Report on Potential Supply of Technology Transfer Services in North East Romania

Yannis TOLIAS*

17 March 2017

* Contact details: Innovatia Systems, 22 Dodekanissou st., GR-546 26 Thessaloniki, Greece. Tel: +302310567442, Fax: +302310567443, email: tolias@innovatiasystems.eu.

TABLE OF CONTENTS

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 project 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 RIS3 in North East Romania with a focus, among others, to supporting the Region in assessing its potential for technology transfer from the supply-side.

This report aims to quantify the supply-side of technology transfer in North-eastern Romania and in turn, inform the regional smart specialisation strategy. It does so by summarising the regional context in Section II, then by presenting the methodology in Section III and finally by presenting and analysing the results in Section IV and providing policy recommendations in Section V.

II. CONTEXT

According to [2](pp. 18-19), the public RDI system in Romania consists primarily of national institutes for R&D, institutes of the Romanian Academy, and universities. The organisations most closely identified with 'research and development' are the national R&D institutes (NRDIs): of the around 50 such organisations that are currently active, a little over 40 are coordinated by the Ministry of Education and Scientific Research (MESR). The 'fundamental research' function is typically attributed to the institutes of the Romanian Academy (RA). There are currently around 60 institutes and research centres within the Romanian Academy. The latter is complemented by several branch academies – primarily the Academy of Agricultural Sciences and Forestry, and the Academy of Health Sciences, each of them operating 25 institutes. Universities, both public and private, have rapidly increased in number since the early 1990s. The current figure is a little below 100 accredited higher education institutions (HEIs), roughly evenly split in terms of public / private ownership. Public universities lead in both student enrolments and research production, and are the only ones to enjoy institutional public funding. However, the universities are comparatively new players in RDI and have been struggling to adapt to this new section of their mission after 1990. Their ties to industry remain weak. R&D activities in academia are rather irregular, depending only on project-based funding and on faculty's publishing efforts. Only 'teaching duties' are clearly defined for individual faculty in virtually all Romanian academia, so a 'research duties' is more informally set at 25% of the former. For this reason, in official statistics the number of researchers in universities is estimated simply as the equivalent of 25% of all academic staff.

Technology transfer activities undertaken by public bodies in Romania are regulated by Art. 13 of Ord. 57 (16.8.2002) and Art. 117 of the National Education Law 1/2001. The latter includes knowledge transfer in the mission of Higher Education Institutions (HEIs).

North East Romania and especially the Iasi County has a long tradition in higher education. The first higher education institute that functioned on the territory of Romania was Academia Vasiliana founded in 1640, followed by the Princely Academy of Iasi (1707), the first school of land surveyors and civil engineers with instruction in the Romanian language (1813), the Academia Mihaileana (1835), the University of Iasi (1860) and the Polytechnic Institute (1912). Table 1 identifies the public research and higher education landscape in the region, with the majority of the entities being located in Iasi. In addition to these, there are also five private universities operating in the region (Mihail Kogalniceanu, Petre Andrei, Apollonia, Stefan Lupascu in Iasi and George Bacovia in Bacau).

TABLE 1 PUBLIC RESEARCH AND HIGHER EDUCATION ENTITIES (SOURCE: [3])

s)n	Institution	Entity	Location
1.	NIRDTP (ANCSI)	National Institute of Research & Development for Technical Physics	Iasi
2.	Romanian Academy	Institute of Archaeology at Iasi	Iasi
3.	Romanian Academy	Institute of Economic and Social Research "Gheorghe Zane"	Iasi
4.	Romanian Academy	Institute of Macromolecular Chemistry "Petru Poni"	Iasi
5.	Romanian Academy	Institute of Romanian Philology "A. Philippide"	Iasi
6.	Univ Al.I.Cuza		Iasi
7.	Technical Univ Gh. Asachi		Iasi
8.	Univ of Medicine and Pharmacy Gr.T Popa		Iasi
9.	Univ "Vasile Alecsandri"		Bacau
10.	Univ "Stefan cel Mare"		Suceava
11.	Univ Agricultural and Veterinary Sciences "Ion Ionescu de la Brad"		Iasi
12.	Univ of Arts "George Enescu"		Iasi

Table 2 in the next page presents North East Romania's key regional statistics that are relevant to the context of this report. The key points are highlighted below:

TABLE 2 KEY INDICATORS: NE ROMANIA VS ROMANIA VS EU28 (SOURCE: EUROSTAT AND [1]).

Indicator-Year	*NE Romania*	*Romania*	*EU28*
GDP at current prices, mil EUR - 2014	15 328	150 230	13 954 739
Population			
Total – 1.1.2015	3 269 598	19 870 647	508 450 856
Aged 15 to 64 – 1.1.2015	2 133 762	13 414 063	333 100 000
Unemployed, aged 20-64 - 2015	57 400	582 200	21 498 000
Tertiary Education (2013-14)			
Institutions	14	103	
Faculties	70	590	
Teaching Staff	5 092	28 211	
Enrolled Students	56 175	433 234	
Graduates (2012-13)	13 169	111 028	
Human Resources in Science and Technology - 2015			
Persons with tertiary education, number	217 000	2 126 000	95 932 000
Persons with tertiary education, % of active population	11.10	19.60	32.00
Persons with tertiary education and employed in Science and Technology, number	146 000	1 253 000	48 941 000
Total R&D personnel by sectors of performance; Researchers (FTEs) – 2015			
All Sectors	1 730	18 109	1 760 232
Higher Education	1 048	6 378	692 390
Business	201	5 244	845 940
Government	481	6 409	207 533
Total R&D personnel by sectors of performance; Researchers (Headcount) – 2015			
All Sectors	3 372	27 535	2 706 928
Higher Education	2 585	14 743	1 407 020
Business	237	5 848	1 048 575
Government	510	6 799	264 483
Patent applications to the EPO by priority year;			
Number – 2012	4.93	60.33	56 600.00
Per million inhabitants – 2012	1.50	3.00	111.90
Patent applications to the National Office by residents;			
Number – 2013	180.00	995.00	n)a
Per million inhabitants – 2013	55.05	50.07	n)a
Total intramural R&D expenditure (GERD);			
EUR per inhabitant – 2015	13.20	28.80	564.40
Percentage of GDP – 2014	0.28	0.38	2.04
Higher Education	0.10	0.06	0.48
Business Sector	0.06	0.16	1.30
Government Sector	0.12	0.16	0.25

- North-East Romania, being inhabited by the 16.45% of Romania's population, educates 13% of the population enrolled in HEIs by using 18% of the country's teaching staff. Of the 56 175 students enrolled in higher education in the Region, 2 620 were PhD candidates [3].
- The percentage of persons with tertiary education in the active population at 11.1% is very low, being the 57% of the national average and 35% of the EU28 average. In practical terms, this means that the stock of human resources with qualifications that can potentially support innovative activity is very low.
- The higher education sector employs 76% of the regional headcount of researchers, followed by the government sector with 15%. A considerable gap is noticed between then headcount of teaching staff in tertiary education reported by the National Statistics Agency (5 092) and the headcount of researchers reported by EUROSTAT in higher education (2 585). This suggests that almost half of the teaching staff is not directly involved in research. This also seems to be compatible with the '25% rule' mentioned earlier (1 048 researcher FTEs out of 5 092 headcount of teaching staff in HE).
- Total intramural R&D expenditure of 0.28% of the GDP is very low at the 74% of the national average and at the 14% of the EU28 average. The R&D expenditure of the business enterprise sector

at 0.06% of the GDP is at the 32% of the national average. The R&D expenditure reported for higher education (0.10% of GDP in 2014) and the government sector (0.12% of GDP in 2014) does not reflect the researchers' FTEs, suggesting that research in higher education is rather underfunded.

- The number of patent applications to the national office by Romanians per million inhabitants is 5 percentage points higher than the national average; however, the same metric for EPO applications is 50% of the national average which, in turn is very low when compared to the EU28 average. Both of these suggest that patenting activity has to do more with the prestige of holding a patent (as suggested in [2], p. 50) rather than trying to secure intellectual property rights in international markets.

Regarding the quality of research, there are no data available at the regional level. At the country level, as mentioned in [2] (p. 50), since 2000 the percentage of publications in the top 10% most cited only increased from just a bit below 5 to just a bit above that figure, with an average of 5.28. This is less than half the corresponding EU28 figure (11.29). The author's analysis of data compiled from researchranking.org shows that in the period from 2008 to 2015 four regional HEIs/PROs (namely: Institute of Macromolecular Chemistry "Petru Poni", Univ. Al. I. Cuza, Technical Univ. "Gh. Asachi" and Univ "Stefan cel Mare") participated in 41 CORDIS-listed projects and were funded by approximately €18.8mil. The aggregate figures for Romania in the same period were 992 and €306.3mil, respectively. These figures suggest that the research competitiveness of the regional key actors is rather modest when compared to the national performance which is also modest at the European level.

Finally, regarding the fields of education undertook by the graduates, as mentioned in [2] (p. 60), there was a trend during the last decade for obtaining social sciences and humanities degrees, which was reinforced by private higher education programmes. As shown in Table 3, the most recent data for HEI graduates in North East Romania suggest that 55% of the graduates with a bachelor's degree, 60% of the graduates with a master's degree and 58% of the new PhDs in 2014 studied Natural Sciences, ICT, Engineering, Agricultural/Veterinary Sciences and Medical Sciences. In stricter terms, the percentage of the 2014 cohort of graduates with a STEM degree was 32% at the bachelor's and the master's level, and 27% at the PhD level.

TABLE 3 GRADUATES IN TERTIARY EDUCATION, NE ROMANIA, 2014 (SOURCE: INSEE TEMPO DATABASE)

International Classification of Educational Standards (ISCED-F 2013)	*Bachelor*	*Master*	*PhD*	*Total*
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

III. METHODOLOGY

According to [4], technology transfer takes place in channels of interaction between research/academia and other stakeholders (firms, public administration, individuals and the society as a whole). Knowledge can be produced, mediated, reproduced, acquired, and transformed in and between the different forms through these channels. The channels themselves can be direct or indirect/mediated. A typical (but not exhaustive) classification of channels includes networks (both formal-between organisations and informal-between individuals), continuous professional development, consultancy, collaborative research, licensing, spin-offs and teaching. Figure 1 describes the typology of knowledge that stems from research, the channels and the beneficiaries of the technology transfer process.

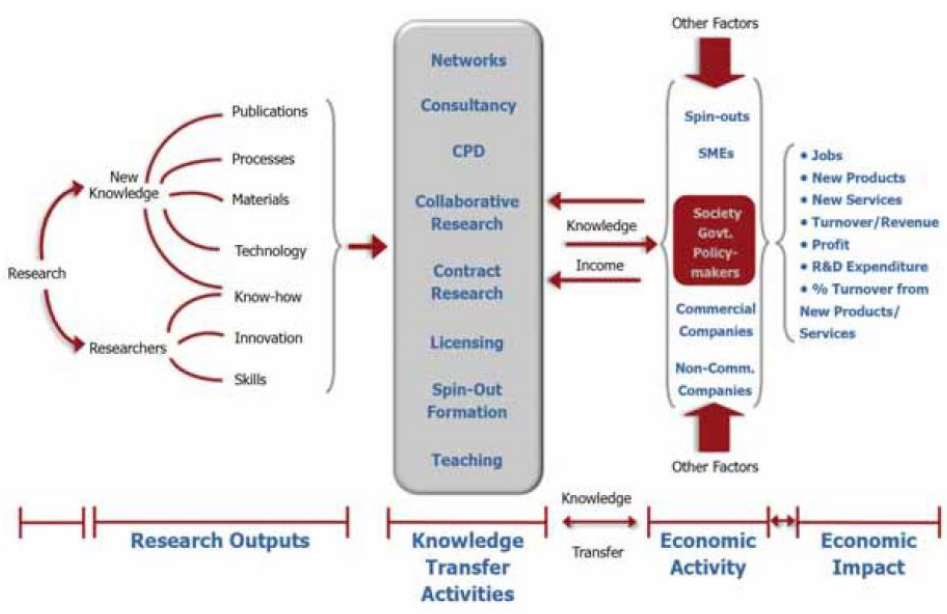

FIGURE 1 MODEL OF TECHNOLOGY TRANSFER WITHIN THE INNOVATION ECOSYSTEM (SOURCE: [5]).

To assess the potential of the supply-side for technology transfer in North East Romania we used the model by Rothaermel *et al*. [6] shown in Figure 2 as the underlying framework of analysis.

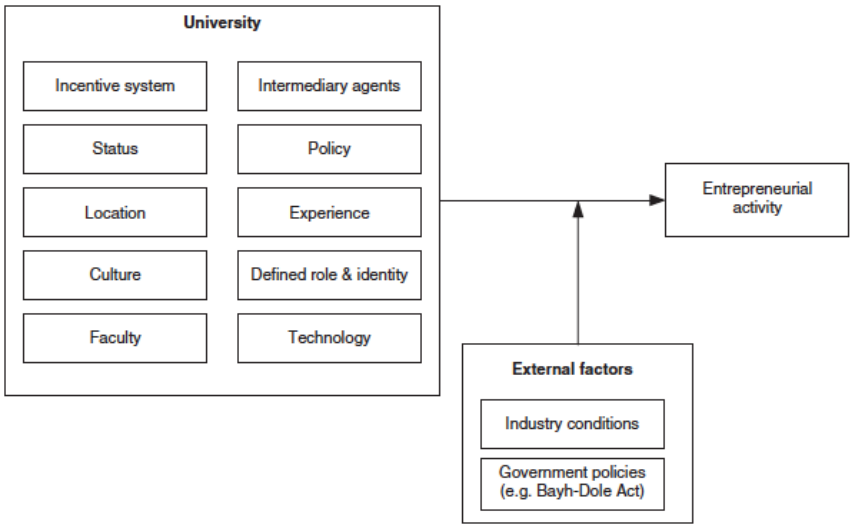

FIGURE 2 THE FRAMEWORK OF ANALYSIS FOR THE SUPPLY-SIDE OF TECHNOLOGY TRANSFER.

The generic attributes of the higher education and research system and the external factors (ie, government policies, regulatory framework, funding) are well-documented in [2] and the most relevant to the objectives of this report have already been summarised in Sec. II above. The business structure in the region is also well-documented in NE Romania's smart specialisation strategy [3]. This report shall focus on quantifying and assessing specific attributes related to the supply of technology as follows:

1. Identification of regional suppliers of knowledge and technology (Higher Education Institutions & Public Research Organisations) and assessment of their TT-related policies and outcomes. A complete census of all HEIs/PROs that perform technological research would be performed. The population is defined in Table 1 above.
    - Two research instruments were designed, one to assess HEI/PRO policies (Appendix VI.A) and another, which was based on [7], to quantify outcomes (Appendix VI.B). These instruments would collect information on:
        - Institutional policies on research commercialisation and intellectual property rights, balancing stakeholders' interests, incentive systems for faculty and departments, engagement with industry, establishment of spin-offs.
        - Existing stock of intellectual property rights owned by HEIs and PROs.
        - Scale and intensity of technology transfer interactions with industry in terms of licensing agreements, joint research projects and consulting services.
    - To quantify the knowledge production in the region and get insights on the active research fields we used Thompson/Reuters Web of Science data for the period from 2013 to 2016. Measurement and analysis was performed both at the country and at the regional level by searching the database ADDRESS field for all publications with an author from Romania and by specifying the county capital cities (ie, Iasi, Bacau, Suceava, etc), respectively. The database RESEARCH AREA field was used to calculate regional scientific specialisation by calculating location quotients and normalising them using the function $n(x) = (1-x)/(1+x)$. With this selection of the normalisation function, a value of 0 means that the regional location quotient is equal to the national one, values around 0.25 indicate that the regional location quotient is 50% stronger than the national one and values below 0 indicate weaker location quotients.
2. Scale and performance of accredited intermediary agents for technology transfer. A separate research instrument (see Appendix VI.C) was developed to collect data on the type of intermediary institution, the legal framework under which they operate, their age, staff and the expertise and service mix and their contribution to technology transfer.

IV. RESULTS AND DISCUSSION

IV.A NEW KNOWLEDGE PRODUCTION & REGIONAL SPECIALISATION

According to the Thomson/Reuters Web of Science bibliographical database, in the period 2013-2016 there were 38221 records having an author from Romania. Of these, 6521 records included one of the North-East Romania's county capitals in the address field. This suggests that NE Romania contributed 17.06% of the national volume of WoS-listed publications in the reference period, a number that is compatible to the percentage of the regional headcount of researchers in the national figure (17.56%).

The regional HEIs/PROs which are the major contributors to the regional publications listed in WoS were Alexandru Ioan Cuza Univ with 2013, followed by Gr. T. Popa Univ of Medicine and Pharmacy with 1714, Gh. Asachi Tech Univ Iasi with 1443 and Petru Poni Institute of Macromolecular Chemistry with 1075. The number of publications with contributions from other HEI/PROs in the region are an order of magnitude lower than those of the major contributors (Vasile Alecsandri Univ Bacau with 164, Stefan Cel Mare Univ Suceava with 137, National Institute of Research and Development for Technical Physics with 118 and Ion Ionescu de la Brad Univ Agr. Sci. Vet. Medicine with 60).

In terms of international co-authorship, there is evidence of 110 different countries/territories in the address fields provided by WoS with the 10 most frequent countries being France (534), Italy (441), Germany (321), UK (275), USA (251), Spain (191), Belgium (159), Poland (153), Switzerland (122) and Turkey (102).

The top 15, by number of publications, research areas in the region using the WoS-provided classification were Chemistry (1739), Engineering (1593), Materials Science (1257), Physics (1128), Mathematics (831), Environmental Sciences-Ecology (687), Pharmacology-Pharmacy (618), Biochemistry-Molecular Biology (598), Polymer Science (546), Spectroscopy (377), Computer Science (346), Crystallography (346) and Agriculture (318). It should be noted that WoS might provide more than one Research Area per record and, therefore, numbers do not necessarily have to add up to the total of 6521. Appendix VI.D lists the full dataset.

Figure 3 presents the normalized location quotients for the 30 research areas with the largest number of publications at the country level in decreasing order. In 12 of them, the relative share of publications in the region exceeds the national one thus suggesting some level of specialization. Polymer Science, with 546 publications from the region in 1179 from Romania is the most prominent regional scientific specialisation. Table 4 presents the Research Areas having a normalised location quotient value greater than 0.25 by decreasing number of regional publications.

TABLE 4 REGIONAL RESEARCH SPECIALISATION AREAS BY DECREASING NUMBER OF PUBLICATIONS.

Research Area	*RO21*	*RO*	*LQ_N*
POLYMER SCIENCE	546	1179	0.462
CRYSTALLOGRAPHY	346	1084	0.303
UROLOGY NEPHROLOGY	202	729	0.238
WATER RESOURCES	179	630	0.250
LIFE SCIENCES BIOMEDICINE OTHER TOPICS	177	689	0.202
SOCIOLOGY	123	430	0.253
SOCIAL WORK	98	195	0.493
SOCIAL SCIENCES OTHER TOPICS	85	270	0.297
RELIGION	67	262	0.200
LINGUISTICS	66	223	0.269
BIOMEDICAL SOCIAL SCIENCES	62	103	0.558
INFORMATION SCIENCE LIBRARY SCIENCE	62	168	0.368
MEDICAL ETHICS	61	86	0.612
HISTORY PHILOSOPHY OF SCIENCE	56	163	0.336
ARTS HUMANITIES OTHER TOPICS	54	158	0.334
INTEGRATIVE COMPLEMENTARY MEDICINE	23	71	0.310
ART	21	42	0.491
EMERGENCY MEDICINE	14	48	0.262
CRITICAL CARE MEDICINE	12	43	0.241
NURSING	5	19	0.213

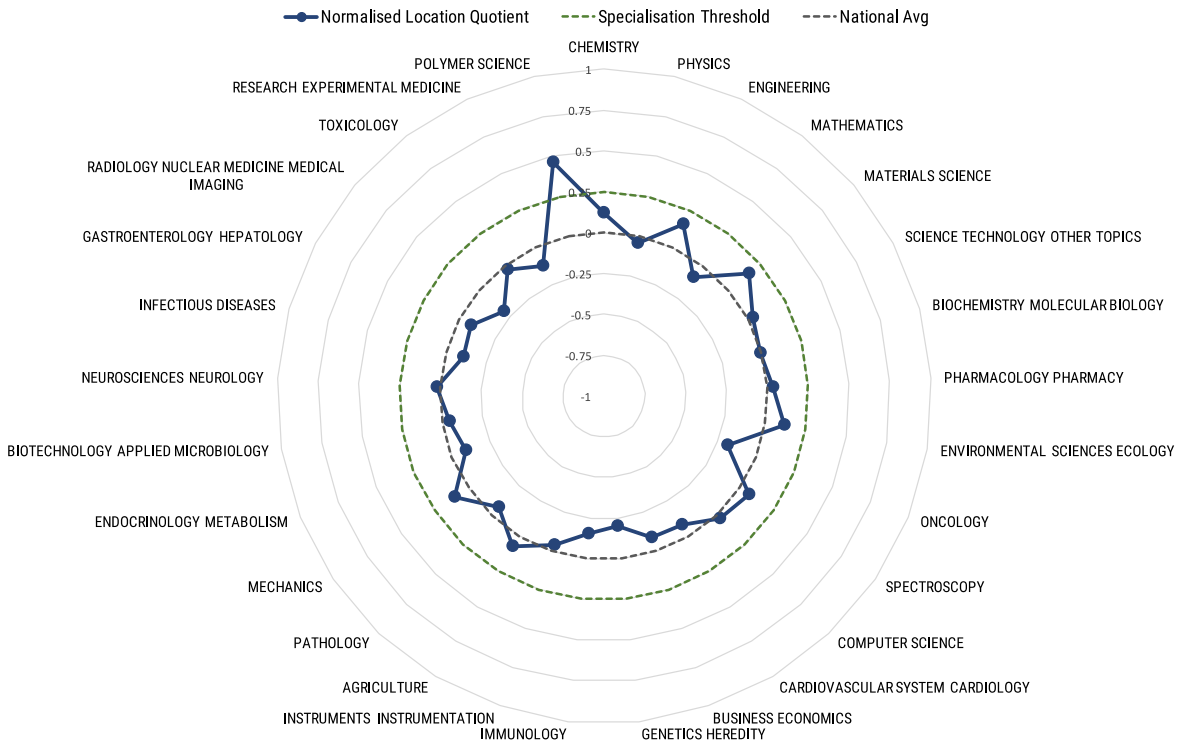

FIGURE 3 RESEARCH SPECIALISATION BY NUMBER OF PUBLICATIONS, NORTH-EAST ROMANIA VS ROMANIA.

The data in Table 4 show how the regional tradition of education that was discussed in Sec. II is currently reflected in terms of specialised research in Physical Sciences (e.g., Polymer Science, Crystallography) and Social Sciences/Humanities (e.g., Sociology, Religion, Linguistics, History, Art). The data in Figure 3, with the exception of Polymer Science, indicate that the overall structure of the regional research system matches that of the national one with slight variations.

Table 5 synthesises our analysis of the knowledge supply in the region with the RIS3 priorities [3]. The most relevant research areas are connected to each field of intervention. Regional specialisation (above the national level) is indicated by underlined text, existing research areas below the national level are shown in plain text and missing areas are shown in strikethrough text.

TABLE 5 KNOWLEDGE SUPPLY AND REGIONAL S3 PRIORITY SECTORS.

Priority Sector	*Fundamental Field*	*Re-configuration challenge*	*Relevant Research Areas*
Agrofood	Agronomy	Sustainable development of field crops production – circular agriculture (secondary and tertiary crops); Culture of technical plants	<u>Agriculture</u>;
	Horticulture	Development of new products, practices, processes and technologies in horticulture; Agrofood products processing technologies, winemaking technologies, plant genetics	<u>Plant Sciences</u>; Food Science Technology
	Zootechnics	Healthy, sustainable and competitive zootechnics; Intelligent farms; Fishery techniques, aquaculture, biotechnology	Zoology; Veterinary Sciences; <u>Fisheries</u>; Marine Freshwater Biology;
	Food Engineering	New innovative business models for traditional products; Safe food products – organic products certification and selling with focus on domestic products; Nutritionally optimized food products (additives, concentrates and nutritional supplements)	Food Science Technology; Toxicology; Biotechnology Applied Microbiology; Biochemistry Molecular Biology

Priority Sector	*Fundamental Field*	*Re-configuration challenge*	*Relevant Research Areas*
	Forestry and Wood Engineering	New innovative business models for traditional products; Bio-energy; Development of new products, processes and technologies	Forestry; Energy Fuels, Thermodynamics
Biotechnology	Chemical and technologic engineering	Pharmaceutical biotechnologies (obtaining effective antitumor, antiviral, antimicrobial vaccines preparations); Biofuels, bio-catalysts of industrial use	Engineering; Chemistry; Pharmacology-Pharmacy; Biotechnology Applied Microbiology; Biochemistry Molecular Biology.
	Biology and micro-biology	Bio- & nano-technologies (markers and imaging for early diagnosis of maladies)	Microbiology; Medical Informatics; Imaging Science Photographic Technology; Medical Imaging;
	Food engineering	Agrofood biotechnologies (new improved products)	Food Science Technology; Toxicology; Biotechnology Applied Microbiology; Biochemistry Molecular Biology
Textiles and new materials	Chemical Engineering	Advanced biomaterials; Innovative product design (nano bio textiles, incorporated sensors)	Engineering; Chemistry; Polymer Science
	Technology of Textile Products	Functional textile with applicability in medicine; Intelligent textiles; Exploitation of natural fibres; Technical textiles, composite textile structures;	Engineering;
	Engineering of knitted fabrics and clothing	Knitted structures with thermal properties, knitting for mechanical protection, synergetic clothing	Engineering;
	Industrial Management	Waste collection and recycling (up-cycling, slow fashion); New business models (digital fashion, interaction with the customer)	Water Resources; Environmental Sciences Ecology; Business Economics;
ICT	Computers & Information Technology	Artificial intelligence (robotics, manufacturing integrated systems, computing systems, voice recognition); Improved energy efficiency, energy-net, Smart city; Cybernetic security	Computer Science; Robotics;
	New Media	Gamification;	Computer Science;
	Public Health	Big-data analysis applied in telemetry, telematics, tele-assistance, telemedicine e- Medicine, e-inclusion; real-time monitoring of social systems; tracking food products along the whole value chain	Computer Science; Telecommunications; Medical Imaging; Biomedical Social Sciences; Instruments Instrumentation; ~~Medical Informatics~~
	Electronic Engineering & Telecoms	Nano electronics, optoelectronics; Industrial software	Engineering; Optics; Telecommunications; Computer Science; Science Technology Other Topics
Environment	Agricultural Sciences	Responsible exploitation and sustainable management of green heritage; New plant genotypes with increased resistance to climate change; Precision agriculture	Plant Sciences; Biochemistry Molecular Biology;-Engineering; Agriculture
	Environment Engineering	Biodiversity; Enzymatic systems for pollution monitoring; waste water treatment technologies; Waste recycling technology	Engineering; Chemistry; Water Resources; Environmental Sciences Ecology;
	Industrial management	Smart factoring – energy efficiency and waste water valorisation; Industrial water monitoring, surface and ground water management;	Energy and Fuels; Water Resources; Environmental Sciences Ecology;

The mapping of research areas to RIS3 priorities suggests that in principle, most of the priorities are well-connected to the regional supply of knowledge with the exception of Food Engineering in two priority sectors. In addition, the regional aspiration for ICT-led pathways to development might be inhibited by the wide range of IT specialties that the RIS3 requires. To address this risk, a more in depth analysis of the specific sub-topics of computer science research at the regional level is needed, which is beyond the scope of this report. Given that our data measure new

knowledge production using scientific publications as a proxy, we cannot make any judgement regarding how competitive is this new knowledge at the international level. Therefore, we cannot assume that the regional HEIs/PROs will be the sole providers of all new knowledge needed to support the regional industry to modernise and diversify itself in line with the RIS3 priorities; however, we can safely assume that the regional stock of researchers has enough absorptive capacity to guide the industry in making the proper choices.

IV.B PATENTING ACTIVITY

Patent indicators and patent-based statistics are frequently used as a proxy indicator of technology output since they can provide insights on the inventiveness of countries, regions, firms or individual inventors, under the assumption that patents reflect inventive output and that more patents mean more inventions. Patents statistics are also used to map certain aspects of the dynamics of the innovation process (e.g. co-operation in research, diffusion of technology across industries or countries, etc.), or of the competitive process (the market strategy of businesses), or the research strategies of HEIs and PROs. However, an invention covered by a patent (a new product or process) need not actually be industrially applied if the inventor realises that the invention does not have sufficient economic value or that a superior invention can be marketed more rapidly. In an increasing number of countries, number of patents is used by funding agencies or ministries to evaluate the performance of academic institutions or individual researchers. In such cases, patent-related statistics should be explained with caution, having in mind that patents might be just a supplement to scientific publications in high-impact journals with the intend to advance researchers' careers or attract funding [8].

In principle, the impact of the research sector in technological development can be observed by compiling counts of the patents they have taken, their (forward) citations, etc. It can also be observed from the citations of academic research in patents filed by industry. Moreover, patent statistics can help estimate the research sector's contribution to the development of the Key Enabling Technologies (KETs) [9].

In the context of this report we consider HEI/PRO patents as inputs to the technology transfer process in the sense that they are the basis for licensing agreements, thus providing potential for industry-developed innovative products and a new stream of revenues for HEIs/PROs.

To do so, we searched the European Patent Office database for all records mentioning the institutions listed in Table 1 as applicants and selected the records having publication year 2007 or later. The resulting record set consisted of 768 entries (patent families) of which 766 (99.74%) were initially filed in Romania, one in Spain (and later PCT, EPO, US and Japan) and one was submitted to the EPO (and was withdrawn 3 years later). There were five cases of more than one applicants, four of them being a collaboration between "Gheorghe Asachi" and "Grigore T. Popa" and one between "Alexandru Cuza", "Gheorghe Asachi", "Ion de la Brad" and the Institute of Biological Research of Iasi.

Of the 584 patent applications with priority year 2007 or later in our dataset, 149 patents were granted. Table 6 presents the aggregate data for patent applications (national and international offices) having priority year 2007 or later. Joint applications were counted as one per institution. According to the data in Table 6, there is evidence of a surge in patenting activity in 2010-2011, when more than half of the last decade's patent applications were filed. Although the reasons for this peak in inventive activity remain rather unclear, the tougher publication standards for career advancement in higher education and in other research organisations put in place in 2007 [2](p. 50) and the low cost of patenting and maintaining a patent in Romania[1] might partially explain the phenomenon.

Table 7 presents the number of patents granted to each one of the HEIs/PROs in NE Romania per calendar year (i.e. irrespective of the priority year) since 2008. The total number is 332, with 186 of them (56%) belonging to Stefan Cel Mare University of Suceava. These data verify Univ of Suceava's role as the dominant patent holder both at the regional and at the national level (see [2] for the national details).

[1] See http://www.osim.ro/index3_files/patents/tabel.pdf. The list price is 3852 RON (~€865) but for research/academic organisations it can be as low as 770 RON (~€173).

In an attempt to explain University of Suceava's success in patenting performance, the author has interviewed Prof. Mihai Dimian, USV's Vice-Rector for Research [11]. The summary of this interview is presented in Box 1 at the end of this section.

TABLE 6 HEI/PRO PATENT APPLICATIONS PER PRIORITY YEAR.

Institution	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*
UNIV STEFAN CEL MARE DIN SUCEAVA		1	23	129	86	46	35	39	1	
UNIV TEHNICĂ GHEORGHE ASACHI DIN IAȘI	1	3	15	33	29	14	10	7	13	1
INST DE CHIMIE MACROMOLECULARĂ PETRU PONI DIN IAȘI			3	8	5	13	3	5	2	
UNIV VASILE ALECSANDRI DIN BACĂU			1	7	5	7	2	2		
UNIV ALEXANDRU IOAN CUZA DIN IAȘI			1	5	5	2	6	2	1	
UNIV DE MEDICINĂ ȘI FARMACIE GRIGORE T POPA DIN IAȘI					1			4	5	1
INST NAȚIONAL DE CERCETARE DEZVOLTARE PENTRU FIZICĂ TEHNICĂ IAȘI				3	1		2	2		1
UNIV DE ȘTIINȚE AGRICOLE ȘI MEDICINĂ VETERINARĂ ION IONESCU DE LA BRAD					2	5			1	
INST DE CERCETARI BIOLOG IASI					1					
Totals:	1	4	43	185	135	87	58	61	23	3

TABLE 7 PATENTS GRANTED TO HEI/PROS PER CALENDAR YEAR.

Institution	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*
UNIV STEFAN CEL MARE DIN SUCEAVA		27	28	65	43	20	2		1	
UNIV TEHNICĂ GHEORGHE ASACHI DIN IAȘI		7	5	19	22	10	8	3		
INST DE CHIMIE MACROMOLECULARĂ PETRU PONI DIN IAȘI		1	3	9	8	6	2			1
UNIV VASILE ALECSANDRI DIN BACĂU				11	3	5			1	
UNIV ALEXANDRU IOAN CUZA DIN IAȘI		1	1	2		3		1		
UNIV DE MEDICINĂ ȘI FARMACIE GRIGORE T POPA DIN IAȘI						1				
INST NAȚIONAL DE CERCETARE DEZVOLTARE PENTRU FIZICĂ TEHNICĂ IAȘI	1	1	1	2		3	2	1	1	
UNIV DE ȘTIINȚE AGRICOLE ȘI MEDICINĂ VETERINARĂ ION IONESCU DE LA BRAD						1	3			
INST DE CERCETARI BIOLOG IASI						1				
Totals:	1	37	38	108	76	50	17	5	3	1

An analysis of the International Patent Classification (IPC) codes of all records in our data indicates that there were 775 different full codes and 442 4-level codes linked to the patent families of North East Romanian origin. Of these, 11 full codes and 27 4-level codes had ten or more entries. Table 8 lists the 15 most frequently occurring 4-level IPCs and Figure 4 shows the distribution of all level-4 IPC codes. Finally, Figure 5 shows the distribution of the IPC codes that have been associated with Key Emerging Technologies (KETs) in Annex II of [10]. Of the

three major spikes in Figure 5, two have been associated to Photonics (G01J3/28 and H02N6/00) and one (G01P13/04) to Advanced Manufacturing Techniques.

TABLE 8 MOST FREQUENT 4-LEVEL INTERNATIONAL PATENT CLASSIFICATION CODES.

IPC Code	*Num. Records*	*Description*
G01N21	80	Investigating or analysing materials by the use of optical means, i.e. using infra-red, visible or ultra-violet light
F03G6	38	Devices for producing mechanical power from solar energy
G01N33	38	Investigating or analysing materials by specific methods not covered by the preceding groups
H02K33	35	Motors with reciprocating, oscillating, or vibrating magnet, armature, or coil system
G01N27	34	Investigating or analysing materials by the use of electric, electro-chemical, or magnetic means
G01N3	31	Investigating strength properties of solid materials by application of mechanical stress
G01J3	25	Spectrometry; Spectrophotometry; Monochromators; Measuring colours
G01R31	20	Arrangements for testing electric properties; Arrangements for locating electric faults; Arrangements for electrical testing characterised by what is being tested not provided for elsewhere
H01F29	19	Variable transformers or inductances not covered by group H01F21
G09B23	19	Models for scientific, medical, or mathematical purposes, e.g. full-sized device for demonstration purposes
F03G7	18	Mechanical-power-producing mechanisms, not otherwise provided for or using energy sources not otherwise provided for
G01R29	18	Arrangements for measuring or indicating electric quantities not covered by groups G01R 19/00-G01R 27/00
H01F27	17	Details of transformers or inductances, in general
H02N2	15	Electric machines in general using piezo-electric effect, electrostriction or magnetostriction
F04B9	15	Piston machines or pumps characterised by the driving or driven means to or from their working members

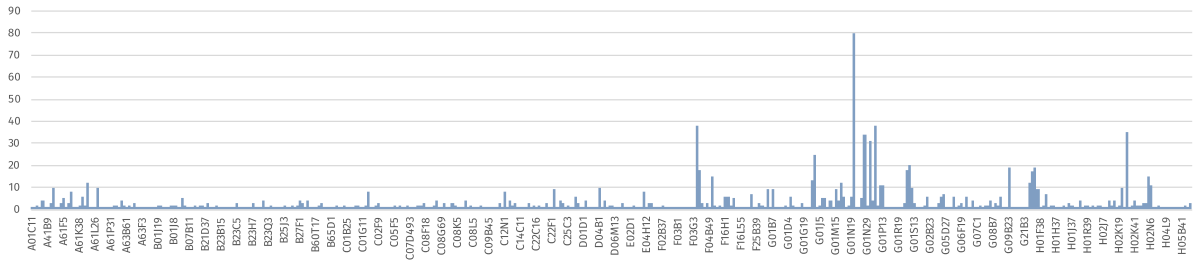

FIGURE 4 DISTRIBUTION OF THE 4-LEVEL IPC CODES.

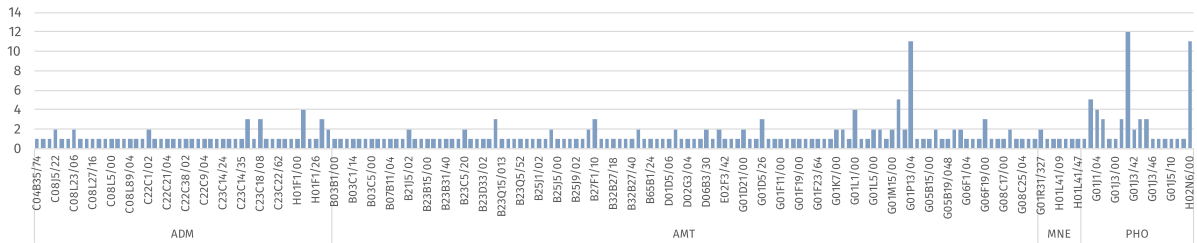

FIGURE 5 DISTRIBUTION OF THE KET-RELATED IPC CODES.

The results both in Table 8 and in Figure 4 indicate spikes of patenting activity in the fields of electrical and mechanical engineering, being skewed by the contributions of Stefan Cel Mare University of Suceava.

Box 1. Suceava University's Patenting Championship Explained.
An interview with Professor Mihai Dimian, Vice Rector for Research, USV

Q1. To the best of your knowledge, which are the factors that led to a surge of patenting activity by HEI/PROs in Romania between 2010 and 2012?

A1. During 2007 and 2008, the accreditation methodology of the universities as research units imposed three main indicators (ISI raked articles, patents and contracts with industry). In addition, the funding methodology of the universities introduced patents as one of the main indicators in evaluating (and financing) the universities in terms of research. It was not an important part of the funding but was not completely neglected, as before. So many researchers have started to apply for patents during these years (2007-2008, and later). The evaluation process for a patent takes about 3-5 years in Romania so the impact is seen 3-5 years after 2007-2008.

Q2. Given that USV is the national leader among Romanian Universities and Research Institutes in terms of patenting, were there any additional, institution-specific, reasons for being consistently at the first position? If yes, can you please elaborate?

A2. From my point of view there are 3 main factors: (a) USV has encouraged and praised the professors who applied for patents during the time when they were not encouraged and praised by the state. It is true that during those time, professors have applied as individuals (and not in the name of the institution) because the patenting fees were lower. Once patenting was reintroduced in funding and research accreditation methodology, this process was taken back at the university level and ownership from the individual level and ownership. (b) We have several leaders (2-3 people) very passionate about inventions (and then patenting). They have created inventors' centres and groups and developed them regardless of the state incentives. (c) Some professors saw patenting as a simpler way to get some recognition (maybe used for promotion and salary increase) than to publish ISI ranked articles.

USV uses the following means to encourage patenting activity among its faculty: i. In the annual faculty evaluation which counts for the teaching load and annual salary increase, the score for a patent is the same as the score for an ISI ranked article (although at the national level was usually lower); ii. The university funds participation to National and International Invention Expo and acknowledges their participation and awards (both inside and outside the university); iii. We involve Master and PhD students in innovative and patenting activities and they seem to be more attracted to getting their name on a patent than getting their name on an article; iv. The University Office for Technological Transfer and Spin-off Companies are providing the necessary contracts, forms and advice for filling the patent applications.

Q3. Is there an explanation for national-only patenting?

A3. The main explanation is the patenting fee. At the European Patents Office, the fees were about 10.000 Euros while at the national level is about 500 Euros. In Romania, it is difficult to find companies willing to pay tens of thousands of Euros for a patent from a university. Usually, the universities do not pay for additional 5 years' protection since the patent continue to exist in their portfolio (even if you do not pay the protection) and not many patents generate actual revenues, especially after five years.

Q4. USV's activity report for 2014 does not include any mention of licensing revenues from the patent portfolio that USV has built over the years. Is this the case?

A4. There is some revenue but it is a small portion in the overall funding for R&D and that is why is not identified. We looked overall at the private funding versus state funding, but the problem is a little bit more complicated.

Although the breadth (775 IPC codes) of patenting activity indicates a diverse technological capability in the Region, there are very few records being classified to IPC codes that have been associated with Key Emerging Technologies. This, in conjunction with the Romania-only patenting pattern which is dominant in our data, casts considerable doubts upon the exploitation potential of the stock of intellectual property rights in the portfolios of the regional HEI/PROs and the cost-vs-benefit of maintaining them. Nevertheless, this recently expanded portfolio of IPR is the foundation on which any regional initiative to promote technology transfer will be built on.

IV.C Research Infrastructures & Services

The ERRIS (Engage in the Romanian Research Infrastructures System) Portal (http://erris.gov.ro/) is an UEFISCDI initiative launched in 2015 aiming to promote research infrastructures and facilitate access to them. It provides searchable information for 1385 infrastructures all over Romania, 7400 research services, 49 technological services and 19600 pieces of equipment but not IPR available for licensing.

In this sense, ERRIS is an excellent interface between research and industry since it minimises the cost of searching and provides opportunities mainly for consulting and contract research contracts.

All the regional HEI/PROs are listed. There are no publicly available data on ERRIS's effectiveness in matching needs and solutions.

IV.D Institutional Policies In Support of Technology Transfer

Our research instrument (see Appendix VI.A) was administered to all regional HEI/PROs with the intermediation of the RDA in mid-January 2017 and by the (extended) deadline of 10 March 2017 the replies of the following institutions were received:

- "Gheorghe Asachi" Technical University of Iasi (TUI)
- "Vasile Alecsandri" University of Bacău (UBC)
- Institute of Biological Research Iasi (IBRI)
- Universitatea Națională de Arte "George Enescu" din Iași (UNAI)
- National Institute of Research & Development for Technical Physics, Iasi (NIRDTP)
- Romanian Academy, Iasi Branch (ARFI)

The summaries of their responses are presented in the subsections that follow.

IV.D.i TUIASI—"Gheorghe Asachi" Technical University of Iasi

According to TUIASI's charter, it is a high-end research and education institution with a mission is to carry out specific activities to create, to exploit and to transfer knowledge to the society in fundamental areas – Technical Sciences, Architecture and Urbanism – as well as in interdisciplinary and complementary fields, involving the local community, as well as regional, national and international levels. The University's charter explicitly mentions "conducting scientific research, development, innovation and technology transfer, as well as exploitation and dissemination of results" as part of its mission.

The vice-Rector responsible for the RDI activity at the university level is responsible for the governance/ oversight of technology transfer. Starting from 1992 until December 2016 CCTT POLYTECH (the Centre for Research and Technological Transfer POLYTECH) was responsible for the implementation and monitoring of TT. The main activity of POLYTECH has been focused on the management and monitoring of the research projects with public/private funds. Another basic activity was to support researchers for the new patent applications filed to the National Office (formal aspects, correspondence with OSIM-the national patent office). Starting from January 2017 the new structure with TT attributes is CTT POLYTECH (Centre for Technological Transfer), with three different departments for Consultancy for Business, Intellectual Property Rights and Training & Marketing. The university's TT policy covers all the attributes in the checklist.

TUIasi has a procedure (TUIASI.POB.38[2]) for the exploitation of the outputs of the RDI contracts with public funds which provides the legal framework of the IP and authors' rights; the documents templates and the

[2] http://www.calitate.tuiasi.ro/TUIASI.POB.38.htm

steps for TT, know-how and consulting–engineering contracts are also provided. The guidelines for the knowledge transfer are included in the Strategic Plan of the University for 2016-2019[3]. CTT's IP department handles all the key processes for TT except from invention disclosures and assessments that are performed at the research centre/faculty level. However, CCTT or CTT have not carried out any licensing agreements ever.

TUIasi does not seem to have a single point of reference for providing information to any interested party on opportunities to use research outcomes or license IPRs. At national level, the outcomes of each finalised publicly-funded project are uploaded on the RO INNO platform (http://registru.roinno.ro/) designed by the National Authority for Scientific Research and Innovation (ANCSI)[4].

The research activity, including the collaborative contracts with industrial partners, is subject of periodic review measures, the outputs are included within the annual reports of the university (see Chap. 5 of the 2015 annual report[5], a table in p. 40 reports patent applications/patents granted per department).

IV.D.ii UBC—"Vasile Alecsandri" University of Bacău

The UBC Charter (articles 18, 19, 20 and 21) states that the university supports the promotion of innovation and technology transfer through modern, regularly updated study programmes (bachelor, master and doctoral), structures that allow research development, national and international partnerships, participation in national and international research projects and research calls. Technology Transfer is explicitly mentioned in the University's mission (art. 18) and in the means for implementing it (art. 21).

The organisational units responsible for implementing UBC's technology transfer mission are: (a) the Institute for Research, Development, Innovation, Counselling and Technological Transfer[6] (ICDICTT) that operates since 2016, which is responsible for the organization, planning, reporting and assessment of the UBC-performed research and related activities and (b) the UBC's Research Centres[7]. ICDICTT is funded by 5% of the UBC's revenues from research contracts, consulting fees and technology transfer income. The knowledge transfer policy outputs are reviewed every year, when the annual reports are developed and also when external evaluations are made. Internal measures for improvement are taken every year, occasioned by the Management Analysis performed.

Although UBC reported that its knowledge transfer policy covers all the attributes in the checklist except conflicts of interest or commitment, no evidence was provided to verify this.

Regarding the organisational units responsible for the key processes in support of technology transfer, it seems that ICDICTT and the Rectorate are responsible for invention disclosures, the individual faculties handle patent applications and review of joint research contracts, the University's Accounting Dept. is in charge of verifying licensing revenues. No procedures currently exist for evaluating invention disclosures, drafting licensing contracts and equity sharing agreements.

UBC does not seem to have a single point of reference for providing information to any interested party on opportunities to use research outcomes or license IPRs.

The University reports its technology transfer outcomes within the Academic Year Reports[8]. Financial data seem to be consolidated under the "revenues from research" budget line (Table 68, A3) and value of new contracts and number of patents per year are also reported under the section "Research Activities" (Chap. 6, Table 83).

---

[3] http://www.tuiasi.ro/uploads/files/plan_strategic_general_2016-2019_final.pdf

[4] Project outcomes can be found at site.roinno.ro.

[5] http://www.tuiasi.ro/uploads/files/Raport_starea_universitatii_TUIASI_2015_fara_anexe.pdf

[6] http://www.ub.ro/cercetare/icdictt/prez-icd

[7] http://www.ub.ro/cercetare/icdictt/centre-cerc

[8] The UBC Report for the academic year 2015-2016 is available here:
http://www.ub.ro/files/universitate/doc/Contract_institutional/CI_2016/UBc_24855_Raport_UBc_15-16.pdf

IV.D.iii NIRDTP—National Institute of Research & Development for Technical Physics, Iasi

The National Institute of Research and Development for Technical Physics (NIRDTP) belongs to the network of Romanian national institutes coordinated by the National Authority for Scientific Research and Innovation. NIRDTP conducts research, development and innovation activities in the field of materials with novel structures and properties, devices, apparatus and equipment based on such materials, new preparation methods and characterisation techniques and non-destructive evaluation, electrical and magnetic separation methods, special materials and devices with applications in engineering, medicine and biotechnology. The applications resulted from the research activities are developed in the frame of the national programme for research, international programmes in collaboration with both research institutions and universities, as well as with industrial partners.

NIRDTP's strategy for the period 2015-2020[9] includes a section on technology transfer (see Sec. 8, pp. 19-21) that was summarized in their response as follows: (a) orientation of the research activities towards economic domain, to attract partners with financial potential from the country and abroad that develop activities in the field of expertise of the institute; (b) creation of a spin-off company for the exploitation of research results of the institute, which will become partner for future applied research projects and (c) achieving a common platform for capitalization of research results and technology transfer, together with local, regional and / or national partners. A department for the valorization of research is included in NIRDTP's organization, being the owner of the relevant procedures.

Although NIRDTP reported that its knowledge transfer policy covers all the attributes in the checklist except conflicts of interest or commitment, no evidence was provided to verify this and no evidence appears in the public section of their site. Their TT procedures are implemented through an IP specialist (invention disclosures and assessments, patent applications), their legal department (drafting of contracts and agreements) and Accounting (verification of licensing fees).

NIRDTP's site provides an overview of their products and services[10] but not the IPRs that are available for licensing. They report the outcomes of each finalised publicly-funded project on the RO INNO platform.

NIRDTP's site also includes two annual reports[11], but the most recent refers to 2009. Section 7 of the 2009 activity report includes data on patent applications, patents granted and the number of new products/services/technologies introduced during the reporting period.

IV.D.iv IBRI—Institute of Biological Research Iasi

The Institute of Biological Research Iasi, as a branch of NIRDBS Bucharest does not have its own policy of knowledge transfer and procedures to implement it. In case of projects which include technology transfer activities, terms and conditions are set by partnership agreements, in the limits of regulation in force, and are reviewed and approved by the head of the research department. The main achievements, including research outcomes of different projects are published on the institute website, but IBRI's official RDI outcomes are consolidated with those of NIRDBS Buchares.

IV.D.v UNAI—Universitatea Națională de Arte "George Enescu" din Iași

As expected by its orientation towards pure artistic and cultural activities, the *National University of Art "George Enescu"* does not currently have any type of policy regarding technology transfer. However, after having introduced some new specialties during the last decade (Design, Applied Graphics, Preservation-Conservation, Cultural Management), they are considering to introduce such a policy and are examining the legal framework to define its scope and the necessary adjustments in their organisational structure.

[9] https://www.phys-iasi.ro/sites/default/files/Strategia%20INCDFT-IFT%20Iasi%202015-2020.pdf

[10] https://www.phys-iasi.ro/en/products-and-services/products-services

[11] https://www.phys-iasi.ro/en/reports

IV.D.vi ARFI-Romanian Academy Iasi Branch

The institutional structure of the ARFI consists of 11 Research Institutes, an administrative service and the Romanian Academy Library, Iasi Branch. By 2015, the Romanian Academy, Iasi Branch has a staffing structure with a total of 240 employees of which 159 researchers and 81 administrative staff.

Although technology transfer is explicitly mentioned in ARFI's development strategy for the period 2015-2020[12], from their answer it seems that they have not developed the necessary organisational structures and the procedures in support of technology transfer.

The most recent activity report that is available in their website presents the outcomes of two projects only[13].

IV.E HEI/PRO TECHNOLOGY TRANSFER PERFORMANCE

Our research instrument (see Appendix VI.A) was administered to all regional HEI/PROs with the intermediation of the RDA in mid-January 2017 and by the (extended) deadline of 10 March 2017 the replies of the following institutions were received:

- "Gheorghe Asachi" Technical University of Iasi (TUI)
- "Vasile Alecsandri" University of Bacău (UBC)
- University of Medicine and Pharmacy "Grigore T. Popa"
- Stefan cel Mare University of Suceava (USV)
- Institute of Biological Research Iasi (IBRI)
- Universitatea Națională de Arte "George Enescu" din Iași (UNAI)
- National Institute of Research & Development for Technical Physics, Iasi (NIRDTP)
- Romanian Academy, Iasi Branch (ARFI)

Most of the responses had some data quality issues, with the most common being reporting data on firms in North East Romania only and not filling values in the headline indicators. These were corrected manually, assuming that the total value of the headline indicator equals the value reported for the regional level. It should be noted that the values reported by HEI/PROs -especially those on the number of agreements and the financials- cannot be verified by other means. Table 9 presents the aggregate results.

Starting with the total number of new research agreements[14] per year (Indicator 1.1 = Indicator 1.2 + Indicator 1.3) we notice the overall yearly performance at around 65, most of them (96%) being with regional firms. Three out of seven institutions contribute to the 94% of the value of this indicator, all of them being HEIs. Overall, there seems to be a slight preference to contract research agreements (52%) over collaborative research agreements (48%) but this is mainly circumstantial. Consultancy agreements (indicator 1.4) seem to have an increasing trend during the last three years, all of them being agreed with regional firms. These results provide evidence of engagement with the local industry, but also indicate the regional sphere of influence of the local HEI/PROs in terms of technology transfer.

The financial value of all agreements[15] (Indicator 1.6) during the three-year reference period was 14.56mil RON, 97% of which being agreements with regional firms. A single HEI contributed to 52% of the value of this indicator and the top 3 to the 97% of the same. The average contract value was found to be 43 990 RON (approx. €9 885).

[12] See general objective 4 in http://home.acadiasi.ro/ro/content/strategia-filialei-ia%C8%99i-academiei-rom%C3%A2ne

[13] http://home.acadiasi.ro/sites/default/files/Registru%20de%20evidenta%20a%20rezultatelor%20C-D%202014.pdf

[14] All contracts where a firm funds the HEI/PRO to perform research on behalf of the firm, with the results usually provided to the firm. Include collaborative agreements where both partners provide funding and share the results. Exclude cases where the firm funds a research chair or other research of no expected commercial value to the firm. Also exclude consultancy contracts.

[15] Includes every type of research agreement and consultancy contracts.

TABLE 9 TECHNOLOGY TRANSFER PERFORMANCE INDICATORS

Performance Indicators	*2014*	*2015*	*2016*
1.1 Number of research agreements	62	57	76
with firms in NE Romania	59	55	74
1.2 Number of collaborative research agreements	37	20	36
with firms in NE Romania	35	18	34
1.3 Number of contract research agreements	24	37	40
with firms in NE Romania	24	37	40
1.4 Number of consultancy agreements	34	49	53
with firms in NE Romania	34	49	53
1.5 Average share of total research expenditure funded by the private sector (%)	5.05	16.35	3.18
min/max	1.6 / 11.86	0.056 / 46.9	0 / 6.9
1.6 Financial value of all research agreements (in RON)	4 859 699	3 690 758	6 010 680
with firms in NE Romania	4 738 210	3 506 658	5 894 530
2. Number of invention disclosures received during the year	79	39	37
3. Total patent applications filed during the year	42	49	56
to the National Office	41	49	56
to the European Patent Office	1	0	0
to the USPTO	0	0	0
4. Total number of new patents granted during the year	33	23	54
by the National Office	33	23	54
by the European Patent Office	0	0	0
by the USPTO	0	0	0
5. Total number of licences executed	0	0	0
6. Total license income earned (in RON)	0	0	0
7.1 Number of spin-offs established during the year	0	0	0
7.2 Number of active spin-offs at the end of the year	1	1	1
7.3 Revenues generated from spin-off royalties/profits/equity sales	0	0	0

TTOs in HEI/PROs	
Number of active TTOs	3
Avg (min/max) year of establishment	2003 (1992/2012)
Total / Average number of all TTO staff in FTEs	5.50 / 1.83
TTO Activities	
Seeking and/or managing research contracts from government	2 (67%)
Seeking and/or managing research contracts with industry	3 (100%)
Selling expertise/consultancy/services to the industry	3 (100%)
Managing the patent portfolio	3 (100%)
Scouting for new IP/technology	1 (33%)
Licensing	3 (100%)
Creation of spin-off companies	2 (67%)
Continuous Professional Development	2 (67%)
Management of Science or/and Technology Parks	1 (33%)
Agreements with seed capital funds or business angel networks	0 (0%)

Only five institutions reported their share of total research expenditures funded by the private sector (Indicator 1.5). The average values of this indicator fluctuate over the years, with the three-year average of averages being 8.20%. According to [2](sec. 5.7.1) the level of public R&D expenditure funded by the Romanian business enterprise sector as a percentage of GERD increased considerably between 2008 (6.64%) and 2011 (10.53%),

followed by a drop in 2012 (8.56%) and a subsequent minor rise in 2013 (8.82%) and a drop in 2014 (€48m, 8.36% of GERD).

Moving on to IPR-related indicators, we note that only two three institutions (TUIasi, USuceava and IFT) reported invention disclosure data (Indicator 2). Invention disclosures[16] are a lead indicator of knowledge transfer activities and their reporting suggests that some of the HEI/PROs have codified their IPR processes and have a specific disclosure practice. The declining trend in invention disclosures should be noted.

The patent statistics that were reported (Indicators 3 and 4) are higher than the respective EPO-collected data (see Table 6 and Table 7 in p. 13), but most probably this has to do with the author's use of priority and publication years for applications and granted patents, respectively, and not actual dates of submission and notification.

Beyond the number of invention disclosures and / or patents granted, what really matters about the technology transfer activities of HEI/PROs is their capacity to transfer their inventions to the real economy and be able to reap their share of the economic value that is created. Under this perspective, the number or licenses executed in a certain year represents a useful indicator of this capacity. Moreover, the amount of licensing revenues is also a relevant indicator to consider when assessing the impact of HEI/PROs to the smart economy. In these terms, their reported performance on the total number of licenses executed[17] (Indicator 5) and the total license income earned[18] (Indicator 6) is rather disappointing. From the data that we have collected we cannot assert whether failure to license has to do with institutional TT strategies or the capacity of TTOs to promote their IPR portfolio or the quality of the portfolio itself, but it seems that all interested parties are rather happy having collectively spent approximately €300.000 for patent fees during the last decade with no obvious direct economic impact on the regional economy.

Beyond engaging with the industry in terms of research or consulting engagements and patenting, another TT-related activity traditionally performed by HEI/PROs is the support (and motivation) for the creation of spin-off companies[19]. Among others, spin-offs are considered to be the best vehicle for commercialising highly valuable research outcomes or know-how in cases when the industry cannot appreciate the commercial potential of the knowledge involved. Indicators 7.1-7.3 capture the situation. There are only two known spin-off companies in the region, founded by entrepreneurial faculty members of Technical University Iasi and Univ of Suceava. The former is wrongly, according to the definition[19], considered as a spin-off, since there is no licensing agreement or equity relationship between the company and TUI. The latter was founded in 2016 and therefore no revenues can be declared in indicator 7.3. The legal framework regulating spinoffs is rather vague in Romania, and HEI/PROs apparently have neither set their institutional rules on the subject nor tried to promote the concept.

Four institutions have reported having a TTO (TUI, IFTI, UBC, USV). However, based on what is reported in Sec. IV.D.ii , the structure at University of Bacau is a Research Council without dedicated personnel and not a TTO; therefore, it is was not considered in the descriptive statistics. TUI was the first to establish such a structure in 1992, currently employing a staff of 3.5 FTEs. TUI's structure is also involved in the management of TEHNOPOLIS Science Park (see next section). All TTOs reported that they're engaged in typical TTO activities (seeking/managing research contracts with industry, selling expertise/consultancy/services to the industry, licensing) with the exception of raising seed capital (for spin-offs or student start-ups).

[16] Descriptions of inventions or discoveries to be evaluated by technology experts to assess their commercial application.

[17] Include all licenses, options and assignments for all types of IP (copyright, know-how, patents, trademarks, etc). Count multiple (identical) licenses with a value each of less than €500 as one license. A license grants the right to use IP in a defined field of use or territory. An option grants the potential licensee a time period to evaluate the technology and negotiate the terms of a license. An assignment transfers all or part of the right to IP to the licensee.

[18] Total income from all types of know-how and IP (patents, copyright, designs, material transfer agreements, confidentiality agreements, etc) before disbursement to the inventor or other parties. Include license issue fees, annual fees, option fees and milestone, termination and cash-in payments. Exclude license income forwarded to other institutions than those served by the TTO or to companies.

[19] A new company explicitly established to develop or exploit IP or know-how created by the HEI/PRO and with a formal contractual relationship for this IP or know-how, such as a license or equity agreement. Include, but not limit to, spin-offs established by the institution's staff. Exclude start-ups that do not sign a formal agreement for developing IP or know-how created by the institution.

IV.F TECHNOLOGY TRANSFER INTERMEDIARIES

Two intermediary entities are reported to operate in the Region [3]:

- The *Technological Information Centre INDTECH NORD-EST* (http://ccibc.ro/agentii-speciale/indtech-nord-est/) that operates within the Chamber of Commerce, Industry and Agriculture in Bacau since 2014. It has been accredited to support three sectors: the mechanical processing industry, the wood industry and environmental protection. According to its website, it provides a very wide range of business support services (business establishment, consulting, identification of business opportunities, marketing / promotion, support for internationalization, organization and support for participation in fairs/exhibitions, training, research & innovation support).
- The *TEHNOPOLIS Science and Technology Park* (http://tehnopol-is.ro/) which is a joint venture of the Iasi County & Municipal Councils and the four Universities in Iasi. TEHNOPOLIS is both a science-technology park and a business incubator.

Of these two entities, only TEHNOPOLIS provided answers to our questionnaire for intermediaries (see Appendix VI.C). They are summarized below.

Tehnopolis Iasi was established in 2005, being a non-profit entity whose majority is controlled by public entities. In 2016, it employed a staff of 14. It has a sectoral focus on biotechnology, ICT and Telecommunications. During each of the last three years (2014-2016) it provided services to four Universities, more than 60 private enterprises of which less than ten were newly established.

Beyond managing the Science Park and the Business Incubator, its knowledge transfer service mix includes providing consulting and expertise services to the industry, continuous professional development services and the assessment of the commercialization potential of research results. It *does not* include the management of the patent portfolio of the academic entities served or the creation of spin-off companies.

Tehnopolis mix of business support services includes information provision, accounting and legal support, technology brokerage, cluster stimulation, promotion of internationalization, coaching/mentoring, needs assessments and audits and providing access to finance.

Tehnopolis contribution to the innovation ecosystem of NE Romania was the establishment of 16 start-ups during the last three years, the provision of incubation services to 7 newly established firms and the provision of hosting services to more than 20 companies.

V. CONCLUSIONS AND POLICY RECOMMENDATIONS

Article 117 of the National Education Law 1/2011 defines the mission of higher education as follows:

"*The mission of higher education is to generate and transfer knowledge to society through:*

a) initial and continuous training at university level in order to develop personal, professional insertion of the individual and the need to satisfy the competence of socio-economic environment;

b) scientific research, development, innovation and technology transfer through individual and collective creation, sciences, engineering sciences, the arts, the letters, ensuring performance and physical development and sports, as well as capitalizing and disseminating their results."

As we have seen (Sec. IV.D) all of the regional HEIs that responded to our survey have transposed this mission into their charters. Moreover, all of the regional PROs have also included technology transfer and capitalisation of research outcomes into their development strategies. However, as the data presented earlier suggest, both HEIs and PROs have not put enough emphasis on this part of their mission, focusing mainly on their education and scientific research activities, respectively.

The HEIs' focus on educating the population is fully justified if we consider the statistics of persons with tertiary education as a percentage of active population (see Table 2, p.5) which suggest that both the region and the country have considerable work to do in this respect. As implied by the horizontal priorities of the regional smart specialisation strategy [3], higher education graduates should also be provided by general-purpose soft skills (e.g., entrepreneurship and creativity), but this discussion is beyond the scope of this report. The higher education statistics that are relevant to technology transfer are the number of graduates (see Table 3, p.6) that actually stay in the region and become agents for knowledge spill-overs to the society as a whole. Unfortunately, no regional HEI tracks the career paths of its graduates and therefore, no estimation of spill-over effects can be made.

With the 'research outputs' part of Figure 1 as a reference, let us now discuss our evidence regarding the researchers and the new knowledge that they produce. A headcount of 3.095 researchers in the higher education and government sector (see Table 2, p.5) is the key input for the supply of new knowledge in the region. We have used WOS publication data (see Sec. IV.A and Appendix VI.D) as a proxy to specify regional scientific specialisation and also we have found that most of the sectoral priorities of the RIS3 are supported by knowledge available in the region (see Table 5, p.10). Secondary data (see p.6) suggest that the research competitiveness of the regional key actors is rather modest when compared to the national performance which is also modest at the European level. This might have implications both on the regional HEIs' ability to attract talented students and researchers and also on the industry's propensity to collaborate with regional researchers in developing state-of-the art technologies. The latter is further supported by the evidence on KET-related patenting activity (see Figure 5, p.14). The patenting statistics (see Sec. IV.B , pp.12-16) suggest that the regional researchers are *highly inventive;* however, this inventiveness, as suggested by the survey outcomes of spin-off creation and licensing of IPR (see Table 9, p.20) has not been transformed into innovation yet. This transformation is a policy challenge that has to be urgently addressed.

With the 'knowledge transfer activities' part of Figure 1 (p.7) as a reference, let us now discuss the channels of interaction between research and the other stakeholders after we exclude teaching and continuous professional development which are parts of the education mission. Assuming that the data reported by the institutions are correct—since triangulation is not possible, we refer to the data in Table 9. Overall, the aggregate number of research agreements of any type and consultancy agreements that are reported are very low when compared to the 6690 enterprises in the region with more than 10 employees, of which 1762 in manufacturing [1]. This suggests that there seems to be a problem of effective interaction between academia/research and the industry that also has to be dealt with by applying proper policy instruments. The average contract value for all types of agreements that was reported in Sec. IV.E is also an indication of rather short-term engagements. We have no data available to quantify the informal networks between researchers in HEI/PROs and the industry and examine whether they eventually transform into formal ones. Also, the reference period of our survey cannot effectively capture the network-enhancing effects of the EDP process that started in 2016. ERRIS, a highly valuable initiative by the Romanian Government to reduce-among others-the search cost of enterprises in finding the 'right' research

partners (see Sec. IV.C), is also a very recent development in the right direction. It should be leveraged by HEI/PROs as a platform to showcase their offerings, including their IPR portfolios. So far, the intermediary organisations that operate in the region (see Sec. IV.F) do not seem to have any contribution in creating knowledge flows between academia and industry.

The incongruity between patenting and licensing activity by HEI/PROs requires a special mention. It is rather evident, especially in the light of Box 1 in p. 15, that the surge of inventive activity that appeared throughout the country between 2010 and 2012 was the research system's response to the new rules of evaluation and funding and not the outcome of the institutions' R&D&I strategy. HEI/PROs seem to consider their patents as an equivalent of research publications-that become public domain 5 years after they are granted since they're left to lapse, and not as an opportunity for long-term licensing revenues. Under this perspective, any entity wishing to support HEI/PROs into commercializing their IPR portfolios, in addition to a poor track record of zero licensing revenues that creates high uncertainty regarding its sustainability, has also to cope with a limited time-window to assess potential for commercialization and enter negotiations with prospect licensees.

Said these, it is time to answer the key question that needs to be answered. Is there potential, in terms of supply, for technology transfer in North East Romania? And if yes, which are the policy recommendations that can unleash this potential?

In brief, the answer is that there is considerable supply of relevant-for the regional development priorities-knowledge in the region that has to be unleashed by improving, through policy and appropriate delivery instruments, the exploitation of the knowledge in HEI/PROs for the benefit of the industry.

The first policy challenge is *how to transform HEI/PRO knowledge into an economic asset* for both the industry and the institutions themselves. The first stream of activity has to do with existing IPRs. As we have seen, HEI/PROs have created large portfolios of patents that are currently unexploited. The structures within the institutions are rather understaffed and ineffective and therefore they cannot guarantee successful exploitation. HEI/PROs have to clear their portfolios (i.e., check which patents awarded to them are still valid) and transfer their rights in bulk, non-exclusive, licenses or options to one or more professional technology brokers for a small fixed fee per patent and a larger share of the income generated if the patent finds its way to the market. If HEI/PROs feel that there's more value in their portfolios than what they expect to gain by following this approach, they could also consider setting up their own technology broker organization as a joint venture. The second stream of activity has to do with spin-off firms. The legal framework for this is unclear, especially in terms of conflicts of commitment or interest. Until this is sorted out by the Government, the HEI/PROs should define and enforce such rules for their faculty members and also define their internal policies regarding equity shares and/or licensing. This could clear the way for interested faculty members to engage in such activities and benefit, either from existing co-funding opportunities for newly-established firms or from special funding for spin-off creation that has to put in place by the Government's agencies. There is so much empirical evidence in the literature to justify the benefits of spin-offs to ignore this issue.

The second policy challenge is *how to improve knowledge exchange between academia/research and the industry* for mutual benefit. We have seen that so far, the degree of engagement is rather low, but from our evidence we cannot derive the reasons behind this symptom. We have also seen that the Romanian Government understands that this is a two-sided problem and has tried to introduce IT platforms (e.g., ERRIS for services and research infrastructures and ROINNO for research project outcomes), to bring the two parts together by reducing search and information costs. These initiatives should be continued and become, if possible, integrated into one and only platform that mediates all types of interaction between research and industry. Opportunities for interaction should be provided to both sides, mainly in terms of collaborative applied research projects focused on real industry needs. Such projects would harness the inventiveness and knowledge of HEI/PRO researchers for the benefit of the industry and moreover could create new jobs for young researchers to address brain-drain. More valuable and revenue-generating joint patents between HEI/PROs and the industry could also be an outcome of such schemes. Special attention should also be put in stimulating first-time interactions of firms with HEI/PROs. A well-designed innovation voucher scheme of a value of €3.000 (which is 33% of the average contract value reported in Sec. IV.E) would be the proper instrument here, especially if connected to a competitive approach to solve the firm-reported innovation needs (e.g., by proposing to the firm 3 candidates listed in ERRIS and asking them to pitch for being

awarded the voucher). If successful, such short-term, voucher-supported interactions would lead to more long-term ones. Finally, intersectoral mobility schemes ranging from rather simple to set up summer internships for undergraduate students to a Romanian version of Knowledge Transfer Partnerships[20] and Industrial Masters or PhD degrees would help formalize and maintain knowledge spillovers.

The final paragraph in this report has to do with how the government can accelerate the transition from adequate technology transfer performance to good. We have seen (Box 1, p. 15) that during 2007 and 2008, the Government-designed accreditation methodology of the universities as research units imposed three main indicators (ISI ranked articles, patents and contracts with industry). In addition, the funding methodology of the universities introduced patents as one of the main indicators in evaluating (and financing) the universities in terms of research. This approach has created some unintended consequences, namely a huge surge in unexploited patents, which, we can assume, was not the target of government policy. Since two of the three evaluation indicators have to do with technology transfer, the author would suggest to reconsider them and start using, after proper notice to the institutions, three alternative indicators: (a) The total value of all new agreements with enterprises within a year (collaborative and contract research and consulting agreements); (b) the total income from the same types of agreements per year, and (c) the total income from licensing, spin-off profits or equity sales. These three indicators capture the outcomes of the technology transfer process and not the lead indicators. Moreover, since technology transfer is by law part of the mission of higher education, it should be monitored more carefully and the results should be made publicly available. Fiche B2 of the ARACIS database contains a section (B313) entitled "Research Valorisation" that reports data on: (i) B313.3: Number of research contracts with various companies in the country and (ii) B313.7: Number of patents under protection or intellectual property rights. Clearly, these two are not adequate to monitor technology transfer. If adopted, the set of indicators provided in the research instrument used in this report (see Appendix VI.B) would be far better and also provide the basis for benchmarking country-level data with international ones. They could be also be considered for inclusion as a template in the annual activity reports produced by HEI/PROs. Transparent public ranking of performance always works, and if set-up correctly, it can drive much-needed change.

[20] https://connect.innovateuk.org/web/ktp

REFERENCES

[1] National Institute of Statistics, *Romanian Statistical Yearbook 2014*, Bucharest: NIS, 2015.

[2] R. Gheorghiu, L. Andreescu and J. Zifciakova, "RIO Country Report 2015: Romania," JRC, Seville, JRC101213, 2016.

[3] ADRNE, *Strategia de Specializare Inteligentă Nord-Est*, 2e, Aug. 2016.

[4] European Commission. *Metrics for Knowledge Transfer from Public Research Organisations in Europe*. Luxemburg: Office for Official Publications of the European Communities, 2009.

[5] LibraryHouse. *Metrics for the Evaluation of Technology Transfer Activities at Universities*. 2008.

[6] F.T. Rothaermel, S.D. Agung and L. Jiang, "University entrepreneurship: a taxonomy of the literature," *Industrial and Corporate Change*, Vol. 16, No. 4, pp. 691–791, 2007.

[7] A. Piccaluga, C. Balderi and A. Patrono. *The ProTon Europe Seventh Annual Survey Report (Fiscal Year 2009)*. Brussels: ProTon Europe, 2011.

[8] OECD. *OEDC Patent Statistics Manual.* Paris: OECD Publishing. 2009.

[9] S. Montresor and F. Quataro. *Key Enabling Technologies and Smart Specialisation Strategies. European Regional Evidence from Patent Data.* IPTS Working Papers on Corporate R&D and Innovation No 5, Seville: JRC, 2015.

[10] P. Gkotsis. *The Capability of the EU R&D Scoreboard companies to develop Advanced Manufacturing Technologies-An assessment based on patent analysis.* JRC Technical Report 27176, 2015.

[11] M. Dimian, private communication, March 2017.

VI. APPENDIX

VI.A INSTITUTIONAL TECHNOLOGY TRANSFER POLICY REVIEW QUESTIONNAIRE

Institution Name:
Institution Type: University / Public Research Centre / Other (specify)
Name:
Position:
Date:

Q1. According to the National Education Law of 2011 (Art. 117), the mission of higher education includes the transfer of knowledge to society by capitalising and disseminating research results. Does your institution have a written policy on knowledge transfer?

Please provide a summary of the policy (1-3 lines):

-

Please provide link(s) to your institution's web site for more details:

-

Q2. Which organisational unit(s) is (are) responsible for the implementation of your institution's knowledge transfer policy?

Please provide a list of organisational units responsible for knowledge transfer and their roles (ie, governance/oversight, implementation, assessment):

- …
- …

Please provide link(s) to your institution's web site for more details:

-

Q3. Attributes of the knowledge transfer policy: Please indicate if your knowledge transfer policy covers the following attributes:

Yes/No	Ownership of Inventions and Supportive Technologies
Yes/No	Use of Institution's Name and Logo
Yes/No	Ownership of copyrights (publications, software, online courses)
Yes/No	Conflict of commitment and outside professional activities by faculty
Yes/No	Open access to research
Yes/No	Revenue sharing with inventors
Yes/No	Spin-off creation & institutional involvement (e.g., equity vs licensing)
Yes/No	Collaboration with industry and contract research

Q4. Has your institution developed the key processes needed to support the knowledge transfer policy?

Process Title:	*Deployed:*	*Responsible Org. Unit:*
4.1 Invention Disclosure	Yes/No	
4.2 Invention Assessment	Yes/No	
4.3 Patent Application	Yes/No	
4.4 Drafting Licensing Contracts	Yes/No	
4.5 Drafting Equity Sharing Agreements	Yes/No	
4.6 Review of Joint Research Contracts	Yes/No	
4.7 Verification of Licensing Revenues	Yes/No	

Q5. Does your institution provide information on opportunities to use research outcomes and/or technologies available for licensing?

Your answer (1-2 lines):

-

Please provide link(s) to your institution's web site for more details:

-

Q6. How often does your institution review the outputs of the knowledge transfer policy and how does it use the review outcomes?

Your answer (1-3 lines):

•

Please provide link(s) to your institution's web site for more details:

•

Q7. Does your institution report the outputs of the knowledge transfer policy to the public?
Your answer (1-3 lines):

•

Please provide link(s) to your institution's web site for more details:

•

VI.B TECHNOLOGY TRANSFER OUTPUTS QUESTIONNAIRE

Performance Indicators	**2014**	**2015**	**2016**
1.1 Number of research agreements			
with firms within NE Romania			
1.2 Number of collaborative research agreements			
with firms within NE Romania			
1.3 Number of contract research agreements			
with firms within NE Romania			
1.4 Number of consultancy agreements			
with firms within NE Romania			
1.5 Share of total research expenditures funded by the private sector (%)			
1.6 Financial value of all research agreements (in RON)			
with firms within NE Romania			
2 Number of invention disclosures received during the year			
3.1 Number of new patent applications filed to the National Office			
3.2 Number of new patent applications filed to the EPO			
3.3 Number of new patent applications filed to the USPTO			
4.1 Number of new patent grants by the National Office			
4.2 Number of new patent grants from the EPO			
4.3 Number of new patent grants from the USPTO			
5 Total number of **licenses** executed			
with firms within NE Romania			
6 Total licence income earned (in RON)			
by firms within NE Romania			
7.1 Number of **spin-offs** established during the year			

Performance Indicators	**2014**	**2015**	**2016**
7.2 Number of active **spin-offs** at the end of the year			
7.3 Revenues generated in the reference year from **spin-off** royalties / profits / equity sales (in RON)			
8 Number of **start-ups** established during the year			

HEI TT Profile

Year of foundation of your TTO	
Total number of TTO staff in full-time equivalents (FTE) in 2016	
Number of professional TTO staff in full-time equivalents in 2016	
*TTO Activities (Please reply **Yes** where applicable):*	
Seeking and/or managing research contracts from government organisations	Yes/No
Seeking and/or managing research contracts with industry	Yes/No
Selling expertise/consultancy/services to the industry	Yes/No
Managing the patent portfolio	Yes/No
Scouting for new IP/technology	Yes/No
Licensing	Yes/No
Creation of spin-off companies	Yes/No
Continuous Professional Development	Yes/No
Management of Science or/and Technology Parks	Yes/No
Agreements with seed capital funds or business angel networks	Yes/No
*Written policies (Please reply **YES** if your HEI has one of these):*	
Inventions	Yes/No
Ownership of copyright	Yes/No
Involvement of students in contract research with companies	Yes/No
Collaboration with industry and contract research	Yes/No
Creation of spin-off companies	Yes/No
Conflict of commitment or interest	Yes/No

VI.C Questionnaire for Technology Transfer Intermediaries

A. Background variables

A1. Entities served by the organisation

A.1.1.a Does your organisation serve one or more universities or public research centres?

A2. Types of entities served by the Organisation

*Please state the **actual** number of entities served by your organisation during the last three years:*

a. University or other higher education institution
b. Hospital (linked to a university or independent)
c. Government research institution
d. Private research institution
e. Private firm existing for more than 3 years
f. Newly established private firm (<3 years)
g. Individuals, natural persons

A3. Age and Size of the Organisation

A3.1 Year of foundation of your Organisation
A3.2 Total number of your staff (incl. admin & support)
A3.3 Total number of your staff (incl. admin & support)
A3.4 Total number of contractors/outsourced work
A3.5 Total number of contractors/outsourced work

A4. Legal status of your organisation (Choose one)

Mark X in one of the cells.

☐ A4.1 Department/Unit of University or Research Centre
☐ A4.2 Non-profit entity whose majority is controlled by University(-ies) or research centre(s)
☐ A4.3 For profit entity whose majority is controlled by University(-ies) or research centre(s)
☐ A4.4 Non-profit entity whose majority is controlled by other public entity
☐ A4.5 For profit entity whose majority is controlled by other public entity
☐ A4.6 Non-profit entity of the private sector
☐ A4.7 For profit entity of the private sector

B. Service Mix

B1. Does your organisation undertake the following **knowlege transfer** activities? (Mark X to all that apply)

☐ Seeking and/or managing research contracts from government organisations
☐ Seeking and/or managing research contracts with industry
☐ Selling expertise/consultancy/services to the industry
☐ Managing the patent portfolio of the academic/research entities served
☐ Scouting for new IP/technology
☐ Licensing of intellectual property rights
☐ Creation of spin-off companies
☐ Continuous Professional Development
☐ Management of Science or/and Technology Parks
☐ Agreements with seed capital funds or business angel networks
☐ Assessment of the commercialisation potential of research results
☐ Valorisation of intellectual property rights

B2. Does your organisation undertake the following **business support** activities? (Mark X to all that apply)

☐ Information provision
☐ Awareness raising
☐ Training
☐ Accounting, legal (incl. patents, trademarks) and administrative services
☐ Technology brokerage
☐ Prototyping
☐ Recruitment services including placements and internships
☐ Stimulation and/or running of networks and clusters
☐ Promotion of internationalisation
☐ Promotion of foreign investors
☐ Coaching / Mentoring / Tailored advice

☐ Needs assessment, audits

☐ Access to finance (business angels, venture capital, equity investors)

☐ Science and technology services

B3. Does your organisation undertake **infrastructure provision** activities? (Mark X to all that apply)

☐ Business inclubation services

☐ Business acceleration services

☐ Technology / Science Park services

B4. Does your organisation have a sectoral focus in service provision?

If yes, please list the relevant sectors below:

[Fill in sector 1]

[Fill in sector 2]

[Fill in sector 3]

[Fill in sector 4]

C. Performance indicators

Please indicate how many of the following outputs were achieved with your organisation's intermediation per year (2014-2016).

1.1 Number of research agreements
with firms in North-East Romania

1.2 Number of collaborative research agreements
with firms in North-East Romania

1.3 Number of contract research agreements
with firms in North-East Romania

1.4 Number of consultancy agreements
with firms in North-East Romania

1.6 Financial value of all research agreements (in RON)
with firms in North-East Romania

2 Number of invention disclosures received during the year

3.1 Number of new patent applications filed to the National Office

3.2 Number of new patent applications filed to the EPO

3.3 Number of new patent applications filed to the USPTO

4.1 Number of new patent grants by the National Office

4.2 Number of new patent grants from the EPO

4.3 Number of new patent grants from the USPTO

5 Total number of **licenses** executed

with firms in North-East Romania

6 Total licence income earned (in RON)
with firms in North-East Romania

7.1 Number of **spin-offs** established during the year

7.3 Revenues generated in the reference year from **spin-off** royalties / profits / equity sales (in RON)

8 Number of **start-ups** established during the year

9.1 Number of companies that received incubation services

9.2 Number of companies that received acceleration services

9.3 Number of companies hosted in science/technology park

VI.D PUBLICATIONS PER RESEARCH AREA AND REGIONAL SPECIALISATION

Research Areas	*Romania*	*North East Romania*	*Normalised Location Quotient*
CHEMISTRY	7972	1739	0.122
ENGINEERING	6807	1593	0.157
MATERIALS SCIENCE	5281	1257	0.165
PHYSICS	7160	1128	-0.040
MATHEMATICS	5851	831	-0.091
SCIENCE TECHNOLOGY OTHER TOPICS	4180	761	0.032
ENVIRONMENTAL SCIENCES ECOLOGY	3204	687	0.114
PHARMACOLOGY PHARMACY	3384	618	0.034
BIOCHEMISTRY MOLECULAR BIOLOGY	3573	598	-0.010
POLYMER SCIENCE	**1179**	**546**	**0.462**
SPECTROSCOPY	1908	377	0.073
COMPUTER SCIENCE	1906	346	0.031
CRYSTALLOGRAPHY	**1084**	**346**	**0.303**
AGRICULTURE	1603	318	0.075
MECHANICS	1450	303	0.101
CARDIOVASCULAR SYSTEM CARDIOLOGY	1802	261	-0.082
BUSINESS ECONOMICS	1778	254	-0.089
INSTRUMENTS INSTRUMENTATION	1611	254	-0.039
NEUROSCIENCES NEUROLOGY	1385	246	0.020
ONCOLOGY	2013	234	-0.190
PATHOLOGY	1534	232	-0.060
BIOTECHNOLOGY APPLIED MICROBIOLOGY	1426	223	-0.044
PLANT SCIENCES	1133	219	0.062
IMMUNOLOGY	1643	207	-0.150
ENDOCRINOLOGY METABOLISM	1439	203	-0.095
UROLOGY NEPHROLOGY	729	202	0.238
TOXICOLOGY	1222	197	-0.028
GASTROENTEROLOGY HEPATOLOGY	1334	194	-0.080
GENETICS HEREDITY	1686	191	-0.202
INFECTIOUS DISEASES	1340	184	-0.108
WATER RESOURCES	**630**	**179**	**0.250**
LIFE SCIENCES BIOMEDICINE OTHER TOPICS	689	177	0.202
PUBLIC ENVIRONMENTAL OCCUPATIONAL HEALTH	1059	173	-0.022
RESEARCH EXPERIMENTAL MEDICINE	1189	160	-0.118
FOOD SCIENCE TECHNOLOGY	972	156	-0.031
NUTRITION DIETETICS	909	153	-0.007
CELL BIOLOGY	1079	148	-0.109
GERIATRICS GERONTOLOGY	1158	145	-0.153
HEALTH CARE SCIENCES SERVICES	920	145	-0.040
RADIOLOGY NUCLEAR MEDICINE MEDICAL IMAGING	1270	144	-0.202
RESPIRATORY SYSTEM	913	138	-0.060
ENERGY FUELS	881	133	-0.061
MEDICAL LABORATORY TECHNOLOGY	914	132	-0.083
GENERAL INTERNAL MEDICINE	874	130	-0.068
PHYSIOLOGY	798	128	-0.031
MATHEMATICAL COMPUTATIONAL BIOLOGY	680	127	0.045
ZOOLOGY	816	126	-0.050
PEDIATRICS	908	123	-0.115
SOCIOLOGY	**430**	**123**	**0.253**

Research Areas	*Romania*	*North East Romania*	*Normalised Location Quotient*
SURGERY	1157	121	-0.240
METALLURGY METALLURGICAL ENGINEERING	667	120	0.027
ELECTROCHEMISTRY	609	119	0.068
OPTICS	1013	118	-0.189
THERMODYNAMICS	729	116	-0.035
BIOPHYSICS	563	107	0.054
BIODIVERSITY CONSERVATION	619	103	-0.013
MICROBIOLOGY	580	103	0.020
BEHAVIORAL SCIENCES	725	102	-0.096
PSYCHOLOGY	886	101	-0.199
AUTOMATION CONTROL SYSTEMS	672	98	-0.078
DEVELOPMENTAL BIOLOGY	895	98	-0.218
SOCIAL WORK	**195**	**98**	**0.493**
METEOROLOGY ATMOSPHERIC SCIENCES	598	96	-0.030
PSYCHIATRY	676	93	-0.107
ANATOMY MORPHOLOGY	635	91	-0.087
OBSTETRICS GYNECOLOGY	509	91	0.023
REPRODUCTIVE BIOLOGY	538	91	-0.004
FORESTRY	372	89	0.167
SOCIAL SCIENCES OTHER TOPICS	**270**	**85**	**0.297**
DERMATOLOGY	532	80	-0.063
HEMATOLOGY	678	80	-0.182
TRANSPLANTATION	404	76	0.049
DEMOGRAPHY	473	75	-0.037
GEOLOGY	595	74	-0.157
COMMUNICATION	474	70	-0.072
MICROSCOPY	473	69	-0.078
RELIGION	262	67	0.200
LINGUISTICS	**223**	**66**	**0.269**
BIOMEDICAL SOCIAL SCIENCES	**103**	**62**	**0.558**
INFORMATION SCIENCE LIBRARY SCIENCE	**168**	**62**	**0.368**
MEDICAL ETHICS	**86**	**61**	**0.612**
VETERINARY SCIENCES	377	59	-0.043
HISTORY PHILOSOPHY OF SCIENCE	**163**	**56**	**0.336**
ARTS HUMANITIES OTHER TOPICS	**158**	**54**	**0.334**
PHYSICAL SCIENCES OTHER TOPICS	444	52	-0.186
RHEUMATOLOGY	346	50	-0.083
ROBOTICS	309	48	-0.047
ASTRONOMY ASTROPHYSICS	690	46	-0.438
TELECOMMUNICATIONS	276	45	-0.023
EDUCATION EDUCATIONAL RESEARCH	285	44	-0.050
GEOGRAPHY	487	43	-0.318
ORTHOPEDICS	315	43	-0.111
OPERATIONS RESEARCH MANAGEMENT SCIENCE	206	41	0.077
PHYSICAL GEOGRAPHY	210	41	0.067
MARINE FRESHWATER BIOLOGY	250	38	-0.058
DENTISTRY ORAL SURGERY MEDICINE	319	37	-0.191
PARASITOLOGY	255	34	-0.123
HISTORY	501	32	-0.455
CONSTRUCTION BUILDING TECHNOLOGY	256	27	-0.236
PUBLIC ADMINISTRATION	232	27	-0.189

Research Areas	*Romania*	*North East Romania*	*Normalised Location Quotient*
OPHTHALMOLOGY	168	26	-0.049
EVOLUTIONARY BIOLOGY	234	25	-0.230
PALEONTOLOGY	199	25	-0.152
VIROLOGY	170	24	-0.094
INTEGRATIVE COMPLEMENTARY MEDICINE	**71**	**23**	**0.310**
MYCOLOGY	98	23	0.158
AREA STUDIES	381	22	-0.494
ACOUSTICS	242	21	-0.326
ART	**42**	**21**	**0.491**
GOVERNMENT LAW	283	21	-0.394
LEGAL MEDICINE	166	21	-0.148
LITERATURE	104	21	0.084
GEOCHEMISTRY GEOPHYSICS	347	20	-0.495
ANTHROPOLOGY	135	19	-0.096
SOCIAL ISSUES	132	18	-0.112
ARCHAEOLOGY	101	17	-0.007
OCEANOGRAPHY	127	17	-0.121
PHILOSOPHY	144	17	-0.182
ENTOMOLOGY	88	16	0.032
NUCLEAR SCIENCE TECHNOLOGY	336	16	-0.564
EMERGENCY MEDICINE	**48**	**14**	**0.262**
ALLERGY	163	13	-0.363
INTERNATIONAL RELATIONS	84	13	-0.049
MINING MINERAL PROCESSING	84	13	-0.049
TRANSPORTATION	74	13	0.015
ANESTHESIOLOGY	75	12	-0.032
CRITICAL CARE MEDICINE	**43**	**12**	**0.241**
MEDICAL INFORMATICS	77	11	-0.089
MINERALOGY	53	11	0.098
IMAGING SCIENCE PHOTOGRAPHIC TECHNOLOGY	149	10	-0.435
FISHERIES	45	9	0.079
REHABILITATION	91	9	-0.266
OTORHINOLARYNGOLOGY	96	8	-0.344
SPORT SCIENCES	75	8	-0.231
NURSING	19	5	0.213
ARCHITECTURE	46	4	-0.325
CULTURAL STUDIES	39	4	-0.249
SUBSTANCE ABUSE	17	4	0.159
FAMILY STUDIES	17	3	0.017
FILM RADIO TELEVISION	24	3	-0.154
MATHEMATICAL METHODS IN SOCIAL SCIENCES	25	2	-0.362
REMOTE SENSING	37	2	-0.519
URBAN STUDIES	31	2	-0.451
CLASSICS	6	1	-0.012
ETHNIC STUDIES	23	1	-0.594