 2017, a number of 97,476 individual employment contracts were active for the 10 occupations in the IT sector that enjoy tax incentives[25]. By June 2018, the number of valid employment contracts had risen to 110,490 (**Table 9**).

[25] The tax incentives apply to 8 occupations that require an academic degree: software designer; analyst; programmer; software system engineer; software system programmer; software system engineer; software project manager; database administrator; and to 2 occupations that require high school IT education: assistant programmer; assistant analyst.

Table 9

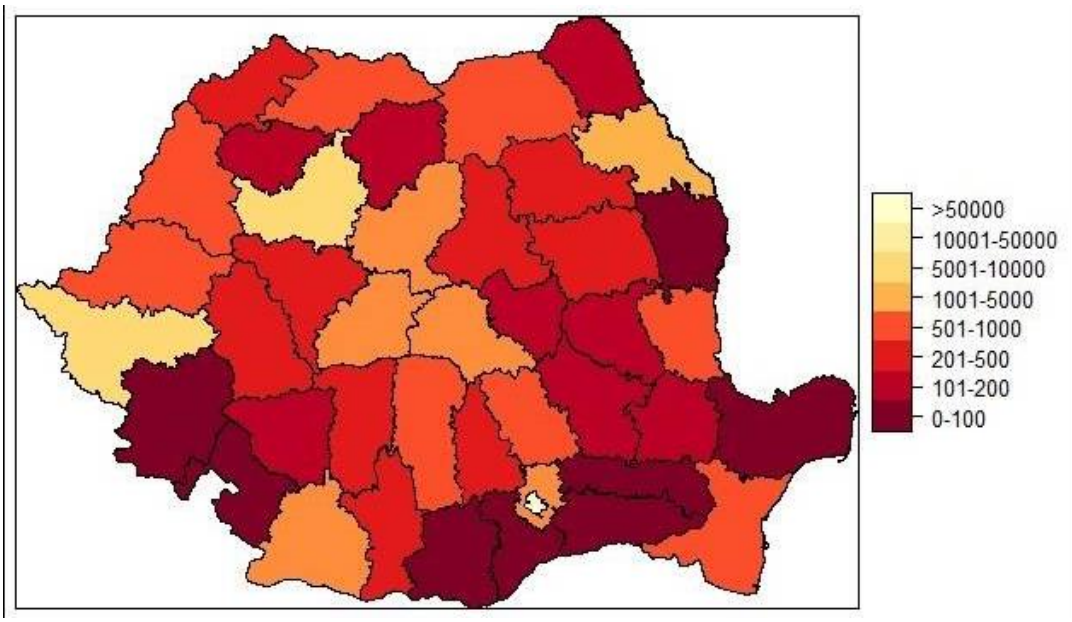
Number of individual employment contracts for the 10 occupations that enjoy tax incentives, by county, 2017-2018

	2017		2018	
	Number	% of total	Number	% of total
Total	**97,476**	**100.0**	**110,490**	100.0
Bucharest	46.826	48.0	52,935	47.9
Cluj	14,103	14.5	16,619	15.0
Timiș	9,748	10.0	12,143	11.0
Iași	3,958	4.1	6,409	5.8
Brașov	5,110	5.2	3,524	3.2
Sibiu	2,761	2.8	3,202	2.9
Ilfov	2,687	2.8	2,812	2.5
Dolj	1,462	1.5	1,491	1.3
Mureș	1,030	1.1	1,200	1.1
Bihor	932	1.0	979	0.9
Arges	896	0.9	969	0.9
Prahova	882	0.9	856	0.8
Arad	615	0.6	670	0.6
Galați	660	0.7	619	0.6
Constanta	581	0.6	578	0.5
Maramureș	515	0.5	562	0.5
Suceava	444	0.5	538	0.5
Bacău	376	0.4	385	0.3
Alba	352	0.4	349	0.3
Hunedoara	309	0.3	329	0.3
Harghita	278	0.3	298	0.3
Satu Mare	261	0.3	276	0.2
Olt	250	0.3	267	0.2
Vâlcea	264	0.3	253	0.2
Neamț	262	0.3	251	0.2
Dâmbovița	208	0.2	222	0.2
Gorj	164	0.2	183	0.2
Brăila	157	0.2	160	0.1
Sălaj	143	0.1	160	0.1
Bistrița-Năsăud	128	0.1	159	0.1
Covasna	164	0.2	158	0.1
Buzău	144	0.1	150	0.1
Botoșani	119	0.1	123	0.1
Vrancea	117	0.1	111	0.1
Vaslui	94	0.1	99	0.1
Caras-Severin	82	0.1	87	0.1
Teleorman	72	0.1	76	0.1
Tulcea	69	0.1	68	0.1
Mehedinți	61	0.1	64	0.1
Călărași	108	0.1	59	0.1
Ialomița	55	0.1	58	0.1
Giurgiu	29	0.0	39	0.0

Source: Authors' compilation of IM data.

As can be seen below, the geographical distribution of the individual employment agreements is highly uneven. In 2018, for example, almost half (47.9%) of them were concentrated in Bucharest; the top 9 counties ranked by this indicator account for almost 90% of the total number of individual employment agreements, while the last 9 counties hardly gather up 1% of the total number of agreements (**Map 2**).

Map 2: Average number of individual employment contracts for the 10 occupations benefitting from tax incentives, by county, 2017-2018



Source: Authors' compilation of IM data.

The individual employment agreements for graduates of IT higher education hold a majority share of 87.5%. The remaining share of 12.5% are agreements for workers with high school education.

By type of occupation, programmers are the most numerous (31.0%), next come the analysts (15.1%), followed by software system engineers (11.4%), assistant programmers (accounting for 9.8% of IT workers), software project managers (9.7%), and software system engineers (8.9%)

5.2.2. Forecasts regarding labour demand and supply in the ICT sector

If we start from the afore-mentioned estimations, the labour deficit in the ICT sector is likely to rise from 18,200 specialised personnel in 2018 to app 20,000 in 2021.

The estimations did not take into account the emigration of IT experts.

The purpose of our case study in the IT sector is to draw the attention of decision makers to the urgency for a strategic approach of the human resource issue regarding the IT sector and the geographical discrepancies affecting it. Such an approach, if pursuing to proceed to an accurate and meaningful examination of the state of facts, cannot do without up-to-date and detailed data.

The following sections address our detailed arguments sustaining our estimations.

5.2.2.1. Estimated demand for labour

Based on an expected growth of labour productivity in the software and IT services sector from 44.5 thou' euro/employee in 2017 to app 55.2 thou' euro/employee in 2021, ANIS forecasts a growth in the number of employees (full time workers) from 89,850 in 2017 to 124,740 in 2021 (**Table 10**).

Table 10

Recent trends and forecast regarding the number of employees and the labour productivity in the software and IT services sector

	2014	2015	2016	2017	2018	2019	2020	2021
Number of employees (full time workers)	71,590	77,335	83,565	89,850	96,490	104,520	113,800	124,740
Annual growth of number of employees (full time workers)	-	5,745	6,230	6,285	7,090	8,030	9,280	10,940
Labour productivity (euro/employee)	39,181	41,896	43,140	44,519	46,637	49,225	52,460	55,150

Source: ANIS data

If the forecasts are proven true, the number of employees (full time workers) in the software and IT services industry would grow by 7,090 in 2018 from 2017, by 8,030 in 2019, by 9,280 in 2020, and by 10,940 in 2021.

If the total share of the technical positions will continue to account for 89% of all IT jobs, then the demand for new entrants to the IT industry would be 6,310 in 2018, 7,147 in 2019, 8,259 in 2020, and 9,737 in 2021.

If we consider the natural exits from the system, plus the retirements, and if we add the demand for IT workers in other branches of the national economy, including the public sector, we foresee an at least 25% rise in the demand for IT qualified workers.

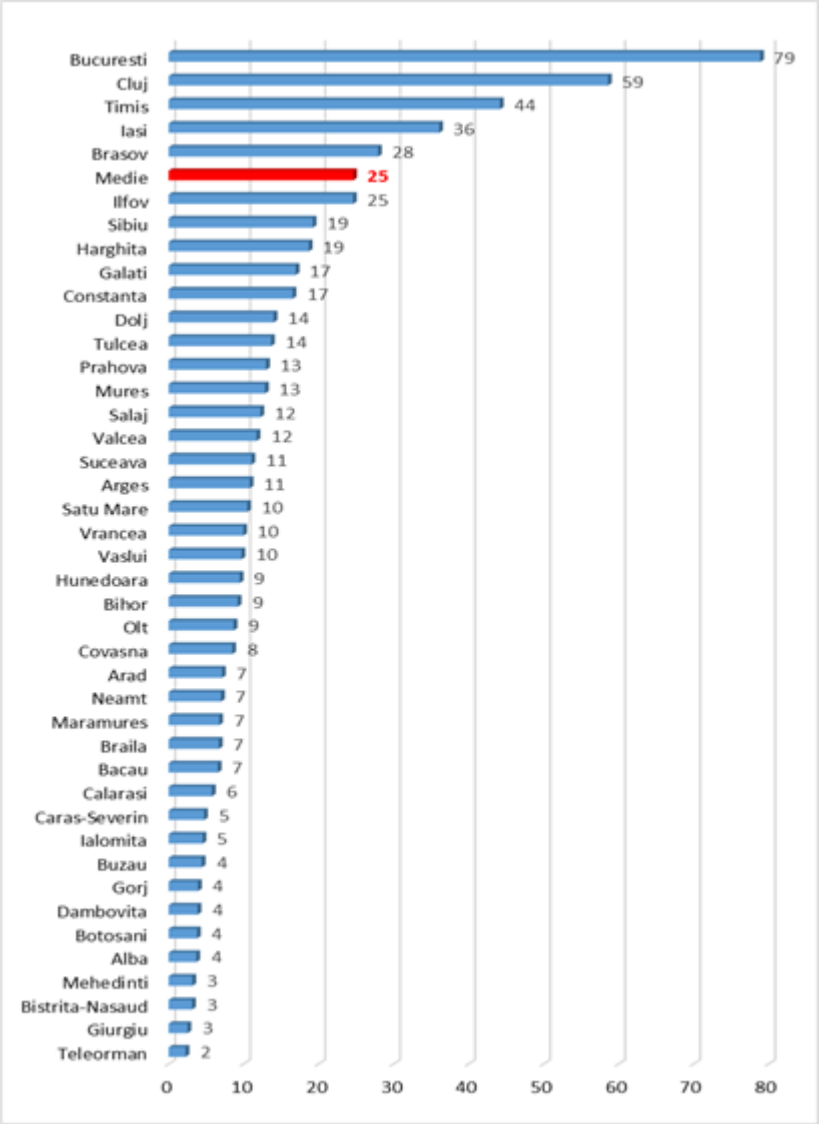
Although the statistic of vacant IT jobs in the inventory of the ANOFM does not hold a prime position among those in high demand, a quick search on two of the recruiting sites of employers seeking candidates for IT jobs identified over 8,000 job offers in each of them.

The Minister of Labour was saying, in November 2017, that, if the next day, by a miracle, the educational system produced 12,000 IT graduates, all at once, they would be absorbed by the labour market within a week.

These being the prerequisites, we predict that the offer of IT jobs was approximately 28,000 in 2018, 29,000 in 2019 and will be approximately 30,000 in 2020, and over 32,000 in 2021.

The estimated figures above do not reflect the attempts to level the significant gaps between regions/counties with regard to the average number of persons working in IT per 1,000 of employed persons (**Graph 13**).

Graph 13: Average number of persons working in IT, per 1,000 employed persons, in Romania, 2017



Source: Authors' compilation of NIS, Tempo online data.

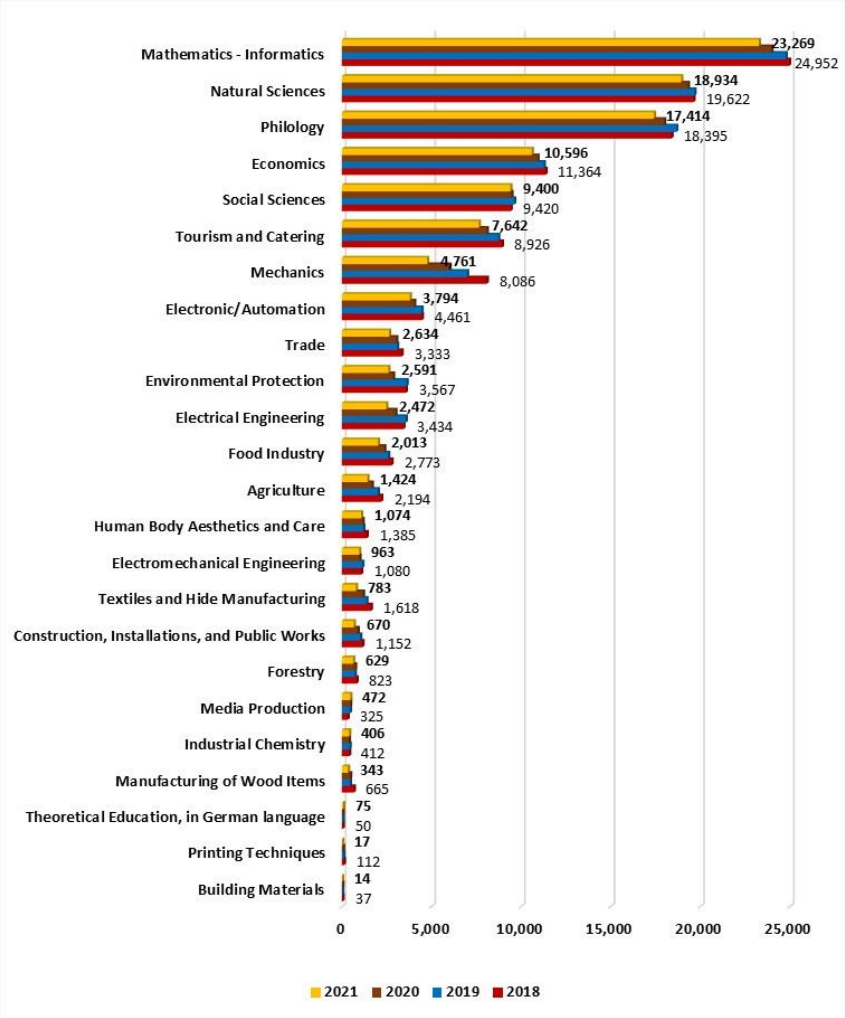
The offers of employment found on the labour recruiting sites cover a broad range of occupations, from entry level jobs for high school, and fresh higher education graduates, to positions for system managers and project managers.

5.2.2.2. The estimated offer of graduates from the educational system

Based on the data regarding the results of the examination for admission to high school, broken down by specialty, for the school years 2014/2015, 2015/2016, 2016/2017 and 2017/2018, available on the site admitere.edu.ro, **the number of high school graduates**, even on the assumption of a zero school dropout rate, continues its **downward trend**: 128,816 in 2018, 125,940 in 2019, 119,084 in 2020, and 112,390 in 2021.

Of the totals above, the number of graduates from the mathematics/informatics high schools/departments are estimated to go down from 24,952 in 2018, to 24,765 in 2019, 23,971 in 2020, and 23,269 in 2021 (**Graph 14**), accounting for a relatively constant share of 19-20% of total high school graduates (**Table 11**).

Graph 14: Forecast of the number of high school graduates, by specialty, with a zero dropout assumption, by 2021



Source: Estimations based on info from admitere.edu.ro

Table 11

Recent trends and forecast of the distribution of high school graduates across specialties, with a zero dropout assumption, by 2021 (%)

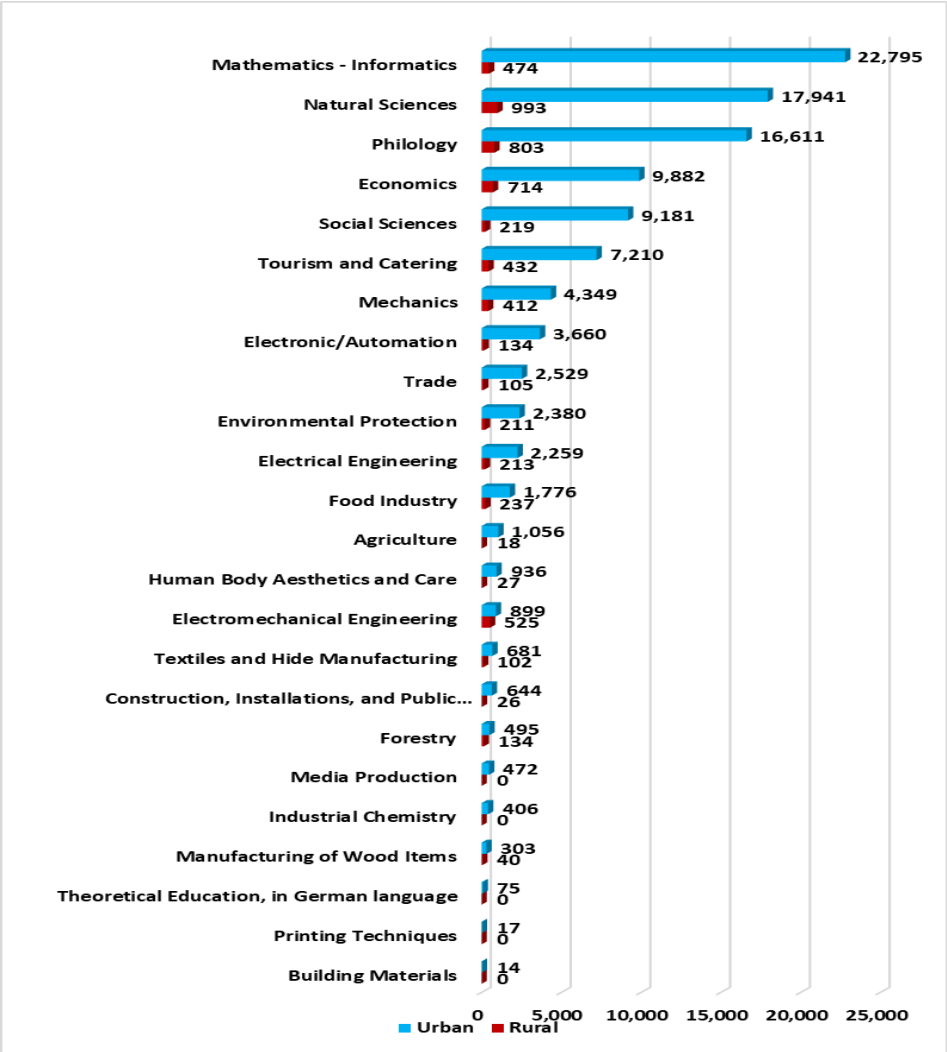
	2018	2019	2020	2021
Mathematics-informatics	19.5	19.7	20.1	20.7
Natural sciences	15.3	15.6	16.2	16.8
Philology	14.4	14.8	15.1	15.5
Economics	8.9	8.9	9.2	9.4
Social sciences	7.3	7.6	7.9	8.4
Tourism and catering	7.0	6.9	6.8	6.8
Mechanics	6.3	5.5	5.0	4.2
Electronics, automation	3.5	3.5	3.4	3.4
Trade	2.6	2.4	2.5	2.3
Environmental protection	2.8	2.9	2.4	2.3
Electrical engineering	2.7	2.8	2.5	2.2
Food industry	2.2	2.1	2.0	1.8
Agriculture	1.7	1.6	1.4	1.3

	2018	2019	2020	2021
Human Body Aesthetics and Care	1.1	1.0	1.0	1.0
Electromechanical engineering	0.8	0.9	0.8	0.9
Textiles and hide manufacturing	1.3	1.1	1.0	0.7
Construction, installations, and public works	0.9	0.8	0.7	0.6
Forestry	0.6	0.6	0.6	0.6
Media production	0.3	0.4	0.4	0.4
Industrial chemistry	0.3	0.3	0.3	0.4
Manufacture of wood items	0.5	0.4	0.4	0.3
Technical sciences, German language intensive	0.0	0.0	0.0	0.1
Printing technology	0.1	0.1	0.1	0.0
Building materials	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0

Source: Estimations based on data from admitere.edu.ro

The number of graduates from vocational high schools in the rural areas continues to be low: 2.03% in 2021 (**Graph 15**).

Graph 15: Number of high school graduates, by specialty and residential environment, by 2021



Source: Estimations based on data from admitere.edu.ro

Based on the assumption of a very low dropout rate of students attending the mathematics/informatics schools/departments (below 1%), of a high successful graduation rate of the baccalaureus examination (98%), and of 95% and plus rate of admission to higher education institutions, we can surmise that very few of these graduates will choose employment after graduation from high school.

Also falling in number were the graduates of post-high school informatics courses: from 1,600 in 2014, to 1,492 in 2015, and 1,483 in 2016 (**Table 12**).

Table 12

Number of post-high school course graduates

Training specialties	2014	2015	2016
Total	32.037	31.083	29.272
Machine building	586	714	555
Electrical and electronic engineering	331	351	347
Mining	:	:	:
Geology	14	15	:
Metallurgy	25	30	48
Energy	207	213	208
Industrial chemistry	284	304	414
Building materials	:	:	:
Construction and assembly	739	683	679
Wood harvesting and processing	277	175	234
Transport	1.447	1.531	1.508
Post and telecommunications	262	228	255
Food industry	522	444	410
Commodities industry	202	213	341
Printing	:	:	:
Agriculture	315	334	292
Forestry	409	440	461
Trade	888	676	726
Finance, accounting, administration	322	288	341
Tourism	1.040	1.062	1.050
Services	682	575	609
Informatics	**1.600**	**1.492**	**1.483**
Health	21.110	20.107	17.938
Culture	39	71	59
Education	43	29	41
Social care	:	12	15
Agricultural and food technology	127	174	378
Management	24	87	73
Other	542	835	807

Source. Authors' compilations of NIS data.

Absent detailed information on the number of first year entrants, we have taken as a premise for our estimations a constant number of approximately 1,500 per year.

The number of graduates from **higher education in the information and communications technology** (holders of bachelor, master, post-academic studies, doctoral and post-doctoral

degrees), according to INS data, followed a **downward** trend, from 7,142 in 2014, to 5,992 in 2015, and then went up to 6,750 in 2016 (**Table 13**).

In 2016, the number of graduates with a bachelor's degree in ICT was 4,891. They were followed by holders of a master's and post-academic degrees (1,821), and the graduates from doctoral and post-doctoral programmes (38).

Table 13

Higher education graduates, ISCED-F 2013: Information and communications technology (ICT)

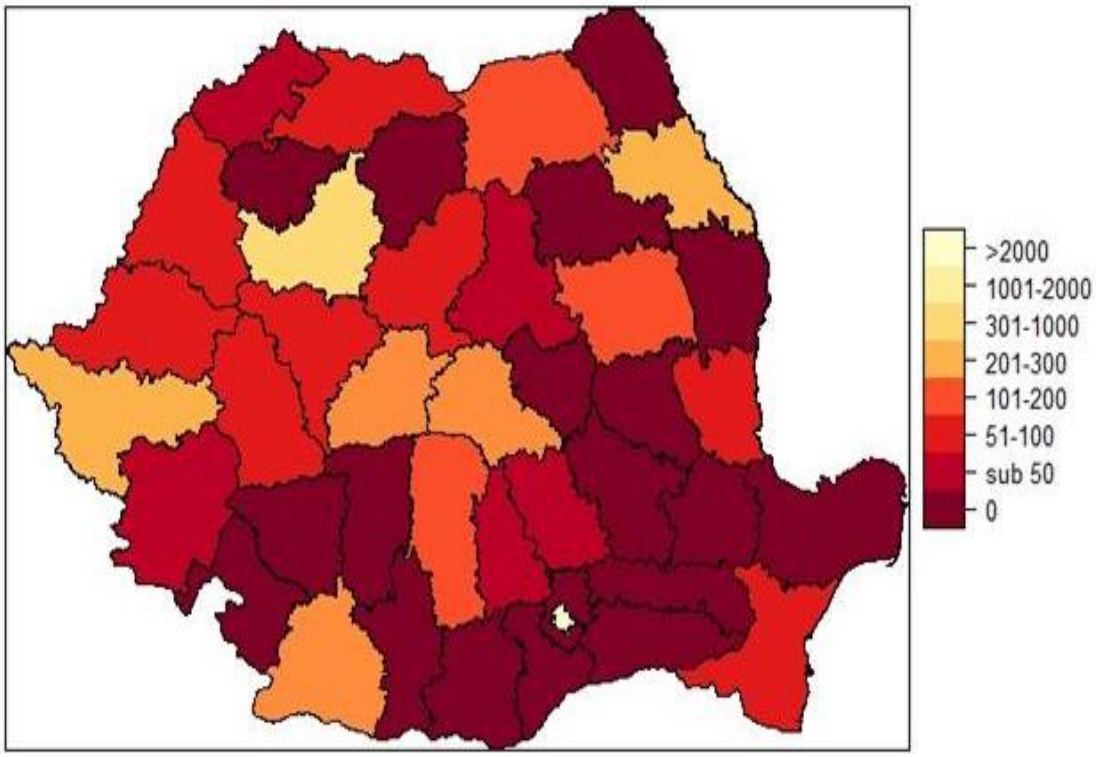
Region/ County	Higher education graduates holding a bachelor's, master's, post-academic, doctoral, and post-doctoral degree			Higher education graduates with a bachelor's degree			Higher education graduates with a master's and post-academic degree -			Higher education graduates with a doctoral and post-doctoral degree		
	2014	2015	2016	2014	2015	2016	2014	2015	2016	2014	2015	2016
TOTAL	7,142	5,992	6,750	4,855	4,.333	4,891	2,184	1,606	1,821	103	53	38
NORTH-WEST	1,074	1,111	1,201	776	859	952	272	225	243	26	27	6
Bihor	139	86	88	95	86	75	44	:	13	:	:	:
Cluj	861	951	1,045	634	710	823	201	214	216	26	27	6
Maramureș	56	54	55	29	43	41	27	11	14	:	:	:
Satu Mare	18	20	13	18	20	13	:	:	:	:	:	:
CENTRE	726	586	669	478	402	431	229	182	236	19	2	2
Alba	40	56	55	31	44	39	9	12	16	:	:	:
Brașov	368	230	283	245	191	199	104	37	82	19	2	2
Harghita	:	:	7	:	:	7	:	:	:	:	:	:
Mureș	86	81	86	74	64	68	12	17	18	:	:	:
Sibiu	232	219	238	128	103	118	104	116	120	:	:	:
NORTH-EAST	763	736	835	600	540	665	153	183	164	10	13	6
Bacău	143	101	121	80	60	93	63	41	28	:	:	:
Iași	535	515	611	457	412	489	68	96	120	10	7	2
Suceava	85	120	103	63	68	83	22	46	16	:	6	4
SOUTH-EAST	195	161	184	142	132	149	49	29	35	4	:	:
Constanta	97	66	87	86	65	78	11	1	9	:	:	:
Galați	98	95	97	56	67	71	38	28	26	4	:	:
SOUTH-MUNTENIA	241	206	264	181	160	174	60	46	90	:	:	:
Arges	165	122	174	139	102	115	26	20	59	:	:	:
Dâmbovița	36	39	49	22	25	30	14	14	19	:	:	:
Prahova	40	45	41	20	33	29	20	12	12	:	:	:
BUCHAREST-ILFOV	2,851	1,961	2,351	1,758	1,316	1,555	1,053	636	772	40	9	24
Bucharest City	2,851	1,961	2,351	1,758	1,316	1,555	1,053	636	772	40	9	24
SOUTH-WEST OLTENIA	336	281	271	210	206	185	124	75	86	2	:	:
Dolj	336	281	271	210	206	185	124	75	86	2	:	:
WEST	956	950	975	710	718	780	244	230	195	2	2	:
Arad	102	97	88	72	74	78	30	23	10	:	:	:
Caras-Severin	4	3	13	4	3	13	:	:	:	:	:	:
Hunedoara	55	58	52	16	22	27	39	36	25	:	:	:
Timiș	795	792	822	618	619	662	175	171	160	2	2	:

Source: NIS data.

The distribution of graduates from an academic course in ICT, in 2016, was the following: 34.8% completed their studies in educational establishments in the Bucharest-Ilfov Region, 17.8% in the North-West Region, 14.4% in the West Region, 12.4% in the North-East Region, 9.9% in the

Centre, 4% in South-West Oltenia, 3.9% in South-Muntenia, and 2.7% in the South-East Region. The graduates' distribution across counties is widely uneven (**Map 3**).

Map 3: Number of higher education graduates, ISCED-F 2013: Information and communications technology (ICT)



Source: Authors' compilation based on NIS data.

The National Register for Higher Education Qualifications (Registrul Național al Calificărilor din Învățământul Superior – RNCIS) carries information about the higher education specialties accredited with various suppliers of academic studies, and indicates the occupations for which the holders of appropriate credentials qualify, and the COR code under which they are listed. The specialties entitling graduates to practise any of the 8 IT occupations requiring higher learning have been excerpted from RNCIS, and are presented in **Appendix 1**.

Based on the information available from each of the universities giving courses for these qualifications, we estimated the number of first entrants the bachelor's courses for the academic years 2014/2015, 2015/2016, 2016/2017, and 2017/2018. In 2018, the **IT sector was declared one of the priority sectors, and the number of places for these qualifications in the higher educational system were supplemented.**

The projections over the following three years, based on the number of entrants, assuming that the current early dropout rates will be constant (app 18%), resulted in the following estimations for the total number of graduates in the 8 IT occupations: 7,000 in 2018, 7,500 in 2019, 8,000 in 2020, and 8,500 in 2021. The same projections predict that app. 2,000 bachelor graduates in 2018, 2,500 in 2019, 3,000 in 2020, and 3,500 in 2021 will not enrol in academic courses for a master's degree.

The array of academic training options for a master's degree in the 8 ICT occupations is prodigiously rich (**Appendix 2**). Master degree studies last for 1-2 years. Taking as a calculation basis the numerus classes for the academic year 2018/2019, the annual number of graduates from a master's course, available to enter the labour market in these occupations is in the region of 5,000.

Based on the assumptions above, the foreseeable labour deficit in the ICT sector is estimated to rise from 18,200 professionals in 2018 to 20,800 in 2021 (Table 14).

Table 14

Forecasts regarding the supply and demand for labour in the ICT sector, 2018-2021 (persons)

	2018	2019	2020	2021
Estimated supply from the educational system	9,700	10,200	10,700	11,200
Estimated demand for labour	27,900	28,900	30,300	32,000
Deficit	18,200	18,700	19,600	20,800

Source: Authors' compilation.

Please note that the forecasted figures do not include the parameter of emigration of IT professionals.

The case study on the IT sector is an attempt to demonstrate the urgency of a strategic approach to the human resources in a sensitive sector, by measures tailored to local specifics, and the need for such an approach to be anchored in update and detailed information permitting accurate and meaningful analyses.

6. Conclusions

The sustainable development of Romania involves long-term strategic approaches in the field of human resources, considering that, over a decade, Romania has lost by emigration an estimated number of 3-4 million working-aged persons.

In recent years, the labour market in Romania became more and more tense, with growing labour shortages that hinder the current activities and the development prospects in important economic sectors: manufacturing and agriculture, construction, services, including tourism and IT, but also in education, health and public administration.

Among the causes of the emergence and persistence of these labour shortages are the unfavourable demographic trends, the massive external migration of the skilled and high skilled labour force, the low level of the participation rate and the high inactivity rate, the limited internal geographical mobility, the size of undeclared work that continues to distort the labour market, the fact that the minimum wage is set in a discretionary manner, the lack of cooperation between employers and institutions with responsibilities in the field of employment and training.

Many studies and reports of prestigious authors and international institutions have drawn attention to the serious challenges facing Romania's labour market, which represent obstacles to potential growth and competitiveness improvement, as evidenced by the increase in the unit cost of labour on the account of faster increase in wages compared to labour productivity. The poor performances of the educational system were also highlighted, which contributed to major discrepancies and inequalities in terms of employment opportunities. Given the low impact of active labour market policies and the high administrative barriers, the public programmes at the local levels have proved ineffective in trying to ensure the professional reconversion towards the required qualifications and skills in the labour market, while the inter-institutional cooperation between the public employment services, as well as between these and the external public services providers, was limited.

The analysis of the over-qualification rate during the period 2008-2016, on the main economic activities NACE Rev. 2, emphasized that, unlike most of the EU advanced countries, in the case of Romania the vertical mismatches have deepened in all these activities, increasing the share of the workers with higher studies employed in jobs that do not require a tertiary level education. The horizontal mismatches for the employed persons in the 15-34 years' age group have also increased, especially in the educational fields with a humanistic and social profile, with the observation that in this age group, in the case of for people with higher education, the mismatches are relatively lower.

According to the surveys conducted at the level of the business environment in Romania, if in 2014, only 2 out of 5 employers had difficulties in filling the vacant positions, the share of employers in this situation has increased to 80% in 2018. An important indicator expressing the gap between the demand and the supply of work in relative terms is the labour market tightness, in the case of Romania it has been significantly increasing in recent years. In the context of serious wage pressures, in 2018, despite the slight improvement of the employment intentions, there has been an exacerbation of the difficulties for companies in recruiting qualified personnel.

The surveys regarding the access of young people to the labour market revealed quantitative and qualitative mismatches between the supply of the education system and the real needs of the labour market. It is worth mentioning that the share of students with professional experience during the studies is very low, about ¼ of the employed young people do not have an employee status, only in the case of 44% of young people there is an adequacy between the level of training and the job requirements. Regarding the nearly one million NEETs (young people who are neither in the labour market nor in the education system), it was found that less than half have graduated programs and qualifications and that 80% of them are not willing to change residence to find a job.

The study also revealed that, seen from the point of view of the vacant jobs, the labour shortages record different amplitudes and connotations from one region to another, from one county to another, from one sector to another, depending on a complex of factors, significant territorial disparities being highlighted.

The case study conducted on the IT&C sector, a developing sector in Romania, with potential and growth rate above the national average, led to the conclusion that, although it was declared a strategic priority by the decision makers, the labour shortages remains high despite the support measures promoted. The estimates regarding different components of the demand (the forecasts regarding the growth potential of the sector) and of the labour force supply (demo-economic components, the enrolments in different forms of education and training in the specializations of the sector, rates of early school leaving) have led to the conclusion that, in the absence of adequate measures, the labour shortages in the IT&C sector will continue to grow to over 20,000 specialists by 2021.

The Coronavirus outbreak early 2020 and became pandemic, beside painful human and social costs, will derail the global economy with effects whose magnitude and duration is difficult to predict. With many vulnerabilities in economy and a precarious budgetary situation, Romania is trapped in an unfavourable position to face these huge challenges. A particularity of Romania under these circumstances and, to some extent, also of other EU Eastern countries, is the one related to the massive return flows of migrant workers and their families from the Western countries, as we have already witnessed since March 2000, due to the loss of their jobs. Depending on how Romania’s authorities succeed to manage the Coronavirus crisis, these flows, at least partially, could be redirected towards the labour market, alleviating the quantitative and qualitative workforce shortages and contributing to maintain the economy in functional parameters, otherwise new tensions may arise on a labour market so fragile and with severe social and economic impact.

In the Part III of the study, which will be published soon, demographic projections and of the main indicators of the Romanian labour market are to be developed with a horizon of 2025, based on econometric models. In this context the labour shortages are to be revealed, as well as some recommendations, measures and policies aimed at mitigating them.

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Appendix 1

Universities providing courses for a bachelor's degree in the 8 IT occupations coded under COR

University	County	Title of Specialty	Occupations that can be practised in the labour market	Occupation's COR code
Academia de Studii Economice din Bucuresti	Bucharest	Economic Cybernetics	Analyst	251201
Academia de Studii Economice din Bucuresti	Bucharest	Statistics and Economic Forecasting	Analyst	251201
Academia de Studii Economice din Bucuresti	Bucharest	Economic Informatics	Analyst	251201
Academia de Studii Economice din Bucuresti	Bucharest	Accounting and Management Informatics	Finance and Accounting Officer / Management Comptroller / Analyst	241104/ 241106/ 251201
Academia Tehnică Militară din Bucuresti	Bucharest	Computer Science and Informatics Systems for Defence and National Security	System Engineer for Informatics /Informatics System Programmer / Computer Network Administrator	251203/ 251204/ 252301
Academia Tehnica Militara din Bucuresti	Bucharest	Engineering and Security of Military Informatics Systems	Expert in Security Procedures and Instruments for Informatics Systems / Software System Engineer / Expert in computer-aided design	251402/ 251205/ 251401
Universitatea 1 Decembrie 1918 din Alba Iulia	Alba	Informatics	Analyst /Informatics System Programmer / System Engineer for Informatics	251201 /251204 / 251203
Universitatea Alexandru Ioan Cuza din Iași	Iași	Physics	Physicist / Assistant Researcher in Physics / Analyst	211101/ 211103/ 251201
Universitatea Alexandru Ioan Cuza din Iași	Iași	Informatics Physics	Physicist/ Assistant Researcher in Physics / Programmer	211101/ 211103/ 251202
Universitatea Alexandru Ioan Cuza din Iași	Iași	Informatics	Database Administrator / Teacher in Lower Secondary (forms 5 – 8) Education / Assistant Researcher in Informatics	252101/ 233002/ 214918
Universitatea Aurel Vlaicu din Arad	Arad	Informatics	Programmer / Database Administrator / Computer Network Administrator	251202/ 252101/ 252301
Universitatea Aurel Vlaicu din Arad	Arad	Applied Informatics	Programmer / Informatics Consultant / Computer Network Administrator	251202/ 251901/ 252301
Universitatea Babeș-Bolyai din Cluj-Napoca	Cluj	Accounting and Management Informatics	Finance and Accounting Officer / Management Comptroller / Analyst	241104/ 241106/ 251201
Universitatea Babeș-Bolyai din Cluj-Napoca	Cluj	Informatics Physics	Physicist/ Programmer / Assistant Researcher in Physics	211101/ 251202/ 211103

University	County	Title of Specialty	Occupations that can be practised in the labour market	Occupation's COR code
Universitatea Babeș-Bolyai din Cluj-Napoca	Cluj	Informatics	Analyst / Programmer / Teacher in Lower Secondary (forms 5 – 8) Education	251201/ 251202/ 233002
Universitatea Babeș-Bolyai din Cluj-Napoca	Cluj	Economic Informatics	Informatics System Designer/ Programmer / Consultant in Informatics	251101/ 251202/ 251901
Universitatea Creștină Dimitrie Cantemir din Bucuresti	Bucharest	Accounting	Finance and Accounting Officer / Adviser/ Expert/ Inspector/ Reviewer/ Business Management Economist / Database Administrator	241104/ 263106/ 252101
Universitatea Creștină Dimitrie Cantemir din Bucuresti	Bucharest	Accounting and Management Informatics	Finance and Accounting Officer / Adviser/ Expert/ Inspector/ Reviewer/ Business Management Economist / Database Administrator	241104/ 263106/ 252101
Universitatea de Vest din Timișoara	Timiș	Accounting and Management Informatics	Accountant / Finance and Accounting Officer / Database Administrator	331302/ 241104/ 252101
Universitatea de Vest din Timișoara	Timiș	Informatics	Database Administrator / Analyst / Programmer	252101/ 251201/ 251202
Universitatea de Vest din Timișoara	Timiș	Informatics	Database Administrator / Analyst / Programmer	252101/ 251201/ 251202
Universitatea de Vest din Timișoara	Timiș	Applied Informatics	Computer Network Administrator / Analyst / Programmer	252301/ 251201/ 251202
Universitatea de Vest din Timișoara	Timiș	Economic Informatics	Informatics System Designer / Analyst / Programmer	251101/ 251201/ 251202
Universitatea de Vest din Timișoara	Timiș	Mathematical Informatics	Mathematician / Analyst / Computer Network Administrator	212009/ 251201/ 252301
Universitatea de Vest Vasile Goldiș din Arad	Arad	Informatics	Programmer / Analyst / Informatics System Programmer	251202/251201/251204
Universitatea de Vest Vasile Goldiș din Arad	Arad	Informatics (IFR) – short-course education	Programmer / Analyst / Informatics System Programmer	251202/251201/251204
Universitatea din Bucuresti	Bucharest	Information Technology	Computer Network Administrator / VOIP (IP telephony) Network Administrator / System Engineer in Informatics	252301/252302/251203
Universitatea din Bucuresti	Bucharest	Physics of Information Technology	Physicist/ Teacher in Lower Secondary (forms 5 – 8) Education / Programmer	211101/233002/251202
Universitatea din Bucuresti	Bucharest	Informatics	Database Administrator / Programmer / Analyst	252101/251202/251201
Universitatea din Bucuresti	Bucharest	Informatics	Database Administrator / Programmer /	252101/251202/251201

University	County	Title of Specialty	Occupations that can be practised in the labour market	Occupation's COR code
			Analyst	
Universitatea din Craiova	Dolj	Computers	Programmer / Software System Engineer / System and Computer Design Engineer	251202 / 251205 / 215214
Universitatea din Craiova	Dolj	Multimedia Systems Engineering	E-Media Specialist / Design Engineer for Communications / Software System Engineer	251303 / 215310 / 251205
Universitatea din Craiova	Dolj	Informatics	Programmer / System Engineer in Informatics / Informatics System Programmer	251202 / 251203 / 251204
Universitatea din Craiova	Dolj	Economic Informatics	Informatics Project Manager / Informatics System Programmer / Analyst	251206 / 251204 / 251201
Universitatea din Pitești	Arges	Informatics	Analyst / Programmer	251201/251202
Universitatea din Pitești	Arges	Informatics (in Râmnicu Vâlcea)	Analyst / Programmer	251201/251202
Universitatea Dunărea de Jos din Galați	Galați	Computers	Analyst / Programmer / System Engineer in Informatics	251201/251202/251203
Universitatea Dunărea de Jos din Galați	Galați	Mecatronics	Electromechanical Engineer / System Engineer in Informatics / Industrial Robotics Research Engineer	215216/251203/215134
Universitatea Dunărea de Jos din Galați	Galați	Accounting and Management Informatics	Database Administrator / Credit Officer / Analyst	252101/241215/251201
Universitatea Dunărea de Jos din Galați	Galați	Informatics	Mathematician / Teacher in Lower Secondary (forms 5 – 8) Education / Programmer	212009/233002/251202
Universitatea Dunărea de Jos din Galați	Galați	Economic Informatics	Computer Network Administrator / Analyst / Assistant Researcher in General Economics	252301/251201/263117
Universitatea Eftimie Murgu din Reșița	Caras Severin	Industrial Informatics	System Engineer in Informatics / Informatics System Programmer	251203/251204
Universitatea Hyperion din Bucuresti	Bucharest	Informatics	Consultant in Informatics / Analyst / Informatics System Programmer	251901/251201/251204
Universitatea Lucian Blaga din Sibiu	Sibiu	Industrial Informatics	System Engineer in Informatics / Software System Engineer / Informatics System Designer	251203/251205/251101
Universitatea Lucian Blaga din Sibiu	Sibiu	Multimedia Systems Engineering	System Engineer in Informatics / Software System Engineer / Informatics System Designer	251203/251205/251101
Universitatea Lucian Blaga din Sibiu	Sibiu	Information Technology	Software System Engineer / Security System Engineer / System and Computer Design Engineer	251205/215222/215214
Universitatea Lucian Blaga din Sibiu	Sibiu	Accounting and Management Informatics	Finance and Accounting Officer / Management Comptroller / Database	241104/241106/252101

University	County	Title of Specialty	Occupations that can be practised in the labour market	Occupation's COR code
			Administrator	
Universitatea Lucian Blaga din Sibiu	Sibiu	Informatics	Informatics System Programmer / Database Administrator / Computer Network Administrator	251204/252101/252301
Universitatea Lucian Blaga din Sibiu	Sibiu	Mathematical Informatics	Mathematician / Teacher in Lower Secondary (forms 5 – 8) Education / Programmer	212009/233002/251202
Universitatea Ovidius din Constanta	Constanta	Informatics	Programmer / Database Administrator / Computer Network Administrator	251202/252101/252301
Universitatea Ovidius din Constanta	Constanta	Mathematics-Informatics	Teacher in High School and Post-High School Education / Teacher in Lower Secondary (forms 5 – 8) Education / Programmer	233001/233002/251202
Universitatea Petrol-Gaze din Ploiești	Prahova	Engineering and Informatics of Chemical and Biochemical Processes	Chemical Engineer / Automation Engineer / System Engineer in Informatics	214513/215202/251203
Universitatea Petrol-Gaze din Ploiești	Prahova	Informatics	Programmer / Database Administrator / Computer Network Administrator	251202/252101/252301
Universitatea Petrol-Gaze din Ploiești	Prahova	Economic Informatics	Database Administrator / Computer Network Administrator / Informatics System Programmer	252101/252301/251204
Universitatea Petru Maior din Târgu Mureș	Mureș	Informatics	Teacher in Lower Secondary (forms 5 – 8) Education / Analyst / Programmer	233002/251201/251202
Universitatea Politehnica din Bucuresti	Bucharest	Applied Automation and Informatics	Automation Engineer / Manufacturing Engineer / Informatics System Designer	215202/215205/251101
Universitatea Politehnica din Bucuresti	Bucharest	Mathematics and Informatics Applied to Engineering	System Engineer in Informatics / Software System Engineer	251203/251205
Universitatea Politehnica din Bucuresti	Bucharest	Information Technology	Informatics System Designer / Software System Engineer / Manufacturing Engineer	251101/251205/215205
Universitatea Politehnica Timișoara	Timiș	Computers	System Engineer in Informatics / Software System Engineer / Informatics Project Manager	251203/251205/251206
Universitatea Politehnica Timișoara	Timiș	Informatics	System and Computer Design Engineer / Informatics System Programmer / Informatics Project Manager	215214/251204/251206
Universitatea Spiru Haret din Bucuresti	Bucharest	Informatics	Analyst / Programmer / System Engineer in Informatics / Programmer	251201 / 251202 / 251203

University	County	Title of Specialty	Occupations that can be practised in the labour market	Occupation's COR code
Universitatea Stefan cel Mare din Suceava	Suceava	Economic Informatics	Database Administrator / Bank Security System Administrator / Computer Network Administrator	252101 / 252201 / 252301
Universitatea Stefan cel Mare din Suceava	Suceava	Computers	Informatics System Designer	251101
Universitatea Tehnica de Construcții din Bucuresti	Bucharest	Applied Automation and Informatics	Automation Engineer / System Engineer in Informatics / System and Computer Design Engineer	215202/251203/215214
Universitatea Tehnica Gheorghe Asachi din Iași	Iași	Applied Automation and Informatics	Automation Engineer / Software System Engineer / Assistant Researcher in Automatics	215202/251205/215240
Universitatea Tehnica Gheorghe Asachi din Iași	Iași	Computers	System Engineer in Informatics / Programmer / Computer Network Administrator	251203/251202/252301
Universitatea Titu Maiorescu din Bucuresti	Bucharest	Informatics	Programmer / Database Administrator / Computer Network Administrator	251202/252101/252301
Universitatea Transilvania din Brașov	Brașov	Applied Automation and Informatics	Automation Engineer / System and Computer Design Engineer / Assistant Researcher in Automatics	251202 / 251214 / 251240
Universitatea Transilvania din Brașov	Brașov	Informatics	Analyst / Programmer / System Engineer in Informatics / Programmer	251201 / 251202 / 251203
Universitatea Transilvania din Brașov	Brașov	Applied Informatics	Informatics System Programmer / Software System Engineer / Informatics Project Manager	251204/ 251205 / 251206
Universitatea Valahia din Târgoviște	Dâmbovița	Multimedia Systems Engineering	Software System Engineer / Web Page Designer (higher education) / Audio video Producer	251205/216610/265430
Universitatea Vasile Alecsandri din Bacău	Bacău	Informatics	Informatics System Programmer / Database Administrator / Teacher in Lower Secondary Education (forms 5 - 8)	233002 / 251204 / 252101

Source. Authors' compilation based on RNCIS and academic web sites data.

Appendix 2

Universities providing courses for a master's degree in the 8 IT occupations coded under COR

Universitatea	Title of master's degree	County	Occupations degree holders may practise in the labour market	Occupation's COR code
Academia de Studii Economice din Bucuresti	Databases – Business Support	Bucharest	Analyst	251201
Academia de Studii Economice din Bucuresti	E-Business	Bucharest	Analyst	251201
Academia de Studii Economice din Bucuresti	Statistics	Bucharest	Analyst	251201
Universitatea 1 Decembrie 1918 din Alba Iulia	Advanced Programming and Databases	Alba	Programmer /Software System Engineer / Informatics Project Manager	251202 /251205 / 251206
Universitatea Alexandru Ioan Cuza din Iași	Development of Software and Informatics Systems for Business Administration / Software Development and Business Information, tuition in English language	Iași	Database Administrator / Informatics System Programmer / Informatics Project Manager	252101/251204/251206
Universitatea Alexandru Ioan Cuza din Iași	Software Systems Engineering	Iași	Database Administrator / Teacher in High School and Post-High School Education / Researcher in Informatics	252101/233001/214917
Universitatea Alexandru Ioan Cuza din Iași	Computational Linguistics	Iași	Database Administrator / Teacher in High School and Post-High School Education / Researcher in Informatics	252101/233001/214917
Universitatea Alexandru Ioan Cuza din Iași	Computational Optimisation	Iași	Database Administrator / Teacher in High School and Post-High School Education / Researcher in Informatics	252101/233001/214917
Universitatea Alexandru Ioan Cuza din Iași	Security of Information	Iași	Database Administrator / Teacher in High School and Post-High School Education / Researcher in Informatics	252101/233001/214917
Universitatea Alexandru Ioan Cuza din Iași	Distributed System	Iași	Database Administrator / Teacher in High School and Post-High School Education / Researcher in Informatics	252101/233001/214917

Universitatea	Title of master's degree	County	Occupations degree holders may practise in the labour market	Occupation's COR code
Universitatea Alexandru Ioan Cuza din Iași	Informatics Systems for Business	Iași	Database Administrator / Informatics System Programmer / Informatics Project Manager	252101/251204/251206
Universitatea Alexandru Ioan Cuza din Iași	Advanced Studies in Informatics, tuition in English language	Iași	Database Administrator / Teacher in High School and Post-High School Education / Researcher in Informatics	252101/233001/214917
Universitatea Babeș-Bolyai din Cluj-Napoca	Data Analysis and Modelling	Cluj	Informatics Project Manager / Informatics System Designer / Informatics System Programmer	251206/251101/251204
Universitatea Babeș-Bolyai din Cluj-Napoca	Databases	Cluj	Database Administrator / System and Computer Design Engineer / Informatics Project Manager	252101/215214/251206
Universitatea Babeș-Bolyai din Cluj-Napoca	High Performance Computing and Analysis of large Data Volumes	Cluj	Informatics Project Manager / System and Computer Design Engineer / Informatics System Programmer	251206/215214/251204
Universitatea Babeș-Bolyai din Cluj-Napoca	Computational Physics, tuition in English language	Cluj	Physicist/ Researcher in Physics / Analyst	211101/211102/251201
Universitatea Babeș-Bolyai din Cluj-Napoca	Design and Development of Enterprise Applications	Cluj	CAD Specialist / System Engineer in Informatics / Informatics System Designer	251401/251203/251101
Universitatea Babeș-Bolyai din Cluj-Napoca	System-aided Economic Decision Making	Cluj	Expert in Business Counselling / Database Administrator / Informatics System Designer	242217/252101/251101
Universitatea Babeș-Bolyai din Cluj-Napoca	Applied Computational Intelligence	Cluj	Informatics System Designer / Assistant Researcher in Mathematical Informatics / Teacher in High School and Post-High School Education	251101/212024/233001
Universitatea Babeș-Bolyai din Cluj-Napoca	Software Engineering	Cluj	Informatics System Designer / Informatics System Programmer / Informatics Project Manager	251101/251204/251206
Universitatea Babeș-Bolyai din Cluj-Napoca	Component-based Programming	Cluj	Informatics System Designer / Assistant Researcher in Mathematical Informatics / Teacher in High School and Post-High School Education	251101/212024/233001

Universitatea	Title of master's degree	County	Occupations degree holders may practise in the labour market	Occupation's COR code
Universitatea Babeș-Bolyai din Cluj-Napoca	Internet-scale Distributed Systems	Cluj	Computer Network Administrator / Informatics System Programmer / Computer Network Administrator	252301/251204/252301
Universitatea de Vest din Timișoara	Artificial Intelligence and Distributed Computing	Timiș	Analyst / Programmer / Assistant Researcher in Mathematical Informatics	251201/251202/214918
Universitatea de Vest din Timișoara	Informatics Applied to Sciences, Technology, and Economy	Timiș	Analyst / Programmer / Assistant Researcher in Mathematical Informatics	251201/251202/214918
Universitatea de Vest din Timișoara	Software Engineering	Timiș	Analyst / Programmer / Assistant Researcher in Mathematical Informatics	251201/251202/214918
Universitatea de Vest din Timișoara	Artificial Intelligence and Distributed Calculation	Timiș	Analyst / Programmer / Assistant Researcher in Mathematical Informatics	251201/251202/214918
Universitatea de Vest din Timișoara	International Development and Management Of Global Affairs	Timiș	International Relations Head Officer / Diplomatic Adviser / Analyst	132414/111201/251201
Universitatea de Vest din Timișoara	Informatics Systems for Finance and Banking	Timiș	Manager for Information and Communications Technology / Database Administrator / Finance and Banking Expert	133007/252101/241204
Universitatea de Vest din Timișoara	Informatics Systems for Business	Timiș	Informatics System Designer / Analyst / Informatics Project Manager	251101/251201/251206
Universitatea din Bucuresti	Algorithms and Bioinformatics	Bucuresti	Assistant Researcher in Informatics / Analyst / Teacher in High School and Post-High School Education	214918/251201/233001
Universitatea din Bucuresti	Databases and Web Technologies	Bucharest	Database Administrator / Web Page Designer (higher education graduate) / Teacher in High School and Post-High School Education	252101/216610/233001
Universitatea din Bucuresti	Software Engineering	Bucharest	Software System Engineer / Programmer / Informatics Project Manager	251205/251202/251206
Universitatea din Bucuresti	Artificial Intelligence	Bucharest	Researcher in Informatics / System Engineer in Informatics / Teacher in High School and Post-High School Education	214917/251203/233001

Universitatea	Title of master's degree	County	Occupations degree holders may practise in the labour market	Occupation's COR code
Universitatea din Bucuresti	Distributed Systems	Bucharest	Researcher in Informatics / Computer Network Administrator / System Engineer in Informatics	214917/252301/251203
Universitatea din Craiova	Software Engineering	Dolj	Software System Engineer / Analyst / Informatics Project Manager	251205 / 251201 / 251206
Universitatea din Craiova	AI Methods and Models	Dolj	Analyst / Informatics System Programmer / Informatics Project Manager	251201 / 251204 / 251206
Universitatea din Craiova	Information Systems for e-Commerce / Information Systems For E-Business	Dolj	Specialist in e-Business / Informatics Project Manager / Analyst	251301 / 251206 / 251201
Universitatea din Craiova	Advanced Techniques for Data Processing / Advanced Techniques For Information Processing	Dolj	Analyst / Informatics System Programmer / Informatics Project Manager	251201 / 251204 / 251206
Universitatea din Petroșani	Applied Information Techniques and Technologies	Hunedoara	Software System Engineer / System Engineer in Informatics / Informatics Project Manager	251205 / 251203 / 251206
Universitatea Dunărea de Jos din Galați	Accounting and Auditing	Galați	Database Administrator / Loan Administrator / Analyst	252101/241215/251201
Universitatea Dunărea de Jos din Galați	Information Systems for Resource Management	Galați	Computer Network Administrator / Analyst / Assistant Researcher in General Economics	252301/251201/263117
Universitatea Lucian Blaga din Sibiu	Advanced Computing Systems	Sibiu	Informatics System Designer / Researcher in Computers / Director Informatics Division	251101/215235/133005
Universitatea Lucian Blaga din Sibiu	Advanced Informatics	Sibiu	System Engineer in Informatics / Software System Engineer / Informatics Project Manager	251203/251205/251206
Universitatea Lucian Blaga din Sibiu	Computer Engineering in Industrial Applications	Sibiu	System and Computer Design Engineer / System Engineer in Informatics / Database Administrator	215214/251203/252101

Universitatea	Title of master's degree	County	Occupations degree holders may practise in the labour market	Occupation's COR code
Universitatea Lucian Blaga din Sibiu	Applied Mathematical Informatics	Sibiu	Researcher in Matematical Informatics / Teacher in High School and Post-High School Education / Informatics System Programmer	212023/233001/251204
Universitatea Lucian Blaga din Sibiu	Advanced Information Systems and Technologies	Sibiu	System Engineer in Informatics / Software System Engineer / Informatics Project Manager	251203/251205/251206
Universitatea Lucian Blaga din Sibiu	Advanced Information Technologies	Sibiu	System Engineer in Informatics / Software System Engineer / Informatics Project Manager	251203/251205/251206
Universitatea Ovidius din Constanta	Distributed Multi-modal Virtual Media	Constanta	Programmer / Informatics System Designer / Assistant Researcher in Informatics	251202/251101/214918
Universitatea Ovidius din Constanta	Information Modelling and Technologies	Constanta	Programmer / Informatics System Designer / Specialist in e-Business / Assistant Researcher in Mathematical Informatics	251202/251101/212024
Universitatea Petrol-Gaze din Ploiești	Advanced Technologies for Information Processing	Prahova	Software System Engineer / Programmer / Specialist in Security procedures and Instruments / Security Procedures and Instruments for Informatics Systems	251205/251202/251402
Universitatea Petru Maior din Târgu Mureș	Information Technology	Mureș	Analyst / Researcher in Informatics / Consultant in Informatics	251201/214917/251901
Universitatea Politehnica din Bucuresti	Databases Administration	Bucharest	Computer Research Engineer / Software System Engineer / Database Administrator	215236/251205/252101
Universitatea Politehnica din Bucuresti	Advanced Computer Architecture	Bucharest	Computer Research Engineer / System Engineer in Informatics / CAD Specialist	215236/251203/251401
Universitatea Politehnica din Bucuresti	Corporate Business –Oriented Architectures for Services	Bucharest	Automation Research Engineer / System Engineer in Informatics / Informatics System Designer	215239/251203/251101
Universitatea Politehnica din Bucuresti	Artificial Intelligence	Bucharest	Computer Research Engineer / Software System Engineer / Informatics System Designer	215236/251205/251101
Universitatea Politehnica din Bucuresti	Automation and Industrial Informatics	Bucharest	Automation Research Engineer / System Engineer in Informatics / Informatics System Designer	215239/251203/251101

Universitatea	Title of master's degree	County	Occupations degree holders may practise in the labour market	Occupation's COR code
Universitatea Politehnica din Bucuresti	Biomedical Informatics	Bucharest	Specialist in e-Health / Analyst / CAD Specialist	251304/251201/251401
Universitatea Politehnica din Bucuresti	Advanced Control and Real-time Systems	Bucharest	Automation Research Engineer / System Engineer in Informatics / Informatics System Designer	215239/251203/251101
Universitatea Politehnica din Bucuresti	E-Governance	Bucharest	Computer Research Engineer / Software System Engineer / Specialist in e-Governance	215236/251205/251302
Universitatea Politehnica din Bucuresti	Graphs, Multimedia and Virtual Reality	Bucharest	Computer Research Engineer / Software System Engineer / E-Media Specialist	215236/251205/251303
Universitatea Politehnica din Bucuresti	Business Systems Engineering and Management	Bucharest	Automation Research Engineer / System Engineer in Informatics / Specialist in e-Business	215239/251203/251301
Universitatea Politehnica din Bucuresti	Internet Systems Engineering	Bucharest	Computer Research Engineer / Software System Engineer / Informatics System Designer	215236/251205/251101
Universitatea Politehnica din Bucuresti	Management in Information Technology	Bucharest	Computer Research Engineer / Software System Engineer / Informatics Project Manager	215236/251205/251206
Universitatea Politehnica din Bucuresti	Management of The Digital Enterprise	Bucharest	Consultant in Informatics / Database Administrator / Analyst	251901/252101/251201
Universitatea Politehnica din Bucuresti	Management, Innovation Et Technologies Des Systems Collaborative/ Management, Innovation, and Technologies of Collaborative Systems	Bucharest	Analyst / Informatics System Programmer / Informatics Project Manager	251201/251204/251206
Universitatea Politehnica din Bucuresti	Information Management and Protection	Bucharest	Automation Research Engineer / System Engineer in Informatics / Specialist in Security Procedures and Instruments for Informatics Systems	215239/251203/251402
Universitatea Politehnica din Bucuresti	Parallel and Distributed Computer Systems	Bucharest	Computer Research Engineer / Software System Engineer / Informatics System Designer	215236/251205/251101

Universitatea	Title of master's degree	County	Occupations degree holders may practise in the labour market	Occupation's COR code
Universitatea Politehnica din Bucuresti	Complex Signal Processing in Multimedia Applications	Bucharest	Research Engineer in Automatic / System Engineer in Informatics / E-Media Specialist	215239/251203/251303
Universitatea Politehnica din Bucuresti	Security of Complex Information Networks	Bucharest	Computer Research Engineer / Software System Engineer / Specialist in Security Procedures and Instruments for Informatics Systems	215236/251205/251402
Universitatea Politehnica din Bucuresti	Service Engineering and Management	Bucharest	Research Engineer in Automatic / System Engineer in Informatics / Informatics System Designer	215239/251203/251101
Universitatea Politehnica din Bucuresti	Advanced Software Services	Bucharest	Computer Research Engineer / Software System Engineer / Informatics System Designer	215236/251205/251101
Universitatea Politehnica din Bucuresti	Information Systems in Medicine	Bucharest	Research Engineer in Automatic / System Engineer in Informatics / Specialist in e-Health	215239/251203/251304
Universitatea Politehnica din Bucuresti	Integrated Information Systems	Bucharest	Research Engineer in Automatic / System Engineer in Informatics / Informatics System Designer	215239/251203/251101
Universitatea Politehnica din Bucuresti	Intelligent Management Systems	Bucharest	Research Engineer in Automatic / System Engineer in Informatics / Informatics System Designer	215239/251203/251101
Universitatea Politehnica din Bucuresti	Software Engineering	Bucharest	Analyst / Informatics System Programmer / Informatics Project Manager	251201/251204/251206
Universitatea Politehnica din Bucuresti	Advanced Techniques in the Science of Systems and Signals	Bucharest	Research Engineer in Automatic / System Engineer in Informatics / Informatics System Designer	215239/251203/251101
Universitatea Politehnica din Bucuresti	Theory of Information Coding and Storage	Bucharest	Informatics System Programmer / Specialist SIG/IT / Bank Security System Administrator	251204/252901/252201
Universitatea Politehnica din Bucuresti	Information and Computing Systems Engineering	Bucharest	Computer Research Engineer / Researcher in Communications / Informatics System Designer	215236/215226/251101
Universitatea Politehnica Timișoara	Information Technology, tuition in English	Timiș	Programmer / Informatics System Programmer / Informatics Project Manager	251202/251204/251206
Universitatea Politehnica Timișoara	Information Technologies	Timiș	Programmer / Informatics System Programmer / Informatics Project Manager	251202/251204/251206

Universitatea	Title of master's degree	County	Occupations degree holders may practise in the labour market	Occupation's COR code
Universitatea Sapientia din Cluj-Napoca	Development of Software Applications	Cluj	System Engineer in Informatics / Software System Engineer / Informatics Project Manager	251203 / 251205 / 251206
Universitatea Spiru Haret din Bucuresti	Modern Methods in the Information Systems Engineering	Bucharest	Informatics System Programmer / Software System Engineer / Informatics Project Manager	251204 / 251205 / 251206
Universitatea Spiru Haret din Bucuresti	Modern Technologies in the Information Systems Engineering	Bucharest	Informatics System Programmer / Software System Engineer / Informatics Project Manager	251204 / 251205 / 251206
Universitatea Tehnica Gheorghe Asachi din Iași	Distributed Systems and Web Technologies	Iași	Informatics System Designer / System and Computer Design Engineer / Assistant Researcher in Informatics	251101 / 215214 / 214918
Universitatea Tehnica Gheorghe Asachi din Iași	Design of Advanced VLSI Circuits	Iași	Design Engineer in Electronics / Researcher in Microelectronics / Programmer	215213/215229/251202
Universitatea Tehnica Gheorghe Asachi din Iași	Distributed Systems and Web Technologies	Iași	Informatics System Designer / System and Computer Design Engineer / Assistant Researcher in Informatics	251101 / 215214 / 214918
Universitatea Tehnica Gheorghe Asachi din Iași	Automatic Systems and Control	Iași	Automation Researcher / System and Computer Design Engineer / Informatics Project Manager	215238 / 215214 / 251206
Universitatea Tehnica Gheorghe Asachi din Iași	Modern Techniques for Signal Processing	Iași	Design Engineer in Electronics / Researcher in microelectronics / Programmer	215213/215229/251202
Universitatea Tehnica Gheorghe Asachi din Iași	Digital Radio -communications	Iași	Manager of Information and Communications Technology / Design Engineer for Communications / Informatics System Designer	133007/215310/251101
Universitatea Tibiscus din Timișoara	Management of Distributed System	Timiș	Computer Network Administrator / Database Administrator / System Engineer in Informatics	252301/252101/251203
Universitatea Tibiscus din Timișoara	Web-Design	Timiș	Web Page Designer (higher education) / Informatics System Designer / Informatics System Programmer	216610/251101/251204

Source. Author's compilation based on RNCIS data and the approved number of place for each education unit.