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Characterization If Innovation Activity and Technological Transfer at the Level of National Research-Development Institutes in Green Capitalism

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Abstract
Science/technology parks are interface structures with limited presence in Romania, reflecting the different innovation policies applied at the national level. They incorporate SMEs from a region, representing an important pole of sustainable economic development based on promoting technological exchange and applied research. Regarding the National R&D Institutes, they are not residents in science/technology parks.

Keywords: Technological Innovation, Green Capitalism, Sustinable Economy, Technological Exchange

1. Research Methoodology

Through the questionnaire, the aim was to obtain information mainly from individuals who hold a managerial position (general director/scientific director) within the 47 R&D institutes accredited as of 2022 (of which 43 are under the coordination of the Ministry of Research and Innovation, one under the coordination of the Ministry of Labor and Social Justice, one under the coordination of the Ministry of Communications and Information Society, and two under the coordination of the Ministry of Agriculture and Rural Development). Additionally, with the kind cooperation of the general director of the R&D institute, other individuals working within the institute who are involved in technology transfer activities or have expertise in the relationship with the business environment were also invited to complete the questionnaire.

The target group for the questionnaires was 47 individuals from the managerial staff (general/scientific directors), to whom emails containing the questionnaire were sent. The analysis sample corresponding to the received responses was 81 R&D institute employees (N = 81), representing a response rate of 172.34%. There were four R&D institutes that did not respond to the request (both from the managerial and executive staff).

The characteristics of the respondents in the sample are as follows: individuals with professional qualifications (only certified scientific researchers with mandatory doctoral studies), and through the current positions of the respondents within the R&D institutes, they represented both managerial and executive staff.

In the first stage of the research, the questionnaire was introduced on a specialized platform, Survey Gizmo®, which was programmed to be accessible online until a certain date for self-administration/online registration of responses.

2. Main Field of Activity

The first section of the questionnaire includes a series of general data regarding the surveyed R&D institute, including the contact details of the designated representative for completing the questionnaire. Information is requested regarding the existence of any technology transfer entity (TTE) within the structure of the R&D institute, as a member of ReNITT and/or European/international networks. Additionally, the affiliation of the R&D institute to any sectoral technological platform, science/technology park, open innovation platform, or cluster / competitiveness pole is checked. It is also tested whether the R&D institute's R&D results have led to the establishment of start-up/spin-off companies. These pieces of information reflect the concern that the surveyed R&D institutes organize specialized structures for innovation and technology transfer, which facilitate contacts with their clients/partners and the extent to which they are integrated into national/international networks, sectoral technological platforms, science / technology parks, open innovation platforms, clusters/competitiveness poles, as support tools for improving performance in the field of technology/knowledge transfer.

The identification of the main field of activity of an R&D institute (according to the Government decision establishing it) is very important because it is the only main activity object according to current legal regulations, representing a significant percentage (over 50%) of the institute's overall activity.

The 81 respondents chose the division with the CAEN code 72 Research and Development, which includes three types of research and development: fundamental research, which involves experimental or theoretical activities primarily aimed at acquiring new knowledge about observable phenomena without a specific application or use in mind; applied research, which consists of original investigations and research conducted to gain new knowledge primarily directed towards a practical or specific objective; and experimental development, which involves systematic activities based on existing knowledge acquired through research and/or practical experience, aimed at producing new materials, products, and facilities, developing new procedures, systems, and services, as well as substantially improving existing ones. The research and experimental development activities in this division are further subdivided into two categories: social sciences and humanities, and natural sciences and engineering.

The three types of research and development (fundamental, applied, and experimental development) conducted by the R&D institute are prioritized in the RDI Strategy and serve as a source for frontier and interdisciplinary research.

From the participants' responses, the following were noted: 78 respondents declared the subdivision with the CAEN code 7219 Research and development in other natural sciences and engineering. This class includes experimental research and development in natural sciences and engineering other than biotechnological research and development: research and development in natural sciences; research and development in engineering and technology; research and development in medical sciences; research and development in agricultural sciences; interdisciplinary research and development predominantly in natural sciences and engineering. 1 respondent declared the CAEN code 7220 Research and development in social sciences and humanities. This class includes research and development in social sciences; research and development in humanities; interdisciplinary research and development predominantly in social sciences and humanities. 2 respondents declared the CAEN code 7310 Research and development services in physical and natural sciences (including 6 codes related to experimental development and research activities in the field of physical and natural sciences).

These CAEN subdivisions indicate that research and development activities are carried out in the field of technology transfer and towards smart specialization directions (which are open to any scientific discipline) for all potential sectors of Romania or based on its major societal challenges.

3. Secondary Fields of Activity

According to the available data, respondents have identified 61 secondary fields of activity for the R&D Institute (specifying a maximum of 5 CAEN code options).

The secondary field of activity represents any other activities carried out by the R&D Institute in areas where it has expertise. These activities produce goods or services, and there is no limitation in legislation regarding the number of secondary objects of activity. The authorized secondary objects of activity are discussed, in accordance with the organization and functioning regulation of the R&D Institute, approved by a Government decision and registered with the Trade Register. These activities include technical and professional tasks, including management, consulting, design, and specific training, provided on the basis of research contracts or service agreements. These activities facilitate the transfer of knowledge from the research and development field and indicate the extent to which third parties are involved in research and development and/or technical support activities.

Examples of the scope of the CAEN code for secondary activities belong to the following fields: manufacturing industry, code 3320-2042 (18 activities, ranked 1st); professional, scientific, and technical activities, code 7490-7022 (12 activities, ranked 2nd); agriculture, forestry, and fishing sector, code 1102-121 (6 activities, ranked 3rd); information technology service activities, code 6311-6201 (5 activities, ranked 4th); education activities, code 8560-8532 (3 activities, ranked 5th); waste management and decontamination activities, code 3822-3700; support service activities, code 8299-8230; publishing activities, code 5814-5811 (2 activities, ranked 6th); construction, code 4321; other service activities, code 9412 (1 activity, ranked 7th).

In conclusion, the R&D Institute carries out a variety of secondary objects of activity, which represent less than 50% of the total activities conducted, but they have a significant contribution to the turnover.

4. The Scientific Field of R&D Institute

Regarding the scientific field of the R&D Institute, participants had the opportunity to provide multiple responses regarding the field of expertise in which their activity takes place, according to the list specifying the domains/subdomains of smart specialization and health, based on criteria related to competence, ongoing contracts, collaborations, etc.

Table 1: Centalization of responses regarding the field of expertise of the R&D Institute

The field of expertise of R&D Institute	Responses	% of the total
Bioeconomy (including 4 subdomains)	108	36,6
Information and communication technologiesm space, and security (including 3 subdomains)	37	12,6
Energy, environment, and climate change (including 3 subdomains)	65	22
Eco-nano-technologies and advanced materials (including 4 subdomains)	59	20
Health (including 11 subdomains)	26	8,8
Total	**295**	**100**

From the participants' responses, it is evident that the R&D Institute is oriented towards multiple complementary domains. The options expressed by participants regarding the field in which the R&D Institute operates have provided the basis for their prioritization as follows: bioeconomy - highlighting the potential of the agri-food industry, biomass valorization, and biofuels; energy, environment, and climate change - aiming to reduce the country's energy dependence, diversify resources, and protect the environment; eco-nano-technologies and advanced materials - focusing on activities dedicated to eco-technologies to preserve the properties of water/air/soil, develop nanotechnology or materials-related fields. Almost all R&D Institutes have materials research as their main field of activity; information and communication technologies, space, and security - aiming to develop specific applications in the field of security culture (regional/local, societal, combating threats, etc.); health - a

domain with a significant impact on the use of public resources to improve the quality of life, population health, and indirectly influencing the economic perspectives of society.

5. Technology Transfer Entity (TTE) within the Structure of the R&D Institute, Member of ReNITT

According to the respondents' answers, the R&D Institute houses a total of 87 Technology Transfer Entities (TTEs), categorized as follows: Technology Transfer Centers (TTC) -48 (23 provisionally authorized/25 accredited); Technological Information Centers (TIC)-15(10 provisionally authorized/5 accredited); Industry Liaison Offices (ILO)-10 (7 provisionally authorized / 3 accredited); Technological and Business Incubators (TBI)-14(6 provisionally authorized/8 accredited).

The Technology Transfer Centers (accredited / provisionally authorized) are the most numerous, accounting for 55% of the total. Technological Information Centers (accredited / provisionally authorized) are in second place with 17%, followed closely by Business Incubators (accredited / provisionally authorized) with 16%. Industry Liaison Offices (accredited / provisionally authorized) are the least represented, with 12%.

In conclusion, it is worth noting that the three categories of Technology Transfer Entities (TTC, TIC, and ILO) are organized within the scope of the R&D Institute and serve as a support for the economy by promoting technology transfer to meet the needs of accessible beneficiaries in domestic and international markets. On the other hand, the main focus of Business Incubators (BI) is on business incubation, with a lesser emphasis on technological incubation.

6. Technology Transfer Entity (TTE) with Specialized Personnel in Promoting and Commercializing Research Results

As a general rule, TTEs can be described as structures with a small number of dedicated technical and administrative personnel. The majority of respondents stated that the existing TTEs within the R&D Institute have specialized personnel (49 respondents, representing 60.5%), with a diverse range of professions, including innovation managers, marketing managers, intellectual property advisors, and technology brokers.

The R&D Institute is not hesitant in hosting TTEs with specialized personnel for promoting and commercializing research results. The differentiating factor lies in the mix of specializations within the TTEs' staff. The breakdown of personnel specializations within the TTEs is as follows: 34 innovation managers (69.4%, 1st place), 19 technology brokers (38.8%, 2nd place), 24 intellectual property advisors (49.0%, 3rd place), 33 marketing managers (67.3%, 4th place), and 14 individuals with other specializations in promoting and commercializing research results (28.6%, 5th place).

7. Technology Transfer Entity (TTE) within the R&D Institute, a member of European/ international networks

The identification of European/ international networks in which R&D Institutes are integrated or have common interests, as well as the need for involvement in the decision-making process at this level, has been pursued. Only 24 respondents (30%) stated that the TTE within the R&D Institute is a member of European/international networks.

Across all 47 R&D Institutes, there is a very low participation/anchoring of the TTE to the declared 14 European/ international networks (13 out of 14 declared networks).

All TTE entities within the R&D Institute are accredited by ReNITT. Regarding the declaration of membership in the National Innovation and Technology Transfer Network (ReNITT), this is a trademark of the Ministry of Research and Innovation, but it does not have legal personality and is not integrated into a European-level technology transfer network. However, some innovation and technology transfer entities, as members of ReNITT, are part of other international associative structures, namely the Romanian Association for Technology Transfer (ARoTT), which aims to promote and protect the business environment of technology transfer entities (incubators, parks, etc.) and innovative businesses in Romania by consolidating the technological base and innovation. ARoTT is a member of the largest European support network for small and medium-sized enterprises, the Enterprise Europe Network (EEN).

On the other hand, the Enterprise Europe Network (EEN) helps businesses innovate and grow internationally and includes the following categories of member organizations: technology poles, innovation support organizations, universities and research institutes, regional development organizations, chambers of commerce and industry. Additionally, the High-Energy Physics Technology Transfer Network (HEPTech) is a technology transfer network in the field of high-energy physics, encouraged by CERN, composed of institutions active in nuclear physics with the mission to enhance the transfer of technology from fundamental research in physics to society, and its program is aligned with the guidelines of the European Strategy for Particle Physics.

The other nominations made by respondents represent technological platforms (European Nanoelectronics Initiative Advisory Council ENIAC, The European Technology Platform on Smart Systems Integration EPoSS, The European Technology Platform Photonics).

In conclusion, there is a very low participation in European/international technology transfer networks, which results in a weak promotion of experience/ information exchange regarding R&D, discouragement of partnership building for accessing European funds for R&D, and non-participation in public debates on the development of innovation capacity and innovation management at this level.

8. Membership in a Sectorial Technological Platform

Only 21 respondents (25.92%) declared membership in a sectoral technological platform, as follows: Animal Task Force, The European Technology Platform on Smart Systems Integration (EPoSS), European Photovoltaic Technology Platform, Technological Platform for Mechatronics, Integronics and Adaptronics (Mecatron), the European Integrating Technology and Innovation Platform on Nanotechnology (NANOfutures), ETP Fibres Textiles Clothing, Sustainable Chemistry (SusChem), European

Nanoelectronics Initiative Advisory Council (ENIAC), European Technology Platform for Micro- and Nano Manufacturing (MINAM), High-Energy Physics Technology Transfer Network (HEPTECH), European Hydrogen and Fuel Cell Platform - FCH2JU.

European technological platforms represent knowledge networks that have an increased capacity to use/exploit existing knowledge resources more efficiently than if these resources were exploited separately by each owner. There is a significant number of European technological platforms that INCD has joined, in fact representing their adherence to the themes of the working agendas for research programs of strategic interest for Europe. Each platform has a theme of interest/ problems to be solved, with a wide range of topics of interest to INCD as relevant institutions in Romania. Therefore, INCD does not show reluctance in terms of membership in a sectoral technological platform and even expresses its interest in participating as much as possible in the activities carried out within these forms of collaboration in areas of maximum interest at EU level.

9. Membership in a Science / Technologica Park

The respondents did not provide a response to this question, and therefore we cannot deduce that there is no direct collaboration between INCD and innovative SMEs in various economic sectors within these parks.

10. Membership in an Open Innovation Platform/Open Source Platform

Only 11 respondents (13.58%) declared membership in an open innovation platform / open source platform, which is created through a private initiative of a company/research center. Through this open source platform, important/key actors from outside are invited to contribute to the development of new applications. This is a specific collaboration service for sectors with higher costs, such as ITC (software and hardware), energy (smart energy grids), aerospace.

The main open innovation platforms / open source platforms mentioned by the respondents are as follows: Clean Sky, IMT-MINAFAB (IMT Centre for MIcro and NAno FABrication), ARCGIS, ECO INOVARE, EIDA, European Technology Platform Manufuture, EUROP-EUropean RObotics Technology Platform.

11. Membership in a Cluster

Only 49 respondents (60.49%) declared membership in 45 clusters in various development domains, with 13 clusters being labeled as follows: 8 bronze label (MECHATREC Strategic Innovative Cluster, Bio Danubius, RoHealth, bioROne, ETREC Innovative Cluster, Agri-Bio-Tech Start Innovation, Energy Management and Sustainable Development Innovative Cluster, Agr Transilvania Cluster); 4 silver label (IND-AGRO-POL, Agro Transilvania Mobilier Transilvan, DOROT HY Urban Logistics, Romanian Textile Concept); 1 gold label (Mobilier Transilvan Cluster).

From the information presented in the annual reports of INCD, we found that only 8 INCDs have created a cluster within their structure (namely IFIN-HH, INFLPR, INCDMTM, INCAS, ECOIND, INCDFM, INMA, INCDTIM) which aims to facilitate access to funds for the creation and development of clusters, as well as to promote their technology transfer activities. Additionally, several INCDs (INCDTP, IFIN-HH, INFLPR, INCDFP, IMT, URBAN-INCERC, INSB, INCDTIM, INOE, ICECHIM, GEOECOMAR, INCDM) are members of clusters in various domains of interest for the economy, such as information technology and telecommunications, agriculture and food industry, textiles, and machinery construction. These collaborations serve a common purpose or lay the foundation for long-term partnerships. This highlights the fact that INCDs are aware of the collaboration opportunities that membership in such associations can generate, primarily due to the legislative efforts undertaken by the Romanian government to create and develop clusters.

Furthermore, it stimulates knowledge and technology transfer in key areas for Romania, which can have an impact on the national economy. It also allows access to the organizational facilities of INCDs, contributing to the growth of the regional/national economy. Moreover, this wide diversity of INCDs that are members of such association initiatives enables a connection with strategies for territorial and community development. The cluster market in Romania is currently entering a new evolutionary stage, with approximately 79 clusters and competitiveness poles being registered in the records of the Ministry of Economy. Therefore, INCDs can represent a generator of innovative solutions applicable to the real needs of members in these clusters, which are internationally evaluated by the European Cluster Analysis Secretariat.

12. Generating the Establishment of Start-up/Spin-off Companies

The respondents did not provide an answer to this question, although some INCDs have established and operate start-up/spin-off companies, according to the annual activity reports of the INCDs. Publicly available information reflects the existence of approximately 41 spin-offs/start-ups created in Romania as a priority for promoting investments in R&D, developing connections and synergies between businesses, research and development centers, and higher education.

Furthermore, through the start-up/spin-off establishment and funding program, the level of regulation of knowledge transfer activities at the national level provides an idea of their development within the SNCDI context. The interface structures of the INCDs have gradually led to an increase in the regulation of technology transfer processes within the POC and PN III programs. These regulations, as well as the funding methods/schemes that appeared later than the establishment of the interface structures, are a response to the need to establish a regulatory framework for the main activities they carry out (intellectual property being the most regulated activity, followed by rules regarding licensing activities and the creation of spin-offs/start-ups).

Moreover, the increase in the number of patents resulting from R&D activities has been determined by the growth of human and financial resources for R&D, as well as the creation and professionalization of interface structures in technology transfer (namely the ETTs).

13. Discussions

The second section of the questionnaire, comprising questions 1-10, refers to the objectives of transferring new knowledge from national research and development institutes (INCDs) to companies/enterprises (degree of integration into national/international TT networks, methods used in knowledge/technology transfer, the role of

implemented innovation strategies within INCDs, the proportion of available technologies in the portfolio according to their TRL and their alignment with smart specialization/public national priority strategies, important factors facilitating knowledge/technology transfer, allocation of public funds for transferring new knowledge), as well as major issues that arise in the knowledge transfer process between national research and development institutes (INCDs) and enterprises. These pieces of information, through their interpretation based on specific functional correlations of technology/knowledge transfer processes, will allow for the evaluation of the perception of members of the R&D community in INCDs and companies regarding the objectives, content, influencing factors, and methods through which the competitiveness of the innovation ecosystem in our country can be enhanced.

For questions 1-8, the responses from scale 4 (to a large extent) were combined with those from scale 5 (to a very large extent) and renamed as scale 4+5 (large + to a very large extent). Participants were invited to choose their responses on a scale ranging from 1 (to a very small extent) to 5 (to a very large extent), with the option of selecting multiple answers. The obtained values clearly indicate that all three objectives are equally appreciated for raising the technological level in companies within the respondents' area of expertise. In the large + to a very large extent category, option b) which aims to intensify partnerships with R&D organizations and similar profiled companies for industrial research and experimental development activities in the company's own interest (34% of responses) ranks first, followed by option c) which involves promoting an innovation culture in the business environment (34% of responses), without neglecting the increase in value added to products/services and the development of their own R&D strategy (32% of responses) which ranks third. This clearly demonstrates that the relationships between INCDs and enterprises are relatively frequent and that the business environment understands innovation, which will lead to an increase in the technological level of enterprises.

The obtained values clearly indicate that respondents appreciate that most of the services provided by the technology transfer entity (TTE) within the national research and development institute (INCD) are integrated into national networks (39% of responses), followed by integration into European/international networks/services (second place) and integration into both national and international networks/services (28% of responses) in third place. The difference between the second and third places is minor, indicating that the vast majority of service categories are active at both national and international levels. Integration into European/international networks in the field of technology transfer will influence the opening of TTE services to the European/international business environment.

Regarding the extent to which new knowledge and research results are transferred to enterprises, the obtained values show that option c) is in first place, as 55% of respondents appreciate that this is achieved through other means due to reporting indicators such as articles, lectures, seminars, workshops, and others. Option a) ranks second, as 38% of respondents consider that these are directly transferred through other means of the INCD (through agreements, contracts, and others, through the INCD's own TTE). Option b) ranks third, as 7% of respondents consider that these are indirectly transferred through an external TTE of the INCD. There is a decrease in the reporting indicators from option a) in favor of those from option c), although it would be desirable for this activity to be carried out through the INCD's own TTE to be effective.

Regarding the ranking of responses regarding the innovation strategy predominantly adopted by the INCD, options a) and b) are tied for first place, with option a) being a proactive strategy aimed at creating high-tech products (28% of respondents) and option b) ensuring continuity in the implementation of new innovative projects (27% of respondents). Option c) ranks third, with a strategy oriented towards gaining competitive advantages (26% of respondents), followed closely by option d), which establishes a business model oriented towards increasing enterprise competitiveness (19% of respondents). It can be concluded that all strategy options are appreciated by respondents, as INCD strategies have these characteristics.

In terms of ranking the responses, the majority of researchers interviewed (73 respondents, which represents 42%) consider that the predominant technologies in the portfolio of national research and development institutes (INCDs) are at TRL 1-3 (first place), which refers to research and development activities through analytical and experimental studies at the laboratory scale. Next, TRL 4-6, which involves validating the laboratory model/prototype/system at a full-scale in a relevant environment under conditions similar to real-world operations, is ranked (63 respondents, which represents 37%). TRL 7-9, which is necessary for demonstrating the functioning of the prototype in a relevant environment for real-world applications or that the technology has reached its final form and can be used under all intended conditions, is ranked very low (36 respondents, which represents 21%). This reflects the fact that the R&D activities initiated by the INCD in technology development, from idea (level 1) to complete product implementation in the market (level 9), are not representative in the sense that the achieved result/progress is far from level (+9), where the product/process/service can be commercially launched/adopted by a group of customers.

Technology is proven to function in its final form and under the intended conditions when it reaches level 8, which in most cases represents the end of true system development. In the specialized literature, it is appreciated that INCDs should have TRL 4-6, and yet we observe that the maturity level is low at laboratory conditions when INCDs should be at the prototype level, indicating the need to increase the maturity level of the technologies developed within the INCDs.

The options unanimously expressed by the participants regarding the factors that greatly facilitate the transfer of R&D results and new knowledge from national research and development institutes (INCDs) to the industry provided the basis for ranking them in descending order.

In terms of ranking the responses, option b) direct collaboration with relevant INCDs in the company's own research for the development of new products/technologies/services ranks first with 76 responses, representing 21%. Option c) INCDs should become more receptive to market needs ranks second with 73 responses, representing 21%. Option a) cooperation should be based on long-term partnerships ranks third with 71 responses, representing 20%. Option e) communication between INCDs and companies should be done through customer-

specific methods ranks fourth with 68 responses, representing 19%. Option d) methods of presenting new knowledge should be adapted to the understanding level of companies ranks last with 66 responses, representing 19%. It can be concluded that the order established for the top three ranks is relatively close to the ranks of 4-5, indicating that the factors are perceived as equally important.

All participants largely or very largely agreed with the following statements: Option d) The state should provide more funding for development and research, with tax incentives, ranks first with 74 responses, representing 16%. Option a) INCDs should be more market-oriented ranks second with 71 responses, representing 15%. Option h) regarding the existence of public funding instruments in strengthening knowledge transfer partnerships (e.g., POC-G program) ranks third with 58 responses, representing 13%. Option k) there are not enough formal and informal contacts between researchers from institutes and specialists from companies ranks fourth with 50 responses, representing 11%. Option c) the new knowledge generated by INCDs is too costly for companies ranks fifth with 36 responses, representing 8%. Option g) cooperation is often established based on personal connections ranks sixth with 35 responses, representing 8%. Option i) these researchers from INCDs are not familiar with the real needs of companies ranks seventh with 33 responses, representing 7%. Option b) INCDs do not sufficiently encourage researchers to focus on applied topics ranks eighth with 29 responses, representing 6%. Continuing the ranking, option e) the attitude of management personnel in companies towards cooperation with INCDs is negative ranks ninth with 27 responses, representing 6%, and option f) there is a lack of coordination among key actors within INCDs ranks tenth with 26 responses, representing 6%. Finally, option j) INCDs are requested/engaged by companies in external procurement procedures for competencies, know-how, etc. ranks eleventh with 20 responses, representing 4%.

From the analysis of the top 3 rankings, the following conclusions can be drawn: INCDs request funding to support R&D activities; INCDs need to be market-oriented to leverage and efficiently use the public funds allocated for R&D; the existence of funding instruments from public funds and European structural funds is important for strengthening knowledge transfer partnerships.

Respondents had the opportunity to choose multiple answers regarding their involvement in specific R&D projects, beneficiaries of support funding mechanisms for economic exploitation in smart specialization areas or public priority areas. From the respondents' answers regarding their participation in specific R&D projects, it can be observed that specific R&D projects have been developed in all smart specialization or public priority areas.

Table 2: Participation in specific R&D projects

Specific R&D projects in smart specialization areas	Responses	% of total
Bioeeconomy	96	17
Information and communication technologies, space and security	133	24
Energy, environment, and climate change	110	20
Eco-nano-technologies and advanced materials	107	20
Health (including pharmaceutical science)	44	8
Heritage and cultural identity	58	11
Total	548	100

It is highlighted that the following areas have recorded the most involvement in specific R&D projects, beneficiaries of support funding mechanisms. In first place is the Information and Communication Technologies, Space and Security domain (24%), followed by a tie between the Energy, Environment, and Climate Change domain and the Eco-nano-technologies and Advanced Materials domain (20% each). In third place is the Bioeconomy domain (17%). The Heritage and Cultural Identity domain ranks fourth (11%), while the Health domain ranks fifth (8%), recording the fewest involvements in projects benefiting from support funding mechanisms.

To answer the ninth question, participants were only allowed to choose 5 out of the 11 statements, resulting in an automatic ranking performed by the Survey Gizmo® specialized platform program.

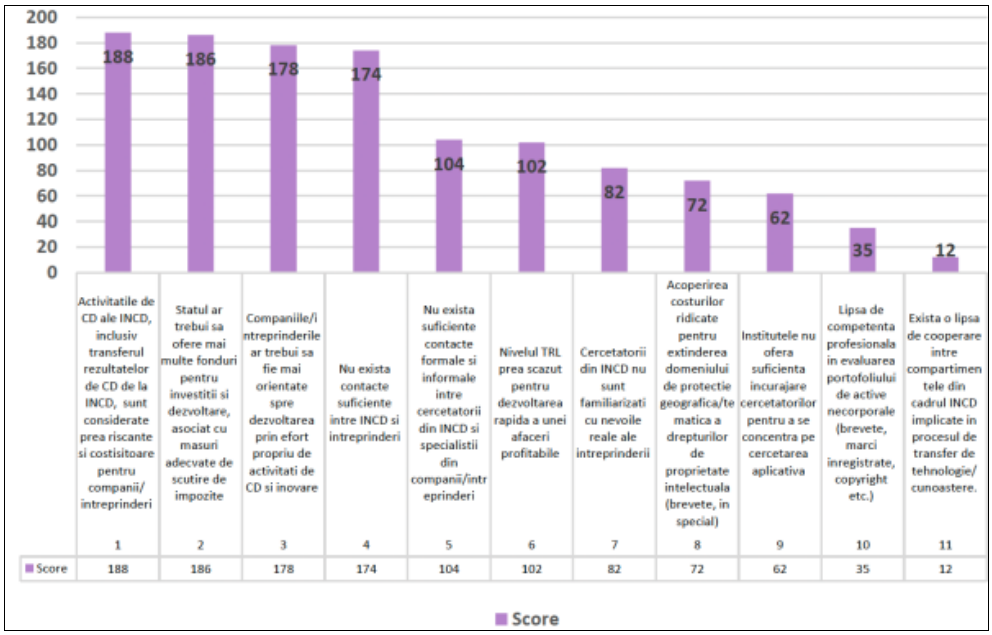

Fig 1: Ranking of major issues un the knowledge transfer process between R&D institutes and enterprises

In terms of ranking the responses, the ranking orders the statements that describe major issues that arise in the knowledge transfer process between R&D institutes and enterprises as follows: 1st place - R&D activities of the institutes, including the transfer of R&D results from the institutes, are considered too risky and costly for companies and enterprises; 2nd place - the state should provide more funds for investment and development associated with appropriate tax relief measures; 3rd place - companies/enterprises should be more oriented towards developing R&D and innovation activities through their own efforts; 4th place - there are not enough contacts between the institutes and the enterprises; 5th place - there are not enough formal and informal contacts between the researchers from the institutes and the specialists from the companies/enterprises; 6th place - the TRL level is too low for the rapid development of a profitable business; 7th place - researchers from the institutes are not familiar with the real needs of the enterprise; 8th place-covering the high costs for expanding the geographic/thematic scope of intellectual property rights (patents, in particular); 9th place-the institutes do not provide enough encouragement for researchers to focus on applied research; 10th place - lack of professional competence in evaluating the portfolio of intangible assets (patents, trademarks, copyrights, etc.); 11th place-there is a lack of cooperation between the departments within the institutes involved in the technology/knowledge transfer process.

In conclusion, it can be said that the major issues that arise in the knowledge transfer process between national research and development institutes and enterprises are determined by the fact that the institutes are not able to familiarize themselves with the real needs of companies/enterprises, and their resources are limited (the TRL level is too low for the rapid development of a profitable business, the high costs for expanding the scope of intellectual property rights, lack of competence in evaluating the portfolio of intangible assets). Therefore, the state must continue to provide innovative financial instruments for R&D institutes so that they are particularly oriented towards development objectives through technology transfer and equally, contribute to ensuring access to funding for enterprises.

The participants' responses to the eighth question focused on proposals to double the eligible cost level of projects for the three categories of expenses from the funds allocated for the transfer and application of R&D results from the European Structural and Investment Funds, as provided for in Article 69(3) of Regulation (EU) No 1303/2013 for each category of expenses. This aid would provide an incentive for the transfer and application of R&D results by reducing the co-financing rate borne by R&D institutes/ enterprises for these categories of expenses (such as action 1.2.3 project type: knowledge transfer-section G of the Competitiveness Operational Program-Priority Axis 1: Research, Technological Development and Innovation (RTDI) in support of economic competitiveness and business development); and encouraging non-R&D performing enterprises to engage in such activities. This means that Article 25 concerning aid for research and development projects in Regulation (EU) No 651/2014 declaring certain categories of aid compatible with the internal market under Articles 107 and 108 of the Treaty needs to be revised. To achieve this, the Intermediate Body of the Ministry of Research and Innovation (which administers the sources on behalf of the state) should notify the Competition Council to modify the existing/granted state aid, which has the role of establishing the conditions under which research aid can be considered necessary and to ensure its extension without distorting the competitive environment.

The proposals put forward by the respondents regarding the three categories of eligible costs indicate a growing interest in demand for applied research and its funding sources. Support mechanisms for R&D activities from the European Structural and Investment Funds are necessary to increase the resources allocated to R&D institutes for enhancing innovation capacity, intensifying R&D activities, and technology absorption by SMEs.

The third section of the questionnaire includes several open-ended questions. Question 11 aims to highlight success stories related to technology/knowledge transfer. Questions 12-13 focus on suggestions for improving the transfer of new knowledge from R&D institutes to the socio-economic environment, to overcome the problems encountered between the involved partners, and the role of the Ministry of Research and Innovation in supporting innovative business development services in R&D institutes. The responses to these questions outline particular aspects, expressed freely by the surveyed R&D personnel, which can complement the current situation and perspectives in the field of technology/knowledge transfer from R&D institutes to the socio-economic environment in our country.

On the other hand, from the responses provided by the participants, it is noted that the nominations made present the diversified service offers of R&D institutes, which aim either to stimulate economic sectors or to exploit their potential advantages. The available service offers of R&D institutes (counseling, expertise services, access to R&D infrastructure, technological information, micro-production, etc.) cannot be considered as evidence of innovative solutions implemented in enterprises, as well as other forms of technology transfer, and not connected to the business environment.

The successful categories of technology transfer services provided by R&D institutes are technology transfer services that have been useful for R&D development or applied to an SME and can be grouped as follows: basic R&D services: research and testing facilities; assistance and consultancy for acquiring new technologies; market studies/analysis/research/forecasts; exploitation of research results; analysis of technological trends; access to databases with R&D and TT offers; facilitation of technology transfer partnerships; regional analysis and information services with added value, based on the specialized/specific advantage of R&D institutes; consultancy in implementing/testing technologies; advanced R&D services: assistance in the field of innovation; cooperation in the development of new products; technological evaluation and audit.

Only 55 respondents have provided recommendations, summarized in the 139 common suggestions for a more successful cooperation between National Research and Development Institutes (NCDIs) and companies/enterprises to overcome the existing problems in the knowledge transfer process from NCDIs to businesses.

All the responses received from researchers working in NCDIs are summarized in the 78 common suggestions on how to support the business development services offered by NCDIs/enterprises to be improved. Based on the analysis of the suggestions received, the respondents believe that

there is a low level of scientific and business collaboration, as well as a weak commercialization of research results. According to them, implementing the mentioned suggestions could contribute to a more efficient and frequent technological transfer of knowledge from NCDIs to enterprises.

The main categories of suggestions regarding the R&D policy field are as follows: a more active role of the state through: allocating resources from the state budget in areas where scientific research and technological development correspond to concrete social needs; predictable and stable public funding for the R&D system; increasing public funding for R&D with a focus on the efficiency of public spending on R&D; mechanisms to attract research investments from the private sector (targeting 1% of GDP); creating investment mechanisms for risky investments in innovation (venture capital fund, business angels); strengthening public responsibility through: professionalization measures for the technological transfer activity in NCDIs (and other innovation-oriented organizations), with the training of specialized human resources in technological transfer activities and the development of commercialization capacity for R&D results; increasing the long-term efficiency of state budget investments by adopting a roadmap for the development of R&D infrastructure in public law organizations; reforming the national research, development, and innovation system; focusing institutional resources; improving public R&D management; increasing the share of funds for R&D to stimulate competition; NCDIs should become more open by: absorbing available EU funds; optimizing the utilization of R&D infrastructure; accelerating the transfer of R&D results; strengthening human capital (career conditions, employment opportunities, and funding/remuneration of researchers); industry innovation should be based on internal technological solutions (as companies do not have innovation departments, the secondment of personnel from NCDIs to SMEs is beneficial); strengthening research and development departments in enterprises: supporting enterprises to launch innovative products/services through venture capital funds, grants, collaborative projects, etc.; encouraging demand from the private sector for R&D activities; improving the business investment climate for innovation; raising awareness among researchers to transfer R&D results.

14. Conclusions

An analysis was carried out to gather sufficient information on the national research-development-innovation system, the support provided for knowledge and technology transfer, the interface infrastructures that provide this TT service, and the context in which this activity takes place. The preliminary analysis to identify the main factors and their degree of influence on the performance of INCD in terms of technological transfer highlighted both strengths (access to multiple sources of funding, diverse R&D results that are applied, permissiveness for collaborative and multidisciplinary research) and a series of weaknesses (disruptions in funding mechanisms, moderate attractiveness of the researcher career, various barriers that do not allow technological transfer to the economy/society).

Technology transfer and innovation pose a series of problems regarding the absorption of knowledge in order to maximize the effects of the knowledge potential managed by INCD. In order to increase competitiveness and improve the efficiency of INCD, it is necessary to adopt/revise decisions in the development of national and institutional policies that reflect the impact of R&D activities funded within public R&D institutions, namely INCD. In this regard, the following are absolutely necessary: reconsideration of R&D policies through: creating a national innovation system (legislative, financial, and institutional); increasing institutional funding capacity from public funds for INCD; creating new research funding mechanisms (innovation funding with venture capital, technology investment with venture capital, mutual funds for innovation investment); increasing R&D activity efficiency through: predictable funding, decentralizing R&D program management, improving institutional management, restructuring evaluator panels, performance appreciation of companies not to be quantified by indicators referring to international recognition of articles; stimulating R&D investments; enterprise program by creating mechanisms for: stimulating R&D activities carried out by the enterprise in order to increase technological capacity; improving company R&D performance (tax incentives, financing industrial activities derived from R&D funded by public funds to favor TT, creating R&D-based businesses funded by public funds); reconsidering the applicable legislation for public-private partnerships and for the research-development field (Law no. 233/2016 on public-private partnership), so as to improve the interface between science and industry (to connect those who conduct research in the public sector and those who can apply R&D results in the private sector); identifying standardized indicators specific to the 7 research areas in SNCDI for evaluating INCD, so as to reduce disparities in allocating funds within institutional research programs (core program/basic and complementary funding program).

15. References

1. Chesbrough HW. Open innovation: The new imperative for creating and profiting from technology. Boston, MA: Harvard Business School Press, 2006.
2. Fulga S, Marin A, Hadăr A, Badea DM, Vlăduț G, Ciocănel B, *et al*. Bussiness models for increasing technological transfer effectivenesss. Annals of the Academy of Romanian Scientists, 2016.
3. Marin A. Modele ale transferului de cunoaștere sau tehnologie din universități către mediul socio-economic. Market Watch. 2017; 192:18-20.