

HIGHER EDUCATION SYSTEM PREPARES SCIENTIFIC RESEARCHERS?

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Abstract: It has been proven as indubitable the assertion that the progress of human society is unthinkable without the research and development efforts. If for the personnel of design, execution and management, there are higher education structures that prepare engineers, economists, managers etc. to research work, the problem of ensuring with personnel do not seem to be solved. This paper aims to analyze how higher education, especially the technical one, meet the needs of highly specialized training and specific expertise for the comprehensive and noble specific research work. Without claiming an exhaustive treatment of the matter under discussion, the paper is rather a call to quickly find viable solutions. Therefore, considering on the one hand the basic skills required to a „researcher” in the light of researcher job contents, and on the other hand, the existence of dedicated study of the occupation, the content of study programs and especially the analytical programs for the subjects of specialty should be topics of future study.

Keywords: RESEARCHER, SKILLS, HIGER EDUCATION, STUDY PROGRAMS, SYLLABUS

1. Introduction

When we look back at the fundamentally new developments of the past fifty years, we recognize that the “speed” in all a ctivities and domains , as well as the impact, of change have increased quite dramatically. The Greek philosopher Heraklitos once said: “*Change is the only thing in the world which is unchanging.*” It is the result of unprecedented development of science and technology, where a decisive role was played by research activities and researchers in all fields.

We have become part of a dynamic ongoing process only loosely characterized by the term “globalization”, a process that involves the inexorable integration of markets, nation-states, and technologies to a degree never before witnessed, in a way that is enabling individuals, co-operations, and countries to reach around the world further, faster, deeper, and cheaper than ever before. Universities and other research institutions play a decisive role in this battle for the future of our planet. (Moïsi, 2009)

We have been living for far too long on borrowed time and borrowed dimes. We need to get back to work on our country and on our planet. The hour is late, the stakes could not be higher, the project could not be harder, and the pay-off could not be greater. (Friedman, 2009)

Research is not a goal in itself, or “for the sake of art” - unless eventually when responding to a need for knowledge or individual curiosity. Research responds, usually of development needs to place a position as best in competition economic and social need for better, more beautiful, lighter, farther, deeper, cheaper, cleaner , healthier etc.

Science, technology and innovation field is regarding research-development, innovation, patents, technological design and other objects of industrial property which are activities made by specialized units with main activity in research-development, economic and social units having research-development staff, agricultural production and research institutes and stations, higher-education units and university clinics which have research-development structures, non-profit organizations which carried out research-development activity.

2. The research, current status and challenges

The current situation – as seen from a European perspective – is as follows: Though the EU is the world’s largest “producer” of scientific publications as well as graduates, and PhDs, it has been losing ground in the field of basic breakthroughs. And the gap in R&D investments per capita between the EU and the US is steadily increasing. Apart from a few research areas such as astrophysics, space research, nuclear physics, and molecular biology, Europe suffers from an almost total lack of transnational support of basic and strategic research.

With respect to top ranking elite institutions, most European countries find that few or none of their universities appear at the top of such lists. For example in the ranking of the world’s best universities published by QS World University Rankings, the first places are found in US universities (MIT-1 ... California Institute of Technology-5 etc.) and Asia; Europe is present with King’s College London-19, Amsterdam University-55, Cardiff University-122, Erasmus University Rotterdam-126, Politecnico di Milono-187, Twente University-188, State Institute of Moskow-397, University of Tomsk-481, Lobachevski University, University of Belgrade, University of Cluj, University of Sofia, Polytechnic University of Bucharest- all 701+. If we look at the engineering faculty of the top, we see that in the first 400 we find only 10 in Europe and none of its eastern half. What is the reason?

The causes are multiple in number and complex as the contents in large, involving large differences within Chapters: recruitment base, trainings, methods of teaching / learning / assessment, the material, training of teachers, language teaching, number of journal publishing, websites, links with industry, foundations and funding organizations, government financing, the specific organizational culture by governments, universities, doctoral schools, companies etc., material and social gratitude for job of researcher or university professor . This just likes to call them only and not to make an analysis of each factor, which is the objective of this paper.

Current R & D field is mirrored in statistical yearbooks of individual member states. A quick look at the data thrown dry and dull diagrams of such directories we can reveal underlying causes of system but also, and possible future action to stop the decline. In the following, only for Romania, to not make uncomfortable the readers of other nationalities, present diagrams in Figures 1, 2 and 3 that originate from Romanian Statistical Yearbook 2013.

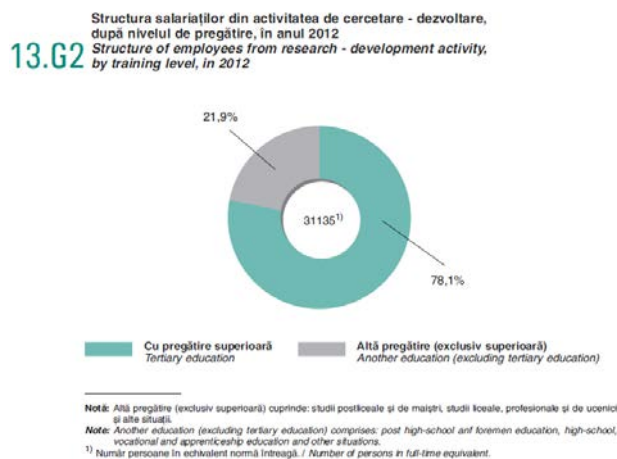


Fig. 1. Structure of employees from R&D activity, by training level in 2012 (Romanian Statistical Yearbook 2013)

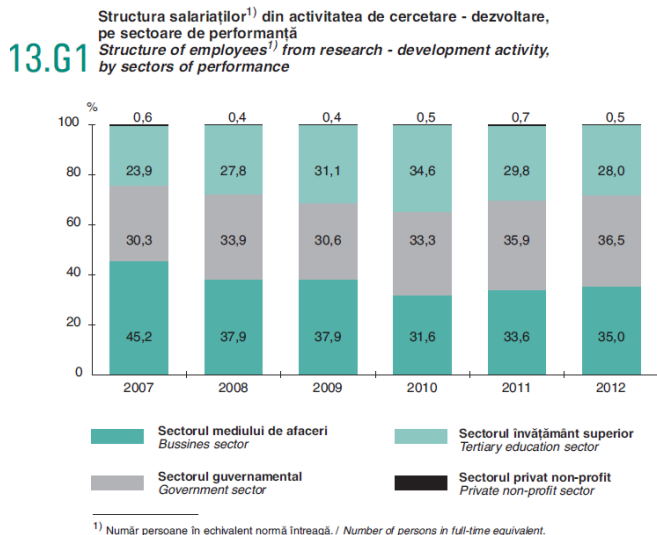


Fig. 2. Structure of employees from R&D activity, by sectors of performance (Romanian Statistical Yearbook 2013)

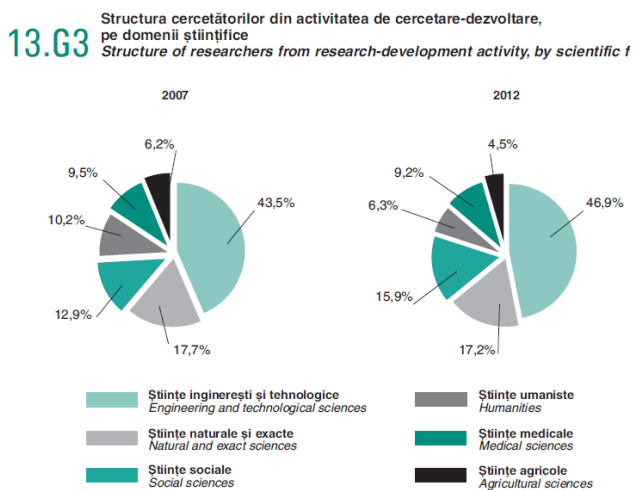


Fig. 3. Structure of employees from R&D activity, by scientific field(Romanian Statistical Yearbook 2013)

3. What we mean by R&D?

Research-development is a systematic and creative activity initiated to enhance the volume of knowledge and using them for new applications. A didactics classification of the types of R & D activities almost unanimously recognized by academics is the following:

- fundamental research, experimental or theoretical activity primarily initiated to accumulate new knowledge on the fundamental aspects of phenomena and facts that could be examined, without having in view a special or specific application;
- applicative research, activity of original investigation in order to accumulate new knowledge, being mainly oriented towards a specific practical purpose or objective;
- experimental development, systematic activity which uses the knowledge accumulated as a result of research and/or practical experience in order to launch in fabrication new materials, products and devices, to introduce new procedures, systems and services or to significantly improve those already existing.

Usually, staff from research-development activity is constituted of persons who participate in carrying out research themes or who provide services directly related to this research-development activity.

Research-development staff was broken-down by several criteria (some refer only to the staff with higher qualification), as follows:

a) by occupation:

- Researchers - experts working for accumulating knowledge, concepts, creating new products and procedures, methods and systems. This category includes certified scientific researchers and other categories of higher education staff, directly carrying out research-development activity;
- Technicians and assimilated - persons with high- school education or completed by post high-school specialised training for a technical field or another, and who take part in research-development activity, under direct control of researchers;
- Other categories - workers and secretariat and office staff who take part in research-development projects or are directly involved in such projects.

b) by level of training:

- Staff with tertiary education, comprising doctorate, post-university and tertiary studies;
- Staff with another education (excluding tertiary education).

The data by training level are presented according to the International Standard Classification of Education (ISCED), following:

- doctorate holders;
- post-university education (excluding doctorate holders);
- long-term tertiary education;
- short-term tertiary education;
- other education (post high-school and foremen education, high-school, vocational and apprenticeship, other situations).

4. What is required from the researcher

Research guides and manuals existing in literature shows interest by appealing style, sometimes persuasive, often motivating for the adoption of a career in research in order to satisfy their curiosity or desire of individual knowledge (Ballenger, 2009), (Hitchcock, 2012).

Nowadays is manifested the concern that the researcher or academics and research workers develops its activity in the field outside of our discipline concerns about. This divergence is likely to lead to a theory and a practical irrelevance unauthorized and invalid. Such results will damage our reputation and ultimately will lead to our dissipation.

Without excluding the value of writings about "how" and "who" and "where" the research is done, the researcher must be, above all, a man with a higher education in the field of activity. The ideas "brilliant" arisen "out of nowhere" and belonging to other fields than that in which has been deeply trained, are exceptions. The exceptions are those of an educated mind to make connections, to look beyond appearances and from more sides less usual, to apply methods and models incompliant in solving seemingly trivial.

Looking through the employer, researchers, and for example research engineers and research assistants in manufacturing carried out research and development in the field of mechanical systems with application in various areas (security, health, etc.), transport and road vehicles, materials, nanotechnologies, to new production systems in energy etc.

Depending on the job, the researcher can be employed in research through competition, additionally young university graduates to prepare master in research, experienced specialists for research or scientific researchers. For some, doctoral professional degrees are required.

Research institutes offer the possibility of developing a scientific career and for this are favorable the activities environment created by working with doctoral universities in the country and abroad. Overall, a researcher can perform the following activities within a research center:

- Conceive, experiment, collecting data, do qualitative and quantitative analysis, substantiates technological solutions, methods, procedures and the like in the research theme
- Draws from that deriving from the research report
- Responsible for the scientific quality of the work performed
- Capitalize original scientific research through articles published in journals, presentations at conferences or symposiums, patents etc.
- Participate in the development of research projects (forms competition project submission)
- Prepares the necessary internal documentation and reporting of research.

In terms of a researcher career path, each state has its own hierarchical system, competency-based assessment and indicators in Romania, career in research involving accession to positions and higher professional degrees. The professional degrees of staff conducts scientific research is: scientific researcher - Researcher, senior researcher II - CS II, senior researcher III - CS III, researcher - CS, assistant scientific research - ACS. The professional degrees staff with higher technical performing technological development is: development engineer technology degree - IDT I, engineer technological development Grade II - IDT II, engineer technological development Grade III - IDT III, engineer technological development - IDT. Besides the professional ranks, his career can mean accession to leadership (ex. Research department director - development).

5. Who and how are they trained researchers

For some academics, development of a researcher is seen as being achieved in four stages:

- primarily during doctoral studies and the early stages of an academic career, until a threshold point of competence and confidence is attained ;
- second when researcher has success and recognition; Then, once that stage is reached, the idea of further development is perceived as relevant. After all, once one knows how to research successfully! what else is there to learn? This way of thinking about research developer would support the unbalanced attention in the literature on research developer during doctoral studies compared to research development after academic appointment.
- third, when researcher increasing his productivity as a researcher, either in terms of an increasing rate of production or accumulation of research over time. This way of thinking about researcher development is very much in line with focus on quantitative indicators of research output. It also seems likely that such accountability measures might encourage in academics this way of thinking about their development.
- fourth – researcher emerged from the study in terms of ongoing qualitative improvements in one's ability to research, through continuing developments in one's knowledge, theoretic: understanding and awareness of broader perspectives. It is only in this way thinking that the potential for ongoing growth is seen as endless (Akerlind, 2007).

For all the above categories, but especially the first three, for the development of the R&D activities, most European countries, and even the European Commission, provides, through competition Doctoral and Postdoctoral Programs as support for increasing the competitiveness of research sciences. For example in Commission Recommendation of 11 March 2005, the European Charter for Researchers and a Code of Conduct for the Recruitment of Researchers, paragraph (6) stipulating: "The introduction and implementation of new instruments for the career development of researchers, thus contributing to improve the prospects of a career for researchers in Europe".

For this reasons the overall objective of this programs is to "encourage excellence in university research career by supporting postdoctoral graduates and researchers to increase the involvement and motivation in research in the fields of Mathematics, Physics, Chemistry, Computer Science". To this end, they will seek to attract, support and motivate graduates and researchers postdocs, research activity, both at the start career and advanced level,

benefiting thus training programs and documentation, institutional infrastructure, and and financial support for research mobility and internships.

Regarding the training of young researchers - Like 40 years ago, the management of higher education institutions remained in the hands of teachers, the formation mostly scholastic, for which research work is not a defining part of their work. Their requirements to the students, their education system are not usually oriented towards students highlighting young talented and with creative power. Paradoxically, although master studies would be to prepare students for future doctoral research work, among the subjects studied there was not one which will reveal the mysteries of research. Therefore higher education institutions in Romania today, cannot develop creative skills. Attending examination, are found mainly, university professors do not appreciate the student who mostly "understand" but the student who, above all "know", when in fact, science needs people who, above all "understand". Hence, the selection of graduates in employment after the exams notes is very risky. This was felt by big companies who transferred this task to a service or a recruiting firm specializing in through evaluation and job placements.

Regarding the selection of young researchers - In Romania today, selecting - like training - of scientific staff is left to the institutes of higher education, where only to the end of their studies, based on skills, but particularly on the marks obtained, most suitable graduates are selected for this type of activity and directed to doctoral studies. Only here they come into contact with scientific work and only now can they put out any creative possibilities - over 23 years, so with a delay of 4 or 5 years from when the experts say that talent is recognizable. On the other hand, higher education institutes have only a very small measure of teachers who are at the same time researchers in the true sense of the quantum to be lived for and research work done by all the rules of this job. Experience shows that a regular teacher is not necessarily equipped with the skills of the evaluator and teacher of creative characteristics of students. Moreover, and worse for educating young people for science based subjects are not taught at the appropriate level. In the past, this task was entrusted to the best and most experienced teachers, today covering positions by other criteria, or even in their absence, and training is the so-called modern technology to "break the link between teacher and student and favors absenteeism or sleeping in the projection rooms - better than in an well-lit amphitheater" (Prince, 1963).

Moreover, there are still people who believe that any scientific work must have a direct technique consequence. They are those who confuse research work with engineer work, fundamental research with productive engineering. This confusion should disappear completely and the selection of future research among future engineers should be continuous throughout the regular studies and after a unitary procedure which have the basic competency criteria rigorously defined.

Postgraduate education accordingly Law 1/2011 - Romanian Education Law, is accomplished through:

- Postdoctoral programs for advanced research, for people who earned a PhD in not more than five years before admission to the postdoctoral and who want to improve in an institution other than that in which they obtained a doctorate;
- Postgraduate training programs and professional development for graduates who have at least a university degree or equivalent diploma (ex.: postgraduate courses, postgraduate training in order to obtain certificates of complementary studies). They are organized by higher education institutions that have accredited at least undergraduate degree programs in the respective scientific field.

6. Results of discussions

To better understand the role of higher education in researcher training in the field of engineering, the authors examined in a comprehensive review of both literature and the employer's requirements, characteristics that must possess researchers from

academia and manufacturing, their training and their work environment. Areas analyzed should be developed by faculty and departments dealing with assessment, career development, professional socialization, organizational development, in the higher education and in research and development enterprises. The results show that in addition to terms of knowledge and skills in an area of research, successfully scientists possess values and attitudes derived from the specific experiences of socialization academic, the significant support given by mentors and colleagues or the organization of their research activities.

Another key element will be the introduction of guidelines on research opportunities, facilitated by the Department of Research at the university level, to assist the researcher in order to:

- enhance personal development centered learning postgraduate students by promoting joint learning opportunities and generic skills training to meet current needs and prepare for future careers in research;
- Promote courses open to researchers from any discipline at any stage The advantage of a session open to any discipline is the opportunity for those with some experience to share this so that good practice might be transferred from one discipline to another.
- Promote best practices and to provide a focus for dissemination, debate and involvement in the local, national and international postgraduate research (Byatt, 2013).
- Training of postgraduate and early career researchers. This enables the researcher to identify areas where they might lack expertise that they require to develop and find suitable training in the one place.
- Engage PhDs and early career researchers to offers seminars to doctoral study centre belong university.
- Engaging with the early career researcher and principal investors or particular funders.

Analyzing curricula and syllabuses of master level programs it can be concluded that almost all study subjects lacking or not allowing future doctoral chapters to acquire basic skills. It is the second "key" in going through the edifice called the lack of research.

There were also searched and the keys teachers, mentors, activities organization of theoretical and practical research in particular. We know how it should look like but if they exist and what state are we analyze in future work, when time and space will allow us.

7. Conclusions

Such an approach at university, faculty, doctoral school and enterprise offers several advantages in taking this multi-level approach. It provides opportunities for different groups to be targeted but also facilitates their attending joint events. There is value in encouraging cross and multi-disciplinary exchange of good ideas.

For beginner researcher, the entry level must be closely related to research and development strategy of the university, which ensure in this way that these skills are incorporated into attributes of researchers. In the future, the university might be able to assume a greater level of previous knowledge, but for now it is best to assume basic knowledge before and adapt when participants demonstrate a high level of expertise.

Faculty based sessions have the advantage that they can be more bespoke and deal specifically with particular types of data, highlight discipline specific best practice and guidance on appropriate funder requirements.

The Doctoral School sessions are an important avenue that enables the promotion of good practice while facilitating review and discussion on the core principles. The structure of a Doctoral School is such that it can draw in a range of experience.

Investors training session in the areas where it might seem obvious who might be the main funder, needs to be flexible enough to cover the unexpected and being able to respond to this.

Finally, the authors believe that such an approach is recommended for training researchers from the bottom up, embedded in the organizational structure at the university, college and school doctors. Multi-level approach will facilitate cross-border and multidisciplinary opportunities for sharing ideas and will continue to be a valuable means to provide training for future researchers. Co-delivery of information in the context of scientific communication is an essential element in the success of the training provided and this model will be important to maintain and even develop for the future.

The key to the commitment of researchers in this case, is the fact that the central purpose of the event is clearly known in advance and the value of co-delivery will certainly be unexpected that they can facilitate that each session will be successful.

The exodus of young educated towards American or Western universities, is unfortunately, a well-known phenomenon. Government programs targeting the repatriation of those who have specialized abroad have not reached yet, the goal - ineffectiveness of these programs deserve a separate discussion. In these circumstances, beyond the material problems faced by (mostly) young researchers, a scheme to promote further scientific salubrious, more efficiently and in accordance with the EU and the United States - systems whose reliability is difficult to put the doubt - would be a pull factor for young Romanians in addition will become academics / researchers.

On the other hand, even assuming that the exodus continues, it is all the more important in the country to form valuable researchers. Not eventually, the return to the country of young people receiving training abroad and can be accelerated by having a coherent research system based on value and encourage personal development in the early stages of scientific and academic career. All those involved in scientific know, not only for financial reasons, the performance fell to us. In particular, the doctoral title is granted too easily.

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