THE IMPLEMENTATION OF THE RESEARCH DEVELOMENT AND INNOVATION PROGRAMS IN ROMANIA

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Abstract: *Starting from the main challenges and growth opportunities of Romania, and also considering the actual context of the social and economic developments, the aim of the paper is to analyse in terms of the research opportunities, the core activities that can be applied in Romania, in order to increase and support sustainable and favourable social inclusion. The analysis will be based on the National plan and the National strategy of the research, development and innovation projects that will also include sets of objectives that have close links for forecasting the results -of the national RDI system. At the same time, this program is supported by the state, which emphasizes the importance of the correct organization of funds in order to create activities necessary for the wellbeing of the society. Therefore, this work will also analyze the strategic orientation of the European Structural and Investment Funds for the period 2014-2020, learning from the lessons of the programming period between 2007-2013, in order to find out the answer to the research question: What are the main sectors in Romania where research development, and innovation projects would be needed as a priority? Following the qualitative analysis carried out by observation and comparison methods, it has been found that there are thirteen main areas that require the priority attention of the research, development, innovation programs, which are divided into two categories: smart specialization and public relevance. First, the field of smart specialization includes: bio-economy; information and communication technology, space and security; energy, environment and climate change; eco-nano-technologies and advanced materials. Secondly, the category of public relevance includes: the field of health; heritage and cultural identity and new and emerging technologies. Consequently, all of the above mentioned aspects are not possible without the stimulation of research and technological innovation programmes. Also through the correct application of the involution processes, using creativity and development-based entrepreneurship, it will be possible to train the population to generate credible program models, eventually this process becoming a lifestyle that will encourage the culture of innovation. Therefore, the purpose of RDI programs is to provide members of the global scientific community with an attractive development environment, involving both young researchers and top researchers from around the world.*

Keywords: *Research; Development; Innovation; National Strategy of RDI; National Plan of.*

JEL Classification: *O21; O31; O32.*

1. Introduction and research methodology

It is well known that today's society is considerably influenced by the existence of the new technologies, which are constantly evolving over time. Consequently, this

modernization process is needed in order to development a proper economic growth and sustain the prosperity of the society.
Moreover, in this current era, the economy and the competitiveness are not only focused on primary production coefficients, such as access to natural resources or cheap labor, but are largely connected to innovation, which is a dominant source of competitive advantage. In this way, it can be understood that innovation has the capacity to obtain profitable services and products, using the maximum resources of the existing technology. (Holzinger A., 2011, p. 27)
This paper will analyze both the ordinance regarding the research-development-innovation activity applied in Romania, as well as the National Plan for Research Innovation Development and the National Strategy for Research Innovation Development, in order to have an overview on the objectives, programs and indicators used for the programs of RDI in Romania.
Between 2007-2013, Romania concluded a cycle of public policies in the sector of research, development, innovation, followed by the beginning of the new cycle of the RDI program in 2014-2020. One of the main tools of the National RDI Plan is the National Strategy for Innovation Development Research 2020. Among the National Plan of the RDI activities, five programs are listed: The first program involves the development of the national research and development system; The second program supports the increasing number of competitivity of the Romanian economy through the RDI plan; The third program refers to the European and International cooperation; The fourth program studies the frontier and fundamental research, and lastly the fifth program is related to research in areas of strategic interests. (National Research and Development Plan 2015-2020, Art. 2, (3)).
The main objectives of the National Plan of research development and innovation III is to support the idea of increasing the competitiveness of the Romanian economy, to increasing the scope of science in society and not lastly to improve the Romanian contribution to the progress of knowledge. Also, it is important to note that the RDI activities will focus on the private and on the public investments that are involved in the priority areas, where Romania already has an existing potential. Through this, specializations such as the branch of economic intelligence, or other activities supporting a specific national interest will be supported. (National Research and Development Plan 2015-2020, Art. 6,(1),(2))
At the same time, it is important to mention that the specialized central public administration body of Romania is the Ministry of Research and Innovation, which fulfills the tasks of the state authority for the R&D sector. This authority has the main responsibilities in: updating, elaborating, stimulating, developing, supporting and monitoring the national strategy of research-development and innovation; coordination of government policies at national level and to conduct certain activities of the research-development-innovation programs. (Ordinance 108, art. 4, p. 4)
As a result, the paper wants to find out the answer to the following research question: What are the main sectors in Romania where research development, and innovation projects would be needed as a priority? To answer the research question, the National Strategy for RDI 2014-2020, will be the basis for the elaboration of the paper, specifying the new strategic cycle needed to be implemented in order to help the development process.

The methodological approach used for this work will be based on academic journals, books and online sources. At the same time, the main sources used in the realization of this article are focused on: The National Plan for Research Development and Innovation for the period 2015-2020 (Decision 583/2015); on the Ordinance regarding the research-development and innovation activity with modifications of normative acts pursuant to art. 108 of the Constitution of Romania, republished, and of art. 1 (X) of Law no. 183/2018 regarding the Government's ability to issue ordinances elaborated by the Government of Romania and not least on the National Strategy for research, development and innovation for the period 2014-2020.

The secondary research method has been chosen in order to provide a well-defined academic framework and to answer the research question, using sources such as ordinances, laws and programs that are closely related to research, development and innovation topic. Also, the qualitative research method is applied, by using the observation and comparison methods that will help to analyze the case studies, regarding the modalities of research, development and innovation programmes.

Therefore, the subjects of the research, development and innovation programs have always been a concern for the developing countries. From the previous literature it can be seen that there were a number of factors that influenced the innovation process.

As the author Dan Voiculescu also stated, in his book entitled The Romanian Economy, there are several types of financing methods used in the Romanian economy, such as: self-financing, financing through the credit market or the capital market, mixed financing or other financing methods. Due to the fact that economies are divided into economies that focus on financing systems through the savings market and the capital market, the banking market is at the base of these models. For example, in the proportion of over 70%, the US economy is financed through the financial market, while in the European economy financing is capitalized using approximately 70% from the banking market. As for Romania, the financing of the economy is achieved through the banking market, because the capital market is well below the necessary level of development. (Voiculescu, 2015, pp. 50-51) Therefore, financing Romania through research, development, innovation programs is another way to increase the welfare of the country, by obtaining funds and expertise from the foreign sector.

At the same time, the author Dorin Isoc, emphasizes the need to raise the Romanian standard in terms of accessing and completing the research and development projects, taking example from the developed states of the world, such as France, Germany or the United States of America, which have proven a broad social and economic involvement. (Isoc, 2007, p. 2)

The structure of the paper is divided into five chapters as follows: the first part presents a short introduction and background to the research, development and innovation programmes by also analysing the research methodology used in order to elaborate the work; the second section is considering the financing process of the RDI programmes in Romania; the third chapter reviews the tools of implementing the National Strategy for the RDI activity, the fourth part examines the results of the

research question and lasty the fifth chapter is concluding the work and suggests improvements for the future.

2. Financing research, development and innovation activities in Romania

Due to the fact that all people have the right to develop research-development-innovation activities, this program has free access to the funds and it represents a guaranteed right, if the conditions of the legal provisions and competences of the persons or institutions applying for these funds are respected. (Ordinance 108, Art. 5, (1) p. 5).
Also, it is important to note that the research-development and innovation activities of the institutions and units within the national RDI system is financed from: the state budget funds; funds coming from international programs and cooperation; funds attracted from the economic agents or other funds according to the law. (Ordinance 108, Art. 40, p. 16)
Accordingly, the amounts allocated by the state budget are used as a priority to help finance the objectives that were agreed in the National Strategy, the Core Program, in the National and Sectoral Plan. (Ordinance 108, Art. 41, (3), p. 17)
Moreover, in order to achieve new objectives of the national interest, it is required to have investment expenditures financed in part or in full by the state budget. These expenditures are included in the draft of the state budget, based on a list of investments, and by also having the opinion of the state authorities for research-development-innovation. (Ordinance 108, Art. 41, (5), p. 17) Therefore, the financing of the research-development and innovation activities from the funds included in the state budget, are carried out in a competitive system, based on the proposed programs and projects. (Ordinance 108, Art. 43, p. 18)
In the table below, the government budget expenditures of Romania for the last 10 years is illustrated, for the research, development and innovation activities, according to the statistics published on the website of the European Commission.

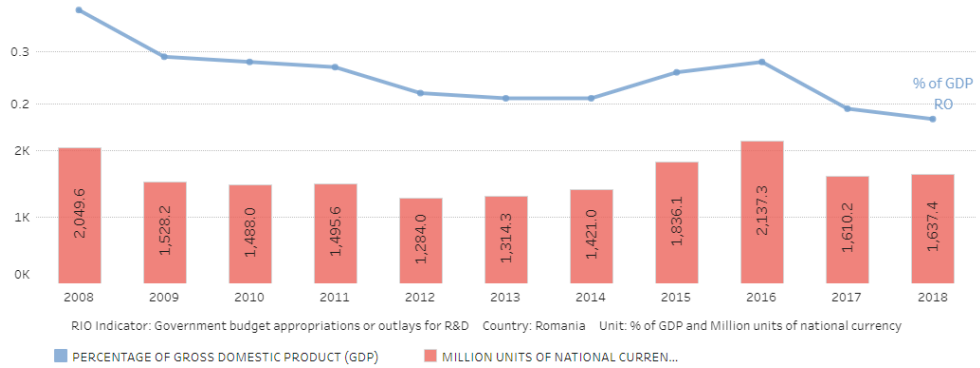

Figure 1: Romania's government budget expenditures for research, development, innovation projects between 2008-2018

Source: European Commission, 2020 Available at https://rio.jrc.ec.europa.eu/stats/government-budget-appropriations-or-outlays-rd-0?GEO_DESC=Romania

From the table above, it can be observed that Romania had approximately the same amounts of funds distributed over the period of 2008-2018. However, in 2016 it could be observed a slight increase of the funds invested, which is due to the fact that at the end of 2016, a number of 44386 employees were involved in developing the field of research and innovation, this number being slightly increased compared to the end of 2015, when 43448 were involved in the same process. Thus, more employees meant more specialist that could visibly develop the RDI activities. (National Institution of Statistics, 2017)
At the same time, in order to financially support research, development and innovation activities, it is necessary to diversify the structure of the financing resources with the massive help of the private sector and capital markets. (Iancu, 2005, p.9) Currently, there is a common implementing regulation for the programming period of 2014-2020 for the European Regional Development Fund (ERDF), the European Social Fund (ESF), the Cohesion Fund (CF), the European Agricultural Fund for Rural Development (EAFRD) and European Fishing and Maritime Fund (EMFF). (Voiculescu, 2015, p. 31)
Therefore, in order to achieve the goals set out in the Europe 2020 Strategy, the new Member States will have priority in obtaining structural funds. At the same time, this allocation of funds will be based on the competitiveness of the countries, menaing that if a country proposes a qualitative portfolio of projects that exceeds the financial allocation initially granted, it may benefit from funds allocated to another country whose program portfolio either does not correspond qualitatively or as a number for the absorption of the allocated budget. Therefore, the financial allocation for the 2014-2020 programming period of Romania is 22904 million euros, being distributed as follows:

- Cohesion Fund - 6935 million euros
- Less developed regions - 15058 million euros
- More developed regions - 441 million euros
- European territorial cooperation / cross-border cooperation 364 million euros
- Youth employment initiatives - 106 million euros. (Voiculescu, 2015, pp. 40-41).

3. Tools for implementing the National Strategy for research, development and innovation

Firstly, based on the National research-development and innovation strategy, the obligations of research, development and innovation institutions, which are financed from public funds, are obliged to: plan their own development plans or strategies, monitor the fulfillment of the objectives set in their own plans, periodically organize examinations both on the financial-economic activity and on the performance management and annually report to the state authority the scientific performances

and the results of research-development-innovation results. (Ordinance 108, Art. 32, p. 14)
Secondly, the implementation of the National Strategy for Research, Development and Innovation is carried out through: The National Plan for Research-Development and Innovation, the Core Program for Research-Development and Innovation, the Sectoral Plan of Central and Local Public Authorities for Research-Development and Innovation and other research, development and innovation programs, projects or plans. (Ordinance 108, Art. 33 p. 14)
Another important aspect is the fact that on the one hand the national plan, including the necessary financial resources, is administered and elaborated by the state authority, the approval being made by Government decision, and the financing is multi-year, using a competitive system. (Ordinance 108, Art. 36, p. 15)
Annually, the State Authority for research-development and innovation projects draws up proposals for research topics for the Core Programs, with objectives for solving socio-economic problems. (Ordinance 108, Art. 37, (2) p.15)
Therefore, as a target for 2020, the research and development programs was to exceed the reference value registered in 2011, as can be seen in the table below.

Table 1: Achieving the target values of the RDI program for 2020

No.	Indicators	Reference value (year 2011)	Target 2020
1.	Public expenditure on research-development-innovation (% of GDP)	0.31	1.0
2.	The number of doctoral graduates per 1,000 inhabitants aged 25-34	1.4	1.5
3.	Number of public sector researchers (full-time equivalent)	12409	17000
4.	Scientific publications in the top 10% of the most cited publications in the world (% of total scientific publications in the country)	3.8	7
5.	International scientific co-publications (number per 1 million inhabitants)	148	300
6.	Venture capital (% of GDP)	0.033	0.090
7.	Business sector research and development expenditure (% of GDP)	0.17	1.00
8.	Number of researchers in the private sector (full-time equivalent)	3518	14500
9.	Public-private co-publications (no. / 1 million inhabitants)	8.3	16.0
10.	Share of innovative collaborating SMEs (%)	2.93	6.00
11.	EPO patent applications (no. / Year)	40	120
12.	USPTO patent applications (no. / Year)	17	60

Source: National Plan for research, development and innovation 2015-2020, Art. 9.

According to the table above, the value of the indicators that must be increase significantly to reach the target for 2020 compared to 2011 are: the number of

researchers in the public sector; scientific publications in the top of the most cited publications in the world; international scientific publications; the number of researchers in the private sector; public-private co-publications; the share of collaborating innovative SMEs and patent application.
The most difficult target to achieve is the increase in the number of researchers in the private sector, and the easiest target is the number of doctoral graduates per 1,000 inhabitants aged 25-34. Therefore, to achieve these goals, five programs have been implemented, which are the basis for the development of RDI activities, which are listed in the table below.

Table 2: Programs underlying RDI activity

Nr.	Denumire program
1.	Development of the national RDI system for increasing the capacity in resources, performance and quality of RDI activities
2.	Increasing the competitiveness of the Romanian economy through RDI to support the productivity of enterprises and progress on value chains through partnerships between enterprises and public organizations
3.	European and international cooperation - participation in international research programs that facilitate the mobility of researchers, circulation of ideas and knowledge, access to transnational collaboration networks, programs of research institutions that are not available in Romania
4.	Fundamental and frontier research to maintain and develop niche areas where Romanian fundamental research has a comparative advantage and critical mass of researchers or where there is the possibility of international collaboration
5.	Research in areas of strategic interest support program led by institutions with the role of scientific coordination in areas of strategic interest

Source: National Plan for Research, Development and Innovation 2015-2020.

4. Results of the research, development, and innovation activities

Based on the previous chapters, the answer to the research question: What are the main sectors in Romania where research development, and innovation projects would be needed as a priority? will be detailed in the following paragraphs.
First of all, the strategic cycle of 2014-2020, takes into account the shortcomings of the last two decades of the RDI programs, in order to be able to focus on the improved results and to have practically visible impact for the future programmes. Based on previous experience of the national strategy, the optimal development of the research programs should be achieved through strong partnerships for innovation. These partnerships involve long-term coordination following the factors of: securing the resources by planning and approving public budgets; through the environmental predictability of the research, development and innovation activity, this program is enjoying stable rules that can help to increase collaboration; and last but not least, the credibility of public-private partnerships that are aided by private spending on the R&D program, which aims to reach 1% of GDP by 2020. (National Strategy for Research, Development and Innovation 2014-2020, p.7)

At national level, in order to fund research, development and innovation programmes, there is a need to access structural funds, which are based on limited sets of strategic priorities. Therefore, through the National RDI Strategy 2014-2020, the areas in which Romania could significantly contribute to the development of future technologies were identified. Thus, the Research, Development and Innovation Strategy pursues two types of priorities, as described below:

• Smart specialization priority - represents the consolidation and definition of high areas of competences, with a significant comparative advantage to contribute to GDP growth. It is therefore necessary to concentrate resources by mobilizing a mass of researchers in order to penetrate both the regional and global dimensions.

• Public relevance priority - considers the allocation of resources in the sector where technological development and research needs concrete social assistance. These priorities involve increasing the capacity of the public sector to track the space of emerging technologies and to find innovative solutions through research, development and innovation activities. Furthermore, fundamental research retains its importance, being a priority program within the National RDI Strategy 2014-2020 - covering socio-economic and humanities disciplines - also representing a source of interdisciplinary and frontier research. (National Strategy for Research, Development and Innovation 2014-2020, p.7)

Secondly, the priority research areas were established following the organization of a broad consultative process, which defined an extended participatory procedure, being structured in the following essential steps:

1. The first step was the selection of a set of strategic domain and priority subdomain, based on the consultation of a large panel of experts which were also based on empirical evidence. This process also included important criteria for smart specialization, such as: capitalizing on the social and economic potential of the research and development results; capitalizing on proven scientific performance; and lastly capitalizing on Romania's strategic development interests. This process was designed to be future-oriented, taking into account the new regional and global trends, societal challenges, emerging technologies, and the behavior of different economic agents. Also, this stage was based on a first consultation of the online environment with a number of 28,000 experts, who were represented by guests and stakeholders, who completed a total number of 1322 questionnaires on the 13 distinct areas.
2. The second stage was about the exploration of the 13 candidate areas. These areas involved the formation of a panel of specialists for each strategic specialization, to discuss according to a grid of criterias, the needs and the research potentials of the programmes.

   A major tool used in this process was the so-called "knowledge map", which represented the central component of the exploration process. This map was based on the objective evidence of the relationships of the main economic operators. Also, the organization of the knowledge map was primarily based on the relationship and the processing of over 6,000 databases of all projects funded in Romania in the 2007-2013 cycle; secondly, the use of approximately 100,000 publications by Romanian authors; and last but not least, the use of 7,000 patents granted to over half a million of companies.

3. The third stage was the selection of the main list of the priority areas. This stage was based on an extensive consultation of the online environment, based on an argumentative procedure. The survey also aimed to rank the 13 candidate areas, in order to establish the final set of priority areas for research, development and innovation programmes for the period of 2014-2020. (National Strategy for Research, Development and Innovation 2014-2020, p.8)

Finally, the answer to the research question in relation to the areas that requires priority involvement of the research, innovation and development programs is divided into two areas: the category of smart specialization and the category of public relevance. First of all, the field of intelligent specialization includes: Bioeconomy; Information and communication technology, space and security; energy, environment and climate change; eco-nano-technologies and advanced materials. Secondly, the category with public relevance includes: the field of health; heritage and cultural identity and new and emerging technologies.

The first category smart specialization is supporting the economic behaviour besides the importance of the technological and social impact of science the in relevant sectors. This specialization presupposes a dynamic style, which can be characterized by the continuous collection and analysis of data both for national and regional level. From the point of view of the intelligent specialization, the bio-economy benefits from a great potential of Romanian agriculture, in order to create a local food industry and to activate and grow standards. This field is especially developing the main pharmaceutical industry's products, food industry outcomes, animal husbandry, fisheries and horticulture. Concerning the information-communication technology area, and space-security area, both are supported and expertised by raising the higher level education and the academic research for this relevant discipline. This area also focuses on the use of software and the calculation of several performances. Regarding the space applications, this field can be dedicated or integrated based on space technologies and infrastructures in order to be able to use their own and international spaces. The security of society is supported by the expansion of products, technologies and research capabilities for a systematic system of local and regional security, cyber security, emergency management for counter-terrorism, cross-border threats, illegal trafficking and security crises. The field of energy, environment and climate change, are responsible for the reduction of Romania's energy dependence, with the help of the higher recovery fossil fuels and by diversifying national resources such as nuclear or renewable resources. And last but not least, the field of eco-nano-technologies and advanced materials are part of the TGE (Essential Generic Technologies) category, which is helping Romania's automotive industry. (National Strategy for Research, Development and Innovation 2014-2020, pp. 17-18)

With regards to the second category of innovative solutions concerning the public sector, this category of health represents a critical area in terms of quality of life; Thus, this category of heritage and cultural identity promotes the language habits of each member country and last but not least the field of the new and emerging technologies has the role of supporting the economy by solving specific problems in order to feed public needs.

5. Conclusions

Aiming to capitalize on the research potential, both state authorities and ministries work together to ensure partnerships between academies, research units, institutions and education. This can be achieved by organizing joint research and development innovation teams, regardless of the form of organization.
At the same time, the technical assistance program is encouraged, which involves direct collaboration between research, development and innovation institutions and economic agents that use the results of RDI programs. (Art. 57, (3) pp. 24-25)
The advantages of the research-development and innovation projects can make major contributions in both the private and public sectors, by playing an important social and economic role, being an essential service provider, regulator and potential future employer.
The disadvantages that may occur during the research, development and innovation projects are the possibility of market failure, but the state accepts this risk. This may be due to the fact that the generated goods are mainly public, which also involves the process of exploring the unknown, which also implies an inherent risk of not achieving the proposed objectives or hypotheses. Instead, these shortcomings will be observed during the evaluation and monitoring of the ongoing programs. (Art. 64, p.28)
Therefore, a possible solution to address the above-mentioned disadvantage is to turn to an advisory body to support the state authorities for research, development and innovation activity. This advisory body could be the Consultative College for Research-Development and Innovation, being the main specialized consultant of the state authority. This college is made up of researchers, teachers and other specialists whose role is to provide scientific support at the national level in establishing the strategies and policies needed for the research, development and innovation programs. Other similar bodies that could help the RDI process are: the National Council for Scientific Research, the National Council for Ethics in Scientific Research, the Technological Development and Innovation, the Romanian Committee for Research Infrastructures and the National Council for Technology Transfer and Innovation.
Although the international standards for the research, development and innovation industries are well structured at European level, Romania does not have yet the necessary number of researchers to meet the country's domestic needs. Moreover, the European Commission also debated Romania's main challenges in terms of its low competitiveness. The data indicate a limitation in the marketing capacity of Romanian research, development and innovation results. Therefore, in response to the challenge mentioned above, the National Strategy suggests the formation of an innovation ecosystem through public-public and public-private partnerships. (European Commission, 2013, p. 226)
Another problem is the decrease of the researchers in the field of individual businesses, and the large number of multinational companies with subsidiaries in Romania, are reluctant to set up local research centers. It has also been observed that the private sector has limited access to public infrastructure, and as a result the

use of these facilities is declining. Therefore, the research, development and innovation sector in Romania is undersized due to the fact that the demand for RDI activity is not sufficiently stimulated. Thus, as a possible solution the business environment and the general public must be connected in order to develop the economic and social situation of the country. (National Strategy for Research, Development and Innovation 2014-2020, p.6)

As a recommendation for the future, there is a need for professionals in public organizations in order to ensure technology transfer and to facilitate knowledge of public-private partnerships. This recommendation would be beneficial, as research, development and innovation organizations do not have adequate teams to realize the research potential in the best possible way. Therefore, it is necessary to specialize the staff in order to achieve the technology transfer by focusing on human resource training. Also, the development of the fields of doctoral schools by allocating some increased shares of resources to intelligent specialization, will increase the resources necessary for the development of the economic environment.

Nevertheless, in order to create stronger collaborations at international level, Romania must consider increasing their participation in projects such as: Horizon 2020 Framework, supporting participation in European initiatives by collaborating with European Union programs in "twinning" or "teaming" projects. For this process, it is also necessary to attract young people to science and not only; being necessary the scientific literacy of the population of all ages.

As a prediction for the future, even more research, development and innovation projects will be needed, because this generation requires more exploitation, which is why research will be one of the most important tasks of society. (Jain, Triandis and Weick, 2010, p. 20)

In conclusion, this paper demonstrated that the purpose of the research, development and innovation program was to create the right conditions to ensure the growth and competitiveness of the Romanian research system. (Galsworthy and McKee, 2013)

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