

Action Plan on Human Resources Development and Mobility in North-West Romania

Elaborated by

The High-Level Working Group on Human Resources Development in
North-West Romania

under the facilitation of

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I. INTRODUCTION AND SCOPE

A European Parliament Preparatory Action (EPPA) centred to enhance the competitive advantage and the potential for smart specialisation at the regional level in Romania has been launched in 2016. The Action entitled “RIS3 for lagging regions” is implemented by the Territorial Development Unit of the European Commission’s Joint Research Centre (JRC), in close cooperation with DG REGIO and the Regional Development Agencies of North East and North West Romania, with the support of selected independent experts.

In line with the objectives of the preparatory action, support is provided to implement the regional Smart Specialisation Strategy (RIS3) in North-West Romania with a focus, among others, on the development of a strategy for human resources development and mobility.

This report presents the output of the work of the regional High-Level Working Group on Human Resources Development in NW Romania (WGHR) that was delegated the task of elaborating an Action Plan on Human Resources Development and Mobility, aiming to specify in detail the fourth pillar of the regional RIS3. In doing so, the WGHR was facilitated by a JRC-appointed expert. The same expert was commissioned by JRC to perform a technology transfer policy analyses. This work is undergoing and relevant findings will be incorporated in this study when available.

The report is structured as follows: section II summarises the regional context, the needs and the challenges faced by the regional innovation system with respect to human resources; section III presents the Action Plan and finally, section IV discusses delivery, funding and monitoring.

II. CONTEXT AND NEEDS ASSESSMENT

Nord-Vest (North West) is a development region in Romania, created in 1998. The Nord-Vest region is made up of six counties (Bihar, Bistrița-Năsăud, Cluj, Maramureș, Satu Mare and Sălaj) having a multi-ethnic population of 2.58 million inhabitants (2015, 13% of Romania) and a regional GDP of 18.27 billion Euros (current prices; 2015; 11.42% of Romania). The economy of Nord-Vest is mainly agricultural even though there is some heavy and light industry in the major regional industrial centres of Cluj-Napoca, Oradea, Baia Mare, Bistrița, Satu Mare and Zalău. Employment in agriculture was 22% of total population in 2016, 27% in industry, 7% in construction and 44% in services. North-West Romania contributed 12% of Romania’s GDP from agriculture, forestry and fishing and 11.7% of the country’s manufacturing. The official rate of unemployment was 3.2% in 2016¹. This is very low by European standards, but it is also an indication of emigration or brain-drain. Figure 2 presents the trends in leaving education and training in the last decade. *It seems that the situation in North-West Romania is steadily deteriorating*, although it has started from a very favourable, even by EU28 standards, position. Table 4 in the Appendix provides a snapshot of the key development indicators of the region.

Demographics. The trends in births are declining over time (Figure 1) and together with emigration this trend is expected to create significant shortage of labour in the next decades. It will also reduce the number of students in tertiary education and if the trends in early leavers from education and training are not mitigated, the supply of tertiary education graduates will gradually decline.

Structural business statistics. The overall business structure of the region is dominated by manufacturing, wholesale and retail trade (low intermediate skill), construction and transportation and storage. For the Nord-Vest region this identifies a *concentration on low-skill, low-tech sectors* including food, textiles, wood, leather, rubber, plastic and metal products. Only the manufacture of motor vehicles within the region is considered high intermediate tech. Within the services sector, *telecommunications and computer programming and related activities which are considered high-skill, high-tech are identified as a regional specialisation in terms of employment*. Other dominant high-skill sub sectors include real estate, architectural and engineering activities and management consultancy (see Appendix, Figure 4 and Figure 5). A recent DG REGIO-commissioned report² indicates that *the business sector—especially computer programming, is dominated by out-sourcing*

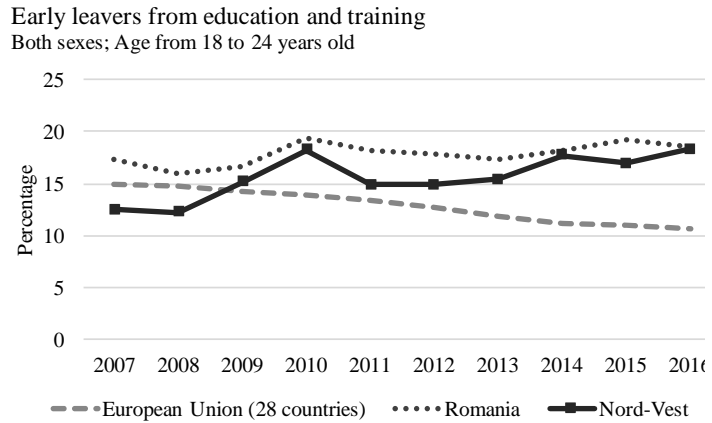


FIGURE 2 EARLY LEAVERS FROM EDUCATION AND TRAINING.

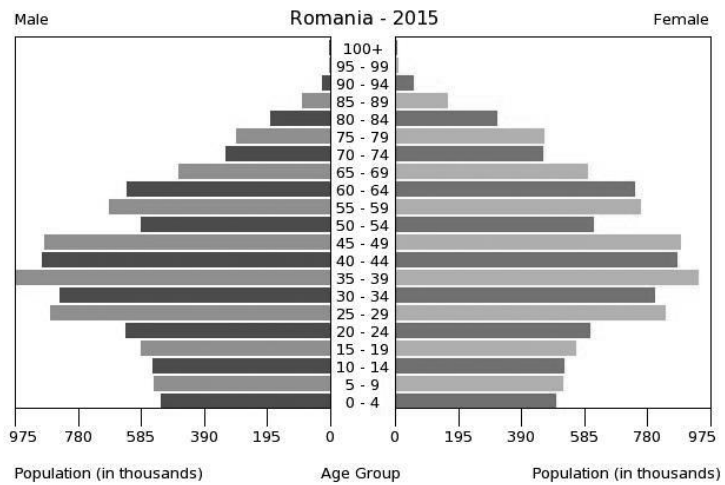


FIGURE 1 POPULATION PYRAMID, ROMANIA, 2015.

¹ INSEE Tempo Database, table SOM103A.

² A. Healy, *North-West Romania. Needs Assessment: University-Business Cooperation*, Aug. 2017.

activities with minimal innovation needs. This is verified by the last available official statistics³ which indicate that there were 401 innovative enterprises in the Region in 2014, equally split between industry and services, of which 257 were small and 37 large. The total number of active enterprises in the Region for the same year was 72444, of which 2273 in the primary sector and 8090 in manufacturing.

Structure of Higher Education and scientific specialisation. The regional higher education institutions have a strong reputation of academic excellence in Romania. According to Thomson/Reuters Web of Science data processed by the facilitator, Babes-Bolyai University, UMF Iuliu Hatieganu and TUCN, all in Cluj-Napoca, are among the top regional performers in the number of scientific publications in the period 2012-2016. The same data suggest that the regional scientific production in terms of publications is very strong in Social Sciences and Humanities (Area Studies, Psychology, History), Medical Imaging, Mechanics and Oncology while it matches the national average in Chemistry, Mathematics, Environmental Science and Computer Science. A bibliometric analysis commissioned by UEFISCDI in 2015 lists Babes-Bolyai and UMF Iuliu Hatieganu universities in the top 10 performers in terms of paper count in Romania between 2005 and 2014⁴. Participation in highly competitive European research projects is also a proxy for research excellence. A JRC analysis of FP7 participation statistics indicated that Nord-Vest received 11.4% of the total FP7 contribution in Romania (behind București-Ilfov with 54.4% and Nord-Est with 12.1%) and TUCN was the third most active Romanian organisation with 12 projects⁵. Babes-Bolyai University was the second performer in the region in terms of participation, but far behind TUCN. The facilitator's processing of FP7 and Horizon2020 project information provided by the European Union's Open Data portal⁶ is summarised in Table 7 of the Appendix. The leading positions of TUCN and Babes-Bolyai University are confirmed, and a rather good performance from private sector enterprises is also noted.

Higher education graduates. In 2015, the total enrolment in tertiary education in the Region was approximately 91000-of which 6000 in non-public sector institutions. Of these, approximately 17900 have successfully obtained their tertiary education degree (see Appendix, Table 6). However, the share of the graduates that stayed in the Region is unknown. Evidence from a recent survey by the National Alliance of Student Organisations in Romania⁷ suggests that dropout rates in Universities are high (31.13% of students enrolled in bachelor and masters' programmes) and the main reasons cited are lack of money, poor career counselling in high school and legislation. The TUCN Rector's Report for 2016 indicates that 36.4% of the 2400 students that received psychological counselling in 2016 indicated their intention of abandoning their studies and 63.6% faced difficulties with their academic activities. The same report indicates that only 65% of the students registered in the terminal year of their studies in 2015 have actually graduated. These suggest that universities (Higher Educational Institutions – HEIs) have a serious problem in retaining their enrolled students.

Availability of human resources for Research and Innovation. The number of researchers in the region was 2280 (8.26% of Romania) in 2015, and 1453 researchers' full-time equivalents were reported (see Table 4 in the Appendix). Higher Education Institutions (HEIs) together with Public Research Organisations (PROs) seem to be the main actors, providing 82.5% of the headcount of researchers and 79.2% of the researchers' full-time equivalents. The latest Rectors' Reports indicate *a trend of unusually large number of vacancies in HEIs* that if reversed, could expand the headcount of researchers in HEIs to match the national average⁸. The low salaries of faculty members might partially explain the vacancies. *Leveraging this pool of researchers as an agent of change for promoting innovation, diffusing valuable, close-to-the-market knowledge and stimulating the transition of the regional economy to higher value-adding activities while maintaining the status of excellent research is the major challenge faced by regional HEI/PROs.*

³ INSEE Tempo Database, table INO101C.

⁴ Thomson Reuters, "Bibliometric Analysis of Romania's Research Output, 2005-2014," Thomson Reuters, 2015.

⁵ JRC, "Stairway to Excellence Facts and Figures: Romania," Publications office of the European Union, Luxembourg, 2015.

⁶ See the CORDIS datasets at <https://data.europa.eu/euodp/data/>

⁷ http://stiri.tvr.ro/unul-din-trei-studenti-renunta-la-facultate--cauzele-abandonului-universitar_815022.html

⁸ For the regional headcount of researchers in HEIs to reach the national average, approximately 500 vacancies should be filled.

Relevance of regional research to the RIS3. The mapping of the active research areas in NW Romania to the regional RIS3 priorities⁹ suggests that most of the priority areas are well-connected to the regional supply of knowledge with the exception of furniture and packaging in the second pillar¹⁰. This finding suggests that investments related to research and innovation (both people and infrastructure) should focus in the following research areas (in alphabetical order): Agriculture; Agronomy; Artificial Intelligence; Biochemistry & Molecular Biology; Biomedical Engineering; Biotechnology & Applied Microbiology; Chemistry; Computer Science; Dairy Animal Science; Dermatology; Electrical & Electronic Engineering; Food Science & Technology; Forestry; Horticulture; Industrial Engineering; Manufacturing Engineering; Materials Science; Mathematics; Mechanical Engineering; Metallurgy & Metallurgical Engineering; Nanoscience/Nanotechnology; Nutrition-Dietetics; Oncology; Pharmacology-Pharmacy; Plant Sciences; Radiology & Medical Imaging; Robotics; Software Engineering; Telecommunications; Toxicology; Veterinary Sciences; Zoology.

Institutional settings to promote HEI/PRO—industry linkages. A recent survey on the technology transfer policies of regional HEI/PROs has shown that they are still in their first steps towards developing comprehensive technology transfer policies and in deploying and managing the necessary processes needed to implement them. This, in a context of under-staffed and under-funded public-sector research governed by a legal framework that does not appreciate technology transfer *outcomes* when assesses tenure and promotion, inhibits the potential of otherwise excellent research institutions of becoming the locomotive for the transition of the regional economy towards knowledge-based, high value-added endeavours. It is clear that having a Technology Transfer Office, irrespective of its actual name, is a necessary but not sufficient condition for the flow of knowledge and its commercial exploitation¹¹. Healy mentions very limited connections between research and market (both in terms of people and themes), which need to be addressed if innovation is to occur. There is very limited contract/consultancy research with firms. This, it is reported, reflects a lack of critical mass of researchers cooperating with industry (with some notable exceptions). Technical facilities at universities are good (for example a modern supercomputer) but this potential is underused by industry. Industry argues that such facilities can't be used long-term, as firms need their own infrastructures. However, such arguments potentially confuse innovation processes (proving and demonstrating concepts) with eventual commercial activities¹². Moreover, during the kick-off meeting held on the 10th of October 2017, considerable doubt was cast on the organisation of the HEIs administrative services and the managerial skills of the personnel.

Skills supply and demand. An OECD report suggests that, according to 2011 data, the Cluj county was in a “high skill equilibrium” where a high supply of skills is matched by a high skills demand. The Bistrita Nasaud county was in deficit of skills, Bihor county had a surplus of skills while the remaining three counties (Satu Mare, Maramures and Salaj) were in low skill equilibria where a low skills supply is matched by a low demand¹³. More recently, a country-wide mismatch was reported between supply and demand, reflected in the relative disconnection between the higher education system and the labour market, the former responding to the short-term student population demands, while the PhD holders supply exceeds the capacity of absorption by the chronically underfunded R&I system¹⁴.

Employment prospects for graduates. According to the latest results of the national study of monitoring the labour market insertion of higher education graduates at the bachelor's level¹⁵, students graduated in 2010 assessed their studies as poorly organised (63%) and lacking practical orientation (79%) although the content of their study programmes were good (67%) and they received good counselling from faculty members (66%). Of the 5602 graduates that were surveyed, 93% had completed their studies in the standard period and 65% had participated in an internship/practice programme during their studies. Although 13% reported some experience

⁹ ADR-NV, “Documentul cadru pentru strategia de specializare inteligentă Regiunea de Dezvoltare Nord-Vest,” Agenția de Dezvoltare Regională Nord-Vest, Cluj-Napoca, 2017.

¹⁰ Y.A. Toliás, *Report on the Potential of Supply for Technology Transfer in North-West Romania*. (forthcoming).

¹¹ Ibid.

¹² See Healey (2017); p.5-6).

¹³ Data: <http://dx.doi.org/10.1787/9789264215009-graph147-en>

¹⁴ M. Chioncel and J. Zifciakova, “Rio Country Report 2016: Romania,” Publications Office of the European Union, Luxemburg, 2017.

¹⁵ <http://www.absolvent-univ.ro/UserFiles/File/rezultate/domeniu%202010.pdf>

with studies abroad, only 5% have spent an entire semester out of the country¹⁶. Eighteen months following graduation, from the same cohort of 2010 graduates, 55% were employed, 31% were employed and also enrolled in studies, 7% were exclusively enrolled in studies and 5% were actively seeking for a job. The average period between graduation and their first job was 7.9 months. Although 68% stated that their field of study was appropriate to their current type of activity, only 42% mentioned that they fully utilise their knowledge and skills at their workplace.

Regional development priorities. The draft of the regional Smart Specialisation Strategy (RIS3) as presented in the Regional Concept Note (or Framework Document) is based on four pillars (see Figure 3) of which three refer to vertical pillars (i.e., health and well-being, new materials and products and digital transformation) while the fourth is horizontal in coverage. Within the fourth pillar, the Region aims to set the regional innovation system in motion by stimulating RDI tailored to the needs of the local production system, supporting innovation and digitization within enterprises and building collaboration networks.

"By 2034 the North-West Development Region will be in the top of the most innovative regions from Central and Eastern Europe capitalizing on research-development-innovation results, with the aim to raise incomes, the number of workplaces and level of living standard."

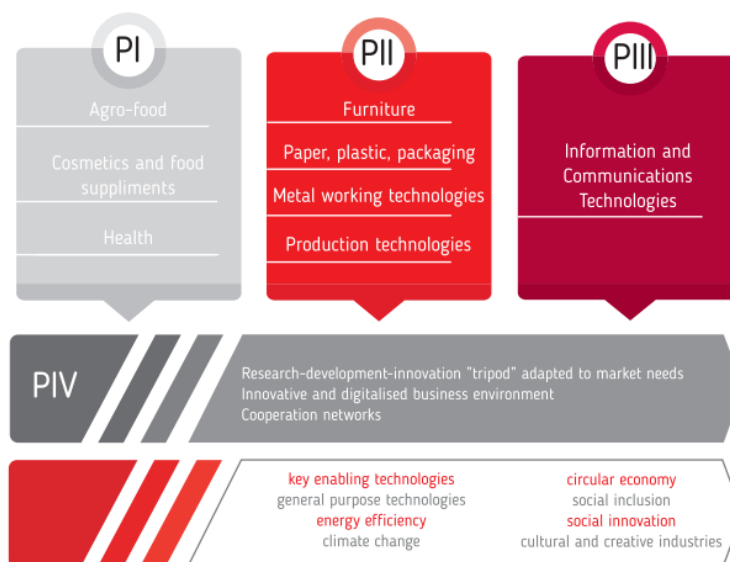


FIGURE 3. THE FOUR PILLARS OF THE REGIONAL SMART SPECIALISATION STRATEGY OF NORTH-WEST ROMANIA.

The following actions, which are highly relevant to this action plan, are included within the fourth pillar. They have been taken into account in elaborating the interventions described in the next section.

Action 1.1:

- providing researchers with access to the latest information on technological developments;
- development of human resources involved in RDI activity, including through promoting multidisciplinary research and mobility.

Action 1.2:

- creating links between the business environment and the academic environment;
- development of human resources for the purpose of providing specific services;

Action 1.3:

- the development of human resources involved in the provision of technology transfer services

Action 2.4:

¹⁶ In terms of student mobility through the Erasmus Programme, ADR-NV collected data from six regional universities indicate a lively stream of 5555 outbound and 4711 inbound students in the period from 2007 to 2016. It is noteworthy that Babes-Bolyai University attracted 65% of all inbound students in this period and that it is the only institution where the number of inbound students was higher than the number of the outbound ones.

- correlation of the educational offer with the market demand in the fields of smart specialization
- increasing the number of employees in the fields of technology-engineering-science-mathematics (STEM)
- development of placement schemes for researchers within the businesses;
- increasing the level of digital literacy of employees' assurance

Action 2.5:

- developing entrepreneurial spirit among young people and competences among entrepreneurs;

Action 3.1:

- supporting the co-operation of the regional R&D, innovation and technology transfer entities from with entities at the national and at the international level, in particular integration into the European networks;

Action 3.3:

- creating mechanisms and tools to facilitate quadruple-helix interactions.

A critical cross-evaluation of the above leads to the following summary of needs:

- 1) The leading position of the regional research endowment should be sustained and improved; it should be also leveraged for supporting the transition of the regional economy to more value-added activities.
- 2) The exodus of talented graduates should be reduced and this can be done only by providing good jobs and merit-based career prospects.
- 3) The culture of opportunity-based entrepreneurship must be diffused to the greatest extent, not only to students but also entrepreneurs themselves. This cultural change should also be supported by the provision of appropriate 21st century skills and knowledge.
- 4) Unfavourable demographics require providing tertiary education to the highest possible percentage of the population; therefore, dropouts from the education system should be minimised.
- 5) The knowledge-based transformation of the regional economy will require the institutionalisation of triple-helix interactions, considerable capacity building and organisational innovations in all three strands.

III. STRATEGY AND ACTION PLAN

III.A. THE VISION FOR 2023 AND THE PATHS TO GO THERE

The discussion among the members of the High-Level Working Group on Human Resource Development has led to the following statement that describes their aspiration for North-West Romania's status by the end of 2023, the year when the impact of the interventions in this Action Plan will be measured:

Following a series of well-planned, timely and competently executed interventions in line with the regional smart specialisation strategy, North-West Romania has been adding new, knowledge-intensive jobs in the private sector during the last three years thus, not-only reversing the brain-drain but also attracting well-qualified personnel from other regions to live and work there.

A shift is clearly noticeable in the attitudes of the youth regarding the necessity of education and the lifetime benefits associated with it, leading to increased enrolment into post-secondary education after well-informed career advice sessions and reduced dropout rates.

The regional HEIs, having updated their curricula to become relevant to the skills needed for the 21st century, are becoming the first choice for students to study and talented researchers to work, thus improving their position in international rankings and their linkages to the European Research Area. More and better research continuously drives curricula updates.

The dialogue among the regional stakeholders is active and institutionalised, a common understanding of the regional development challenges has been achieved and each strand of the triple helix understands its role and the required contribution in achieving mutually agreed objectives. Jointly developed interventions have established a virtuous, self-reinforcing development cycle that has created jobs, profits and exports for the industry, new sources of revenue for education and research, and more investments in infrastructure and the overall attributes that make the region an attractive place to live and work.

The roadmap that leads to the above future state is described in the sections that follow. It sets out a broad set actions, integrated under strategic objectives, to help North-West Romania meet the challenges of improving and retaining its human resources for the benefit of regional development. In making its recommendations, the High-Level Working Group took into account the overall national strategy on the development of human resources as described in the partnership agreement for 2014-2020 and the relevant operational programmes and chose to focus on specific interventions that are highly relevant to the regional context and complement the national planning. A single **General Objective** (G.O.) was identified, namely:

G.O. 1. Improve the education level of the population in North-West Romania.

The general objective is aligned with Europe2020's headline targets for Education, namely increasing total tertiary education attainment (>40% of population 30-34 years old) and decreasing early leavers from education and training (<10% of population 18-24). To reach the general objective, four **specific objectives** (S.O.) were identified:

- S.O.1. Stimulate employment in research and innovation;
- S.O.2. Skills development for innovation and employment;
- S.O.3. Maximise intake and minimise dropouts in tertiary education;
- S.O.4. Activate and strengthen Triple-Helix interactions.

For each of the above, several specific actions were planned, which are summarised in Table 1 and described in detail in the sections that follow.

The Action Plan assumes that the most viable way to see improvement in the overall education level in the regional statistics is to create new, challenging and well-paid jobs for knowledge workers. These new jobs will be created first in the regional research establishment (HEI/PROs) by leveraging the fame of the regional institutions as the best-in-country and also by providing alternative and additional sources of remuneration for talented faculty/researchers to compensate for their low salaries. This requires maintaining and improving the capabilities of HEI/PROs to do excellent research (e.g., by improving infrastructure and supporting career

development for existing faculty members) and their ability to attract talented young students that will be the future researchers in academia and industry.

The industry, in the medium term, will also create new or better jobs for knowledge workers if it will make the transition to more value-creating activities, in the lines specified by the regional RIS3. This will require teaching new skills to existing employees that will eventually move from technical to managerial positions and also providing knowledge and skilled employees that will be able to support this transition. For this to happen, higher education and research will have to proactively engage with the industry and diffuse knowledge and innovation tailored to the industry's needs (through collaborative research & consulting projects, demonstration projects, intersectoral mobility). They will also have to contribute to training the existing workforce through continuous education or life-long learning structures that offer relevant skills. In the short term, the industry's transition to more value-created activities can be stimulated by supporting new, high-skilled job creation.

A well-functioning, high value-added industry is also expected to create new jobs in supporting sectors, either knowledge-based (e.g., marketing, financial, legal, consulting, engineering/technical, healthcare) or not (e.g., entertainment, culture, recreation/leisure, etc). There's significant evidence in the literature suggesting that there is a clear link between presence of people having completed tertiary education and regional growth. Therefore, the level of dropouts from the education system has to be minimized and this requires wider effort in changing the attitude of the youth towards the benefits of having tertiary education and also comprehensive support (including financial assistance and counselling) so that they complete their studies.

TABLE 1 SUMMARY OF THE ACTION PLAN

<i>Specific Objective</i>	<i>Action</i>	<i>Target Group(s)</i>	<i>Intervention Outputs</i>	<i>Results</i>
SO1. Stimulate employment in research and innovation	A.1.1 – Provide career opportunities for young researchers in academia.	Newly-minted PhDs and Post-Docs.	Number of new researcher jobs (in full-time-equivalents) created during the interventions per sector of performance (HEI or GOV). Net number of vacant positions filled in regional HEIs	R.1.1 Researchers by sector of performance (Headcount, HES)
	A.1.2 – Fill faculty vacancies and provide career development opportunities through mobility	Newly-minted PhDs; Post-Docs and more experienced researchers	Length of stay of incoming researchers (Full-time equivalents); Length of stay abroad of outgoing faculty members (FTEs) Number of HEI teaching staff that received training.	R.1.2 Researchers by sector of performance (Headcount, BES)
	A.1.3 – Stimulate the creation of high-skill jobs in enterprises	Newly-minted MSc and PhD holders	Number of new researcher jobs (in full-time-equivalents) created in industry during the intervention;	
SO2. Skills Development for Innovation and Employment.	A.2.1 – Teach new skills to tertiary education students	Last-year undergraduate (~5600) and graduate students (~2000) at the regional HEIs pursuing STEM and business degrees.	Number of students having attended creativity, innovation, and entrepreneurship courses; Number of students that received support in developing entrepreneurial activities.	R.2.1 Persons with tertiary education and employed in science and technology (percentage of total population)
	A.2.2 – Improve curricula and facilities in tertiary education	Regional accredited Higher Education Institutions	Number of courses with updated curricula Number of accredited programmes developed;	
	A.2.3 – Develop and execute workforce development projects	Employees in RIS3 priority sectors	Number of employees in RIS3 priority sectors with updated and certified skills;	

<i>Specific Objective</i>	<i>Action</i>	<i>Target Group(s)</i>	<i>Intervention Outputs</i>	<i>Results</i>
SO3. Maximise Intake and Minimise Dropouts in Tertiary Education	A.3.1 – Support change of attitude towards tertiary education among secondary education students.	16-year-old students (~ 29000 total; ~16000 in rural areas)	Number of 16-year-old students exposed to awareness campaigns (urban/rural)	R.3.1 Percentage of early leavers from education and training (both sexes, 18 to 24 years old)
	A.3.2 – Improve career counselling in secondary and tertiary education	Secondary and undergraduate tertiary education students	Number of secondary education students that received personalised career guidance; Number of undergraduate students that received personalised career guidance;	
	A.3.3 – Assist tertiary education students at risk of abandoning their studies.	BSc and MSc students in extreme risk of abandoning their studies (5% of a population of approx. 90,000).	Number of tertiary education students that received non-financial support; Number of tertiary education students that received financial support;	
SO4. Activate and Strengthen Triple-Helix Interactions	A.4.1 – Promote intersectoral mobility	Undergraduate and graduate students enrolled in RIS3-related programmes; HEI and PRO Faculty members/Researchers; Researchers and technical staff in the enterprise sector.	Number of tertiary education students that acquired work experience through internships or placements;	R.4.1 Perceived degree of regional innovation policy competences by sector of performance (cross-sectoral survey)
			Number of HEI/PRO researchers that acquired industry experience by working in the business/enterprise sector; Number of students enrolled in industrial MSc or PhD courses. Total days spent by business/enterprise sector researchers in HEI/PRO labs. Number of research outcomes for which the feasibility of commercial exploitation was examined; Number of spin-off companies created	

<i>Specific Objective</i>	<i>Action</i>	<i>Target Group(s)</i>	<i>Intervention Outputs</i>	<i>Results</i>
	A.4.2 – Forecast skill and knowledge input needs & provide opportunities for mutual learning	Local stakeholders in higher education, vocational and lifelong learning with associations of employers, chambers, trade unions and other similar entities and the RDA	Biannual skills gap assessment reports; Number of certified LLL/CVT providers;	
	A.4.3 – Improve the innovation capacity of all regional stakeholders and develop necessary institutional structures	Regional institutional actors in Academia/Research, Enterprise and Government	Number of EDP cycles executed; Number of strategic plans elaborated / institutional policies adopted; Number of markets/technologies monitored; Number of pilot projects implemented.	

III.B. STIMULATE EMPLOYMENT IN RESEARCH AND INNOVATION (SO1)

Rationale

The presence of universities in a region, particularly ones with a high profile nationally and internationally, can act as a real magnet for talent. This can be in the form of students, but also academic and research staff who come to work in them. Where the research expertise of the university maps onto the sectoral specificities of local industry this can create a powerful ‘hub’ for innovation activity. Universities can also be agents in attracting former students back to a region via their alumni networks. These people can be even more valuable in human capital terms than retained graduates, as they bring new experiences, knowledge and networks from their time away from the region.

The number of researchers is a key enabler of the knowledge-based economy. The per capita headcount of HEI researchers in North-West Romania (0.054%) is 69% of the national average (0.079%). To reach the national average, approximately 600 new researcher jobs in HEIs should be created. This can be done either by filling existing vacancies or by creating project-funded jobs for younger researchers starting their careers. For this increase in the researcher base to produce sustainable results, it should be balanced on research areas that are highly competitive—by European standards—in the Region and on research areas that support the regional RIS3.

For the industry, stimulating the creation of high-skill jobs improves their absorptive capacity and their propensity of moving to higher value-added activities. The focus of any such scheme for industry would be to support enterprises in regional RIS3 priority areas.

Approach

This specific objective aims to increase the headcount of researchers primarily in HEIs (A.1.1 & A.1.2) and secondarily (A.1.3) in businesses. The need for providing career development opportunities for existing researchers in HEIs and PROs is addressed through international mobility (A.1.2). Prioritising hiring in A.1.2 requires either individual HEI research strategies¹⁷ or a high-level decision on the basis of the regional RIS3. The ability for creating project-based jobs for younger researchers depends on the competitiveness of the regional HEIs in attracting research funding from national funds (National Plan for RDI 2015-2020), national operational programmes (OP Competitiveness, Priority Axis 1) and European programmes (e.g., H2020)¹⁸.

<i>Action:</i>	A.1.1 – Provide career opportunities for young researchers
<i>Target population:</i>	Newly-minted PhDs and Post-Docs.
<i>Activities:</i>	<ul style="list-style-type: none"> i. Projects in basic research; ii. Collaborative applied research projects; iii. Contract research projects; iv. Scholarships for performing PhD studies; v. Scholarships for Post-Doc research.
<i>Outputs:</i>	<ul style="list-style-type: none"> • Number of new researcher jobs (in full-time-equivalents) created during the interventions per sector of performance (HEI or GOV).
<i>Expected outcomes:</i>	<ul style="list-style-type: none"> • Number of researcher jobs retained one year after the intervention ended per sector of performance. • Number of scientific publications. • Number of citations.
<i>Potential Beneficiaries:</i>	<ul style="list-style-type: none"> i. HEI & PRO ii. HEI & PRO & Businesses iii. Businesses (direct) and HEI/PRO (indirect)

¹⁷ See Specific Objective 4 / Action 4.3.

¹⁸ Setting up organisational structures in support of the HEIs capacities to maximize funding from these sources are also discussed in Specific Objective 4 / Action 4.3.

	iv.	HEI & PRO
	v.	HEI & PRO
<i>Funding sources:</i>	i.	Institutional funding, National Plan for RDI 2015-2020;
	ii.	National Plan for RDI 2015-2020; OP Competitiveness/Axis 1/Action 1.2.1; Horizon2020;
	iii.	Private-sector funding and/or National Plan for RDI 2015-2020; OP Competitiveness/Axis 1/Action 1.2.1.
	iv.	HEI/PRO own funds;
	v.	HEI/PRO own funds.
<i>Action:</i>	A.1.2 – Fill faculty vacancies and provide career development opportunities through mobility	
<i>Target population:</i>	Newly-minted PhDs; Post-Docs and more experienced researchers	
<i>Activities:</i>	i.	Recruitment in HEIs. Fill 50 or more vacancies per year in the next five years with emphasis on disciplines that were identified as relevant to the regional RIS3 priorities.
	ii.	Incoming mobility programmes for PhD holders of the Romanian diaspora. Invite distinguished researchers of the Romanian diaspora to do research with local teams and teach at the graduate level for one semester.
	iii.	Outgoing mobility programmes for staff. Organise one semester-long visits of existing staff abroad to do research with distinguished groups and improve skills, knowledge and networking.
	iv.	Training courses for HEI teaching staff in using innovative learning resources and in improving delivery of courses.
<i>Outputs:</i>	<ul style="list-style-type: none"> • Net number of vacant positions filled in regional HEIs • Length of stay of incoming researchers (Full-time equivalents); • Length of stay abroad of outgoing faculty members (FTEs) • Number of HEI teaching staff that received training. 	
<i>Expected outcomes:</i>	<ul style="list-style-type: none"> • Number of researchers (Headcount) in Higher Education. 	
<i>Potential Beneficiaries:</i>	i.	HEIs
	ii.	HEIs or PROs
	iii.	HEIs or PROs
	iv.	HEIs
<i>Funding sources:</i>	i.	HEIs budget (institutional funding);
	ii.	OP Competitiveness/Axis 1/Action 1.1.4; Erasmus+ and/or Marie Skłodowska-Curie Actions (IF, RISE);
	iii.	Erasmus+ and/or Marie Skłodowska-Curie Actions (IF, RISE);
	iv.	OP Human Capital, Specific Objective 6.9.
<i>Action:</i>	A.1.3 – Stimulate the creation of high-skill jobs in enterprises	
<i>Target population:</i>	Newly-minted MSc and PhD holders	
<i>Activities:</i>	i.	Promote recruitment of new MSc/PhD holders by industry by financial incentives to cover full payroll cost for a period of 12-24 months.
	ii.	Introduction of Industrial PhD programmes (co-)sponsored by enterprises and organised by the regional HEIs.
	iii.	Collaborative applied research projects
<i>Outputs:</i>	<ul style="list-style-type: none"> • Number of new researcher jobs (in full-time-equivalents) created in industry during the intervention; 	
<i>Expected outcomes:</i>	<ul style="list-style-type: none"> • Number of researcher jobs retained one year after the intervention ended. • Number of researchers (Headcount) in Business/Enterprise Sector. 	

- Potential Beneficiaries:*
- i. Enterprises in regional RIS3 priority sectors
 - ii. Higher education institutes
- Funding sources:*
- i. POCU, specific objective 6.13
 - ii. Private-sector funding (plus institutional funding, if needed)
 - iii. National Plan for RDI 2015-2020; OP Competitiveness/Axis 1/Action 1.2.1

Expected Impact

Extending the regional researchers' base (A.1-3) is considered as an enabler for the transition to a knowledge-based economy and for the sustainability of the leading position of the regional HEIs in Romania's academic rankings (in terms of research output and number of citations). Since HEI reputation is one of the major attributes that influences students' decisions to enrol to undergraduate academic programmes, it will also help attract talent in the region.

More and better research can also benefit the education mission of HEIs by updating curricula and keeping them current with respect to research frontiers (SO2), something that also influences students' decisions to enrol to undergraduate academic programmes.

Staff development through mobility (A.1.2) is expected to expose existing researchers to new knowledge and create informal (interpersonal) networks that will eventually evolve to formal (interinstitutional), thus improving the linkages to international research networks and the odds of joining EU-wide research consortia.

Finally, stimulating demand in the enterprise sector for highly-skilled knowledge workers and hopefully transform project-created jobs into permanent ones is considered as a seed investment in absorptive capacity that will be sustained later by graduates having better skills for innovation (SO2) and enhanced knowledge exchanges (SO4).

The key result indicators for SO1 are:

<i>Indicator</i>	<i>Description</i>	<i>Baseline</i>	<i>Target (2023)</i>
R.1.1	Researchers by sector of performance (Headcount, HES)	1409 (2014)	1750
R.1.2	Researchers by sector of performance (Headcount, BES)	399 (2014)	450

III.C. SKILLS DEVELOPMENT FOR INNOVATION AND EMPLOYMENT (SO2)

Rationale

During the last decade, many governmental, academic and non-profit organisations (e.g., US Secretary of Labor's Commission on Achieving Necessary Skills, a US coalition called the Partnership for 21st Century Skills (P21), OECD, the American Association of College and Universities, World Economic Forum, MIT and others) have been trying to define the skills and competencies that are needed by the current and the next generation, i.e. "21st Century skills". The required skill-sets suggested by each party usually vary, but some common themes appear: foundational literacies (language, numbers, science, ICT, financial/business/entrepreneurial, cultural/civic), competencies (critical thinking/problem solving, creativity, communication, collaboration) and character qualities (curiosity, initiative, persistence, adaptability, leadership and social/cultural awareness). They are based on the premise that effective learning, a set of student educational outcomes including acquisition of robust core academic content, higher-order thinking skills, and learning dispositions. This pedagogy involves creating, working with others, analysing, and presenting and sharing both the learning experience and the learned knowledge or wisdom, including to peers and mentors as well as teachers. This contrasts with more traditional learning methodology that involves learning by memorisation and reporting knowledge back to the teacher for a grade.

According to the latest results of the national study of monitoring the labour market insertion of higher education graduates at the bachelor's level, students graduated in 2010 assessed their studies as *poorly organised*

(63%) and *lacking practical orientation* (79%) although the content of their study programmes were good (67%) and they received good counselling from faculty members (66%).

Moreover, a recent DG REGIO-commissioned report indicates that the business sector is dominated by out-sourcing activities with minimal innovation needs and low value-added. This is verified by the latest official statistics which indicate that there were 401 innovative enterprises in the Region in 2014, equally split between industry and services. The total number of active enterprises in the Region for the same year was 72444, of which 2273 in the primary sector and 8090 in manufacturing.

Based on the above, action is needed to provide tertiary education students with foundational literacies, competencies and qualities that would enable them not only to become employable but also engage themselves in high value-added, innovative entrepreneurial activities. The same is needed for people that are currently in the workforce, since they are the ones to support the regional economy's transition to higher value-added activities. Finally, to address the issues of reportedly poorly organised studies that lack practical orientation, the need for some type of curriculum reform is needed that has to carefully balance national and international standards for the body of knowledge that has to be mastered for being awarded a university degree and relevance to the market needs.

Approach

To address the skills challenge three actions are introduced, two short-term and one medium-term. Actions A.2.1 and A.2.3 address the diffusion of the so-called 21st century skills to students and employees, respectively, and action A.2.2 addresses curriculum reforms-which are inherently medium-term due to regulatory issues.

Action A.2.1 aims to introduce entrepreneurial education in HEIs and complement it with soft measures that are inherently easy to implement. Following evaluation, the teaching material developed through A.2.1 can enter the curriculum at a later stage, thus being reused by A.2.2. However, the rest of the activities in A.2.1 need to be coordinated and executed in a periodical manner, either at the level of a HEI or regionally. At the HEI level, this task can be either delegated to an appropriate organisational unit (e.g., Careers Office or equivalent), or it might require setting up a new organisational unit.

Action A.2.2 addresses curricula updates covering the entire cycle of educational offerings, from content creation to accreditation. It builds on inputs on anticipation of labour market needs and on graduates' insertion into the labour market developed at the national (i.e., OP Human Capital 2014-2020/Specific Objective 6.16) and the regional level (S.O.4). Action A.2.2 complements professional development of HEI teaching staff (A.1.2).

Finally, Action A.2.3 introduces the 21st century skills to the existing workforce through properly designed and implemented workforce development programmes that aim to maintain existing jobs and support the career advancement of trainees.

Action: **A.2.1 – Teach new skills to tertiary education students**

Target population: Last-year undergraduate (~5600) and graduate students (~2000) at the regional HEIs pursuing STEM and business degrees.

- Activities:*
- i. Provide education on creativity, innovation, entrepreneurship, business and financial skills through seminars;
 - ii. Stimulate, develop and support early-stage entrepreneurial activities by students (bootcamps, business plan competitions, consulting and mentoring);
 - iii. Support networking between students and industry/enterprise (mentors; start-up careers events; invited talks; start-up internships, etc)
 - iv. Promote or stimulate bachelor and master student participation to research projects.

- Outputs:*
- Number of students having attended creativity, innovation, and entrepreneurship courses;
 - Number of students that received support in developing entrepreneurial

- activities.
- Expected outcomes:*
- Reduced time between graduation and first job for students that were supported.
 - Increased number of start-ups founded by students that were supported.
- Potential Beneficiaries:* Higher Educations Institutions
- Funding sources:* POCU, specific objective 6.13
Erasmus+, cross-border cooperation programmes
- Action:* **A.2.2 – Improve curricula and facilities in tertiary education**
- Target population:* Undergraduate (bachelor) and graduate (master) students at regional HEIs pursuing degrees in RIS3-related disciplines (~45000).
- Activities:* Development of educational content in HEIs that promotes quality learning experiences and incorporates recent research with a focus on RIS3-related disciplines and the provision of 21st century skills.
- Outputs:* Number of courses with updated curricula.
- Expected outcomes:*
- Number courses with updated curricula that were validated and accredited.
 - Reduced time between graduation and first job for students that were supported.
- Potential Beneficiaries:* Accredited HEIs
- Funding sources:* OP Human Capital 2014-2020 / specific objective 6.9.
- Action:* **A.2.3 – Develop and execute workforce development projects**
- Target population:* Employees in RIS3 priority sectors
- Activities:*
- i. Development and implementation of training programs aimed at improving 21st century skills and professional and non-professional qualifications, to maintain employment and to improve careers.
 - ii. Support for the development and implementation of programs in partnership between training providers and employers (action plans, development of learning materials, local curriculum development, etc.);
- Outputs:*
- Number of accredited programmes developed;
 - Number of employees in RIS3 priority sectors with updated and certified skills;
- Expected outcomes:*
- Number of employees that were delegated with higher responsibilities within one year of attending the courses.
- Potential Beneficiaries:* IVT and CVT providers; Agencies and other public bodies in the education sector; Employers' and Professional associations; chambers of commerce, industry and agriculture;
- Funding sources:* OP Human Capital 2014-2020, specific objective 6.17
Erasmus+ Key Action 2

Expected Impact

The first intervention (A.2.1) aims to increase the employability of tertiary education STEM graduates, either in existing businesses or in innovative start-ups. The latter are considered as mechanisms to create challenging, well-paid and high-skill jobs. The second intervention (A.2.2) aims to improve the quality of HEI degrees and their relevance to the market. The third intervention (A.2.3) aims to improve the existing workforce in the RIS3 priority sectors, by supporting their career development and increasing the propensity of them acting as agents of change within their organisations.

The key result indicator for SO2 is:

<i>Indicator</i>	<i>Description</i>	<i>Baseline</i>	<i>Target (2023)</i>
R.2.1	Persons with tertiary education and employed in science and technology (percentage of total population)	7.0 (2013)	10.0

III.D. REDUCE EDUCATION SYSTEM DROPOUTS AT ALL LEVELS (SO3)

Rationale

There is strong evidence on the benefits of extended participation in education. More or better education can lead to a series of positive individual (employment, higher salaries, better health) and societal (less crime, higher social cohesion, lower public and social costs and higher productivity and growth) outcomes. The impact of leaving education and training early can propagate across generations, thus creating multiplicative effects. The literature suggests that the factors contributing to this phenomenon include family, gender, migration/minority background, socio-economic factors, education system related factors (grade retention, socio-economic segregation of schools, early tracking of students, early childhood education and care, the transition from compulsory to non-compulsory education) and labour market factors (employment or unemployment-depending on the context, the existence of vocational education alternatives).

Approach

The approach selected to address leavers from education and training consists of preventive measures that address the population of 16-years-old students with emphasis in rural areas (A.3.1) and providing support schemes for tertiary education students at risk of abandoning their studies (A.3.2 and A.3.3).

Action: **A.3.1 – Support change of attitude towards tertiary education among secondary education students**

Target population: 16-year-old students (~ 29000 total; ~16000 in rural areas)

- Activities:*
- i. Awareness campaigns designed to ensure understanding of the benefits offered by education in relation to future individual status;
 - ii. Organisation of school visits to Universities and Research Centres/Labs;
 - iii. Organisation of High School science/technology fairs or competitions.

Outputs:

- Number of 16-year-old students exposed to awareness campaigns;

Expected outcomes:

- Increased percentage of students that complete secondary education after being supported by the intervention;
- Increased percentage of students that continue with post-secondary education after being supported by the intervention.

Potential Beneficiaries: 255 high schools and vocational schools (39 in rural areas)
HEIs, social partners, NGOs

Funding sources: OP Human Capital 2014-2020, specific objective 6.3

Action: **A.3.2 – Improve career counselling in secondary and tertiary education**

Target population: Secondary and undergraduate tertiary education students

- Activities:*
- i. Development of an online career counselling platform and providing personalised career guidance based on self-declared skills and interests for secondary education students;
 - ii. Increase deployment of career counselling programmes in HEIs.

Outputs:

- Number of secondary education students that received personalised career guidance;
- Number of undergraduate students that received personalised career guidance;

Expected outcomes:

- Improved student satisfaction from career counselling services.

Potential Beneficiaries: i. HEIs and high schools or agencies of the Ministry of Education;
ii. HEIs

Funding sources: OP Human Capital 2014-20, specific objective 6.7

Action: **A.3.3 – Assist tertiary education students at risk of abandoning their studies**

Target population: BSc and MSc students in extreme risk of abandoning their studies (5% of a population of approx. 90 000).

Activities:

- i. Development of early warning systems in HEIs;
- ii. Providing direct financial support (e.g., scholarships, housing, subsistence);
- iii. Providing indirect support (e.g., educational assistance, coaching or mentoring);

Outputs:

- Number of tertiary education students that received non-financial support;
- Number of tertiary education students that received financial support;

Expected outcomes:

- Decreasing rate of tertiary education students coming from disadvantaged social groups that abandon their studies due to support they received.

Potential Beneficiaries: Higher education institutes

Funding sources: OP Human Capital 2014-2020, specific objective 6.7

Expected Impact

The approach selected for SO3 complements the national strategy for improving early childhood education and care programs (ECEC) implemented by the Operational Programme for Human Capital (POCU), which is an essential, but a long-term investment for the youth. In this sense, SO4 is expected to deliver measurable outcomes related to creating potential for improved participation in tertiary education (A.3.1), selecting the most appropriate undergraduate degree that match the individual profiles (A.3.2) and helping tertiary education students to complete their studies (A.3.3). All three interventions are expected to contribute to the long-term objective of improving the tertiary education attainment in the region by reducing the number of dropouts from the system.

The key result indicator for SO3 is:

<i>Indicator</i>	<i>Description</i>	<i>Baseline</i>	<i>Target (2023)</i>
R.3.1	Percentage of early leavers from education and training (both sexes, 18 to 24 years old)	15.4 (2013)	12.5

III.E. ACTIVATE AND STRENGTHEN TRIPLE-HELIX INTERACTIONS (SO4)

Rationale

Lagging regions are typically characterised by a lack of dynamic firms, organisational thinness, lowly specialised organisations, introvert educational institutions, brain drain, loss of highly qualified personnel and weakly developed local networks. Spontaneous knowledge spillovers are limited and institutional systems are unable to foster local knowledge spillovers. Consequently, organisations in such regions must put emphasis on their collaboration processes in order to provide extra-organisational knowledge sources and better support the innovation process. In fact, the knowledge creation success of regions depends not only on internal conditions but on the ability of local organisations to identify and access a diverse set of external knowledge sources, and on their ability to participate and position themselves in inter-organisational knowledge networks.

Establishing and sustaining linkages among the strands of the triple helix so that regional stakeholders acquire a common understanding of the regional development challenges and commit themselves to address them is the core concept behind smart specialisation. There is a growing body of theory and practice that

highlights the importance of building this type of mutual understanding and exploit it for the purpose of regional development.

The theory on inter-organisational knowledge exchange and knowledge spillovers has identified *direct* (joint research, licensing, acquisition of patents and consulting), *indirect* (social networks and non-contractual interactions) and *mixed* (labour mobility and spin-offs) mechanisms for such interactions. From the perspective of this Action Plan, these mechanisms not only promote knowing and understanding among the strands of the triple-helix, but also provide learning and skill development opportunities to the participants. Therefore, they should be encouraged and maintained to foster knowledge spillovers and enhance the potential for innovation at the organisational and the regional level.

Approach

There are three Actions included under special objective 4. The first one (A.4.1) addresses the mixed mode of knowledge exchange interactions providing for intersectoral mobility from academia or research to industry and vice versa. In addition to the evident knowledge exchanges that are inherent in the delivery instruments proposed, opportunities for acquiring new skills and domain expertise for the participants are also a much-wanted additional benefit. It should be noted that financial support for the establishment of start-ups by students is not considered in this Action Plan since it is a measure to be considered under support for entrepreneurship and not skills development. Providing students with the soft skills needed for this was addressed through SO2 earlier.

The second one (A.4.2) deals with anticipating skill needs and addressing them. The proposed Regional Skills and Employment Observatory is meant to be a collaborative triple-helix effort that brings together suppliers and users of skills at the regional level and facilitates their joint strategic planning. For the stakeholders in higher education, the outputs of this effort are expected to drive curricula reforms through SO2/A.2.2. For the stakeholders in life-long-learning and vocational training, A.4.2 will provide the certifications needed so that they are able to launch the workforce development programmes planned for SO2/A.2.3.

Finally, A.4.3 institutionalises the dialogue among the regional stakeholders by formalising the indirect mechanisms for interaction at the regional level and addresses capacity building in the individual strands of the triple-helix in line with the needs and the challenges that have been identified.

Action: **A.4.1 – Promote intersectoral mobility**

Target population: Undergraduate and graduate students enrolled in RIS3-related programmes; HEI and PRO Faculty members/Researchers; Researchers and technical staff in the enterprise sector.

- Activities:*
- i. University to Industry: Internships and placements for undergraduate students; faculty member sabbaticals to work in industry; knowledge transfer partnerships.
 - ii. Industry to University: Industrial Masters & PhD programmes; open access to HEI/PRO labs for researchers in the business/enterprise sector.
 - iii. Academic entrepreneurship: feasibility studies for the creation of spin-off companies and/or direct support for their establishment.

- Outputs:*
- Number of tertiary education students that acquired work experience through internships or placements;
 - Number of HEI/PRO researchers that acquired industry experience by working in the business/enterprise sector;
 - Number of students enrolled in industrial MSc or PhD courses.
 - Total days spent by business/enterprise sector researchers in HEI/PRO labs.
 - Number of research outcomes for which the feasibility of commercial exploitation was examined;
 - Number of spin-off companies created

<i>Expected outcomes:</i>	<ul style="list-style-type: none"> • Reduced time between graduation and first job for students that acquired work experience. • Increased number of co-authorships (scientific publications) and co-inventions (patents) between academia/research and industry. • Number of high-skill jobs created by spin-off companies.
<i>Potential Beneficiaries:</i>	<ol style="list-style-type: none"> i. HEIs and enterprises. ii. HEIs, HEI/PROs iii. HEI/PROs or individual faculty members.
<i>Funding sources:</i>	<ol style="list-style-type: none"> i. OP Human Capital 2014-2020, specific objective 6.13 & OP Competitiveness, Specific Objective 1.4. ii. Private-sector funding; ROP/P.A.10; Erasmus+ K.A.1. iii. OP Competitiveness/Specific Objective 1.3.
<i>Action:</i>	A.4.2 – Forecast skill and knowledge input needs & develop capacity to address them
<i>Target population:</i>	Local stakeholders in higher education, vocational and lifelong learning with associations of employers, chambers, trade unions and other similar entities and the RDA.
<i>Activities:</i>	<ol style="list-style-type: none"> i. Establishment of Regional Skills and Employment Observatory and conduct skill needs surveys (short-, medium- and long-term), analyse education enrolment and graduation statistics, conduct alumni career surveys and finally elaborate gap assessments of qualifications and curricula and initiate appropriate actions. ii. Develop and certify the supply of life-long-learning (LLL) and continuous vocational training (CVT) services and programmes.
<i>Outputs:</i>	<ul style="list-style-type: none"> • Biannual skills gap assessment reports; • Number of certified LLL/CVT providers; number of certified LLL/CVT programmes.
<i>Expected outcomes:</i>	<ul style="list-style-type: none"> • Curricula updates in HEIs to address identified skills gaps. • Increased usage of focused LLL/CVT services to address identified skills gaps.
<i>Potential Beneficiaries:</i>	Partnerships of local stakeholders in higher education, vocational and lifelong learning with associations of employers, chambers, trade unions and other similar entities and the RDA.
<i>Funding sources:</i>	<ol style="list-style-type: none"> i. OP Human Capital 2014-2020, specific objective 6.16; Erasmus+ Key Action 2 & 3. ii. OP Human Capital 2014-2020, specific objectives 6.12 and 6.17; Erasmus+.
<i>Action:</i>	A.4.3 – Improve the innovation capacity of all regional stakeholders and develop necessary institutional structures
<i>Target population:</i>	Regional institutional actors in Academia/Research, Enterprise and Government
<i>Activities:</i>	<ol style="list-style-type: none"> i. Institutionalise a continuous Entrepreneurial Discovery Process, building on the experience of RIS3 and continuously improve the process by incorporating new tools (e.g., foresight, scenario planning, innovation trajectories). ii. Build evidence-driven strategic planning & execution capacity in HEI/PROs (incl. research priorities and staffing, HR hiring and promotion and remuneration policies, technology transfer and industry engagement policies, capacity to attract international funding, opportunities for

- interinstitutional interdisciplinary research).
- iii. Support the capacity of the enterprise sector to monitor markets and technologies and to predict and adapt to change.
 - iv. Promote policy experimentation at the regional level.
- Outputs:*
- Number of EDP cycles
 - Number of strategic plans elaborated / institutional policies adopted
 - Number of markets/technologies monitored
 - Number of pilot projects implemented.
- Expected outcomes:*
- Improved competencies in elaborating and executing a regional science, technology and innovation policy
- Potential Beneficiaries:* Regional institutional actors in Academia/Research, Enterprise and Government
- Funding sources:*
- i. National and international technical assistance projects;
 - ii. Institutional funding; national or international technical assistance projects; OP Competitiveness/S.O. 1.2
 - iii. All types of EU transnational or interregional programmes.
 - iv. All types of EU transnational or interregional programmes; technical assistance projects; innovative actions in national OPs.

Expected Impact

All three actions in SO4 support the action plan's long term objective. Action A.4.1 aims to build linkages and breaks down barriers between the university and the private sector which may lead to future collaborations in other areas (e.g. research, consultancy). There can be potential for real transformative effects as enterprises are exposed to the knowledge assets of the university via its staff and students and HEIs can get valuable insights on the actual R&D&I needs of businesses. Action A4.2 can be seen as the one that institutionalises the regional partnership for skills and jobs at all levels of education and training, thus leading to action that guarantees the action plans long term objectives. Finally, Action A.4.3 institutionalises the dialogue among the regional stakeholders which will eventually lead to a better understanding of each other and to joint commitments in addressing the regional development needs. It also provides opportunities for building capacity to develop and execute innovation strategies for individual parts of the triple-helix.

The key result indicator for SO4 is:

<i>Indicator</i>	<i>Description</i>	<i>Baseline</i>	<i>Target (2023)</i>
R.4.1	Perceived degree of regional innovation policy competences by sector of performance (cross-sectoral survey)	n)a	>60%

IV. IMPLEMENTATION

IV.A. DELIVERY

The governance structure for RIS3 in North-West Romania consists of:

- A Steering Committee, which is the advisory forum for the process of strategy development. In performing its duties, the Steering Committee collaborates with and approves the documents / proposals developed / formulated by the following structures:
- A Management team composed of 3-4 experts from the North-West RDA with a role in performing the analyses and strategy development who can be assisted by subcontracted external experts;
- A Scientific Committee composed of 4-5 external experts from HEIs, academia or members of independent European expert groups with specialist knowledge in the field, and able to liaise with European specialist networks, in particular the S3 Platform, with the role to add value to the process through specialized knowledge;
- Working groups made up of representatives of key regional actors. Groups are the forum for consultation in a broader partnership. The working groups can be thematic or sectoral, depending on the topic debated and the stage of drafting the Strategy.

The High-Level Working Group on Human Resource Development and Mobility (HLWG) is considered as one of the working groups of the governance system and it acts as a thematic working group aimed at supporting the implementation of HR specific actions from the policy mix of the strategy. Liaison and reporting back to the Steering Committee shall be done through those members that are both part of the Steering Committee as well as of the HLWG (Professors Luțaș, Loghin and Vodnar).

In the delivery phase of the Action Plan, and unless the Steering Committee decides otherwise, the HLWG with the help of the Management Team can evolve to become the co-ordinating body for the application of the regional HR strategy under Pillar 4 of the RIS3. This would require it to co-ordinate policy initiatives within institutions, preparation, submission and execution of joint projects, shared resources / data and monitoring through the common set of indicators in all institutions.

IV.B. BUDGET AND SOURCES OF FUNDING

Sources of funding were identified for each one of the proposed interventions in the Action Plan on the basis of publicly provided information and the official texts of the EU-funded Romanian Operational Programmes. However, we must note that:

- Full eligibility of the proposed actions cannot be guaranteed until calls for expression of interest are published by the competent managing authorities;
- The internal budget allocation within the proposed actions per specific objective in the national Operational Programmes is not publicly available;
- The competitive nature of most of the calls of the national OPs and the lack of performance data for North-West Romania in the previous programming period imposes several constraints in the exercise of making an informed assumption of the budget that will actually be channelled to the Region.

Given these, an initial estimate for the budget of the Action Plan is provided in Table 2.

TABLE 2 BUDGET AND INDICATIVE SOURCES OF FUNDING.

<i>Own Funding (Institutional)</i>	<i>National OPs</i>	<i>EU Programmes</i>	<i>Total</i>
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	<i>or Private)</i>		<i>& Initiatives</i>	
SO1 - Stimulate employment in research and innovation	7 668 000	5 132 000	2 700 000	15 500 000
SO2. Skills Development for Innovation and Employment	2 813 000	1 600 000	0	4 413 800
SO3. Maximise Intake and Minimise Dropouts in Tertiary Education	282 000	17 736 400	0	18 018 400
SO4. Activate and Strengthen Triple-Helix Interactions	1 180 000	12 230 000	5 990 000	19 400 000
Totals (€):	11 943 800	36 698 400	8 690 000	57 332 200

IV.C. MONITORING PROGRESS

Given the Action Plan's long-term objective defined in section, the most relevant single indicator to assess whether it is met or not is "Population aged 30-34 by educational attainment level by region (%)" as provided by EUROSTAT (table: edat_lfse_12), focusing on the percentage of population with tertiary education (ISCED levels 5-8). For 2013, the values for this indicator were 37.1%, 22.9% and 20.2% for EU28, Romania and North-West Romania, respectively. Having in mind that the target groups for the majority of the interventions in this action plan are of 16-28 years of age, the major impact is expected to appear approximately 6 years after the end of interventions. The same indicator was selected by the Regional Operational Programme 2014-2020 for Romania, setting a nation-wide target of 28.2% for 2023. In this sense, the Action Plan remains aligned to the national strategy.

Output indicators have been defined per Action and result indicators have been defined per Specific Objective. They are summarised in Table 1 (p.13). Table 3 provides the details of outputs per action type and the associated budget.

TABLE 3 OUTPUT INDICATORS AND BUDGET ESTIMATION PER ACTION.

Action	Action Types	Num Units	Unit	Total Cost (€)
A.1.1 – Provide career opportunities for young researchers in academia.	Research Projects (Various)	500	FTEs of New Researchers (HEI/PRO)	3 000 000
	Scholarships for PhD students	200	FTEs of PhD Students	720 000
	Scholarships for PostDocs	100	FTEs of Post-Docs	600 000
A.1.2 – Fill faculty vacancies and provide career development opportunities through mobility	Recruitment in HEIs: 50 positions / yr for 4 yrs	500	Headcount of new HEI faculty	6 000 000
	Incoming mobility programmes for PhD holders of the Romanian diaspora	60	Person-months of incoming researchers	300 000
	Outgoing mobility programmes for staff	180	Person-months of outgoing researchers	900 000
	Training courses for HEI teaching staff in using innovative learning resources and in improving delivery of courses.	500	Number of staff trained	500 000
A.1.3 – Stimulate the creation of high-skill jobs in enterprises	Promote recruitment of new MSc/PhD holders in industry	200	FTEs of New Researchers (Industry)	2 400 000
	Introduction of Industrial PhD programmes	40	FTEs of Industry PhD Students	480 000
	Collaborative applied research projects	50	FTEs of New Researchers (Industry)	600 000
SO1 Totals				15 500 000

Action	Action Types	Num Units	Unit	Total Cost (€)
A.2.1 – Teach new skills to tertiary education students	Provide education on creativity, innovation, entrepreneurship, business and financial skills through seminars	4800	Number of students taking part in entrepreneurial skills and creativity training courses and seminars	2 640 000
	Stimulate, develop and support early-stage entrepreneurial activities by students	96	Number of workshops, public pitching sessions organized for students	96 000
	Support networking between students and industry/enterprise	96	Number of networking events for students to meet industry representatives	28 800
	Promote or stimulate bachelor and master student participation to research projects	96	Awareness raising events within universities regarding financing possibilities and ongoing research projects	24 000
A.2.2 – Improve curricula and facilities in tertiary education	Development of educational content in HEIs	10	Number of university curricula elaborated/revised	25 000
A.2.3 – Develop and execute workforce development projects	Development and implementation of training programs	8	Number of new training programs elaborated in collaboration by companies and HEIs	800 000
	Support for the development and implementation of programs in partnership between training providers and employers	8	Number of training programs implemented by HEIs in cooperation with companies	800 000
SO2 Totals				4 413 800
A.3.1 – Support change of attitude towards tertiary education among secondary education students	Awareness campaigns in schools	6	Number of awareness campaigns in schools	150 000
	Organisation of school visits to Universities	48	Number of (open) events for high school students at public Universities	38 400
	Science/technology fairs or competitions	48	Number of science/technology fairs or competitions organized	120 000
A.3.2 – Improve career counselling in secondary and tertiary education	Online career counselling platform	1	Online career counselling platforms created	150 000
	career counselling programmes in HEIs	48	Number of functional career counselling programmes implemented in public HEIs	2 400 000
A.3.3 – Assist tertiary education students at risk of abandoning their studies	Development of early warning systems in HEIs	8	Number of early warning systems implemented in HEIs connected to career <u>counselling platform</u>	40 000

Action	Action Types	Num Units	Unit	Total Cost (€)
	Provide direct financial support different than scholarships (<i>bursary</i>)	2400	Number of students with drop-out risks receiving financial support to continue their studies	14 400 000
	Provide indirect support different than scholarships at each public university	48	Number of programmes developed by public universities for students with drop-out risks receiving indirect support to continue their studies	720 000
SO3 Totals				18 018 400
A.4.1 – Promote intersectoral mobility	Internships and placements	9000	Number of tertiary education students acquired work experience	6 750 000
	Faculty member sabbaticals	40	Number of faculty members that spend 6 months abroad	480 000
	Knowledge transfer partnerships	60	Number of KtP programmes	720 000
	Industrial Masters Programmes	150	Number of industrial MSc Degrees Awarded	900 000
	Open access to HEI/PRO labs	1500	Number of days spent in HEI/PRO labs	150 000
	Spin-off feasibility studies	50	Number of IPRs checked for feasibility of commercialisation	500 000
A.4.2 – Forecast skill and knowledge input needs & develop capacity to address them	Regional Skills and Employment Observatory	3	Number of biannual skill assessment reports	450 000
	Develop and certify the supply of life-long-learning (LLL) and continuous vocational training (CVT) services and programmes	10	Number of certified CVT/LLL programmes	1 500 000
A.4.3 – Improve the innovation capacity of all regional stakeholders and develop necessary institutional structures	Continuous Entrepreneurial Discovery Process	3	Number of EDP cycles executed	450 000
	Build evidence-driven strategic planning & execution capacity in HEI/PROs	10	Number of HEI/PROs with updated strategy planning and execution capacity	2 500 000
	Support the capacity of the enterprise sector to monitor markets and technologies and to predict and adapt to change	10	Number of enterprise institutional stakeholders supported	2 000 000
	Promote policy experimentation at the regional level	20	Number of policy experimentation projects implemented	3 000 000
SO4 Totals				19 400 000

V. APPENDIX

V.A. KEY INDICATORS

TABLE 4 KEY SMART DEVELOPMENT INDICATORS: NW ROMANIA VS ROMANIA VS EU28.

<i>Indicator-Year</i>	<i>NW Romania (%RO)</i>	<i>Romania</i>	<i>EU28</i>
GDP at current prices, mil EUR - 2014	16 925 (11.27)	150 230	13 954 739
Population			
Total – 1.1.2015	2 585 543 (13.01)	19 870 647	508 450 856
Aged 15 to 64 – 1.1.2015	1 767 831 (13.18)	13 414 063	333 100 000
Unemployed, aged 20-64 - 2015	52 100 (8.95)	582 200	21 498 000
Tertiary Education (2013-14)			
Institutions	15 (14.56)	103	
Faculties	96 (16.27)	590	
Teaching Staff	5 328 (18.89)	28 211	
Enrolled Students	70 436 (16.26)	433 234	
Graduates (2012-13)	16 010 (14.42)	111 028	
Human Resources in Science and Technology - 2015			
Persons with tertiary education, number	280 000 (13.17)	2 126 000	95 932 000
Persons with tertiary education, % of active population	20.20 (103.06)	19.60	32.00
Persons with tertiary education and employed in Science and Technology, number	180 000 (14.37)	1 253 000	48 941 000
Total R&D personnel by sectors of performance; Researchers (FTEs) – 2015			
<u>All Sectors</u>	<u>1 453 (8.02)</u>	<u>18 109</u>	<u>1 760 232</u>
Higher Education	777 (12.18)	6 378	692 390
Business	302 (5.76)	5 244	845 940
Government	362 (5.65)	6 409	207 533
Total R&D personnel by sectors of performance; Researchers (Headcount) – 2015			
<u>All Sectors</u>	<u>2 280 (8.26)</u>	<u>27 535</u>	<u>2 706 928</u>
Higher Education	1 409 (9.56)	14 743	1 407 020
Business	399 (6.82)	5 848	1 048 575
Government	454 (6.68)	6 799	264 483
Patent applications to the EPO by priority year;			
Number – 2012	4.00 (6.63)	60.33	56 600.00
Per million inhabitants – 2012	1.54 (51.27)	3.00	111.90
Patent applications to the National Office by residents;			
Number - 2013	84.00 (8.44)	995.00	n)a
Total intramural R&D expenditure (GERD);			
EUR per inhabitant – 2015	17.70 (61.46)	28.80	564.40
<u>Percentage of GDP – 2014</u>	<u>0.27 (71.05)</u>	<u>0.38</u>	<u>2.04</u>
Higher Education	0.12 (200.0)	0.06	0.48
Business Sector	0.09 (56.25)	0.16	1.30
Government Sector	0.06 (37.50)	0.16	0.25

V.B. PUBLIC RESEARCH AND HIGHER EDUCATION ENTITIES IN NW ROMANIA

TABLE 5 PUBLIC RESEARCH AND HIGHER EDUCATION ENTITIES

s/n	Institution	Entity	Location
1.	Institutul Național de Cercetare-Dezvoltare pentru Tehnologii Izotopice și Moleculare		Cluj-Napoca
2.	Institutul Național de Cercetare-Dezvoltare pentru Științe Biologice (Branch)		Cluj-Napoca
3.	Institutul Național de Cercetare-Dezvoltare pentru Optoelectronică INOE 2000 (Branch)		Cluj-Napoca
4.	Institutul Național de Cercetare-Dezvoltare în Geologie, Geofizică, Geochimie și Teledetectie (Branch)		Cluj-Napoca
5.	Institutul Național de Cercetare-Dezvoltare în Construcții și Economia Construcțiilor (Branch)		Cluj-Napoca
6.	Institutul Național de Cercetare-Dezvoltare pentru Mașini și Instalații destinate Agriculturii și Industriei Alimentare (Branch)		Cluj-Napoca
7.	Romanian Academy – Branch of Cluj-Napoca	Institutul de Arheologie și Istoria Artei “Vasile Pârvan” Institutul de Istorie “George Barițiu” Institutul de Lingvistică și Istorie Literară “Sextil Pușcariu” Centrul de Studii Transilvane Institutul “Arhiva de Folclor a Academiei Române – Filiala Cluj” Institutul de Geografie – Colectivul Cluj Institutul de Calcul “Tiberiu Popoviciu” Institutul Astronomic – Colectivul Cluj Institutul de Speologie	Cluj-Napoca
8.	Univ Babeș-Bolyai		Cluj-Napoca
9.	Univ Tehnică Cluj-Napoca		Cluj-Napoca Baia Mare
10.	Univ Medicină și Farmacie Iuliu Hațieganu		Cluj-Napoca
11.	Univ Științe Agricole și Medicină Veterinară Cluj-Napoca		Cluj-Napoca
12.	Academia de Muzică “Gheorghe Dima”		Cluj-Napoca
13.	Univ Artă și Design Cluj-Napoca		Cluj-Napoca
14.	Univ din Oradea		Oradea
15.	Institutul Oncologic “Prof. Dr. Ioan Chiricuță”		Cluj-Napoca
16.	Institutul Inimii de Urgență pentru Boli Cardiovasculare „Nicolae Stăncioiu”		Cluj-Napoca
17.	Institutul de Urologie și Transplant Renal		Cluj-Napoca
18.	Institutul Regional de Gastroenterologie-Hepatologie “Prof. Dr. Octavian Fodor”		Cluj-Napoca
19.	Spitalul Universitar/ Clinic CF Cluj		Cluj-Napoca
20.	Spitalul Clinic de Recuperare Cluj-Napoca		Cluj-Napoca

V.C. TERTIARY EDUCATION GRADUATES

TABLE 6 TERTIARY EDUCATION GRADUATES, NW ROMANIA, 2015

<i>International Classification of Educational Standards (ISCED-F 2013)</i>	<i>Bachelor</i>	<i>Master</i>	<i>PhD</i>	<i>Total</i>
Education science	350	129	0	479
Arts and humanities	1 006	517	132	1 655
Social sciences, journalism and information	593	354	28	975
Business, Management and Law	2 690	1 222	91	4 003
Natural Sciences, Mathematics and Statistics	846	449	89	1 384
Information and communication technologies (ICTs)	600	153	10	763
Engineering, processing and construction	2 147	1 337	64	3 548
Agriculture, forestry, fishery and veterinary science	647	172	57	876
Health and social care	1 898	1 585	126	3 609
Services (includes environmental protection)	378	230	0	608
Totals:	11 155	6 148	597	17 900

V.D. PERFORMANCE IN EU-FUNDED RESEARCH PROGRAMMES

TABLE 7 FP7 AND H2020 PARTICIPATION STATISTICS FROM NORTH-WEST ROMANIA.

Institution	FP7		H2020 (up to 15.9.2017)	
	Projects (Co-ord)	Budget (€)	Projects (Co-ord)	Budget (€)
UNIVERSITATEA TEHNICA CLUJ-NAPOCA	35 (2)	5 599 678	7 (2)	2 189 381
UNIVERSITATEA BABES BOLYAI	23 (1)	2 673 304	6 (0)	1 995 908
UNIVERSITATEA DE MEDICINA SI FARMACIE IULIU HATIEGANU CLUJ-NAPOCA	7 (0)	746 094	2 (0)	657 431
INSTITUTUL NATIONAL DE CERCETARE- DEZVOLTARE PENTRU TEHNOLOGII IZOTOPICE SI MOLECULARE-INCDTIM CLUJ-NAPOCA	4 (0)	218 142	-	-
UNIVERSITATEA DE STIINTE AGRICOLE SI MEDICINA VETERINARA CLUJ NAPOCA			2 (0)	160 738
UNIVERSITATEA DIN ORADEA	4 (0)	158 324	-	-
UNIVERSITATEA SAPIENTIA DIN MUNICIPIUL CLUJ-NAPOCA	-	-	1 (0)	60 600
PRIVATE SECTOR ENTERPRISES (ALL)	33 (0)	3 829 954	7 (2)	726 732

V.E. REGIONAL EMPLOYMENT SPECIALISATION

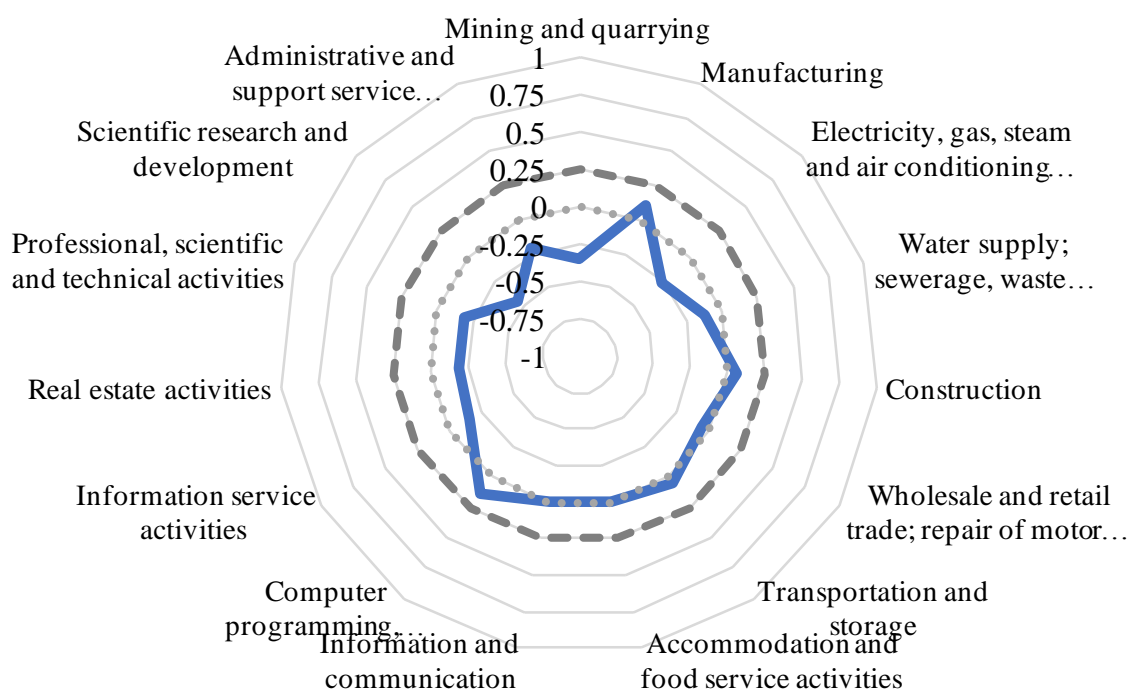


FIGURE 4 REGIONAL EMPLOYMENT SPECIALISATION (DATA: EUROSTAT, YEAR: 2015).

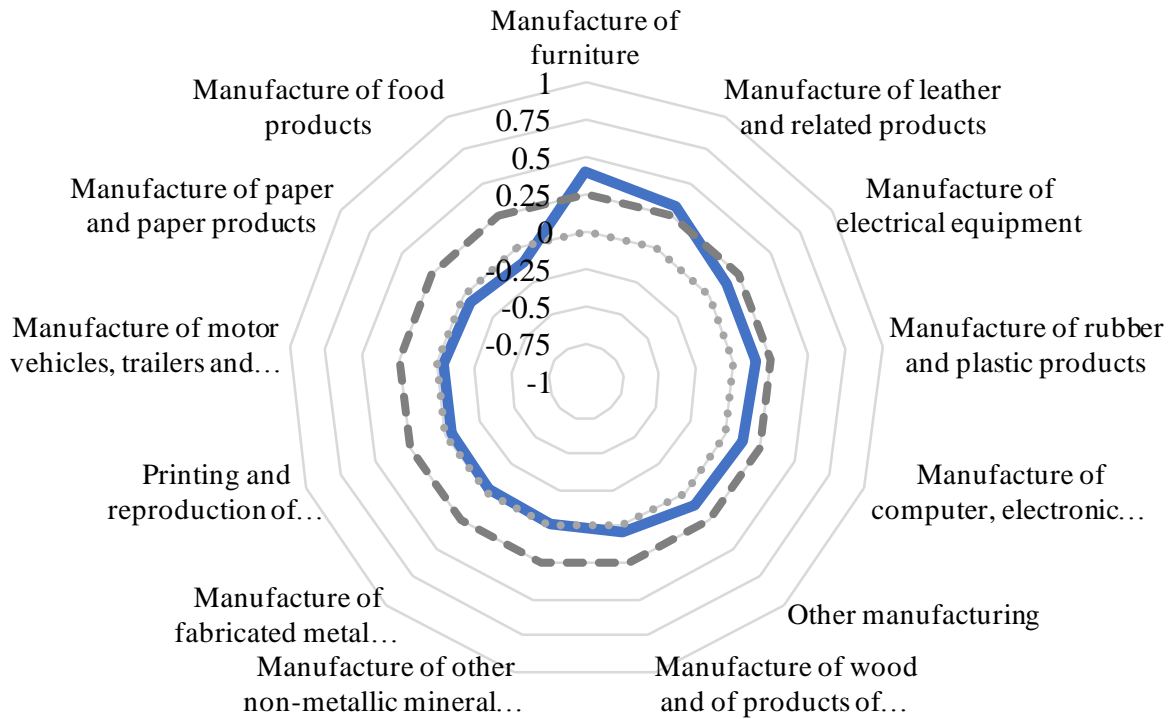


FIGURE 5 REGIONAL EMPLOYMENT SPECIALISATION (MANUFACTURING SUBSECTORS) IN DECREASING ORDER OF NORMALISED LOCATION QUOTIENT (DATA: EUROSTAT, YEAR: 2015).

V.F. REGIONAL SCIENTIFIC SPECIALISATION

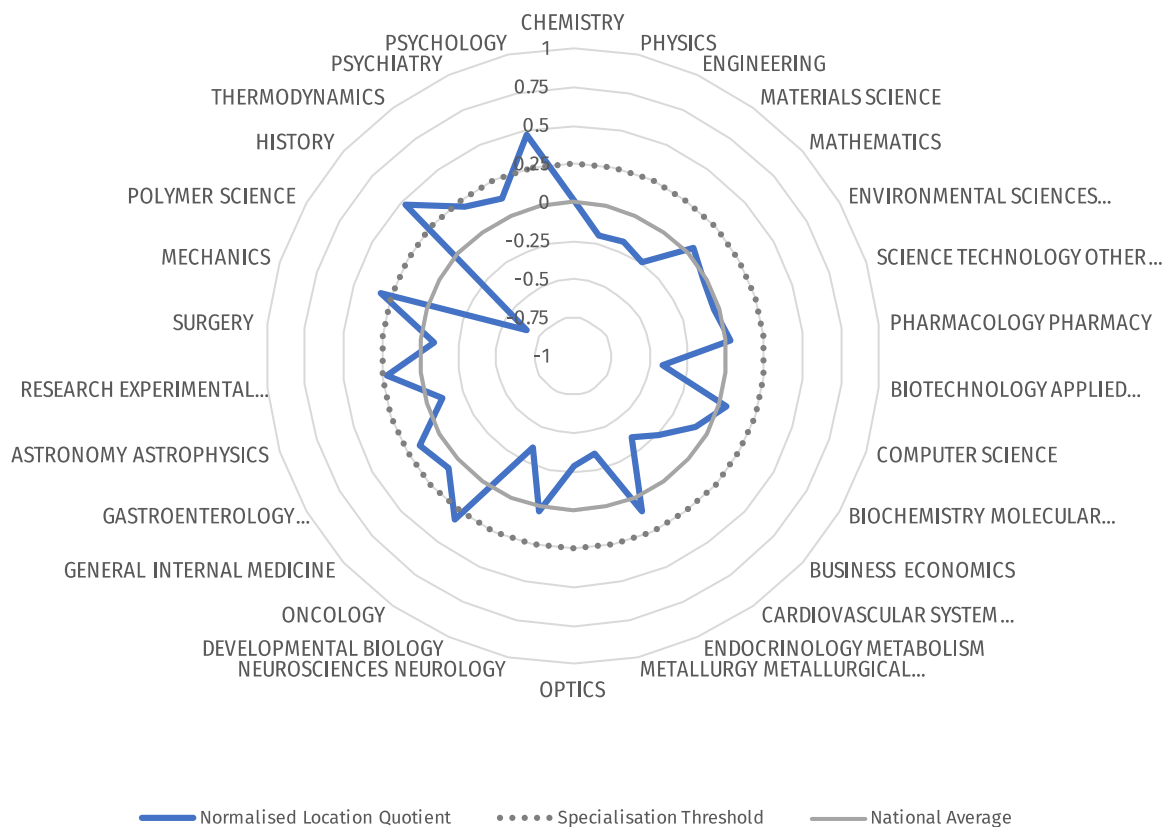


FIGURE 6 REGIONAL SCIENTIFIC SPECIALISATION VS ROMANIA (SOURCE: WEB OF SCIENCE, DATA RANGE: 2012-16).