

THE PERSPECTIVES OF RESEARCH IN THE CONSTRUCTION FIELD IN ROMANIA DURING THE 2014-2020 PERIOD

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ABSTRACT

The construction field represents an important part of the Romanian economy (and of UE), with a strong social impact on the quality of citizen life. Naturally, the research from the construction field should be a priority in research and innovation activity. However, the research programs recently launched (Horizon 2020, from EU, and the Strategy of Research and Innovation 2014-2020 in Romania), don't mention the construction field as an explicit priority. Under these conditions, we can speak of a real identity crisis of the research in construction, a crisis which may worsen in the next seven years, as an effect of limiting the access to material and human resources, caused by the field marginalization. In this paper, a detailed analysis of the mentioned research programs is done, in order to identify possible connections with research in construction and some research directions, additional to the priority directions. Some probable causes that led to the crisis in construction research are identified, as well as possible measures, actions, directions and research topics that can rally researchers in the field. From the conclusions drawn in the final section, it results that the identity, place and role of research in construction can be found in the interaction and close collaboration with research from other areas, in inter-, multi-, or trans-disciplinary teams.

Keywords: research in constructions; identity crisis; research program and strategy; priority fields; interdisciplinarity.

1. INTRODUCTION

Encouraging and supporting research, technological development and innovation (RD&I), as a part of economy, is a constitutional explicit requirement. Article 135, paragraph (2) of the Constitution provides that “The state must ensure...c) the stimulation

REZUMAT

Sectorul construcțiilor reprezintă o parte importantă a economiei României (și a UE), având și un puternic impact social asupra calității vieții cetățenilor. În mod firesc, și cercetarea din domeniul construcțiilor ar trebui să constituie o prioritate în cadrul activității de cercetare și inovare. Totuși, programele de cercetare, recent lansate (Orizont 2020, la nivelul UE, și Strategia de Cercetare și Inovare 2014-2020 în România), nu menționează sectorul construcțiilor ca prioritate explicită. În aceste condiții se poate vorbi de o adevărată criză de identitate a cercetării în construcții, criză care se poate agrava în următorii șapte ani, ca efect al limitării accesului la resurse umane și materiale, cauzată de marginalizarea domeniului. În lucrare se face o analiză mai detaliată a programelor de cercetare menționate, în scopul identificării unor posibile conexiuni cu cercetarea în construcții și a unor direcții de cercetare complementare direcțiilor prioritare. Se identifică și unele cauze probabile, care au condus la situația de criză a cercetării în construcții, precum și posibile măsuri, acțiuni, direcții și teme de cercetare, la care se pot ralia cercetătorii din domeniu. Din concluziile enunțate în final se degajă ideea că identitatea, locul și rolul cercetării în construcții pot fi găsite în interacțiunea, apropierea și colaborarea cu cercetarea din alte domenii, în echipe inter-, pluri- sau transdisciplinare.

Cuvinte cheie: cercetare în construcții; criză de identitate; program și strategie de cercetare; domenii prioritare; interdisciplinaritate.

of national scientific and technological research”.

Without a sufficient capacity of research in the most various fields, the adequate fulfilment of the state duties is endangered. Therefore, the RD&I activity must be a long-term national priority.

The specific aims of the state involvement in RD&I activities include a sustainable economic development, the increase of wellbeing and life quality, the protection and enrichment of national scientific heritage and the participation of this to the world heritage knowledge (OG 57/2002).

For the scientific community in Romania, the last trimester of the year 2013 was marked by two events, in which very important documents were released regarding the role and place of scientific research activities in the society for the next seven years (2014-2020).

The first of these events was the National Conference for introducing the European framework programme HORIZON 2020, held on 4 October 2013 in the Romanian National Library auditorium from Bucharest, the organisation being provided by the Minister of National Education. During the event, a team of European officials from the research field has made the release and the detailed presentation of the main components of Horizon 2020 – The EU Framework Programme for Research and Innovation 2014-2020.

In their turn, the Romanian officials from the National Education Minister (MEN) had interventions related to the main preoccupations of Romania in the research, development and innovation (RD&I) field.

The second major event for the Romanian scientific community consists of a series of meetings organized by MEN, dedicated to the presentation and debate of the National Strategy Project for Research, Technological Development and Innovation (SNCDI 2020) and of the instruments required to implement the strategy: the National Plan 3 (PNCDI3) and the Sectorial Operational Programme for the consolidation of research, technological development and innovation during the 2014-2020 period (POS CDI 2014-2020). As a preamble of these meetings, on December 5, 2013, the preliminary versions of the three mentioned documents were posted, for public debate, on the website of the Ex National Agency for Scientific Research (ANCS) (www.research.edu.ro). Subsequently, in February 2014, a shorter technical version of

SNCDI 2020 (www.cdi2020.ro) was published.

Important EU documents recognize the main role and place of the construction field in the economic and social life of human communities in Europe. Thus, it is considered that “The Construction and construction products sector represents approximately 10% of the EU GDP and shares almost 30% of the industrial employment, which implies important economic and social relevance in the Union. Also, construction represents a key component in the quality of life of the citizen as people leave in buildings, use urban infrastructures and life-lines and will be more or less protected from the consequences of natural and man-made hazards depending on the performance of the structure they live and/or work in, under extreme events”, such as: earthquakes, floods, landslides, fire, explosions, climatic changes (ipsc.jrc.ec.europa.eu/index.php?id=377).

However, a brief analysis of HORIZON 2020 – The EU Framework Programme for Research and Innovation 2014-2020, as well as of the document referring to the scientific research from Romania for the next seven years, documents being in public debate, shows, arguably, the fact that the research in the construction field is no longer considered an explicit priority of the forums that manage the funds allocated for research in UE and in Romania. If the mentioned programmatic documents synthesize the priorities, the tendencies and the needs of research of the European and Romanian society, as is claimed, it seems paradoxical that the research in the field of construction is almost ignored. The paradox comes from the fact that, although a large part of the human activities take place in buildings and are in connections with the built environment, buildings, the built environment and civil engineering, in general, is not mentioned as a priority in the targeted documents. From this point of view, we can talk about a real crisis of identity for the research in construction field. This crisis can be amplified by the lack of funding, as a result of marginalization and of the treatment of this field as a peripheral one.

This paper has as main aim a detailed analysis of recently-launched research programmes, with the purpose to identify some possible connections with the construction research and some directions of research which are complementary to the priority directions, capable to define, more clearly and concise the identity, place and role of research from construction field, in the actual globalizing, inter-, multi- and trans-disciplinary context of the scientific research in UE and in Romania.

2. THE STRUCTURE OF THE EUROPEAN FRAMEWORK PROGRAMME HORIZON 2020

The European Framework Programme “Horizon 2020” is designed to finance especially the projects that are capable to lead to the fulfilment of technical, educational and social objectives assumed by the member states through the strategies „Europe 2020” (ec.europa.eu/europe2020/index_en.htm) and “Innovation Union. A Europe 2020 Initiative” (http://ec.europa.eu/research/innovation-union/index_en.cfm).

The programme is based on four pillars, of which branch out, in a tree structure, other research directions and sub-directions (themes), as it can be seen from the scheme presented in Fig. 1.

It must be pointed out that the Framework Programme presented in Fig. 1 is simplified, as the majority of the directions identified with two numbers are branched, at their turn, with other thematic and research subjects, specific to these directions.

From a detailed analysis of the framework programme structure, it can be concluded that there is no direct or indirect reference to civil engineering, constructions or built environment. It is obvious, under these conditions, that the research in constructions does not have a place or it has lost its identity and must adapt to the priorities and to the actual commandments.

The world in which we are living, and especially the one we are heading to, is a world of interdependencies and of

globalization in the entire field of economic, social and political life. The fundamental and applied research cannot escape these trends, thus it is hard to sustain the research within one specific discipline or even of a wider field if inter-, multi- or trans-disciplinary aspects are not taken into consideration (Georgescu E. & Georgescu M., 2012).

The research in construction must to find its identity, place and role in the interaction, proximity and collaboration with the research from other domains, which, for the moment, have priority.

Returning to the structure of the European framework programme presented in Fig. 1, it can be noticed that pillars 1 („*Scientific excellence*”) and 4 („*Other activities*”) are, in fact, measures, means, processes and instruments designed to identify, to sustain and to spread excellence in research. Of them will benefit, therefore, those research structures (countries, networks, institutions, universities, laboratories etc.), which already have a good research infrastructure and highly qualified staff related to this infrastructure.

In this context, the research an innovation from Romania, which are not yet integrated and fully connected to major European networks in the field, could apply to those activities which aim to “the spreading of excellence and the widening of participation” or “the science with and for society” (www.research.edu.ro).

It is desirable and fully feasible that the research in construction in Romania applies and benefits of the “*Marie Curie Actions*”, aimed to support junior researchers, and to provide scholarships for experienced researchers, exchanges with research and innovation staff, financing of some regional, national and international programmes of doctoral or postdoctoral studies. Moreover, at the chapter “Research infrastructure”, the Romanian researchers in the construction field could apply to create new infrastructures for research at international level, the infrastructure integration of national research at pan-European level or for the development and implementation of the infrastructure of research based on ICT.

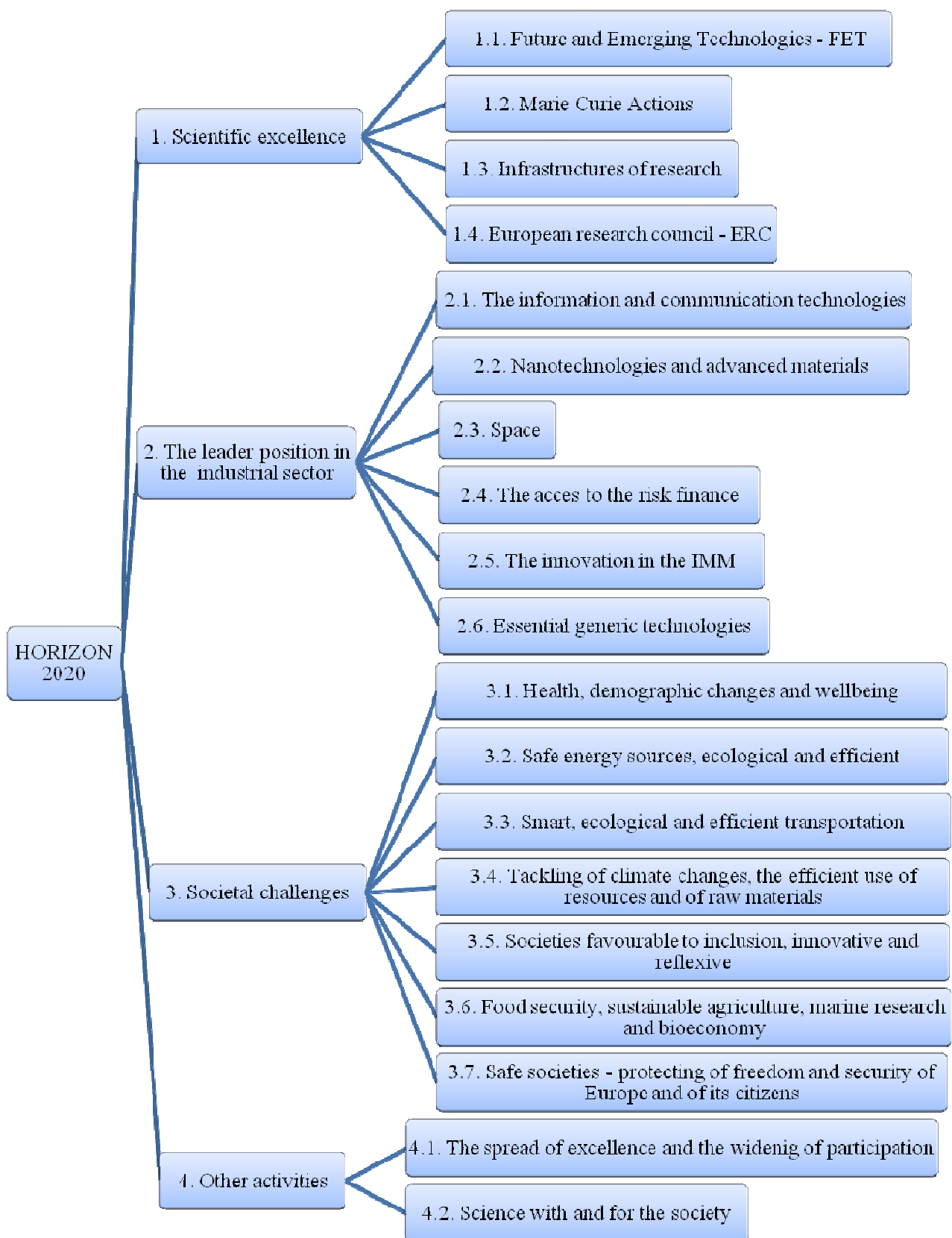


Fig. 1. The structure of the European framework programme "Horizon 2020"

Regarding the second pillar, “*The leader position in industrial sector*”, the researchers in construction can branch to the “*Advanced materials*” section in Direction 2.2 “*Nanotechnologies and advanced materials*”.

Thus, they can propose themes related to materials for a sustainable construction industry, efficient from the point of view of the resources and with reduced emissions, materials used for the rehabilitation and preservation of the heritage buildings, the optimization of material uses and systems of manufacturing and advanced processing for construction materials.

In addition, within the second pillar, the programme Horizon 2020 provides measures of progressive support for SMEs, which perform research and innovation in an intensive way, in particular market-oriented innovation.

The third pillar, “*Societal challenges*”, includes seven research directions, which do not have a direct relation with construction research. However, to at least five of these, the researchers from constructions can contribute with specific expertise, participating in interdisciplinary teams. In this way, within the direction 3.1, “*Health, demographic changes and wellbeing*”, the place, role and the impact with built environment on the health and wellbeing of the population must not be underestimated. This is why demographic changes generated by the emigration of economic and politic nature lead to the overpopulation of some urban areas and to the abandonment of others. These aspects, related to continuous expansion, sometimes uncontrolled, of the built environment in the detriment of natural environment, with unfavourable consequences on the health and wellbeing of inhabitants, have to be investigated.

The next two research directions from the third pillar refer to energy sources and transportation. The research should ensure their development, diversification and integration in ecological conditions of increased safety and efficiency. Both energy and transportation need a specific infrastructure (for production, storage,

distribution and energy consumption, as the raceways and the constructions needed by the means of transportation). This infrastructure can be ensured only by the construction industry. Therefore, the research in construction should solve the problems that involve the development of infrastructure afferent to energy sources and means of transportation.

Direction 3.4, “*Tackling of climate changes, efficient utilisation of resources and of the raw materials*” has many points of interest for construction research. The climatic changes, with their effects on buildings, can lead to the necessity to adapt and modify the design values of some variable actions or even to the emergence of some accidental actions, which have not been taken into account at the design of some constructions. Thus, the time intervals and the temperature differences to which the buildings are exposed are increasing, following the increase, respectively the decrease of temperatures during the periods with extreme heat or excessive frost. The extreme phenomena (storms with very high wind speed and with rain that can cause floods and landslides, snowstorms that can lead to large deposits of snow on some construction elements and structures, frozen rain, ice storms, frost, ice etc.) involve changes to the design standards in terms of values and groups of actions of this nature. If, for the new constructions, these measures can be taken for climate changes tackling and the adaptation to these, since the phase of design, this is much more difficult for existing constructions, this being a big challenge for the construction research.

The sustainable management of natural resources and of the raw materials needed in the construction industry must also be a primary concern for the research.

Finally, within the research direction 3.7. “*Safe societies – protecting of freedom and security of Europe and of her citizens*”, two objectives are foreseen, to which the researchers from constructions, belonging to multidisciplinary teams can contribute with them own expertise. Thus, the objective 3.7.1 “*The fight against crime and terrorism*” states

that the new technologies and the specialized capacities should contribute to the protection of infrastructure, critical systems and services (food, water, energy, communications, transportation, environment, logistics and supply chains). This objective will include the infrastructure analyses and critical services in the network of public and private sectors and in the protection of these against any type of threat.

Objective 3.7.4. “*The increase in resilience of Europe to crisis and disasters*” foresees that technologies and specialized capacities should be developed in order to sustain different types of operations of emergency management (such as civil protection, fire and marine pollution fight, humanitarian help, conflict prevention, the development of medical informatics and of rescue missions of infrastructures and of stabilisation post-crisis), as well as the control of law enforcement.

In conclusion, the research in construction can and must be mobilized, along with the research from other areas, to anticipate, to warn and to manage the security threats such as crime, terrorism and emergency situations of large extent caused by natural disasters or by human activity.

During the same 2014-2020 period, other European initiatives in the field of research-development coexist, among which:

- initiatives financed through the Horizon 2020 budget (joint ventures – JU; common research programmes - JRP);
- initiatives complementary with Horizon 2020 (initiatives of joint programming JPI; technological platforms – among which the European Construction Technology Platform – ECTP; structural and cohesion funds);
- further initiatives in Horizon 2020 (coordination between national programmes – ERA NETs).

In the following period, the research in the construction field in Romania should try, with determination, find some ways to collaborate with the Joint Research Centre – JRC, which is the scientific internal office of the European Commission. At least two of seven institutes,

which activate in different domains of specialization under the JRC, have preoccupations connected directly to construction research: structural mechanics and risk assessment. These are the two institutions in Ispra, Italy, namely: the Institute for Protection and Security of Citizen – IPSC, which supports the UE politics in the domain cyber security and antifraud, natural, technological and economical risk, security and nuclear safety, and the Institute for Environment and Sustainability – IES, which performs research on the levels of air, water and soil contamination, assesses the effects of these contaminations on the environment and citizens and promotes a sustainable management of the environment resources.

3. ANALYSIS OF THE NATIONAL STRATEGY RD&I 2014-2020

3.1. Priorities of smart specialization

The preliminary version of the *National Strategy for Research, Technological Development and Innovation 2014-2020* (SNCDI 2020), must be analyzed and understood along with its first instrument of implementation, the *National Plan of Research, Development and Innovation 2014-2020* (PNCDI3), as well as with the related instrument, *POS-CDI, Sectorial and operational plan for research, development and innovation 2014-2020* (in the technical version of SNCDI 2020, this instrument is called *The Priority Axis, Research, Technological Development and Innovation for the support of business and competitiveness*) (www.research.edu.ro, www.cdi2020.ro).

SNCDI 2020 contains the basic principles, the general and specific objectives, as well as a number of measures, decisions and actions which are expected to govern the activities of RD&I during 2014-2020.

One of the base principles of the vision regarding the research and innovation in Romania in 2020 consists in assuming, at national level, a strategic priority set, grouped in two big categories:

- a) Priorities of smart specialization;
- b) Domains of public priority.

Nowadays, according to the European Commission, “The main challenge for Romania is her weak *competitiveness*” (EU, Research and Innovation...). To increase the *competitiveness*, in SNCDI 2020 the concept of smart specialization is inserted, as “a process of defining and consolidating some areas of competence with high economic potential which, through the concentration of resources and the mobilisation of a critical mass of researchers, can provide the regional and/or global competitiveness” (SNCDI 2020, page 23). The smart specialization domains, identified from a process of consultation with the representatives of research, innovation and economic sectors are shown in Fig. 2.

At a first glance to the priorities of smart specialization, the lack of any explicit reference to research in construction field is surprising, while the “*Bioeconomy*” has no less than 15 themes or research directions (five of which are biotechnology in various fields!). The priority “*Energy and Environment*”, to which the construction research field can rally, has only three themes or research directions. We suspect that one of the causes is the weaker mobilisation of the researchers from the constructions field to the consultation process initiated by the consortium that developed the National Strategy of RD&I, as well as the absence of construction specialists from the expert panels designated to identify the strategic priorities (www.cdi2020.ro). In addition, the lower propensity to research of the private sector, which in 2010 held 99.7% of the total number of companies in the construction field, can be another cause of the situation of the construction research.

Although the four priorities of smart specialization do not make a direct reference to research in construction; however, in the detailed description of these priorities there can be identified themes or lines of research where the researchers in construction can participate, as a part of multi- or interdisciplinary teams. Thus, in priority 3. “*Energy and environment*”, theme 3.1. “*The increase of energy efficiency to consumer*”, the

research in construction can bring important contributions through:

- interdisciplinary research on the energy efficiency in the built environment;
- new solutions for buildings / rural ensembles, smart cities, with high energy performance;
- development of energy design for new and existing buildings, as a complex system of technical, economical and optimization analyses on solutions for the energy performance of buildings.

As economic arguments, for the development of these studies, SNCDI 2020 mentions that the “building sector is responsible for over 40% of the total energy consumption of Romania”, and “construction field is a very dynamic sector with over 99.7% private companies, with an investment of over 10% of GPD (2010)”.

Numerous environmental and economical arguments can be put forward in support to research in construction, to achieve the objective of direction 3.2. “*The optimal use of conventional and non-conventional water resources*”. Thus, the continuous growth of pressure put on water resources, due to its multiple uses (drinking, energy, agriculture, navigation and transportation, sports and recreation, maintenance of the viability of natural ecosystems), still requires interdisciplinary research, regarding (www.research.edu.ro):

- the identification of the relevant parameters that define water resources of the natural environment and of the built environment;
- solutions to minimize consumption;
- the effect of climatic changes on the quantitative and qualitative balance of waters (from underground or surface sources);
- the use of new non-conventional water sources (rain water, waste water etc.);
- the sustainable harmonization of multiple uses of water bodies (navigation, irrigation etc., with the condition of maintaining aquatic ecosystems);
- the development of risk maps, based on meteorological and satellite data;
- the economical feasibility of various irrigation solutions.

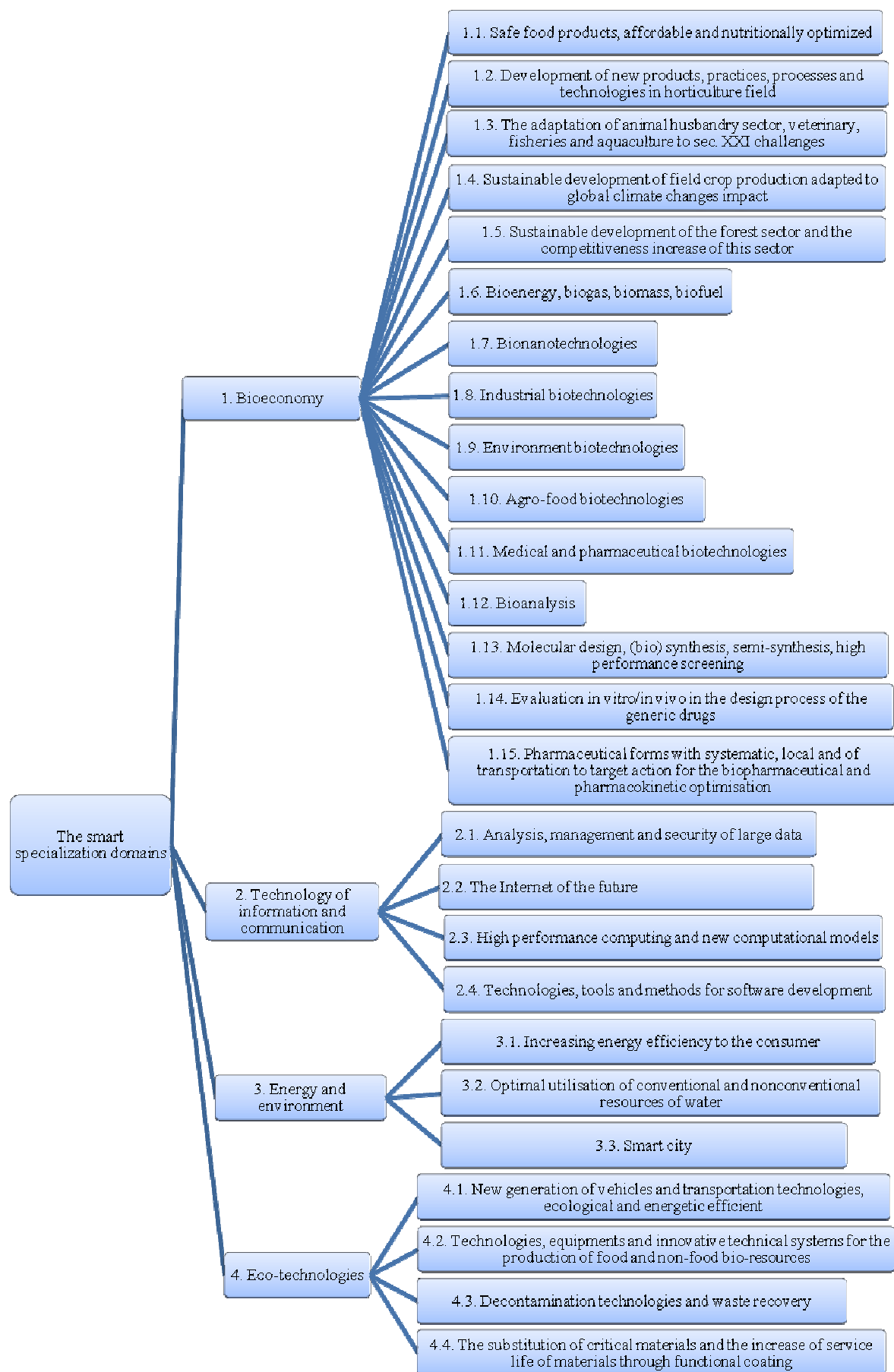


Fig. 2. The smart specialization domains

The problems faced by the urban residents (poor quality of life in large urban areas, high costs of services, transportation problems etc.) must generate interdisciplinary research, to solve, at least partially, the problems. The researchers and the specialists in architecture, urban planning, regional planning, automation, informatics and mandatory from constructions, will have to work together to generate solutions for transforming the cities in sustainable environments, with advanced infrastructure, capable of providing a higher quality of life. “*The smart city*” should not remain just a dream for the priority “*Energy and environment*” or a science-fiction concept, but must become effective through development and integration of smart building components, of analysis and adaptation to environmental factor systems, of public information, of monitoring and traffic management, energy management etc. The municipal authorities from some American cities (Scottsdale, Dubuque, South Bend, Seattle and Boston) have already implemented the components of smart cities by „using technologies that include wireless networks, big data/analytics, mobile applications, Web portals, social media, sensor/tracking products and other tools. These smart city efforts have lofty goals: enhancing the quality of life for citizen, improving government processes and reducing energy consumption, among others” (Violino, 2014).

The construction research has the capacity to respond to some themes in the direction “*Decontamination and waste recovery technologies*“, which is associated to the priority “*Ecotechnologies*”. Romania assumed the target that, until 2020, the recovery of domestic waste in percent of 50% and construction demolition waste at a rate of 70% will be ensured. The achievement of this goal need also research on the development and improvement of decontamination technologies and of waste recovery, the reduction of pollution sources and the monitoring and the integrated evaluation of pollution.

Another line of research to which researchers in the construction field can be connected refers to the “*Substitutions of*

critical materials and the lifetime increase of materials through functional coating”. The construction sector of the economy, like other industries, is interested in research to provide solutions for the partial or total substitution of poor critical materials and for increasing the materials lifetime by using functional coating. There is, also, the requirement of replacing heavy steel components with structures made of light materials of substitution (fiber-reinforced carbon composites, light metal composites, porous materials / foams or materials with property gradients).

In the design of structures, construction elements and products, there is a need for new computational algorithms and numerical methods, to model, to simulate and analyze complex systems in construction field, which will enable the development of software for new hardware architectures (multi-core, GPU etc.). These requirements can be embedded in the research direction “*High performance computing and new computational models*” of the priority of smart specialization “*Information and communications technology*”.

3.2. Public priority areas

The second set of strategic priorities, identified in SNCDI 2020, concerns the concentration of RD&I activities in the areas of public relevance. As an argument, it can be mentioned that “The public sector is an important component of the economy; innovative solutions – products, services and politics – can improve the efficiency and quality of this sector”.

Detailed description of public priority fields, identified through the same extensive consultation process, used and for the smart specializations, are shown in Fig. 3.

The analysis of the (old) three priority areas indicates that one line of research, familiar to the researchers in the construction field, is that connected to the “*Assessment and disaster risk reduction*”, in the field “*Space and security*”.

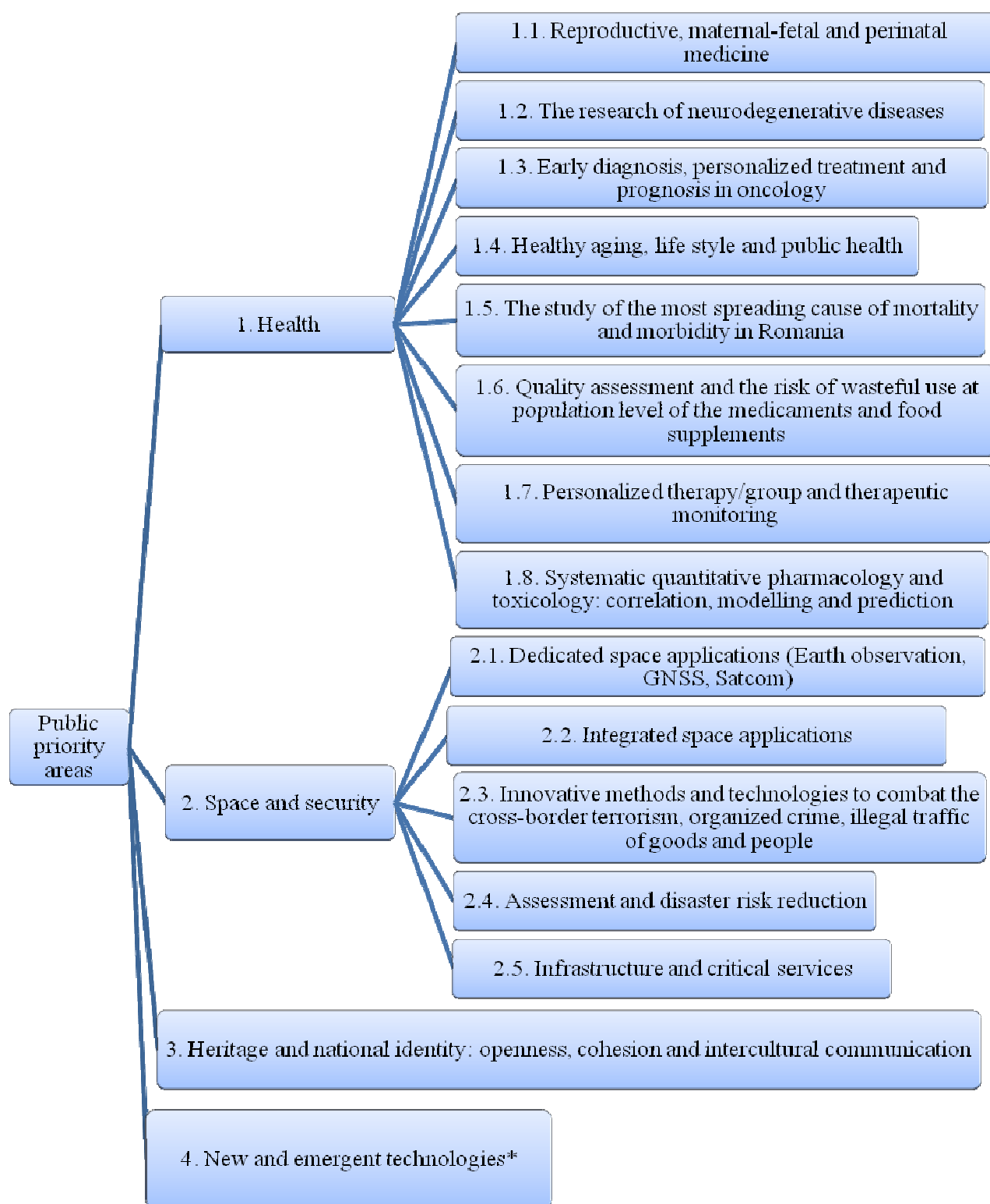


Fig. 3. Public priority areas

* These can be seen in the technical version of SNCDI 2020, dated February 2014, without having a similar description as the other three!?

Because the natural disasters and those caused by human activity are permanent threats to the society, causing annually human and material losses, research in general, and that in construction in particular, must be involved in (SNCDI 2020) by:

- modeling and simulation of dynamic systems which generate hazard;
- developing of monitoring techniques and interactive mapping;
- optimization of rapid systems of assessment and decision making;
- optimization of decision support systems for integration into European networks;
- development of innovative solutions for seismic protection, efficient, functional and economical for the seismic zones in Romania.

The importance of the research topic on seismic assessment and disaster risk reduction is underlined by the fact that recently (in December 2013), the CIB Programme Committee has established a new Working Commission, W120, on Disasters and the Built Environment. The commission establishment is justified by the fact that „Rapid growth of urban centres presents numerous challenges to humanity, many of which can be addressed through built environment solutions. In the face of more frequent and powerful hazards, the future of vulnerable and growing populations is increasingly perilous” (<http://www.cibworld.nl/site/commissions/index.html>).

4. CONCLUSIONS

1. The research and innovation activity, as a part of national economy, must be a long-term strategic priority, because it is able to generate knowledge for a sustainable economic development, in order to increase people’s well-being and quality of life.

2. Wellbeing and the life quality of citizens depend largely on the built environment in which they live or carry on various activities. The Construction and construction products sector is a significant part of the Romanian and EU industry, with a

strong social impact. Although these issues are recognized in the European and Romanian official documents, the research in constructions is not listed as an explicit priority in recently launched research programs (Horizon 2020, SNCDI 2020).

3. The identity crisis in the construction research in Romania could worsen in the next period, due to the exclusion of this domain from the mentioned research programs.

4. The detailed analysis of the European framework programme Horizon 2020 identifies, in the four pillars of this programme (*Scientific excellence; Leadership in industry; Societal challenges; Other activities*), some measures, actions, directions and research topics to which the researchers in the construction field can connect.

5. The Romanian Research and Innovation Strategy for 2014-2020 defines, at national level, a set of strategic priorities, grouped in two categories:

- priorities of smart specialization (*Bioeconomy; Information and Communication Technology (ICT); Energy and Environment; Eco-technologies*);
- public priority fields (*Health; Space and security; Heritage and national identity; New and emerging technologies**).

6. Among the strategic priorities identified in SNCDI 2020, the construction field is not found; among the causes of this situation the following could be included:

- the economic and financial crisis;
- the lower propensity to the research field of the private sector, which holds the majority of construction companies.
- the poor mobilization of researchers from the construction field to the consultation initiated by the consortium that developed the strategy;
- the absence (justified or not?!) of the construction specialists from the expert panels designed to identify strategic priorities.

7. The researchers in the construction field can access themes and research directions under the priority “*Energy and environment*”,

only if they associate in multi- or interdisciplinary teams. Similarly, some research opportunities within the priorities “*Ecotechnologies*” or “*Information and communication technology*” can be accessed in conjunction with specialists from other fields.

8. The domain of public priority “*Space and security*” contains, among others, a research direction related to the “*Assessment and reduction of disaster risk*”, in which researchers in the construction field can provide the specific expertise, together with specialist in other areas.

9. The research in the construction field must find its identity, place and role in the interaction, proximity and collaboration with research from other areas, which currently have priority.

10. The final conclusion, which results from the analysis in the paper, is that, in a world of interdependencies and globalization, the fundamental and applied research cannot escape this trend. Under these circumstances, it is difficult to support research in a single discipline or even in a wider field (such as the construction field), without taking into account inter- multi-, or transdisciplinary aspects, beyond the traditional boundaries.

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