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ABSTRACT OF

DOCTORAL THESIS

FUNDING OF RESEARCH AND DEVELOPMENT IN ROMANIA

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INTRODUCTION

In the course of evolution, humans had to be creative and innovative, as they needed to improve living conditions, as well as to survive. For this, they had to appropriately use their resources of materials, energy, time and labor. Thus, for satisfying some practical needs, humans had to discover and develop certain areas of science. Astronomy appeared as a response to the needs of agriculture, arithmetic was requested by the needs of accountancy and trade, geometry – to make measurements in constructions, mechanics from the need to facilitate labor and to increase yields, etc. Science and technology have steadily progressed over time, either with great accumulations, or with smaller steps, contributing to the development of human civilization.

In the course of the development of human society, great changes have occurred, at certain time intervals, which resulted in a progressive leap. Thus, the stopping of migration and the people's settlement on geographical spots was considered a first revolution, also due to the fact that they worked the fields where they had settled, producing a revolution in agriculture. The second great transformation was the industrial revolution, which had the deepest impact on human society and which was determined by the invention of the steam engine by J. Watt in 1788. This fact resulted in the construction of increasingly powerful machines, the introduction of mechanization in production processes, the involvement of an increasingly larger number of workers and specialists, the increase in production and productivity. (Hall B.H. & Lerner J., 2010).

The new scientific and technical revolution profoundly influenced the Current Era, an era characterized by rapid changes in technology, through the expansion of automations, as well as through the rapid processing and transmission of information. From households to the outer space, affecting all areas of life, sciences and technologies develop at an astounding pace. Some previously set laws can be contradicted by new scientific discoveries, such as the indivisibility of the atom, the theory of the species, etc. The period between a scientific discovery and its practical application is thus reduced. (Plumb I. *et al*., 2007)

An effective economic development requires a continuous modernization process. This entails that nations, as they develop, they progress both from the point of view of their competitive advantage and in terms of ways of enhancing this advantage. In the current era, competiveness and economy do not solely rely on primary inputs, such as cheap labor, or access to natural resources or investments, but rely more and more on innovation, as a dominant source of the competitive advantage, namely on the ability to achieve innovative products and services to the full extent of technology, by using the most advanced methods. (Holzinger A., 2011)

In the 21st century, one can speak of a knowledge-based economy, which is a broader concept, integrating innovation, the information society, as well as human capital. This requires:

- increased use of intelligent systems to assist managers in rapidly making important decisions;
- the drastic change in the ratio between the number of employees working in creating information and those working in the manufacture of goods, significantly increasing the number of those in the first category;
- information becoming a commodity, due to its value and coding, being exchanged / sold in some markets,
- complex and continuous professional training, so that, in the future, a person will have to possess not only the know-how, meaning physical, psychological and mental abilities (education, training, work power, stress resistance), but also the know-what (knowledge of information, facts, phenomena), as well as the know-why (understanding of the phenomena) and the know-who (the ability to interact with people holding information);
- downward trend in the life of the products;
- cheaper products, so that they will become more competitive, with a lifespan set less by the materials they're composed of, and more by marketing strategies;
- the technical progress will include all activities, which means that they will become increasingly efficient;
- most of the products on the market will incorporate intelligent technology (microcomputers, mobile communication systems, multimedia systems etc.);
- the disappearance of the human component in routine activities, so that the products will directly ,,communicate" amongst themselves. (Wetter J.J., 2011)

A society's level of development plays a decisive role in the performance of the education and research system, in the citizens' level of education, ensures the quality of the products of research activities, as well as equitable access for all potential users of this system's services and products.

For achieving the integration of higher education and scientific research in the European space, there must be an acceleration of the Romanian higher education and scientific research process, in relation to the objectives of the European Union, for ensuring the quality and visibility of the Romanian research-development-innovation system The requirements for the integration of Romania's higher education and scientific research in the European space impose moving to a new qualitative stage in the reform of higher education and research.

Research Objectives

The required objectives contribute to the in-depth investigation of the contribution of national and foreign programmes to funding research and development, as well as the implications of this funding on the national economy.

The overall objective of our scientific approach is to identify and present the optimal funding solutions for research and development which will ensure, under the current economical and financial context, the effectiveness of its activity and, through it, the achievement of sustainable economic development.

By using an appropriate methodology of scientific research in a systematic approach, we considered the following specific objectives:

- determining research and development's role and place in the economy;
- reflecting the permanent connections between the information from research and development and implementing its results in the economy;
- emphasizing the contribution of information from research and development in terms of efficiency indicators.
- resenting the main methods and sources of funding for research and development;
- presenting analysis, studies and examples for each of the presented methods of funding;
- presenting a case study whose results emphasize the importance and efficiency of research and development;

- ❖ drawing conclusions and proposals based on the results of the conducted scientific research.

The Romanian research system includes over 700 bodies governed by public law and private law, carrying out research and development activities, 73 accredited universities, of which 55 public ande18 private, 38 national research and development institutes, 327 public institutions subordinated to the Ministry Education, Research, Innovation, Youth and Sports and other ministries, to the Romanian Academy and other specialized academies, as well as over 270 private or state-owned joint stock companies, having research and development as their main activity. (MEC-ANCS, 2006)

Scientific Research Methodology

Any scientific research implicitly involves the combined application of a number of research techniques and procedures, through which the researcher tries to achieve the maximum amount of conclusions, starting from previous researches, complementing with their own experiences and results, for formulating a final conclusion on the analyzed subject. Thus, the very etymology of the Greek word *metodos (road, path)* and *logos (science)* guides us to the same thing. Many times, however, although these methods and techniques are well determined at the beginning of the research process, it is possible that throughout the research they might require changing, under the influence of external factors which may require adopting new study methods or waiving some already adopted ones.

Any efficient research involves the use of acting methods driving the though process, favoring the understanding of concepts and ideas, as well as methods determining the achievement of critical reflections and value judgments.

Throughout time, scientific research has been a debate point in many studies, but analyzing these researches we could conclude that each research process contains several essential stages, to truly contribute to the theoretical progress and to facilitate a better understanding of the phenomena studied by both the specialists in the field and the general public. Thus, the essential elements of the research activity are: the field of research, the purpose of the research, the manner of approach (research methods) and the results of the research.

By using the classical tools of scientific research, based on ***analysis*** and ***synthesis***, to which we added and used to a great extent the ***comparison study***, we performed

substantial and pertinent analysis and studies regarding the mains sources of funding for research and development at both national and international level.

The research results are presented using tables, figures and charts. The theoretical information that formed the basis of the scientific approach has been taken from literature and specialized papers (books, studies, papers, articles etc.) from the field of study, both from domestic and foreign sources.

From the outset, the present study was intended to be a **qualitative research**. Throughout the research, it became more obvious that we needed to expand it with elements of **quantitative** research, meant to grant greater relevance to the findings of the research, and, at the same time, to eliminate subjective factors. The theme of the present paper can be analyzed from several angles. To better comprehend the diversity of all the directions that can be associated with the research and development activity it is however, necessary to have proper knowledge of the concept, its provenance and utility, both in theory and especially in practice.

The motivation and the importance of the research

The motivation behind the choice of this research subject has a double justification. On the one hand, the arguments exposed in our scientific approach regarding the importance of research and development, particularly emphasizing the current context of harmonization within the European Union, and on the other hand, the great importance to be given to its funding, which has lately taken several steps to achieve convergence to the international provisions, especially through the EU's 1^{st}-7^{th} Framework Programmes for funding. We would also like to mention that, for improving the funding conditions for these activities, it is necessary for the information relating to the research to be real, complete, comparative and relevant.

Synthesis of the paper

Chapter 1, **"Scientific knowledge and research – their place in economy"**, presents a chronology of common knowledge from its appearance, which subsequently derived in scientific knowledge, at the time when it came to be focused on a specific scientific field, and from scientific knowledge we took a step forward toward scientific research. When it occurs, the level of knowledge achieved by people is elevated, so that them, through their

activities, have patented inventions and have made both technical and economical innovations in various fields. We have also presented the development stages of a scientific paper, and the results of the research are delivered as research reports or sent to a publishing house for publication as a monograph, journal articles, or to a scientific event, or reach the office for inventions for recognition as a patent.

Chapter 2, **„Particulars of organizing research and development activities in Romania"**analyzes the current state of the Romanian research system, for the three main directions of this activity (academic, universitiesand research institutes), an organizational structure of the research and development activities, the structure of expenditures in research, both current and capital expenses. It also specifies the possible consequences of research funding cuts, several proposals which could increase the value of the research funding, and last, but not least, a SWOT analysis of the research activity. The research continued with the presentation of existing discrepancies between the allocations of funds for research from 2008 until 2012, and these discrepancies were also the basis for the variations in research and development personnel in 2008-2012 in this field, as well as the differences in the structure of expenditure by sources of funding and performance sectors. Part of the data presented in this chapter was also used in econometric study in 5.

In chapter 3, **"Funding programmes for research-development activities"**, the investigations were directed toward a synthesis of national programmes for research funding, the value of budget allocations for this activity in 2003-2012 and the current national programmes for research funding (PNCDI II, the Core Programme and the sectoral programmes) as internal sources of funding, together with the characteristics of these programs. In the final part of the chapter, we presented a series of empirical research studies funded by national programmes, as well as the main funding programmes initiated by the European Union (the 7th Framework Programme, the structural funds, Europe 2020 and Horizon 2020) together with their characteristics and objectives, the allocation of research funds and several series of empirical research studies funded by EU programmes.

Chapter 4, **"Funding of research and development activities in the private sector. Case study",** aims to present the main private sources of funding for research and development, specific to companies that also have research activities, which can e internal or external. The internal sources are those aimed at maintaining or increasing their corporate assets and the external sources include, among other sources of funding, bank

loans, bonds, issues of securities, etc. This chapter also analyzes the main external sources of funding in other EU and US countries, sources of funding which are also available in Romania. Also, with a comparative study, we researched the research funding in 5 European major manufacturers of building materials, study which sought to emphasize the funding allocated by them to research under the conditions of the outburst of the economic crisis in late 2008.

Chapter 5, **„Funding research and development activities under an investment project and under a publicly funded project.Case study”**, investigates the funding for research and development in two projects funded from different sources: a research project funded from structural funds and a research project funded from the budget. The research project funded from structural funds managed to equip a laboratory with equipment and facilities used for tests and which could also be used in other research projects. At the same time, for this project, for emphasizing the need to equip the laboratory with the said equipment and facilities, we used the scenario method for calculating certain economic indicators in the five possible scenarios. The second research project was founded from the state budged, under the Core Programme, and subsequently, in the final part of the chapter, we made a comparative analysis between the two research projects. The chapter also includes an econometric study aimed at liaising the value of the GDP to the research and development expenditure, the number of researchers and the number of institutions performing research and development activities.

The personal contribution, in addition to the processing of data and information collected and received, was more significant in the chapter presenting research funding from private sources, which includes a case study on research funding in five of the major manufacturers of building materials in Europe. Also, we made a proposal for funding research activities, namely for the Romanian state to set up a venture capital fund which would finance research projects benefiting the Romanian state, such as the production of artificial blood. We do believe that once patented, this invention could earn the Romanian state significant royalties, which could be used for funding other research project which could generate income for the Romanian state.

CHAPTER 1
SCIENTIFIC KNOWLEDGE AND RESEARCH - THEIR PLACE IN ECONOMIC DEVELOPMENT

Scientific research is inextricably linked to scientific knowledge.Science and research are both characterized by a certain pattern of thought which exceeds the stage of mere passive observation. Scientific thinking "asks" or "asks questions" and gives "answers" according to certain methodical rules, focusing its point of view on a certain project which thus becomes a research subject. This way, it makes the transition from passive observation to the epistemic statement which originated in dialectics. The data obtained from scientific research is gradually structured, in areas of differentially specialized knowledge and logically ordered, synthesizing a certain category of projects or topics that have a common source, related features, and expresses universally valid truths within scientific knowledge. The result is that the field of scientific knowledge should begin by ordering the projects and their classification.

„Knowledge" and „discovery" have thus laid the foundation of scientific research, as well as the future fields of science. There are stages which build through evolution the history of knowledge and scientific research: the emotional stage, which produced faith, the rational stage, which produced philosophy, and the experimental stage, which produced science itself. (Banal-Estanol A. & Macho-Stadler I., 2010)

The depersonalization of scientific research is a phenomenon that occurs and becomes more accentuated in recent decades. It consists of the transfer of research from the person – the discoverer or scientific researcher – to the group of researchers, namely the groups of specialists employed in a certain field of scientific research. The institute, the center, the laboratory – as research institutions – base their scientific research activities on groups of specialists, with a strictly thematized activity, carried out in planned stages, with clearly defined objectives. The depersonalization of research grants wide open access to knowledge and training, expanding work opportunities, accelerating the pace of discoveries and their immediate practical use. (Gheorghe I. Gh., 2008)

Knowledge is generated by research and discovery. All knowledge is carried out by means of mechanisms which involve multiple functions.

For a field to be considered a "field of knowledge", it must satisfy the following conditions:

- to have a definite object of study or knowledge;
- to contain its own methodology, specific to that field, and to use it for operating the scientific knowledge of the researched project;
- to have its own, specific scientific language, which should be able to express the baggage of knowledge in that scientific field, in an explicit and intelligible manner;
- to have a theoretical purpose, which it pursues and explain, as well as a practical use;
- to comprehensibly interact with other fields of scientific knowledge, having the capacity to establish logical relations with other sciences;
- to create a field of specific knowledge, with their own unique, well determined and supported by facts profile, with its own laws; to be able to create a system of theoretical knowledge a scientific theory or a scientific field which would have scientific truth value;
- to comprehensibly interact with other fields of scientific knowledge, in order to create new, superior fields of synthetic scientific knowledge, with a broader and deeper knowledge horizon;
- to be intelligible, logically organized, after a certain system of values; to accept changes, novelty, to be continuously enriched and to be, in its turn, a creator of new practical values, knowledge and skills;
- to create a system of didactic information-training or a pedagogic system concerning certain projects, phenomena, etc. with teaching role, achieving, for this purpose, an act of training specialists in that scientific field;
- to comply with principles, laws, its own rules, allowing them to guide it and to express its internal relations, but, at the same time, the logical order of that field of knowledge;
- to have the ability to develop a useful practical activity starting from its theoretical knowledge;
- to be accessible, open, permissible to the new and to progress, allowing growth and development;
- to have the ability to construct a theoretical model which would reproduce the project of that scientific knowledge. (Brownyn H.H., 2002)

Scientific research is a systematic and creative activity, aimed at increasing the volume of knowledge, including knowledge about humankind, nature, culture, and using this knowledge for new applications.

The concept of scientific research is also known and used nowadays as research and development (in brief, R&D). (Chiesa V. *et al*., 2004)

Research, development and innovation are the drive of economic and social development for all countries. The common concern of all countries for science and research is a recognition of their role in providing human wellbeing and civilization.(Plumb I. *et al*., 2007)

Scientific research is an important factor contributing to economic and social development and a promoter of social and economic progress; science and technology are basic components of modern life and directly support states in reaching their economic and social goals, for the purpose of achieving sustainable development.

Research and development take the following main forms:

1. **fundamental research** is an experimental or theoretical activity initiated, first, for accumulating new knowledge on the fundamental aspects of observable phenomena and facts, without considering a particular or specific application;
2. **applicative research** corresponds to innovation; it is aimed at acquiring new knowledge with practical application; it is, thus, an activity oriented towards practical and specific purposes: creating new products, processes or services or significantly improving the existing ones;
3. **development research** (experimental) is a systematic activity, which uses the existing knowledge accumulated by research and/or practical experience for the purpose of manufacturing mew materials, products or devices, introducing new procedures, systems or services or significantly improving the existing ones. (Miles I., 2007)

CHAPTER 2
PARTICULARS OF ORGANIZING RESEARCH AND DEVELOPMENT ACTIVITIES IN ROMANIA

Currently, Romania has three priority systems of research, development and innovation:

- the academic system (the Romanian Academy and the specialized academies);
- the system of public institutions (subordinated to/coordinated by ministries);

- the university system.(Văcărel, I *et al.*, 2006)

The current national system of research, development and innovation also has several other structures with research, development and innovation activities, such as:

- state-owned companies, coming from former specialized institutes;
- private-owned companies;
- private foundations and associations.(Văcărel I. *et al.*, 2006)

The existing Romanian research, development and innovation (RDI) system is not capable to ensure the promotion of industrial development, due to several weaknesses, of which the most important ones are:

- extremely low RDI expenditure, compared to other industrialized countries,
- the total or near-total absence of research and development in companies, which is, basically, the main factor of innovation,
- the fragmentation of RDI in the public sector and its insufficient orientation toward the needs of the industrial sector;
- the weakness of the publicly funded RDI institutes;
- the excessive priority granted by some of these institutes to fundamental research, to the expense of applicative research, the fragmentation of scientific research, causing effects to the structuring of non-specific funding methods for universities and academic sectors;
- the attitude and mentality of the researchers in these institutes, who are more concerned with their career perspectives than with the needs of the national industry;
- the lack of appropriate RDI incentives;
- the poor management of the research funds (equipments, scientific events, exhibitions),
- the superficial capitalization of the RDI results;
- the precarious equipment of the RDI activities;
- the lack of a periodical analysis of the real correlation between the needs of the Romanian society and the priority programmes, as a research direction within PNCDI, which would increase the share of priority projects to be granted by public tender, especially for the ones with community interest (e.g. drinking water, wastewater, waste management, air and soil pollution, energy, health);
- discouraging inventions by applying excessive charges in relation to the inventors' incomes; in excellence projects tenders, evaluation criteria inconsistent with the

proposed goal and with the options of the specialized professional associations. (Radu M., 2009)

The goal of the reform of the national research, development and innovation system is to restructure the connections between science, technology economy and civil society, allowing the market to decide the primary distribution of the research, development and innovation resources and to accelerate the marketing of the scientific and technological results.

The objectives of the reform of the national research, development and innovation system are:

I. Changing the organizational structure of the national research, development and innovation system: one solution could be to reinstate the NASR.
II. Transitioning research, development and innovation from the traditional (faulty) model to the emergent model, which appeals to transdisciplinarity and strategic relevance.
III. Multiplying the sources of funding for research, development and innovation and improving the system of funding: finding new sources of funding and better involvement of the private sector in funding research, development and innovation.
IV. Changing the management system in research, development and innovation institutions.
V. Stimulating the creation and functioning of new research organization (publicly or privately funded).
VI. Changing the system evaluating the results of the research.
VII. Improving the communication and dissemination system for the results of the research.
VIII. Stopping the flow of migration / immigration of research, development and innovation specialists. (Radu, M., 2009)

The change of the organizational structure of the national research, development and innovation system is based on a structured vision, which simplifies the components of the system, efficiently correlates them and ensures reduced expenses s.

The Sectoral Operational Programme "Increasing Economic Competitiveness" (hereinafter called POS CCE) is the main tool for achieving the new thematic priority of the National Strategic Reference Framework (NSRF) – namely the long-term increase of Romania's economic competitiveness, priority arising from the National Development

Plan. At the same time, POS CCE more or less contributes to the implementation of all other thematic and territorial priorities of the NSRF.

Despite the progress achieved in the privatization, efficiency and regulation of the financial sector, companies' access to capital still remains limited. Moreover, the use of some high-consuming, outdated technologies and equipments drastically reduces productivity in most economic sectors.

This is why the increase of competitiveness should not be seen as a short-term capitalization of the advantages (for example, the reduced cost of labor), but rather as a process of constructing a new economic structure based on capital investments and on research, development and innovation. In other words, articulating a medium and long-termed convergence perspective and the successful integration of the Romanian market should consider the development of a knowledge-based economy (www.fonduri-ue.ro).

The SME sector is the most affected, due to relatively poor orientation towards productive activities, reduced access to capital, technology and infrastructure, adaptability to the market needs through innovation and due to the low level of managerial skills. The low level of complexity and the domestic market's low purchasing power do not advocate for certification, affecting the companies' capacity to adapt to the standards imposed by EU integration and to the competition caused by globalization.

One of the disastrous consequences of the outburst of the economical crisis in Romania was the decrease of the allocations for research and development. Unfortunately, after 1989, research was a real Cinderella in Romanian economy in terms of budget allocations, because this vital sector has been marginalized by the government.

The State Budget presented by the Romanian governments was not always very generous with research. Several times, in budget revisions, funds have been cut from research and allocated to other economic fields.

Under these conditions, the relevant ministry reconsidered its priorities, acting in three directions:

i) Granting priority to honoring commitments under international collaborations, by fully funding the projects implemented witin international research and development programmes and institutions (e.g.: the R & D Framework Programme of the EU for 2007-2013, the EURATOM programme; participation in projects carried out at CERN and DUBNA).

ii) Maintaining the research capacity of national institutes and supporting core programs, with a budget increased by about 30% over the previous year, for the purpose of maintaining the research personnel, including by fully honoring contracts aimed at reintegrating young researchers who conducted specialized training courses abroad.

iii) Suspending the launch of new competitions under national research and development programmes.

CHAPTER 3
FUNING PROGRAMMES FOR RESEARCH AND DEVELOPMENT ACTIVITIES

The Romanian research and development during the last two decades could be considered a real "Cinderella" of the national economy, because it was either granted insufficient fund, or, when it received higher funds, important amounts were cut in budget revisions.
The first funding system for research and development, not for institutions, was only introduced in 1997, and was called the National Plan for Research, Development and Innovation. After that, the new programme was "Horizon 2000", extended until 2002.
The National Plan for Research, Development and Innovation comprised 14 complex programmes, of which 4 were issued at the beginning of the plan and 10 were issued in 2001, grouped by two major development objectives: one for the economic support through research and one for the development of new technologies, biotechnologies and the informational society. The programmes for research and development and stimulation of innovation were:

- *The Economic Recovery Programme through Research and Innovation -RELANSIN*, which was mainly aimed at the recovery of economic units, groups of categories of units by implementing integrated projects covering both the research and development process and the achievement of the investment necessary for obtaining the expected economic results.(www.ancs.ro)
- *The Quality and Standardization Program -CALIST*, mainly aimed at increasing Romania's capacity to manufacture safe, high-quality products, in accordance with international and especially European Union standards, as well as ensuring the correct application of Community requirements in the Single Market, the ones relating to the free movement of goods, services and people.
- *The Consolidation of Standardization Infrastructures Programme*, which was mainly aimed at developing the national standardization in accordance with international principles and practices designed to eliminate barriers to trade, especially with the ones in the EU, meant to promote the free movement of goods, as well as creating the premises

necessary for the national standardization body to become a full member of the European Committee for Standardization. (www.ancs.ro)

- *The International Cooperation and Partnership Programme -CORINT*, which supported international partnerships, as well as the support measures, the integration of the Romanian scientific and technological community in the International, and especially European Community, by increasing the level of excellence, harmonizing the national trends in the development of the scientific and technological potential with the international trends and the increase of the efficiency and effectiveness of research, development and innovation, by acquiring modern techniques for research and its management. 2001 marked the launch of the ten previously mentioned programmes, which, together with the other ongoing ones, completed the governmental objectives of achieving favorable effects for Romania's development and facilitating its social and economic integration in the regional and Euro-Atlantic structures. These newly-launched programmes were:

- *Agriculture and Food – AGRAL*, which aimed at rendering scientific substantiation and elaborating solutions, technologies, equipments for the sustainable development of the food and agriculture production, achieving food security, improving the quality of life and sustainable rural development in Romania.

- *Environment, Energy and Resources – MENER*, which aimed at supporting the growth of economic competitiveness and sustainable economic growth by protecting, capitalizing and rationally exploiting the Romanian environment and natural capital, increasing the efficiency of the entire chain of production and energy exploitation and integration of the energy sector in the EU standards, geological environment protection and rational exploitation of mineral resources; providing the scientific and technological support necessary for nuclear energy production, in compliance with the nuclear safety requirements and developing the nuclear techniques in Romania.(www.ancs.ro)

- *Spatial planning and transport – AMTRANS*, which aimed to create a balanced management of the Romanian territory, in order to improve living conditions, the responsible use of basic resources and meeting the quality requirements regarding the functionality, safety, comfort and conditions specific for various works of construction, urbanism and spatial planning; the development of a efficient, safe and clean transport system for passengers and goods, ensuring the interconnection and interoperability of transport networks and designing, performing and managing the infrastructures in such

manner as to reduce damages to the environment and to increase the quality/price ratio.(www.mlpat.ro)

- *Life and health – VIASAN*, which was aimed at promoting and supporting basic, strategic and applied medical research for understanding human disease mechanism, treating pathological afflictions and preventing high impact diseases in the population.
- *Stimulating the application of inventions – INVENT*, which intended to stimulate the rapid economic capitalization of inventions, especially those in advanced technical fields.(www.ancs.ro)
- *Information Society – INFOSOC*, aimed to systematically analyze, stimulate and favor the large and coherent development of the information society in Romania, within the general trend of evolution to the society based on knowledge and communications, as well as in correlation with Romania's medium-term national economic development strategy, the national informatization strategy and with the provisions of EU documents concerning "e-Europe".
- *Biotechnologies – BIOTECH*, aimed at socially and economically modifying, developing and capitalizing the potential of living systems through specific modern technologies, for obtaining new products and services.
- *New materials, micro and nanotechnologies – MATNANTECH*, which was aimed at exploiting the existing potential in known materials and developing new materials and technologies for micro and nanostructures and integrated microsystems, new technology for product manufacture, high precision systems, instruments and equipment.
- *Aeronautics and space technologies– AEROSPAȚIAL*, which aimed to develop basic and applicative research and aeronautics and space technologies and to develop the social and economic applications in telecommunications, medicine, agriculture, forestry, environment, geology, meteorology and other social and economic areas.(www.ancs.ro)
- *Basic research of socio-economic and cultural interest – CERES*, which aimed to broaden the ability for knowledge and for generating new scientifical and technical information (in various fields of science and technology), to open new lines of research or for to continue and deepen the existing ones, to ensure a vanguard role to the Romanian science; foundation and support of sustainable development policies and strategies of the country in economically, socially and for the EU integration; the development, protection and enhancement of the cultural heritage in the perspective of a multinational and multicultural Europe.

In addition to these programs, it is worth mentioning the Excellence in Research Programme (CEEX), which made possible the renewal of the research infrastructure, in truth, to a lesser extent, but at least a small part of the research infrastructure, purchased in 1960 and 1970, and made its replacement possible. (www.ancs.ro)

The National Plan is the main instrument for the implementation of the National Strategy. It was approved by Government Decision nr. 475/2007, legislative act setting out the rules and principles of implementation, the composing programmes, the investment model and the budget – 15 billion lei for 2007-2013, the monitoring procedure, as well as the evaluation and impact indicators.

With the launch of this research funding programme, the "research and development" (R&D) terminology will be replaced with the "research, development and innovation" (RDI) terminology, as the funding programmes will also include innovation. The National Plan for Research, Development and Innovation for 2007-2013, hereinafter called – The National Plan II – NP II is the main instrument the National Authority for Scientific Research (NASR) uses to implement the National Strategy for research, development and innovation. (www.ancs.ro)

The conception of the NP II, took into account the national research, development and innovation system's role of developing science and technology by increasing economic competitiveness, improving social quality and enhancing the knowledge with potential for exploitation and broadening the horizon of action.

Core Programs are regulated by HG no. 137/2003 regarding scientific research, and the methods of contracting, funding, monitoring and evaluation of these programmes are regulated by the Methodological Norm no. 6/2003. This norm regulates the fact that these programmes are approved by the state authority for research and development, namely the National Authority for Scientific Research (art. 11). These norms also provide a 30% down payment of the payments expected to be carried out under the programme (art. 16), but in recent years, this down payment is more and more frequently required at 90%.

Although this norm also stipulates that the amount of funding from the budget may not exceed 50% of the revenues that the research and development activity generates, there were changes within the legislation and, at this time, the amount of funding from the budget can reach up to 75% of the revenues that the research and development activity generates.

The Research and Development Sectoral Plan is an instrument through which the central and local public administrations as well as the branch academies accomplish the research policy which they coordinate. These programs are funded through sources intended for scientific research from the state budget. These sectoral plan funds are accessible only to establishments or institutions belonging to that specific sector. It`s important to note that the allocation of sectoral plan projects can be also made through auctions, based on the "expression of interest" that may be submitted by a single participant or a group (associated consortium of participating, natural or legal persons who act as partners in the project) and in the case of legal persons, participation must be within the categories of businesses or institutions accredited for this purpose. (Şimandan, M, 2010)

On November 30th, 2011 the European Commission presented a package of measures to stimulate research, innovation and competitiveness in Europe. Thus, the Horizon 2020 investment in research and innovation program was launched, with a budget of over 80 billion Euros.

This funding program for research and innovation is the successor of the FP7 program but will not be called FP8. On the other hand, this program brings together, for the first time, all EU research and innovation funding and will focus on the transformation of scientific discoveries into innovative products and services that provide business opportunities and seeks to improve people's lives. The allocation of funds will be made within an operational program called Operational Program of Competitiveness. 1.329 billion Euros were allocated to Romania through this program for the period 2014-2020.

The Seventh Framework Program for Research and Technological Development (FP7) is the European Union's main instrument for funding research in Europe. FP7, which was applied between 2007 and 2013, naturally follows the Sixth Framework Program (FP6) and is the result of years of consultation with the scientific community, research institutions and policy making institutions which collaborate with other interested stakeholders.

Since their launch in 1984, the Framework Programs played a lead role in multidisciplinary research and cooperative activities in Europe and beyond (see chart budgets). FP7 continues that task, and is both larger and more comprehensive than earlier Framework Programs. Operating from 2007 to 2013, the program had a 53.2 billion Euros budget over its seven-year progress. This represents the largest funding allocation, for such programs, to this day.

Funding the research and development activity is provided, for Structural Funds, under the Program for Increasing Economic Competitiveness (POSCCE) Priority Axis 2, and for lesser values funding was made through Priority Axes 1 and 3.

The degree of structural funds absorption registered an upward slope from a value of 3.52% at the end of 2008 to a value of 17.5% at the end of 2013. Even if this represents a more than 5 time increase, Romania still remains the second lowest among European Union countries at absorption of funds level. The amount allocated to Romania for the period 2007-2013 was of 19,213,000 Euros[1]. But, even with al the efforts to access these funds, until the end of 2015 the degree of absorption would reach to 60%-70%, a low rate compared to Poland, which accessed all structural funds, thus achieving a 100% absorption rate.

Because of the joining of more states to the European Union creating common policies to ensure the development of the EU has become increasingly necessary. Thus common policies have been written in fields such as agriculture, trade, fishing, taxation, justice, internal affairs, etc.

The European Union`s research policy is part of a broader policy of this European construct, namely "Science and Technology". This broader policy gave birth to policies in the field of information Society concerning the audiovisual and media branches, space, life sciences and biotechnology (M. Taylor, 2011).

The reason for a research and innovation policy is to meet two needs: first, the need to coordinate the activity of Member States in terms of increasing efficiency and reducing costs, and second the need to strengthen the international competitiveness of the European economy. Also, through research and development the economy grows and creates new jobs and by innovating technology social problems such as poverty, certain diseases and environmental degradation can be fought respectively diminished.[2]

Horizon 2020 is a key pillar of the flagship initiative "a Union of Innovation", part of the larger Europe 2020 strategy, aimed at increasing European competitiveness globally. The European Union is a world leader in terms of technological advancements, but faces increasingly fierce competition from both traditional powers and the emerging economies. The Commission proposal will be discussed by the Council and the European Parliament for adoption by the end of 2013.

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[1] www.fonduri-ue.ro

[2] http://www.euractiv.eu/uniunea-europeana/articles/Politicile-Uniunii-Europene.htm

Funding provided by Horizon 2020 program will be more easily accessible because it provides a simpler structure, a single set of rules and less bureaucracy. How will Horizon 2020 work: the reimbursement will be considerably simplified by introducing a single flat rate for indirect costs and only two funding rates - for research and market activities, a single point of access for participants, less paperwork for preparing proposals and abandoning all unnecessary controls and audits. A key objective is to reduce the time between the request and receiving the grant funding by 100 days, on average, which means that projects can be initiated earlier.

As part of Horizon 2020, the EIT will play an important role by bringing the best higher education institutions, research centers and businesses together to create the entrepreneurs of tomorrow and to ensure that the European "knowledge triangle" rises to the level of the best in the world. The Commission has decided to significantly increase its support for the EIT by proposing a 2.8 billion Euros budget for the period 2014-2020 (compared to 309 million Euros since its launch in 2008). EIT is based on the innovative concept of a cross-border public-private partnership platform called Knowledge and Innovation Communities (KIC). To the three existing KICs, focused on sustainable energy (KIC InnoEnerfy), climate change (Climate KIC) and information and communication society (EIT ICT Labs) six new KICs will be added between 2014 and 2020.

The funds allocated to the European Research Council (ERC) will be increased by 77%, thus reaching 13.2 billion Euros. The ERC supports the most talented and creative scientists in Europe to achieve innovative research of the highest quality, in a program that is recognized and respected internationally.

CHAPTER 4
FUNDING OF RESEARCH AND DEVELOPMENT ACTIVITIES IN THE PRIVATE SECTOR
CASE STUDY

For a company to achieve its fundamental strategic objective, which is to maximize its market value, it has to perform activities that will generate profit and ensure a satisfactory profitableness, for both short and long term. This requires obtaining sufficient profit to distribute dividends but, simultaneously, also to reinvest a portion of these profits in development.

Since the beginning of its operations, a company needs an initial capital that is established either directly in the form of financial contributions, or indirectly through contribution of assets in kind. The share capital, constituted when the company was founded, will be used either for conducting current activities and / or for investments. Also, the social capital is the main guarantee of the company in relation to creditors to whom it will appeal for funding necessary to undertake their activities.

Along with carrying out its activities but especially for extending them, a business needs to increase capital through both endogenous and exogenous sources of funding. The main endogenous sources are self-financing, the transfer of assets and disinvestment. These funding sources are through their nature long term because they emphasize capitalizing part of the net profit as well as amortization which compensates for the physical and moral usages of company assets.

The capital of a company can increase itself by using exogenous sources, which can be long-term sources, such as issuing shares, contributions in kind, incorporation of reserves, the payment of dividends in shares, bank loans, long-term bond loans, leasing, factoring, and short term sources which most often are short-term bank loans.

Appealing to domestic sources of financing is less risky for a company but can cause dissatisfaction among the shareholders because they have to choose between dividends and growth when they decide how to distribute the net profit, which means that they have to decide between an immediate and certain gain (dividends) or a future but uncertain gain (resulting from the reinvestment of profits). There is also the possibility that the yield obtained from the distribution of dividends to be lower that the yield obtained from raising capital, but the decision depends on the investor's aversion to risk. If the shareholder prefers a less risky investment, he is willing to sacrifice a higher gain and chooses the distribution of dividends. The dissatisfaction of shareholders eager for an immediately gain, combined with a lack of internal sources of funding, determines the company to resort to external funding sources. The main difference between the two methods of financing comes from the deductibility of expenses with the interest from taxable profits, resulting in fiscal savings from debt. However this only happens if the company is profitable. Also, in case of bankruptcy, the creditors will be paid before the shareholders, whether they own common or preference shares.

In the case of exogenous sources of financing, choosing between one of these methods must cover both the perspective of business interests and the prospective of investors (shareholders, creditors). Often this choice is difficult because the apparent advantages of

one of these sources could, in fact, prove to be nonexistent when performing a more complex analysis. For example, the use of funding through an equity issue may seem advantageous, especially for the management team, which can retain the flexibility of a future loan, thus also avoiding an increase in the cost of the loan. The company must take into account the position of the former, more conservative, shareholders who chose this company for its stability and reliability and, moreover, to decide the desired framing of the new issue of shares within a class of shares, because, in this way, their control position, that they held until then, may be affected.

Internal financing or self-financing is the oldest method of financing which ensures all companies the renewal of their productive potential both in order to preserve and to increase their patrimony through economic growth. The importance of this financing method increases when a company has no access or limited access to capital from the money or capital market. Some companies, especially small, medium or new companies, depend exclusively on internal funding as the cost of borrowed capital is high so they avoid getting into debt. But for companies that have a good financial standing, having large cash flows (profit), domestic funding is a basic alternative for funding. (Pirtea, M. et al., 2010)

During the course of its activity a company funding needs. If funding cannot be provided from domestic sources then the company needs to resort to external sources. One way to ensure funding is to apply for a bank loan.

In this context, commercial banks play the role of an active partner for companies, regardless of their form of organization. Thus banks can see, when it`s appropriate, if a company needs funding, and so, preventing the emergence of phenomena that would create risks for a company. However, in order for the banks to intervene and offer loans, companies need to operate cost-effectively, they need to be adaptable to market conditions and, if necessary, they need be able to restructure their activities at any time.

Given these characteristics of the companies, it is estimated that banks have a unique or special role in comparison with other companies in the financial sector and the importance of this role is given by their main functions:

- a more efficient allocation of available funds by lending within the real economy;
- monetary transfers between businesses, because of an appropriate monetary policy of the central bank;

- insurance over deposit operations for companies and institutions, as a sign of confidence in the stability and liquidity of the banking system etc.

After acquiring a transfer of financial nature, the beneficiary of these resources has the obligation to return them in the future and to pay a tax for the right to utilize them. Thus we could argue that in these cases transfer of financial nature occurs which generates changes o the patrimony of the partners. This transfer has a temporarily and refundable title and generates interest.

The concept of "credit" is addressed both legally and economically in scientific literature. From a legal standpoint, a credit is defined as an agreement between creditors and debtors, which serves the production and movement of goods process. From an economic point of view, a credit is defined as the distribution of a part of the gross national product or the national income, in order to satisfy the need for capital.

Credit operations can occur in a wide range, from relationships between people - as simple personal agreements - to formalized transactions that occur on developed monetary and financial markets which are formulated within complex contracts. We could say that the role of the credit in today's economy lies in its contribution to meet certain economic objectives.

CHAPTER 5
FUNDING RESEARCH AND DEVELOPMENT ACTIVITIES UNDER AN INVESTMENT PROJECT AND UNDER A PUBLICLY FUNDED PROJECT
CASE STUDY

The project that is the subject of the case study concerns the modernization of a " research and tests laboratory on high capacity SEISPLAT seismic simulators" and was proposed to be financed from the European Regional Development Fund within the Sectorial Operational Programme - Increase of Economic Competitiveness (SOP - IEC) axis 2 - "Increasing economic competitiveness through research, development and innovation", the area of intervention 2.2. - "Investments in RDI infrastructure and development of administrative capacity", operation 2.2. - "Development of existing R-D infrastructure and creating new infrastructure (laboratories, research centers)" and was carried out between 2008 and 2010.

The intermediate body responsible for the implementation of axis 2 of the SOP - IEC is the Ministry of Education and Research through the National Authority for Scientific Research (NASR).

By implementing the project, the expected investment was made in the Iaşi Branch of the National Institute of Research - Development in Construction and the Economics of Construction, in the research and testing on high capacity seismic simulators laboratory.

The cost of developing the project

Total project value is 34,186,950 lei (9,767,700 Euros).

The costs of equipment and devices necessary for research activities is 69% of the total investment value. The staff will be also trained to use the equipment purchased in November, in the last investment year.

The management of investment activities was made after studying the possibilities, which can often be limited by external factors, such as regulations concerning acquisitions of equipments by auction, accreditation procedures in the field of research, and the time it takes to train personnel in accordance of each equipment used in the newly created space.

Projected operating revenues and expenditures

In addition to the investment costs, the project also generates long term expenses presented staggered in Annex 3 - Rescheduling operating expenses. These costs were based on the past 3 year`s financial and accounting documents of the INCERC, taking into account the national economic situation and market developments relevant to this European level project. Medium and long term expenditures were divided into six categories according to their destination. At the same time, spending growth rates of 1-5 % per year were taken into account, given the general trend of rising prices and tariffs from one year to another for raw materials, materials and services, as reflected by the market developments.

Assessing financial and economic results using the scenario method

An analysis of the economical and financial outcomes to the various changes that may occur in conditions of a market economy was concluded for that investment project. This type of analysis aims to determine how sensitive the future goal will be to certain changes that may occur during its future exploitation.

Among the mentionable components that can change their influence level during a 10 year functioning time of the objective are: changing tariffs, in the sense of increasing them for fuel and electricity, which will influence the yearly operational costs, changing project implementation incomes, especially incomes obtained from other research projects.

However, both a wage growth in leaps and the obsolescence of equipment, which may increase operating costs or reduce demand for some rendered services can have negative influences.

The results of the economic and financial analysis were based on a number of change assumptions for each variable. Thus the values of these variables used for the economic and financial analysis may change and affect the expected situation. Because of this the sensitivity of indicators, updated to the changes in key variables, should be tested.

To study the sensitivity of the project towards these changes, five scenarios were considered under which economic variables are changed, resulting in changes to the economic and financial indicators` values of the investment project.

These scenarios took into account potential variations of the following factors: income from various sources, nominal wages at the institute, branch or the laboratory level and the costs of materials and utilities. Under the circumstances these changes occurred, the above mentioned categories have arguably the biggest impact on the effectiveness of the project, fact provable through a comparative study of the indicators variation, financial rate of return on investment and capital, discounted net revenue, and the cost-benefit ratio.

The name of the project funded through the Core Program is: **"Sustainable solutions concerning the earthquake safety of precast concrete framed structures"**.

The project objective is to determine the seismic safety and protection of constructions.

The following results were expected in order to achieve the objective of this project:

- a new solution to combine elements of precast reinforced and precompressed concrete frames, based on seismic safety criteria and ensuring the sustainability of the structure;
- a new technology to combine elements of precast reinforced and precompressed concrete frames, obtained by implementing not adhering precompression systems with defatted strands;

- providing experimental data to the scientific community regarding testing the behavior of combining elements of prefabricated frames accomplished through not adhering precompression to inelastic cyclic stresses;
- defining sustainable design parameters of prefabricated reinforced and precompressed concrete structures.

The economic model: *The research and development (RD) expenditures* represent an important indicator, that is influenced by many factors. Taking this into account, the first important issue is to highlight the *influence of the economic growth rate (*Δ%GDP*) on the growth of the research and development budget (*Δ%RD*)* during the analyzed timeframe. In this respect, it is necessary to prove that the research and development expenditures are significantly influenced by the GDP dynamics and that the developed model is globally significant. Thus, the Student and Fischer tests were applied.

The calculations showed that the Student ratio, t* = 2,201, is higher than the theoretical value, $t^{\alpha/2}_{n-2}$ = 2,17, which means that the H_0 hypothesis is rejected and the H_1 hypothesis is accepted, i.e. it can be guaranteed with a 95% probability that the research and development expenditure indicator is significantly influenced during the analyzed period, by the national economies growth rate. Thus it appears that the independent variables significantly influencing Δ% RD are: Δ%GDP (x_1), Δ%NP_{CD} (x_3), while the Δ% NICD variable is excluded from the model because the p-value is greater than the accepted value of 0.05.

CONCLUSIONS, PROPOSALS AND PERSONAL CONTRIBUTIONS

It is imperative to stress that scientific research is not a business. However, many official documents give the impression that the main justification for investments in scientific research is the need for new products: as productivity increases, fewer and fewer employees can do the same job and the following question arises: how to give an occupation to the others if you don`t create new industries?

In a sense, the association is correct: there are no new products and industries without research.

In another way, a confusion arises: the reason and usefulness of the research system is not only to create new types of marketable products, but also to create and improve the scientific methods of predicting reality. Thus some side effects of scientific progress are of economic nature, of which, a small part takes the form of creating new industries.

Misinterpretation of the social utility of research, in terms of the collateral commercial effect, may give rise to harmful long-term strategy errors.

After all, it should be explicitly noted that the field of research, development and innovation cannot benefit from foreign loans or EU funds under the form of national grants, as it happens, for example, in agriculture. Exceptions in this regard are the Structural Funds related to this field. Accessing EU funds is only possible through competitive funding programs within the European Community. Thus, it is necessary to stimulate them within the economic entities in order to increase the volume, quality and competitiveness of research, development and innovation activities in Romania, in line with developments and requirements at a European level. Cooperation between businesses, universities and / or institutions specialized in research, development and innovation is necessary, in order to rapidly implement research results into the economy.

In recent years, research institutes have purchased new equipments which are more efficient than the ones owned by domestic enterprises. But the collaboration between these institutes and enterprises cannot be limited to punctual services. It must take into account both product and advanced technology development that can be competitive both nationally and internationally. This is not achievable without a strategic perspective, sustained through public and privet investments. But, out of a European approach perspective, continuing the activities of the INCD is necessary. The INCD carry, in addition to research, commercial services as well, as economic entities in the private sector, even if sometimes the results are not the ones expected.

Of the two case studies analysis, one of which is presented in this paper and the other results in a scientific theorem, we sought to present their approach in terms of profitability (effectiveness), the results being totally different: thus, if in the case of the first research contract one can speak of a 5% profit, in the case of the second research contract, which is a scientific research contract, there is no profit to be made at all.

Although the research activities are so far generally underfunded not everything that was accomplished to this day should be blamed or ignored. Great emphasis was put on maintaining the existing system, i.e. survival of the research activity. For a long time been both research institutes and private economic entities were financed at the same time,

without calling the economic efficiency of the results into question. Also, no institutional restructuring, or at least a review of the research management system, was performed.

However, this can be achieved through control over the research activity, the following these criteria:

- the manner of allocation and use of research funds from the state budget should be made according to the specific entity receiving the funds;
- stimulating the private sector to contribute to the research and development effort;
- qualitative, and not only quantitative, development of the research and development infrastructure;
- stabilizing research structures and their orientation towards competitiveness and efficiency;
- stimulating youth participation in research and development projects.

Personal contributions: processing of data concerning the current research system in Romania, data processing for the case study referring to the research activity undertaken with private funding, a study published in a ISI Thompson ranked journal, processing and analysis of information from various information sources, comparative studies presented within this paper, the econometric model which followed the possibility of linking the Romania's GDP to the value of research and development expenditures, the number of researchers in the field and the number of institutions carrying out research and development activities, as well as interpreting the results obtained in this scientific approach.

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