



CROATIAN RESEARCH AND INNOVATION INFRASTRUCTURES ROADMAP



Ministry of Science, Education and Sports

Zagreb, April 2014



Special emphasis should be given to the development of modern and efficient research and innovation infrastructure, as a foundation for creating a dynamic model of development through the so-called knowledge triangle that includes education, research and innovation. In this period of difficult budget circumstances, major economic changes and global competition, the development of social values, international competitiveness, job creation, and, in general, raising the standard of living, depend on the innovative processes that are efficient in dealing with social challenges. Key factors for achieving these goals include development of intellectual capital and research infrastructure.

Therefore, the Ministry of Science, Education and Sports has set up Croatian Research and Innovation Infrastructures Roadmap aiming to boost scientific excellence, innovation culture and the application of scientific knowledge to benefit society and the lives of all citizens. Enabling strategic and efficient development of science and innovation is also a prerequisite for cooperation with European partners in future investments in selected national infrastructure projects, taking into account local, national and European interests.

The significance that science and innovation bear for the development of our society goes beyond the scope of theoretical discussion. That is why nowadays more and more countries acknowledge the key steps in fostering the development of innovation culture as strategic guidelines for their development. Every society has a potential for creativity and innovation, and how this potential is going to be used depends on a number of factors. Most of them are well known, but their identification and implementation require building on experience of others and creating your own innovation models of development.

A unique opportunity lies before Croatia to find its rightful place within the European Research Area with quality strategic documents, and feasible and sustainable plans. This Roadmap outlines and optimizes such opportunities so we can conduct investment programmes in the most efficient manner, and these recommendations are important guidelines.

Croatia is "a small country with big know-how", and it has, despite numerous challenges, maintained the awareness that certain core values are irreplaceable, and that is the only guarantee that the road we are taking will lead us to a happier and more meaningful society.

Content

INTRODUCTION.....	4
On Research and Innovation Infrastructure	4
Implementation of the Croatian Research and Innovation Infrastructures Roadmap	5
GUIDELINES FOR THE DEVELOPMENT OF RESEARCH INFRASTRUCTURE.....	6
Organization of Overall Research and Innovation Infrastructure	6
National Research e-Infrastructure.....	7
Principles of Smart Specialization	9
New Models of Cooperation within European Research Area	10
Balanced Financing of the Research and Innovation System	12
PRINCIPLES AND ADDITIONAL CRITERIA IN PROJECT EVALUATION OF RESEARCH AND INNOVATION INFRASTRUCTURE	15
NATIONAL PRIORITIES IN DEVELOPING RESEARCH AND INNOVATION INFRASTRUCTURE IN CROATIA	17
Biomedicine	19
Biotechnology.....	22
Natural Sciences.....	25
Engineering	26
Social Sciences and Humanities	30
Interdisciplinary Sciences.....	31
PAN-EUROPEAN RESEARCH INFRASTRUCTURES	34
CLARIN - ERIC - Common Language Resources and Technology Infrastructure	35
DARIAH - Digital Research Infrastructure for the Arts and the Humanities	35
C - ERIC - Central European Research Infrastructure Consortium	35
ELIXIR - the European Life-science Infrastructure for Biological Information	36
SHARE - ERIC - Survey of Health, Ageing and Retirement in Europe.....	36
ESS - European Social Survey.....	37
ANNEX 1 – PLAN OF INVESTMENT IN RESEARCH INFRASTRUCTURES ON AN ANNUAL BASIS FOR THE PERIOD 2014- 2020 AND FUNDING SOURCES IN EUROS (Funds of the Ministry of Science, Education and Sports, Ministry of Entrepreneurship and Crafts, and Ministry of Economy)	38
ANNEX 2 – INDICATIVE LIST OF RESEARCH INFRASTRUCTURE PROJECT PROPOSALS FOR EUROPEAN REGIONAL DEVELOPMENT FUND 2014-2020	39
ANNEX 3 – LIST OF CAPITAL EQUIPMENT AT PURCHASE PRICE HIGHER THAN 1,000,000.00 HRK.....	40

On Research and Innovation Infrastructure

Research and innovation infrastructure refers to a wide range of tools, facilities and other resources that are essential for the research community to conduct top quality research in all fields of science. New knowledge and innovation can only develop in environment with an adequate research infrastructure. Examples of infrastructure include: individual research installations of scientific equipment for complex experiments, special habitats, libraries, databases, archives, laboratory facilities, research vessels, measuring equipment, coastal observatories, telescopes, networked computer equipment, etc.

It should be noted that the term infrastructure also implies knowledge centers (centers of excellence and centers of competence) that provide services to the wider research community, and are based on a set of specific knowledge, techniques and skills.

Organizational units include different forms depending on the purpose and forms of research and innovation projects.

Croatian Research and Innovation Infrastructures Roadmap is the foundation for future investment in national and international (infrastructure) projects, taking into account the feasible financial framework. The Roadmap is a living document which means it will be continuously updated.

This document represents the first national Research and Innovation Infrastructures Roadmap with the purpose to identify research potential in Croatia in order to direct further development of research infrastructures. At the same time, the Roadmap should ensure support for the implementation of measures stated in the Strategy for Education, Science and Technology, the National Innovation Strategy and Smart Specialization Strategy.

The purpose of this document is not to provide a comprehensive list of research infrastructures, since the Ministry of Science, Education and Sports keeps the Research Infrastructure Register. This register is continuously updated and regularly published on the website of the Ministry of Science, Education and Sports¹. Information on open access research infrastructures throughout Europe in all fields of science can be found in a MERIL (Mapping of the European Research Infrastructures Landscape) database. This database which is continuously updated with data on research infrastructures that satisfy uniform requirements, also includes data on some Croatian research infrastructures, accessible through an interactive portal.

¹ The latest updated list is available at <http://public.mzos.hr/Default.aspx?art=12825&sec=2132>

Implementation of the Croatian Research and Innovation Infrastructures Roadmap

Successful implementation of Croatian Research and Innovation Infrastructures Roadmap requires several steps;

- to identify strategic directions for the development of infrastructure on national level;
- to enable the use of available EU funds and programs for recognized projects aimed at improving and building the research infrastructure;
- to encourage institutions to cooperate in planning and implementation of major infrastructure projects of national significance in order to avoid overlapping and to increase investment efficiency;
- to coordinate research infrastructure investment policies;
- to set out performance monitoring of public policies and investments in science;
- to lay the groundwork for long-term investment planning for major research infrastructure available to the research community;
- to harmonize the principles of use and integration into European infrastructures.

The Ministry of Science, Education and Sports appointed the Committee for Scientific Infrastructure whose task was to develop guidelines for drafting the Croatian Research Infrastructures Roadmap for the Republic of Croatia. The Committee has analyzed the research system, financing models and priorities for the following period in detail, taking into account the strategic documents of the ERA. Another conclusion of the Committee was that Croatian Research and Innovation Infrastructures Roadmap has to be related to the implementation of other strategic documents in the Republic of Croatia, primarily the Strategy for Education, Science and Technology, the National Innovation Strategy and Smart Specialization Strategy.

Therefore, the organizational forms of infrastructure operators should be established in a way that includes the overall human potential of the research community in Croatia. Particularly, the state should take appropriate measures to ensure the establishment, development, and finally, the sustainability of the innovation system. The primary prerequisite for this is providing conditions for the development and operation of research and innovation infrastructure.

Organization of Overall Research and Innovation Infrastructure

The Croatian national research and innovation infrastructure should be viewed as a whole whose aim is to ensure the smooth implementation of scientific and technological research and the further flow of knowledge and skills that can effectively contribute to social development and economic growth, all in line with the European initiative Innovation Union². The infrastructure should be established in such a way that its components are organizationally and functionally identifiable within the ERA and aligned with the preferences of key European policies. Accordingly, the system of research and innovation infrastructure should be developed with a focus on:

- infrastructure for cutting-edge research;
- infrastructure for research aimed at increasing industrial competitiveness, with particular emphasis on areas of key enabling technologies - KETs;
- infrastructure for addressing social challenges.

At the same time the Committee for Scientific Infrastructure highlights the development of e-Infrastructure that should be included in the basic settings of infrastructure development in general. On the one hand, it enables all components of the system to be functionally integrated with one another; on the other hand, it provides adequate software support in line with the requirements of the modern e-Science.

Specifically, research e-Infrastructure can serve as a framework for the establishment of both Croatian and European Research Area. Consequently, even in times of budget constraints, effort

² Innovation Union: A Europe 2020 Initiative: http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=hom

have to be made in order to continuously update the Croatian e-Infrastructure and connect all research locations via broadband communication grid³.

National Research e-Infrastructure

Continuous development of information and communication technology enables us to build integrated environments that radically reshape scientific and research activities. Computer simulations and knowledge extraction from huge amounts of data provide new insights into the phenomena of complex systems.

The e-Infrastructure, as a complex integrated environment based on information and communication technology, consists of a series of interconnected layers (components): advanced computer and communication network, computing and capacity resources located in data centers, intermediate layer responsible for authentication, authorization and accounting processes, data layer based on a digital repositories system, and information layer for operating information systems and to providing information services to users. It allows researchers access to devices and other resources, regardless of their geographic location. Furthermore, it supports new working methods based on cooperation and partnership of different research units around the Croatian and the European Research Area. The e-Infrastructure provides the framework for all research priorities and is therefore highlighted as a separate unit that precedes the description of the priorities themselves.

When planning development of the research e-Infrastructure it is necessary to bear in mind its connection and integration with the higher education e-Infrastructure system.

The e-Infrastructure within the European Research Area is composed of national research and education networks integrated into the common Pan-European research and education network - GÉANT, enabling broadband connection of other e-Infrastructure components. Computing and storage capacities are provided through the paradigm of distributed computing and clouds within the National Grid Infrastructures - NGIs composing the European Grid Infrastructure - EGI. Great computing power necessary for advanced computing is available via the European project PRACE (Partnership for Advanced Computing in Europe).

So far, coordinating and funding the development and maintenance of the e-Infrastructure layers was conducted by the Croatian Academic and Research Network CARNet (network layer: CARNet network) and the University Computing Center - SRCE (other e-Infrastructure layers: CRO NGI - National Grid Infrastructure, the Isabella Computer Cluster, AAI@EduHr - Authentication and Authorization Infrastructure, HRČAK - Portal of Scientific Journals of Croatia, etc.). The role of Ruđer Bošković Institute has to be mentioned since this institution has made a dignificant contribution to the data infrastructure. The Institute's library designed and maintains systems such as CROSBIBibliography, Šestar (database of instruments for scientific research), Who is Who in Coratian Science, FULIR (Full -text Institutional Repository of the Ruđer Bošković Institute) as well as systems

³ Guidelines for the strategy of education, science and technology: <http://public.mzos.hr/Default.aspx?art=11662>

for some other institutions (Faculty of Humanities and Social Sciences in Zagreb, National and University Library in Zagreb).

In order to ensure development, efficient and quality usage, as well as the sustainability of the national research e-Infrastructure in the following period, the following requirements need to be fulfilled:

- a) advanced computing and communication network that enables advanced network services and adequate and reliable broadband connection among all key research and innovation centers in Croatia, as well as the matching connection between them and other partner and associate centers in Europe and the world;
- b) adequate network of common high-reliability data centers for the accommodation of equipment and competent expert teams to support the operation and use of e-Infrastructure;
- c) adequate amount of high-performance computing systems necessary for a wide range of research and innovation projects;
- d) systems for cloud computing using the grid paradigm that allows organized use of processor capacities for complex computing and storing large amounts of data in a specifically organized manner;
- e) Cloud Computing Services that make up the complex high-performance research infrastructure with high degree of virtualization, and are based on advanced programming support from the domain of e-Science technologies; this infrastructure also enables a platform for implementing comprehensive research service applications;
- f) continued systematic use and expansion of the existing Authentication and Authorization Infrastructure AAI@EduHr for access, utilization analysis and calculation of research infrastructure components and resources, with emphasis on the possibility of the establishment and operation of virtual research organizations on a national and European level;
- g) establishment and systematic development of data e-Infrastructure layer that should produce systems and tools for exchanging, sharing and storing research data; primary and secondary research data are nowadays extremely valuable as the starting point of many research activities, and it is therefore necessary to ensure that the data are appropriately collected, described, reliably and permanently stored, and available to the community in a transparent manner;
- h) establishment and sustainable development of national branch (organized by fields of science) and institutional digital repositories that are actually infrastructure for collecting, storing and sharing research data and the basis for management, systematic care, use of and long-term public access to primary, secondary and tertiary research data. Since the scientific and research communities are nowadays turning to the world of digital information, the role of scientific repositories will be of great importance with regard to the amount of data and advanced tools needed to navigate through the collection of data and knowledge;
- i) promotion of open access to research data, especially data funded from public sources;
- j) continuous access to digital sources of data and information, especially commercial databases, and databases with open access to scientific and research data for all

members of the scientific and research community (researchers, teachers and students) in Croatia;

- k) development and maintenance of specialized data systems that would be the basis for management and operation of the research and innovation system, the basis for systematic gathering of data on research and cooperation related to research and innovation, its funding, achieved indicators and results, and the basis for formal evaluation and decision-making in the Croatian research and innovation system.

In line with the achieved results, competences and current situation, the coordination of implementation activities related to the research e-Infrastructure will be carried out by two existing central e-Infrastructure institutions in science and education - Croatian Academic and Research Network CARNet (points a, j) and the University Computing Center - SRCE (points b-i, k). In accordance with the General Principles for Establishing Infrastructure Objects, as host institutions, CARNet and SRCE will promote cooperation as well as joint action with all other research and innovation centers that may contribute to the development and maintenance of components and resources of the research e-Infrastructure. With regard to the development of 'lower' e-Infrastructure layers (points a-e) it is especially important to include all relevant institutions in science, especially the Faculty of Electrical Engineering and Computing and the Faculty of Organization and Informatics at the University of Zagreb, the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture at the University of Split, the Faculty of Engineering at the University of Rijeka, the Faculty of Electrical Engineering at the Josip Juraj Strossmayer University of Osijek, the Ruđer Bošković Institute, etc. The development of the data layer segment (points g-j) requires involvement and cooperation of other key institutions such as the National and University Library, other university libraries and libraries at higher education and research institutions, the Faculty of Humanities and Social Sciences in Zagreb, the Ruđer Bošković Institute, the Croatian State Archives, the Miroslav Krleža Institute of Lexicography, etc.

Principles of Smart Specialization

The Croatian Research and Innovation Infrastructures Roadmap will have to be aligned with the priorities stated in the Croatian Smart Specialization Strategy, as well as other strategic documents. The Smart Specialization Strategy is a strategic approach to the development of economic systems via targeted support to research and development. This strategy will serve as a basis for investment in research and development from the EU structural funds .

The basic principles of smart specialization:

- Alongside the existing research and innovation potential, we should also take into account other conditions such as geographic location, demographic conditions, climate, natural raw materials, social needs and potential markets in the region and outside the region;
- Selection of priority routes should not descend from the top down, but should arise from dynamic research and entrepreneurial processes;
- Specialization must have a competitive global perspective;
- Selection of priority directions should not be focused only on creating local knowledge in a domestic environment, but also on the knowledge and skills exchange with other

environments, and inclusion of that knowledge and skills into technological, organizational, marketing and social innovations;

- Well-designed specialization should optimally exploit Croatian comparative advantages for a clear positioning in an international context;
- Smart specialization does not mean favoring one sector or technology, but their mutual permeation by means of which appropriate innovative solutions are achieved.

New Models of Cooperation within European Research Area

The Horizon 2020 programme formulates specific measures and activities for expanding excellence and including more institutions in less developed regions with weaker results into applying research results and innovations, institutions that have the potential to develop into exceptional institutions capable of successful absorption of EU funds to finance their activities.

The *Teaming* activity is focused on establishing new centers of excellence or significantly improving the existing ones, while supporting the joint teamwork of exceptional institutions and the ones that have been less successful in research and innovation, despite their potential for achieving excellence. The Teaming activity is designed to help stimulate scientific excellence in the transition countries.

The *Twinning* activity supports consolidation of clearly defined fields of research in certain institutions through linking with at least two internationally-leading counterparts in Europe in a defined field.

The ERA *Chairs* activity is focused on carrying out structural changes in the institutions that have the potential to improve their research and innovation activities and achieving excellence through a transparent selection of exceptional scientists whose role is, in accordance with the institution's strategic plan, to ensure the implementation of the priorities of the ERA.

The mission of research and innovation in the field of Future Emerging Technologies (FET) is to turn Europe's excellent science base into a competitive advantage by uncovering radically new technological possibilities.

FET programmes have three complementary activities each of which focuses on different methodologies and includes not only new ideas but also long-term challenges.

FET Open supports early-stage joint science and technology research around new ideas for radically new future technologies.

FET Proactive nurtures emerging themes and communities by addressing a number of promising exploratory research themes.

FET Flagships support ambitious, large-scale, science-driven research aimed at grand interdisciplinary S&T challenges, including research projects anticipated by the research infrastructures roadmap.

Another excellent model of international cooperation as well as a public-private partnership is being developed at the European Institute of Innovation and Technology – EIT that develops programmes based on the concept of the so-called knowledge and innovation communities - KICs. KICs are based on the concept of the knowledge triangle that links education, research in economy and society. They include exceptional higher education institutions, research centers and companies with the aim of developing a pioneering concept of cross-border public-private partnerships. The minimum requirement for the formation of a KIC is a partnership of at least three institutions established in at least three different EU Member States, where one of the institutions must be an institution of higher education and one has to be a private company. KICs are primarily oriented towards creating a stimulating environment that will enable greater and more efficient private sector investments in identified fields of science. This concept is even more important if we consider the fact that the aim of the Roadmap, but also of the Smart Specialization Strategy and the Croatian Industrial Strategy 2014 - 2020, is to identify priority fields of science that would be interesting for future investment in the industry, ensuring an increase in the share of private investment in research and development, as well as stable economic growth and development.

So far three KICs have been established, with a focus on sustainable energy - KIC InnoEnergy, climate change – Climate-KIC, and information and communication society - EIT ICT Labs. In 2014, the EIT plans to establish three more KICs in areas dealing with healthy living (healthy living and active aging), raw materials and food for the future, whereas in 2018 three new KICs in areas of urban mobility, value-added production, and smart and safe societies are envisaged.

The KIC dealing with aspects of healthy living is especially interesting for Croatia, since the focus will be on one of the key challenges for the future - demographic changes caused by an aging population. At the same time, this is an interesting area because of the existing Croatian investments in biomedicine and health, but also due to the fact that the health and food sectors are already recognized as one of the priority investment areas.

In some sectors, due to their importance, complexity and challenges presented by the technologies, their duration and the investments required, public support for individual projects can be inefficient, and in these cases structured partnerships for joint production, financing and implementation of the objectives in the field of research and innovation are required. The European Commission has therefore proposed a package of legislative proposals for the establishment of public-private and public-public partnerships with the Member States within the framework of Horizon 2020. This package includes a total investment of 22 billion euros over the next seven years, using 8 billion euros from Horizon 2020 to incite a 10-billion-euro investment from the industry and a 4-billion-euro investment from the Member States. This will provide the necessary resources for comprehensive, long-term and venture initiatives in the field of research and innovation. They are essential for the strategic technological sectors with global competitiveness, which guarantee high-quality jobs and contribute to achieving the EU target of 20 % of GDP derived from production by 2020.

There are four legislative proposals for the establishment of public-public partnerships with the Member States in accordance with Article 185 of the Treaty on the Functioning of the European Union (TFEU) for the joint implementation of national research programmes. The proposals include the following:

- European Metrology Programme for Research and Innovation: to provide adequate, complete and applied metrology solutions to support innovation and industrial competitiveness, as well as measurement technologies for solving societal challenges such as energy, the environment and health;
- Eurostars 2: to foster economic growth and employment by promoting the competitiveness of small and medium-sized enterprises that conduct activities of research and development;
- The European & Developing Countries Clinical Trials Partnership: to contribute to reducing the social and economic burden caused by diseases associated with poverty;
- Active and Assisted Living Research and Development Programme: to improve the quality of life of older people and their nurses, and to increase the sustainability of the care system by improving the availability of products and services for active and healthy aging, based on information and communication technologies.

The Republic of Croatia addressed an official letter to the European Commission, expressing its intention to participate in the initiatives/partnerships in the European Research and Development Programme jointly undertaken by several Member States aimed at supporting small and medium enterprises engaged in research and development (Eurostars) and the European Metrology Programme for Innovation and Research (EMPIR).

Public-private partnerships in the field of research and innovation at EU level were first introduced in the Seventh Framework Programme for Research and Technological Development, and the main form of their implementation are the Joint Technology Initiatives, which are funded and partially carried out by the EU and the industry sector. Each proposed partnership has clearly defined targets for achieving progress in the following areas:

- Bio-based industry: the development of new and competitive bioindustry value chains which would replace the need for fossil fuels, and have a strong impact on rural development;
- Clean Sky: radically reducing the environmental impact of next-generation aircraft;
- Electronic components and systems: maintaining Europe's lead in the field of electronic components and systems, and opening the way towards faster exploitation;
- Fuel cells and hydrogen: the development of commercially sustainable and clean solutions in which hydrogen is used as a source of energy, and fuel cells as energy converters ;
- Innovative medicines: improving the health and quality of life of European citizens by providing new and more effective diagnostics and therapy such as new antibiotic therapy.

Balanced Financing of the Research and Innovation System

In a time when research and development focus on innovative activity in order to create new products, processes and services, thus contributing to the development of a competitive economy, there is a serious threat of unbalanced funding and of favoring particular levels of the research and innovation system. As a result, it is possible that the financing of infrastructure for cutting-edge research could be overlooked. It is therefore necessary to establish mechanisms that

will allow reasonable funding of various forms of research. The process of determining how to allocate resources is not easy, especially when the total funding is insufficient.

Allocation of budgetary funds for Horizon 2020 for the period from 2014 to 2020, adopted by the European Parliament, can serve as a basis for the evaluation of investments for individual levels of research. In this document, the budget provides:

- 27.8 billion euros (33 %) for cutting-edge research, 15 billion of which (18 % of the total budgetary amount) are allocated for frontier research;
- 20.3 billion euros (24 %) for the development of industrial leadership;
- 35.9 billion euros (43 %) for addressing societal challenges.

As stated above, the allocation of budgetary resources can be determined only after a detailed analysis, and the final decision must be in line with present needs, but also with the long-term strategic guidelines of the country.

The national competitiveness programme can only be implemented by establishing an adequate research and innovation infrastructure. Funding for the development of research infrastructure should be incorporated in the Croatian State Budget, and provided from the Croatian Science Foundation programmes, the European structural funds and programmes, and international research and innovation projects.

In addition to the funds from the Horizon 2020 Framework Programme, the main funding source for achieving the objectives from the Europe 2020 strategy, and the measures and activities from the National Reform Programme are the EU cohesion policy funds (ESI - European Structural and Investment Funds), or more precisely the following three funds:

1. Cohesion Fund - CF;
2. European Regional Development Fund – ERDF;
3. European Social Fund - ESF.

Structural funds are a kind of leverage that can, among other things, be used in the research and innovation infrastructure development. The implementation of ESI funds in Croatia will be carried out through two Operational Programmes (OPs):

1. Operational Programme Competitiveness and Cohesion;
2. Efficient Human Resources Operational Programme.

The European Commission has set 11 thematic objectives that specify the use of European Structural and Investment Funds. Each Member State must choose its investment priorities and define its specific goals within these set objectives. The key goals within the first objective, Strengthening Research, Technological Development and Innovation, are investment in science and research infrastructure, and development of connections and synergies between the entrepreneurship sector, R&D centers and higher education institutions. The proposed total allocation for the aforementioned objective is 534,792,165 euros. One of the main funding sources for this thematic objective is the European Regional Development Fund whose goal is to strengthen economic and social cohesion and diminish the disparities in regional development in the EU.

In addition to this thematic objective, it is important to note that some research infrastructure projects could also be financed through the second thematic objective, Enhancing Access to and Use and Quality of ICT – Digital Growth, with focus on the development of ICT infrastructure, products and services, enhancing ICT applications for e-government, e-learning, e-inclusion, e-culture and e-health and the development of broadband Internet. Part of the projects will be funded through the third thematic objective, Enhancing the Competitiveness of Small and Medium-Sized Enterprises, the Agricultural Sector and the Fisheries and Aquaculture Sector, and the fifth thematic objective, Promoting Climate Change Adaptation, Risk Prevention and Management. Furthermore, part of the funds for research infrastructure development could be allocated through the sixth and seventh thematic objective, Preserving and Protecting the Environment and Promoting Resource Efficiency and Promoting Sustainable Transport and Removing Bottlenecks in Key Network Infrastructures. Various projects on the indicative list of infrastructure projects of several ministries, including the Ministry of Science, Education and Sports, should be funded from these sources. Structural funds are also often used as the basis for public funding in order to promote innovation, research and development, with the aim of developing a stable and sustainable economic growth. Since sustainable growth and development depend on human resources, it is extremely important to emphasize that in the framework of the tenth thematic objective, Investing in Education, Training and Vocational Training for Skills and Lifelong Learning, activities that focus on education and the promotion of mobility and employment of young scientists should be financed.

PRINCIPLES AND ADDITIONAL CRITERIA IN PROJECT EVALUATION OF RESEARCH AND INNOVATION INFRASTRUCTURE

The Committee for Scientific Infrastructure has identified priority areas for investing in the following period, taking into account the principle of rational and socially responsible financing.

The principles for establishing and strengthening of national infrastructure are based on the following:

1. Strategic embeddedness
 - compliance with the Croatian strategic documents;
 - compliance with the European strategic guidelines;
 - ESFRI and ERIC compatibility (for national infrastructures).

2. Scientific potential
 - main purpose of infrastructure;
 - number of researchers with significant research potential;
 - significance of infrastructure for new scientific discoveries and innovation processes;
 - interdisciplinary character of the infrastructure;
 - uniqueness of the planned infrastructure on the national level (whether similar infrastructures are planned);
 - clear indicators of current scientific and professional productivity (scientific productivity, protection of intellectual property rights, licensing, patenting, competitive national and international projects, and projects in cooperation with businesses and the wider community, citations).

3. Usage, size and availability of the user base
 - groups of users that have access to the infrastructure, circumstances of the usage, and the size of these groups;
 - international interest in the infrastructure;
 - corporate and social interest in the infrastructure;
 - whether the use of the infrastructure by groups from other institutions implies fees.

4. Relevance for Croatia
 - the extent to which the planned infrastructure project contributes to the progress of a scientific field and the development of research institutions' competitiveness;
 - the relevance of planned infrastructure for the education of young researchers;
 - usage of research infrastructure for improving university teaching;
 - how infrastructure fits into the Croatian Research Area and innovation environment;
 - contribution of the the planned infrastructure to addressing some of the societal challenges.

5. Sustainability

- whether the infrastructure can be based on the existing technical solutions and equipment or its implementation requires further innovation;
- financing of the infrastructure operation;
- ability of the host institutions to cover the costs of operation and maintenance of the infrastructure;
- time schedule of the infrastructure development;
- ability of host institution to provide the necessary technical conditions for the establishment of the infrastructure and personnel trained for its maintenance;
- indicators of previous success in attracting infrastructure and research projects;
- prior efficacy in the commercialization of research results (patents, protection intellectual property rights, spin-off companies).

The applicability of these principles can vary slightly, depending on the type of research the infrastructure is intended for. When evaluating projects one should take into account multidisciplinary, interdisciplinarity and transdisciplinarity. The same principles are relevant for the evaluation of projects, i.e. their inclusion in other international research organizations and networks.

Bearing in mind the aforementioned general principles, the evaluation of projects for the establishment and strengthening of national infrastructure is carried out according to the following criteria:

- a) compliance with national and European scientific and technological strategies (for research infrastructure development);
- b) compliance with the relevant strategic document of the applicant;
- c) technical competence, i.e. maturity of the project;
- d) support of relevant ministries/local community in project implementation;
- e) the justification of the planned investment;
- f) demonstration of additional benefits for the economic growth (contribution to better cooperation of research and/or higher education institutions and businesses);
- g) demonstration of project sustainability;
- h) human resources needed for project implementation;
- i) demonstration of energy efficiency and use of renewable energy sources.

NATIONAL PRIORITIES IN DEVELOPING RESEARCH AND INNOVATION INFRASTRUCTURE IN CROATIA

One of Croatia's strategic objectives, in line with the Europe 2020 Strategy, is to improve scientific excellence. Regarding this objective, i. e. the increase in international visibility and reputation of the Croatian scientific community, but also the development of the economy and society as a whole, the National Science Council adopted the criteria for the establishment of scientific Centers of Excellence. The purpose of the scientific Centers of Excellence is the further development of Croatian science and its inclusion into the European Research Area, as well as encouraging participation in the EU research programmes and other international programmes.

Networks of excellence have been recognized among the project tasks in the implementation of the Western Balkans Regional Research and Development (R&D) Strategy for Innovation 2014-2020. The Republic of Croatia is one of the signatories of the Declaration on the Western Balkans Regional Research and Development (R&D) Strategy for Innovation. This Strategy represents an important strategic document at the regional level that identifies regional priorities such as the stability of the region and its integration into Europe. The basic goal of this Strategy is to foster the growth and competitiveness of the economy by strengthening the connections between science and industry. This can be achieved through science system financing reforms and strategic investments in the scientific and business sectors. Therefore, in determining priority areas, four main strategic objectives have been taken into account:

- better research base;
- cooperation between science and industry, and technology transfer;
- greater investment by the business sector into science and research, i. e. facilitating business innovation and the establishment of startups;
- better management of the science and research system.

Based upon these objectives, as well as extensive analyses of the system which have been carried out with the aim of determining priority areas of the Smart Specialization Strategy, where one of the important criteria was to identify overlapping areas of business sectors with the greatest potential (according to the categories in the Croatian National Classification of Economic Activities⁴) and the most successful areas of specific research, priority areas for future investments in research infrastructure have been determined. The total system analysis included a number of indicators, from competitiveness clusters as a starting point, a science system analysis, a higher education system analysis, an entrepreneurship analysis, but also analyses of KET areas and investments by innovation companies.

It is important to note that KET encompasses six basic technologies: micro/nanoelectronics, nanotechnology, photonics, advanced materials, industrial biotechnology and advanced manufacturing technologies, and that these technologies are a key source of innovation.

⁴ NKD – the National Classification of Economic Activities is used in the statistics system of the Republic of Croatia, and is in line with the NACE system (Nomenclature statistique des activités économiques dans la Communauté européenne), the European classification system of economic activities

In addition to areas identified in an analysis conducted for the purpose of drafting the Smart Specialization Strategy, the key priorities identified during the development of the Industrial Strategy were also taken into consideration in Roadmap priority-setting. This is important since the Industrial Strategy - along with the National Innovation Strategy, the Strategy for Education, Science and Technology, and Tourism Development Strategy - constitute an integral part of the Smart Specialization Strategy. Based on the analysis of the current situation, the context and model for possible future development, it was concluded that the following industrial activities have great potential and could therefore contribute to the growth and development of the industry:

- production of basic pharmaceutical products and pharmaceutical preparations;
- production of computer, electronic and optical products;
- production of fabricated metal products;
- computer programming, consultancy and related activities (ICT);
- production of electrical equipment;
- engineering and production of devices.

In addition to these activities, the analysis determined two other areas of industrial activity that could play a key role in the future economic growth and development, which are:

- food production;
- furniture production.

For the analysis of the R&D and innovation system in Croatia, numerous international indicators were used, such as the Innovation Union Scoreboard⁵, the Global Competitiveness Index⁶, the Global Innovation Index⁷ and the SCImago Journal & Country Rank⁸, but also the analysis of patent application processes and private sector investments in R&D activities (state aid for research and development projects). For the purpose of defining national priorities, previous investments in the research infrastructure from EU funds, such as REGPOT projects under the Seventh Framework Programme and the EU Pre-Accession Assistance funds (IPA), as well as investments from the State Budget, have also been considered.

In line with the above mentioned indicators, the priority areas for the development of research infrastructure in the Republic of Croatia are the following:

- Biomedicine
 - neurosciences;
 - immunology and microbiology;
 - biochemistry, genetics, molecular biology;
 - public health.
- Biotechnology
 - biotechnology;

⁵ http://ec.europa.eu/enterprise/policies/innovation/policy/innovation-scoreboard/index_en.htm

⁶ <http://www.weforum.org/issues/global-competitiveness>

⁷ <http://www.globalinnovationindex.org/content.aspx?page=GII-Home>

⁸ <http://www.scimagojr.com/>

- forestry and wood technology;
- sustainable agriculture, fisheries and aquaculture.

- Natural sciences
 - environmental science;
 - physics and astronomy;
 - chemistry.

- Engineering
 - ICT;
 - advanced materials and manufacturing processes;
 - safe and clean energy.

- Social Sciences and Humanities
 - demographic challenges;
 - inclusive, innovative, reflective and secure society;
 - national sciences of special importance.

- Interdisciplinary Sciences

It is important to note that the priority areas of the research infrastructure development will be reviewed and updated in accordance with the results of the monitoring and evaluation of project implementation and the actual needs of the research community. The Roadmap covers only a limited number of projects that the Republic of Croatia plans to finance, depending on the availability of funds. This is one of the reasons for the continuous revision of the Croatian Research and Innovation Infrastructures Roadmap.

This may mean that new sources of funding may lead to the existing projects being removed from the Roadmap, or new projects being included into it, in order to maintain the balance between national research priority areas, or because the individual projects listed in this Roadmap have not been funded. Other European countries generally revise their roadmaps every two or three years.

Biomedicine

- neurosciences;
- immunology and microbiology;
- biochemistry, genetics, molecular biology;
- public health.

Biomedicine is a multidisciplinary field of science that explores biological processes in the body and cells from a chemical, molecular, cellular, physiological and medical point of view. Croatian researchers have conducted many studies and infrastructure projects in this field, and in the field of biosciences in general. The funding was usually derived from a number of pre-accession funds

and programmes. Further investment in biomedicine is additionally supported by the fact that biomedicine is the most productive research field in Croatia, according to the data available on the SCImago Journal & Country Rank portal, i.e. in the Scopus database.

Some of the projects funded in the previous period include the equipping of the High-Tech Biomedical Center and the Proteomics Center at the University of Rijeka, as well as the Combining Stem Cells and Biomaterials for Brain Repair project at the University of Zagreb School of Medicine. The following projects are still being funded and implemented:

a) *Bio-Imaging Center*

The aim of this project is to enable all participants access to a wide range of modern light microscopy techniques, with the goal of raising the level of biological and biomedical research in Croatia. The project is an example of successful cooperation between the University of Zagreb, the Ruđer Bošković Institute and the Institute of Physics. It is important to note that the methods of modern light microscopy find wider use in genetics, cell biology, plant biology, microbiology, experimental and clinical medicine, biotechnology, forensics, environmental sciences, and in some areas of applied chemistry and physics. It is these and similar projects, which demand cooperation between various scientific and research institutions and allow open access to the use of research infrastructure. That will be an extremely important factor for the future development and investment in infrastructure projects.

b) *RapidCell*

The project RapidCell - Rapid Identification of Cells in a Clinical Environment aims to establish research infrastructure for biotypization of pathogens and tumor cells. The project leader is the Ruđer Bošković Institute and the research, conducted in cooperation with the Faculty of Food Technology and Biotechnology, University of Zagreb, is based on a new patent-protected reagent and computational method that is a product of several years of collaboration between numerous Croatian and foreign scientists. This original method is based on connecting biochemistry, genetics, proteomics and computing with clinical identification of tumors and pathogenic microorganisms, and provides a significant improvement in medical diagnostics, but can be implemented only in the food and pharmaceutical industries. The project is co-funded by the Science and Innovation Investment Fund (SIIF), within the Regional Competitiveness Operational Programme 2007-2013, and is worth 631,200 euros.

c) *INNOMOL*

The INNOMOL project is focused on the development of diagnostic, preventive and therapeutic methods and medicines for the treatment of major contemporary diseases, including tumors. The researchers from the Ruđer Bošković Institute will be creating the most sophisticated innovation and technology development infrastructure in the field of molecular sciences. Molecular biologists, chemists, biomedical scientists, bioinformaticians and others, explain different processes in living beings and model systems, and study the impact, for example, of potential new drugs on the genetic code, the chemical composition of cells, the concentration of different proteins, cell division and cell appearance, as well as other key processes in living organisms. The project is funded via the FP7-REGPOT scheme with 4.7 million euros, and is carried out over a period of three years.

d) INTEGRA-LIFE

The INTEGRA-LIFE project, conducted by the Faculty of Science, University of Zagreb, will functionally connect and strengthen the most important research groups in the field of glycoproteomics, epigenetics, genetic engineering, biochemistry and bioinformatics, in cooperation with 13 European partner organizations. The project encompasses the acquisition of a new generation of instruments for DNA analysis, glycan and macromolecular interaction analysis, as well as the advanced computer cluster for data analysis. The project is funded via the FP7-REGPOT scheme with 3.2 million euros, and is carried out over a period of three years.

e) GLOWBRAIN

The three-year project Combining Stem Cells and Biomaterials for Brain Repair - Unlocking the Potential of the Existing Brain Research through Innovative In Vivo Molecular Imaging (GLOWBRAIN) aims to introduce cutting-edge technology that will enable stem cell research and monitoring of the role of stem cells in the recovery of the experimental model brain. Along with the researchers from the Croatian Institute for Brain Research at the School of Medicine, University of Zagreb, researchers from seven European countries with expertise in the field of stem cell research, biomaterials and mouse brain scanning will also participate in the project and help Croatian scientists to successfully lead research activities in this area. The project is funded via the FP7-REGPOT scheme with 3.8 million euros.

f) CortexSTIM

The project Enhancement of Science-Business Cooperation for Intraoperative Neurophysiologic Technology in Croatia (CortexSTIM) is conducted by the School of Medicine at the University of Split. The project should result in producing a functional prototype of a new and innovative electrical brain stimulator (CortexSTIM) tested in collaboration with the University Hospital Dubrava, a successful transfer of knowledge and skills for its commercial use and an established protocol for the technology transfer of intraoperative neurophysiologic technology from applied research and development to commercial products (in collaboration with the Office of Technology Transfer at the University of Split). The project is co-funded by the Science and Innovation Investment Fund (SIIF), within the Regional Competitiveness Operational Programme 2007-2013, and is worth 407,320 euros.

g) *Becoming entrepreneurial: Knowledge transfer from the University of Rijeka Faculty of Medicine to the biotechnology business sector*

The aim of this project is to enhance innovation capabilities of the Faculty of Medicine (MEDRI) by using its potential for applied research towards biotechnology industry needs. In collaboration with the partner institution, Hannover Medical School, and eight associates from the Croatian and the EU academia and industry, MEDRI is implementing two strategic projects which will serve as a knowledge transfer and commercialization springboard. For the first one, the ultimate goal is the development of a prototype of a vaccine vector platform based on a live attenuated herpes virus. The total value of the project, co-funded via the Science and Innovation Investment Fund (SIIF), within the Regional Competitiveness Operational Programme 2007-2013, amounts to 486,300 euros.

The Ministry of Science, Education and Sports has a continuously open public call for proposals whose purpose is to select projects in the field of scientific, technological and educational infrastructure. The implementation of these projects could be financed from the European Regional Development Fund within the strategic objectives and priorities of the Regional Competitiveness Operational Programme. As part of the open public call for proposals for the European Regional Development Fund 2014-2020 infrastructure projects, in the forthcoming period Croatia plans to invest into several other projects in the field of biomedicine, depending on available assets from the EU funds and programmes. Two of these projects are listed on the indicative list of the Ministry of Science, Education and Sports projects.

h) *Center of Competence for Translational Medicine Srebrnjak*

The Center of Competence for Translational Medicine operates within the Srebrnjak Children's Hospital in Zagreb, and should enable an increase in capacities of the existing hospital with the purpose of establishing a competitive and innovative infrastructure for a new research paradigm that would conjoin clinical and basic research with practical application. The center aims to integrate different areas of top pediatrics and clinical trials with basic biomedical research units in order to help alleviate chronic childhood illnesses and develop innovative medicines and diagnostic procedures. The project is listed on the indicative list of research infrastructure project proposals for the European Regional Development Fund 2014-2020.

i) *Upgrading the Capacities for Research in Translational Medicine at the Faculty of Medicine University of Rijeka (TransMedRi)*

The project Upgrading the Capacities for Research in Translational Medicine at the Faculty of Medicine of the University of Rijeka (TransMedRi) is conceived to bring together quality research groups, as the framework for the development of translational medical research, in the following priority areas: immunology, cancer research, regenerative medicine and functional neuroresearch. The project will also connect other institutions within the University of Rijeka, such as the Department of Biotechnology, Department of Informatics, Faculty of Humanities and Social Sciences, Science and Technology Park (SteP-Ri) and the Clinical Hospital Center Rijeka (the future University Hospital). The project is listed on the indicative list of research infrastructure project proposals for the European Regional Development Fund 2014-2020.

Biotechnology

- biotechnology;
- forestry and wood technology;
- sustainable agriculture, fisheries and aquaculture.

Research in biotechnology must result in competitive, sustainable products and processes, innovative contributions in agriculture, food and medicine production, as well as improved health care. This activity based on new knowledge about living beings creates many new biochemical products. Biotechnology opens great possibilities for exploitation of marine resources and the sector of marine (blue) biotechnology is predicted to grow by 10 % annually. Research in this area

should contribute to a better understanding of the nutritional value of the food and thus increase its value and competitive advantage on the market. Agricultural production must increase, but it is also necessary to prevent its further expansion to marginal agricultural lands and sensitive ecosystems. In this regard, the solution can be found in economically, environmentally, socially and ethically sustainable agriculture, as a compromise between economic and environmental requirements. Priorities for the development include: the application of standards for quality control in line with EU standards, technological modernization of equipment and machinery, process technology modernization, improvement of ecological and typical products, vertical integration and exploitation of economies of scale, improvement in technical practice and farm management, and adoption of effective measures for controlling animal protection. Therefore, Croatia will be promoting projects that contribute to the development of new food technologies, particularly projects that involve more of above mentioned aspects.

Modern biotechnology is one of the drivers of innovative change in a variety of sectors: health care and pharmaceuticals, green technologies and food production, and it provides many opportunities for the development of new products and services. It is precisely this development of biosciences that will have a significant impact on the efficiency and competitiveness of some of the biggest and most important sectors of the Croatian economy - pharmaceuticals, agriculture and food production. Focusing on the development of modern biotechnology, Croatia has already funded a number of different projects.

It is important to note that the Institute of Oceanography and Fisheries is the main platform for carrying out national and international scientific projects in the field of fisheries and aquaculture. In addition to this, the Institute has been declared the Reference Maritime Center, and the Institute's Laboratory of Plankton and Shellfish Toxicity the National Reference Laboratory for Biotoxins.

The FORESTERRA project (Enhancing FOrEst REsearch in the MediTERRanean through Improved Coordination and Integration) is a project in the field of forestry, whose strategic goal is improving forest research in the Mediterranean region by strengthening scientific cooperation, as well as coordination and integration of research forestry programmes between the countries of the Mediterranean climate regions. Partners from 12 countries participate in the project: Spain, France, Italy, Turkey, Portugal, Tunisia, Morocco, Bulgaria, Slovenia, Croatia, Greece and Algeria as well as two international institutions (the European Forest Institute (EFI) and the International Centre for Advanced Mediterranean Agronomic Studies (CIHEAM)). The Croatian partner in the project is the Ministry of Science, Education and Sports. This is a project funded via the FP7 ERA-NET initiative, which began in January 2012 and will end in December 2015. The project was awarded about 2 million euros from the European Commission funds.

Also, the Croatian Forest Research Institute founded the Division for International Scientific Cooperation in Southeast Europe EFISEE. The Division cooperates with the European Forest Institute as part of the Croatian Forest Research Institute, following the contractual relationship which, in accordance with the autonomous status of the scientific institutes, allows for separate conclusions of international agreements. The significance of the Division for International Scientific Cooperation in Southeast Europe is also reflected in the importance of coordinating and promoting research, connecting forestry sectors in the region and the European Union, as well as the valorization of products derived from forests and the social role of forests.

Additionally, the Republic of Croatia is currently financing and implementing the following projects in biotechnology:

a) *BIOCentar*

The project Incubation Center for Bioscience and Technology Commercialization (BIOCentar) is the result of collaboration between the Ministry of Science, Education and Sports, the Business Innovation Croatian Agency - BICRO, the University of Zagreb and the City of Zagreb, and is funded through the Instrument for Pre-Accession Assistance. The project aims to set up a thematic incubator that will be able to provide the necessary infrastructure and services for the development of start-up companies in the field of bioscience. BIOCentar is located at the Borongaj university campus, but will serve as a national resource in developing a network of interested partners and regional contact points throughout Croatia. The planned infrastructure consists of commercial and laboratory premises for the needs of small high-tech companies, and the central laboratory for the custom development cycle of bioproducts. The project is worth 18.8 million euros.

b) *Enhancing EU Competitiveness of Croatian Wood Flooring Industry*

The project Enhancing EU Competitiveness of Croatian Wood Flooring Industry is a point of collaboration between the Laboratory for Wood in Construction at the Faculty of Forestry in Zagreb and the manufacturers of wooden floors across Croatia. The main goal of the project is to increase the capacities of the Laboratory for Wood in Construction with a view of achieving more efficient cooperation with the industry, the development of new methods of testing the properties of wood floors, improving the existing system of quality control and ultimately enhancing the EU competitiveness of the Croatian wood flooring industry. The project is co-funded through the Science and Innovation Investment Fund from the Regional Competitiveness Operational Programme 2007- 2013, and is worth 473,500 euros.

c) *Enhancement of collaboration between science, industry and farmers: Technology transfer for integrated pest management (IPM) in sugar beet as the way to improve farmer's income and reduce pesticide use*

The aim of the scientists from the Faculty of Agriculture in Zagreb and their colleagues from the Faculty of Agriculture in Osijek working together on this project is to implement the most favorable agro-technical measures and develop a strategy for the integrated protection of sugar beet from pests which ensures high yields, prevent pest outbreaks, reduce the use of pesticides and minimize damage. The budget of the project is to a great extent aimed towards the acquisition of necessary equipment. The project is funded through the Science and Innovation Investment Fund from the Regional Competitiveness Operational Programme 2007- 2013 and is worth 473,600 euros.

In the forthcoming period several other projects in biotechnology are to be funded and some projects in this field are already listed on the indicative list of infrastructure project proposals for the European Regional Development Fund 2014-2020, and one of them can also be found on the indicative list of the Ministry of Science, Education and Sports.

Acquisition of Semi-Industrial Equipment for the Development of Innovative Food Technologies is a project of the Faculty of Food Technology and Biotechnology in Zagreb, and the aim of the

project is to establish the Center for Innovative Food Technology. Modernized infrastructure and equipment of the Laboratory for Food Processes Engineering would improve the quality and availability of research for various partners (research and public institutions, businesses and the food industry).

The infrastructure project proposals indicative list for the European Regional Development Fund 2014-2020 of the Ministry of Regional Development and EU Funds, the Ministry of Economy and the Ministry of Entrepreneurship and Crafts, contains several other projects in this field that, among other things, are in compliance with the Thematic Objective 1 Research, technological development and innovation.

Natural Sciences

- environmental science;
- physics and astronomy;
- chemistry.

The term natural sciences usually includes mathematics, physics, geoscience, chemistry and biology. Natural sciences should not be viewed separately, but in relation to other scientific fields. This is particularly true in mathematics and physics, the two oldest scientific disciplines. Although mathematical knowledge is primarily abstract and theoretical, applied mathematics is essential for the development and emergence of numerous scientific and technical discoveries. Also, technological development that has significantly influenced the development of the society as we know it would be inconceivable without physics (electronic devices, mobile communication devices, nuclear energy applications). The progress in society could also not be possible without biology or chemistry, because it is precisely these two disciplines that are major contributors to the development of modern medical and pharmaceutical science, genetics, biochemistry, cell biology and general disciplines dealing with life processes at the molecular or submolecular level.

Considering horizontal significance of natural sciences, it is very important to enhance the further development of scientific disciplines within the natural sciences, not only by additional funding of research projects, but also by engaging in various international associations.

CERN

The Croatian Government reached a Decision on initiating the procedure for Croatian accession to associate membership in the European Organization for Nuclear Research (CERN). The main CERN project is the Large Hadron Collider - LHC whose main purpose is the analysis of the processes initiated by the high-energy collisions of protons and lead nuclei in order to provide answers to some of the fundamental questions of modern science. Besides the LHC, CERN also conducts other projects in high energy physics, such as the Antiproton Decelerator, linear accelerators, the CERN Neutrinos to Gran Sasso, the Alpha Magnetic Spectrometer. The first step towards full membership in CERN is achieving the status of an associate member. Annual membership fee at CERN for an associate member is approximately 830.000 euros.

ESA

The Republic of Croatia has also initiated the process of becoming a member of the European Space Agency (ESA). The membership in ESA is achieved in three stages. The first is a 5-year Cooperation Agreement, under which the signatory State is not required to pay a financial contribution to the Agency. It is possible to prolong the period. In the second five-year period, the State becomes the so-called European Cooperating State, and as such pays a fixed fee of one million euros per year. Only in the third stage does the State become a full member and is obliged to pay a fee, which is determined on the basis of GDP. In this final stage, the Member State has access to participation in various programmes and industrial activities, thereby optimizing the return on investment.

Center for Advanced Laser Techniques

Lasers and photonics have been recognized by the EU as one of the five Key Enabling Technologies (KETs), i.e. as priority areas for the development of European competitiveness. Given the importance of the application of lasers in various fields of science and technology in modern society, the plan is to establish the national center of excellence in the field of advanced laser techniques. The Center for Advanced Laser Techniques is based on the existing knowledge and expertise of researchers and research groups, as well as the already existing scientific infrastructures in the area of interaction of light and matter at the Institute of Physics in Zagreb. Apart from providing new breakthroughs in the field of basic research, this Center has great potential for the development of new technologies and applications. The synergistic effect of the project, which will bring together scientists from different areas of research in using the new laser infrastructure, is especially important. The basic infrastructure of the Center will be based on four thematic units: high-resolution laser spectroscopy, laser plasma and plasma science, nano- and biosystems and ultrafast dynamics.

Engineering

- information and Communication Technology;
- advanced materials and manufacturing processes;
- safe and clean energy.

The development of new materials and technologies largely stems from basic research in physics and chemistry and, nowadays, the development in this field cannot be expected without interdisciplinary and collaborative approaches. These materials are part of the solution for societal challenges as they enable better performance of products or services, lower energy consumption and sustainable degradation. This field includes research in multifunctional and construction materials used in innovative products, research in production methods and material processing, material management policies, material production for industry, and the development of test procedures, standardization and quality control. Research in advanced production technology and production processes must improve the present forms of industrial production and advance, knowledge-based procedures in order to keep production located in Europe. Technologies for creating companies of the future, increasing energy efficiency, improving energy management

processes, technologies for energy efficient buildings, sustainable production with reduced carbon emissions and sustainable business models are all priorities in this field. Taking into account these priorities, several projects have been financed from various funds:

a) *ARISE*

The ARISE project, co-funded by the Science and Innovation Investment Fund from the Regional Competitiveness Operational Programme 2007- 2013, worth 658,000 euros, will contribute to the development of technical infrastructure in the area of surface engineering for research and application of advanced surface layers using new PACVD technology. The Faculty of Mechanical Engineering and Naval Architecture in Zagreb, together with the Mechanical Engineering Faculty in Slavonski Brod, the Faculty of Engineering in Rijeka and the Institute of Metals and Technology in Ljubljana, as well as in cooperation with private companies, will acquire a new state-of-the-art PACVD device, which will advance scientific research and enable successful collaboration with the industry.

b) *ACROSS*

The project Center of Research Excellence for Advanced Cooperative Systems (ACROSS) aims at unlocking and strengthening the research potential of the Faculty of Electrical Engineering and Computing of the University of Zagreb (UNIZG-FER) in the area of cooperative systems related to robotics, networked-embedded systems and renewable energy systems. Possible applications of such cooperative systems are numerous: advanced flexible manufacturing, renewable and sustainable energy generation, home and office automation, transport, logistics, environmental monitoring, healthcare, security and surveillance, human augmentation, etc. The project is worth 3.4 million euros and is funded by the European FP7 Capacities Research Potential programme.

c) *Investigation of Geothermal Potential as a Renewable Heat Source in the Republic of Croatia*

A group of researchers at the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, in collaboration with the Croatian Geological Survey and researchers from the Royal Institute of Technology – KTH Stockholm, will conduct research on use of heat pumps, coupled with borehole exchangers connected to the ground, for heating and cooling of existing buildings. Research includes drilling of experimental boreholes that will be used for measuring ground thermal response (so-called TRT – thermal response test). Along with the drilling procedure, the geological supervision will be carried out with soil sampling and soil properties determination in order to fulfil the main objective of the project, i.e. to determine the thermal properties of shallow geothermal potential in characteristic regions throughout the Republic of Croatia. The project is funded by the Science and Innovation Investment Fund (SIIF), within the Regional Competitiveness Operational Programme 2007-2013, and is worth 509,700 euros.

d) *WILL4WIND – Weather Intelligence for Wind Energy*

The project is the result of recent research results and long-term experiences of analyzing wind conditions in the Republic of Croatia, created by scientists of the Meteorological and Hydrological Service. The success of the project will be evaluated at the locations of wind farms in the Sibenik-Knin County. Despite the fact that Croatia abounds in strong wind, the current production of

electricity from wind is still at a low level. The innovative weather forecasting system will provide accurate and reliable wind speed and direction forecasts at the locations of wind farms for a period of 6 hours to a few days. The project is funded by the Science and Innovation Investment Fund (SIIF), within the Regional Competitiveness Operational Programme 2007-2013, and is worth 536,000 euros.

e) CEEStructHealth

Scientists from the Faculty of Mechanical Engineering and Naval Architecture at the University of Zagreb, the Faculty of Electrical Engineering and Computing at the University of Zagreb and the Faculty of Civil Engineering at the University of Rijeka are working together to increase the competence of the Croatian HEIs (Higher Education Institutions) and industry in the areas of structural integrity, monitoring and the control of dynamically loaded engineering structures. The objective of the project is to establish a Centre of Excellence for structural health analysis and to establish cooperation between the involved HEIs and industry (KONČAR-Electrical Engineering Institute, Inc.) for mutual benefit. The project is funded by the Science and Innovation Investment Fund (SIIF), within the Regional Competitiveness Operational Programme 2007-2013, and is worth 693,000 euros.

f) MAGEF

The project Permanent Magnet Machine Technology for Boosting the Energy Efficiency in Traction and Marine Applications (MAGEF) in cooperation of the University of Zagreb, Faculty of Electrical Engineering and Computing and the University of Maribor, Faculty of Energy Technology will demonstrate the main features and benefits of permanent magnet technology through the development, design, manufacture and testing of prototypes of a typical traction motor for an electric tram and a motor for ship propulsion. For the implementation of these activities, new computer programmes for the design and optimization of permanent magnet motors will be developed and the existing programmes will be improved. The infrastructure will be established in the Laboratory of Electrical Machines at the Faculty of Electrical Engineering and Computing, required to conduct tests of prototypes of different electrical machines. The project is funded by the Science and Innovation Investment Fund (SIIF), within the Regional Competitiveness Operational Programme 2007-2013, and is worth 279,500 euros.

g) VISTA

A group of researchers at the University of Zagreb Faculty of Electrical Engineering and Computing joined forces together with the researchers at the University of Zagreb Faculty of Transport and Traffic Sciences and proposed the VISTA project focused on the application of advanced techniques of computer vision in road traffic. The project will result in the creation of several computer systems for traffic safety improvement, and in stronger ties with SMEs in the Croatian automotive sector. The project is funded by the Science and Innovation Investment Fund (SIIF), within the Regional Competitiveness Operational Programme 2007-2013, and is worth 685,000 euros.

At the moment there is no infrastructure in Croatia that would enable significant involvement in the development of this sector. Therefore, depending on the available funds, the Republic of

Croatia plans to finance a number of projects that are on the indicative list of infrastructure project proposals.

h) *Croatian Center for Advanced Materials and Nanotechnology (C2AMN)*

The largest infrastructure project in this field is the Croatian Center for Advanced Materials and Nanotechnology (C2AMN) conducted by the University of Zagreb, the Ruđer Bošković Institute and the Institute of Physics. These institutions have agreed to jointly develop an integral part of the North Campus project in Zagreb – a Center with adequate infrastructure that would enable the preparation, processing and characterization of advanced materials on both micro- and nanoscale. The center should demonstrate a new integrative approach in the science of advanced materials and nanotechnology that will enable long-term interdisciplinary research programmes with the aim of developing highly advanced technology in Croatia.

i) *Center of Excellence for Assessment of Structures*

Within this project, which is listed among other project proposals for the European Regional Development Fund 2014-2020 by the Ministry of Science, Education and Sports, theoretical and professional knowledge of four interdisciplinary research groups will be exchanged, including three partners from two universities and one collaborating institution from the business sector (KONČAR - Electrical Engineering Institute, Inc.). In order to develop an advanced wind turbine control system, extensive research will be performed on the KONČAR 2.5 MW-wind turbine during the project. The SIIF funds will be used not only for the acquisition of equipment, but also for the education of scientists, students and professionals from the industry via seminars, workshops and conferences.

A project that promotes the establishment of a data infrastructure cloud with the aim of further developing national e-infrastructures can also be found on the indicative list of infrastructure project proposals for the European Regional Development Fund 2014-2020 selected by the Ministry of Science, Education and Sports.

j) *Croatian Scientific and Educational Cloud (HR-ZOO)*

The main objective of the project conducted by the University Computing Centre (SRCE) is to establish computing and data clouds, as fundamental components of the national e-infrastructure. HR-ZOO is designed as a distributed, national e-infrastructure composed of grid resources nodes, high-performance computing resources nodes and cloud resources nodes. Computing and storage resources of the HR-ZOO will be installed in a network of national data centers in four cities: Zagreb, Split, Rijeka and Osijek. Resources and services will be available to all users and to research and higher education institutions. Computing and storage resources located in the HR-ZOO data centers will be interconnected but also connected to international infrastructures (European Grid Initiative - EGI , etc.), via redundant fiber links of the national academic and research network CARNet.

Social Sciences and Humanities

- demographic challenges;
- inclusive, innovative, reflective and safe society;
- national sciences of special importance.

Researchers in the field of social sciences and humanities increasingly require widely available and internationally networked research infrastructures, based on modern information technology. The development of such tools will significantly contribute to advanced research and analysis of human experiences, actions and decisions, and thus lay the foundations for the development of a reflective and innovative society, competitive business and industry, as well as an efficient public sector.

Social sciences and humanities will be fully integrated into each of the activities within the Horizon 2020 programme. This includes support for research of scientific excellence via the European Research Council, which includes Marie Skłodowska-Curie activities and research infrastructure.

Within the societal challenge recognized in Horizon 2020 as Inclusive, Innovative and Safe Societies, social sciences and humanities have a role in carrying out research in smart and sustainable growth, social changes, social innovations and public sector innovations.

Even though, the state has to take bigger role, interested parties in the economy sector also must be engaged in the field of research aimed at dealing with societal challenges. It is therefore necessary to solve the problem of cooperation of the government with research community by means of institutionalizing that cooperation. Resolving societal challenges will be much more effective if this cooperation is formalized in a sustainable manner. The research community, which is able to assemble competent domestic and even foreign experts, should be systematically involved in the process of resolving certain issues. In this way the funding, which is intended for dealing with societal challenges, will at the same time also contribute to the research community

Traditional research infrastructure for the humanities is related to libraries, archives and museum collections containing historical documents, books and magazines, maps, artifacts, artwork and other sources, scattered across various national institutions. Exploring the characteristics of the Croatian history, society and culture must be an integral part of the research area. Culture lies at the heart of every development. It marks the individual societies and social groups. Special attention has to be given to the preservation of the Croatian heritage in order to maintain the Croatian identity in globalization processes. The cultural sector can become a driver of economic activity and, in collaboration with the economy sector, especially tourism, assist in economic development and employment. The priorities in the social sciences should contribute to detecting focal points in the society and in relation to the environment, the development of harmonious relations and sustainable development with regard to individuals, society and the environment.

The humanities have a special role in Horizon 2020. With regard to that, the following research priorities in the field of the humanities are worth encouraging:

- a) ethical and bioethical issues - interdisciplinary related to all fields of science; biomedicine, biotechnology, natural sciences, engineering and social sciences;

- b) collection of documentation, recording and digitization of the Croatian literary, artistic, musicological, scientific, philosophical and theological heritage and archival materials, and their processing, publishing and research;
- c) collection, research and documentation of the Croatian archaeological, historic, art-historical, anthropological, ethnographic and ethnomusicological heritage in order to preserve the Croatian national identity;
- d) theoretical and applied research in all branches of philology;
- e) collection, presentation and study of the corpus of the Croatian language and literature;
- f) language technologies for the Croatian language;
- g) research of the world cultural (linguistic, literary, artistic) heritage, without which no national culture can equally participate in the European and world culture⁹.

Interdisciplinary Sciences

Cooperation between researchers in resolving complex issues often occurs at the crossroads of disciplines that have emerged in the academic community over time. Several terms are used for such cooperation such as interdisciplinarity, multidisciplinary and transdisciplinarity.

In a multidisciplinary approach of resolving an issue, researchers from several fields are involved, but each operates using exclusively methods of their own field. This is the lowest level of cooperation that does not require any structural changes to the research community nor do researchers have to change their point of view. When resolving the matter interdisciplinary, methodological procedures are transferred from one discipline to another. This approach requires changes in the researchers' way of thinking and the use of research equipment that is arranged in the research community in accordance with the traditional division of the disciplines. Interdisciplinary cooperation can produce new disciplines, and it can be seen as a kind of response to fragmentation of the research area that sometimes seems excessive.

Term transdisciplinary research has been in use lately. It involves organizing the knowledge required to resolve complex issues of a heterogeneous society. These issues go beyond certain existing components of the society and can be addressed effectively only via well-organized cooperation between academic community, economy sector and the society. Transdisciplinary approach therefore involves the engagement of the intellectual potential of the country, and of the global environment.

The Development of Research Infrastructure at the University of Rijeka Campus is just one of the projects funded from the Operational Programme Regional Competitiveness 2007- 2013, worth about 23.6 million euros.

The University of Rijeka intends to allocate prospective means towards equipping research centres and laboratories on the University of Rijeka Campus, which will ensure full functionality of three research centers in the field of nano-bio-info science and laboratory of the Faculty of Civil Engineering:

⁹ Guidelines for the Education, Science and Technology Strategy: <http://public.mzos.hr/Default.aspx?art=11662>

- Center for High Technology in Biomedicine;
- Center for Micro- and Nanoscience and -technology;
- Center for Advanced Computing and Modeling ;
- Laboratories at the Faculty of Civil Engineering that will be fully equipped and put into operation by the time the project ends: Laboratory for Hydrotechnical Engineering, Laboratory for Geotechnical Engineering, Road Safety Laboratory, Laboratory for Materials and Laboratory for Structures.

The project of equipping the campus laboratories will contribute to creating a strong and competitive research base in the field of natural sciences and engineering. It will also help develop applied research in accordance with the priorities defined in the strategic documents of the Republic of Croatia.

The Open Research Infrastructure Platforms for Innovative Applications in Economy and Society (O-ZIP) project is focused on the development of cutting-edge science via interdisciplinary thematic research. This is a five-year development project for open scientific platforms for research, application and transfer of knowledge and technology to society and the business community (pharmaceutical, food, chemical and electronics industries, biotechnology, ICT and other companies), based on the renewed infrastructure of various parts of institutes with the greatest commercial potential, further systematization and thematic guidance of the Ruđer Bošković Institute activities.

The Innovation Center will enable further development of relevant interests of institutes and research laboratories at the Faculty of Electrical Engineering and Computing in Zagreb and the implementation of innovation projects in an environment that is stimulating for early development and validation of technologies intended for commercialization. The Center should set up six research and development institutes aimed at development and facilitated commercialization of innovative technological solutions in the fields of energetics, robotics, biomedical engineering, information and communication technology, advanced component technology and transport. The Center will also be equipped with educational and presentation spaces, incubation space devoted to supporting the business spirit and entrepreneurship development, as well as other facilities.

The EuroFusion Consortium will operate within Horizon 2020 and will be responsible for implementing the Roadmap to the Realization of Fusion Energy. The consortium research areas are interdisciplinary, including interdisciplinary approach to physics, applied mathematics and mechanical engineering. The fusion infrastructure consists of linear plasma devices, ion accelerators with devices for development of radiation resistant material with one or two ion beams, neutron generators, laser plasma diagnostics devices, devices for the analysis of plasma exposed surfaces and materials exposed to strong radiation. The Croatian Fusion Research Unit (CRU), was established in early July 2013. by the Ruđer Bošković Institute, the Institute of Physics, the Faculty of Science in Zagreb, the Faculty of Electrical Engineering and Computing in Zagreb, the Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture in Split, and the University of Rijeka. The work of the EuroFusion Consortium will be fully funded by the agreement between the European Commission/Euratom and the Consortium. The Consortium will get 1.2 billion euros for the next five-year period. The Consortium will, therefore, be fully financed

from the EU budget. As a member of the EU and Euratom, Croatia has no additional financial obligations towards this Consortium, since it participates in the EU budget.

PAN-EUROPEAN RESEARCH INFRASTRUCTURES

Research infrastructure is a prerequisite for conducting research in a wide spectrum of areas ranging from the humanities and social sciences to astronomy, and genome research to nanotechnology. Along with the research equipment, the infrastructure also includes knowledge centers that provide services for wider research community, and are based on a set of specific techniques, skills and knowledge. Research infrastructure is crucial for European competitiveness in all areas and a key requirement for scientifically based innovations. Research in many fields is almost impossible without great computing power, clean rooms for nanotechnology, large-scale meteorological and geophysical observatories, laboratories for materials research and large repositories of data for the social and life sciences. Research infrastructures may refer to one place, be distributed or virtual. The infrastructure supports synergy and coherent approach to all research and educational endeavors and must be achieved through cooperation of European, national and regional funds.

Croatia is determined to follow European initiatives in the establishment and usage of research infrastructure and actively participate in some relevant infrastructure projects.

In accordance with the Horizon 2020 programme, cutting-edge research in borderline areas (frontier research) requires infrastructures that exceed the capacities of individual countries. With that in mind, in 2002 the European Commission established the European Strategy Forum on Research Infrastructures – ESFRI following the consent of all member states.

ESFRI allows all member states to express common interest in the construction and use of research infrastructures. The ESFRI Roadmap was first published in 2006, and revised in 2008 and 2010. The Roadmap identifies 48 projects of varying development stages that represent large pan-European infrastructures within six identified priorities:

- Social Sciences and Humanities;
- Environmental Sciences;
- Bioscience and Medical Science;
- Materials and Analytical Infrastructures;
- Energy;
- Physics and Applied Technologies.

In 2009 the European Commission supported the legal instrument designed for the establishment of future research infrastructures on the European level named the European Research Infrastructure Consortium (ERIC). ERIC provides a framework that regulates issues such as financing, taxation, procurement and other, making it easier for member states to participate in large infrastructures and providing large pan-European research infrastructures with legal personality recognized in all member states.

Research infrastructures have received a more prominent place within the Horizon 2020 framework, and it is likely that the costs of establishing and maintaining the ERIC projects will be covered from the funds of this programme. Therefore, precisely in order to ensure sufficient financial resources, it is necessary to establish a synergy between ERIC and investment projects

financed from the structural funds. Recognizing the importance and opportunities to participate in large transnational projects and consortia, Croatia has applied for membership in several ERIC consortia.

CLARIN - ERIC - Common Language Resources and Technology Infrastructure

The CLARIN project started in 2008 with the aim of building research infrastructure for the humanities and social sciences, in the form of a network of digital repositories that allow researchers across Europe access to digitized material. The CLARIN centers include universities, research institutes, libraries and public archives.

Since Croatia was still not a full member of the EU at the time the CLARIN-ERIC project was approved by the European Commission, it could not be considered a founding project member as was the case with other nine countries. The Croatian partner in the project is the Faculty of Humanities and Social Sciences in Zagreb.

The national fee is calculated in accordance with the GDP and the status of the Member State. For Croatia that means 12,000 euros per year, i. e. approximately 60,000 euros in the first five years. After the first five years the membership of a country is reevaluated. The first five-year period began in 2012.

DARIAH - Digital Research Infrastructure for the Arts and the Humanities

DARIAH is a project that aims to build virtual centers of competence (VCC), as well as e-Science Support in the field of the humanities. The idea of the project is to connect European archives, libraries, museums and other digital repositories in the humanities into one integrated virtual search engine in order to facilitate the access to the digitized material for researchers across Europe.

The initiative for DARIAH came from 10 partners from 14 European countries, including Croatia. The Croatian partner is the Institute of Ethnology and Folklore Research. The Ministry of Science, Education and Sports issued a letter of support for the project in 2007.

The financial contribution for participation in the DARIAH-ERIC is calculated based on the GDP of the Member States, as in the case of the CLARIN-ERIC consortium, and for Croatia it amounts to 3,247 euros in direct (In Cash) and 29,226 euros in indirect form (In Kind). Indirect participation fee will be partly covered by the institutions that have expressed interest in participating.

C - ERIC - Central European Research Infrastructure Consortium

The Central European Consortium of Research Infrastructures (C-ERIC) will connect research infrastructures of many countries in the region, such as Italy, Austria, Slovenia, Hungary, Romania, Serbia and others. The C-ERIC project covers a broad research area of materials science (a field that includes an interdisciplinary approach to physics, chemistry, computer science, applied

mathematics and mechanical engineering) at the nanolevel, including connections with biomaterials and structural biology.

The Republic of Croatia signed a joint declaration on the implementation of the C-ERIC consortium in August 2012, but until this day no Croatian laboratory have been included in the activities of the consortium. The RBI Accelerator Laboratory is in the final stages of negotiations to become an associate laboratory in the C-ERIC consortium. Once established, the Croatian Center for Advanced Materials and Nanotechnology (C2AMN) with more than 200 scientists involved in the field of advanced materials, should assume the role of a regional partner. The support to the participation in the work of the C-ERIC consortium was also expressed by the University of Rijeka, who proposed that the Center for Micro- and Nanosciences becomes the regional partner.

The foundation of cooperation is the equal partnership approach, i. e. the planned cooperation is based primarily on indirect contributions, while the necessary funding is to be provided from the funds of the Horizon 2020 Operational Programme and the structural funds.

Croatia is also considering to join the following ERIC consortia:

ELIXIR - the European Life-science Infrastructure for Biological Information

ELIXIR aims to establish a sustainable infrastructure to support research activities in the field of life sciences, as well as their translating to medicine, the environment, industry and society at the European level. The project was launched in 2007 by the European Molecular Biology Laboratory (EMBL) and the European Molecular Biology Organization (EMBO), and it includes 32 organizations from 15 European countries.

Croatia has the status of the observer and is being considered for full membership. Potential users are the research groups from the Faculty of Science in Zagreb, the Ruđer Bošković Institute, the Faculty of Food Technology and Biotechnology and the Faculty of Electrical Engineering and Computing in Zagreb, the University of Rijeka, the University of Split, and MedILS.

Financial obligations would amount to several thousand euros per year, and since Elixir still does not have the ERIC status, preliminary activities will be financed by the structural funds.

SHARE - ERIC - Survey of Health, Ageing and Retirement in Europe

The Survey of Health, Ageing and Retirement in Europe (SHARE) is conceived as a project that will help researchers understand the impact of population ageing on European societies, providing a basis for new health, social and economic policies. SHARE is a multidisciplinary and multinational database of microdata on health, socio-economic status and social and family ties for more than 85,000 people aged 50 and above and their partners, from 19 European countries and Israel. In 2011 it became the first project with the ERIC status. Although the SHARE-ERIC infrastructure is located at the University of Tilburg/Netspar in the Netherlands, the consortium is coordinated at the Center for the Economics of Aging at the Max Planck Institute for Social Law and Social Policy

in Munich. SHARE is aligned with research on health and ageing conducted in the USA and with the English Longitudinal Study of Ageing (ELSA), and has become a model for more studies on ageing around the world .

Membership fees in the SHARE-ERIC depend on the financial situation of the whole project and the availability of certain funding sources. The estimated cost of participation in the research in the period 2013-2015 would amount to 400,000 euros.

ESS - European Social Survey

In 2001 The European Science Foundation launched the European Social Survey project for the purpose of continuous monitoring of changes in the socio-political attitudes and value systems of the European citizens. The European Social Survey - ESS) is a study that explains the interaction between the changing institutions and attitudes, beliefs and behavior patterns in different European populations. The infrastructure is of particular importance to political scientists, sociologists, psychologists, economists and demographers. The survey is conducted every two years in order to gain better insight in the course of these changes and to allow comparisons between European countries.

Croatia has so far been involved in the two rounds of the Survey. The field research was conducted by researchers from the Institute of Social Sciences Ivo Pilar and funded by the Croatian Science Foundation and to a lesser extent by the Institute itself. Although previous research cycles were successful and enabled comparison using different parameters, since 2012 Croatia is no longer involved in the ESS research.

The ERIC status of the ESS is in its final stage. Croatia would have to pay membership fee around 20,000 euros in the first year, and for each subsequent year the fee would grow by 3 %. In addition to membership fees, it is necessary to allocate around 53,000 euros for one cycle of field research, necessary to ensure the benefits of participation in this project.

ANNEX 1 – PLAN OF INVESTMENT IN RESEARCH INFRASTRUCTURES ON AN ANNUAL BASIS FOR THE PERIOD 2014-2020 AND FUNDING SOURCES IN EUROS (Funds of the Ministry of Science, Education and Sports, Ministry of Entrepreneurship and Crafts, and Ministry of Economy)

	2014.	2015.	2016.	2017.	2018.	2019.	2020.	2021.	2022.	2023.
Total EU assets	254.247.200	37.064.000	99.304.000	101.209.000	133.129.000	139.513.000	145.897.000	151.369.000	141.337.000	98.473.000
Total EU assets	254.247.200	37.064.000	99.304.000	101.209.000	133.129.000	139.513.000	145.897.000	151.369.000	141.337.000	98.473.000

ANNEX 2 – INDICATIVE LIST OF RESEARCH INFRASTRUCTURE PROJECT PROPOSALS FOR EUROPEAN REGIONAL DEVELOPMENT FUND 2014-2020

The indicative list of research infrastructure project proposals for the European Regional Development Fund 2014-2020 that were submitted to the Call for Proposals in four rounds (31 December 2011, 30 June 2012, 30 December 2012, and 30 June 2013) so far includes 12 project proposals for research infrastructure. It should be noted that more rounds of Call for Proposals will be carried out, thus the list will be updated according to the results of the evaluation. In line with that, it is not possible to know at this moment which of the projects will actually be funded through the European Regional Development Fund.

Indicative List of Research Infrastructure Project Proposals for the European Regional Development Fund 2014-2020 (in alphabetical order)	
Project Name	Applicant
Center of Competence for Translational Medicine Srebrnjak	Srebrnjak Children's Hospital
Center for Advanced Laser Techniques	Institute of Physics
Upgrading the Capacities for Research in Translational Medicine at the Faculty of Medicine University of Rijeka - TransMedRi	University of Rijeka, Faculty of Medicine
Croatian Center for Advanced Materials and Nanotechnology (C2AMN)	Ruđer Bošković Institute, Institute of Physics, University of Zagreb
Croatian Scientific and Educational Cloud HR-ZOO	University Computing Center (SRCE), University of Zagreb
Innovation Center	University of Zagreb, Faculty of Electrical Engineering and Computing
Acquisition of Semi-Industrial Equipment for the Development of New Food Technologies	University of Zagreb, Faculty of Food Technology and Biotechnology
Open Research Infrastructure Platforms for Innovative Applications in Economy and Society - O-ZIP	Ruđer Bošković Institute
CECOAET Project – Center of Competence for Advanced Energetics and Clean Transport	KONČAR – Institute of Electrical Engineering , Inc.
Funishing of Newly-Built Facility for Experimental Animals at the University of Split	University of Split
Technology and Innovation Center Virovitica	Virovitica-Podravina County
Technology Park Varaždin - Center of Competence for Renewable Energy Sources	City of Varaždin

ANNEX 3 – LIST OF CAPITAL EQUIPMENT AT PURCHASE PRICE HIGHER THAN 1,000,000.00 HRK

Equipment	Institution	Contact	Year of Purchase	Manufacturer	Purchase Price	Year of Manufacture	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Integrated System for Glycan Analysis	University of Split, School of Medicine	Ozren Polašek	2008	Waters Corporation, USA	983,600	2007	10	80
XPS (X-ray Photoemission Spectroscop)	University of Rijeka	Mladen Petravić	2009	SPECS, Berlin, Germany	1,800,000	2009	15	40
MIS-233-1-67-1- Automatic control type portable undrained ring shear test apparatus with standard accessoris (1set)	University of Rijeka, Faculty of Civil Engineering	Nataša Ilić-Huserik	2012	Marui Company, Osaka, Japan		2012	10	10
Navigation Simulator NTPro 4000	University of Rijeka, Faculty of Maritime Studies	Đani Šabalja	2008	Transas St Petersburg	2,400,000	2008	10	150
Transas ERS 4000 ver.7.3	University of Rijeka, Faculty of Maritime Studies	Josip Orović	2007	Transas St Petersburg	1,000,000	2007	10	68

Equipment	Institution	Contact	Year of Purchase	Manufacturer	Purchase Price	Year of Manufacture	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Distributed parallel computer	University of Zagreb, Faculty of Science	Branko Grisogono	2008	ECS	13,195,212	2008	6	50
Tescan Vega	University of Zagreb, Faculty of Science	Vladimir Bermanec	2003	Tescan	1,403,664	2002	10	75
CAD/CAM Clothing Construction System	University of Zagreb, Faculty of Textile Technology	Slavenka Petrak	2004	Human Solutions, Lectra Systemes, Optitex	2,500,000	2003	10	200
Scanning electron microscope with EDS detector	University of Zagreb, Faculty of Textile Technology	Zorana Kovačević	2009	TESCAN, BRNO, CZ	1,397,246	2009	5	90
Measuring system for high-tech assembling of clothing and technical textiles	University of Zagreb, Faculty of Textile Technology	Dubravko Rogale	2010	Various manufactures	1,200,000	2010	10	100
Measuring system for studying thermal properties of composites and clothing	University of Zagreb, Faculty of Textile Technology	Dubravko Rogale	2010	Jena - optic, Mikrotakt, Faculty of Textile Technology	2,000,000	2010	15	120

Equipment	Institution	Contact	Year of Purchase	Manufacturer	Purchase Price	Year of Manufacture	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Flow cytometer Becton Dickinson FACSVerse	University of Rijeka, Faculty of Medicine	Mirjana Kunišek	2012	Becton Dickinson international, Er embodegen, Belgium (supplier Gorea plus d.o.o., Sveta Nedelja)	903,304	2011	10	30
Transmission electron microscope FEI-Philips EO-Morgagni	University of Rijeka, Faculty of Medicine	Mirjana Kunišek	2002	Philips Morgagni (supplier Kaltim Zagreb d.o.o., Zagreb)	1,107,928	2002	10	15
IVC equipment for experiments with lab mice in SPF conditions	University of Rijeka, Faculty of Medicine	Mirjana Kunišek	2008	Tecniplast, Italija (supplier Frank analab d.o.o., Zagreb)	1,049,880	2008	10	40
Laser scanning confocal microscope with interface	University of Rijeka, Faculty of Medicine	Mirjana Kunišek	2011	Carl Zeiss (supplier Carl Zeiss d.o.o., Zagreb)	2,250,000	2011	10	15
Next generation genome sequencing device	University of Rijeka, Faculty of Medicine	Mirjana Kunišek	2013	LIFE TECHNOLOGIES, USA (supplier Biosistemi d.o.o., Zagreb)	650,000	2013	10	20

Equipment	Institution	Contact	Year of Purchase	Manufacturer	Purchase Price	Year of Manufacture	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Small animal live-imaging system	University of Rijeka, Faculty of Medicine	Mirjana Kunišek	2011	Carestream Molecular Imaging, USA (supplier Koncept lab d.o.o., Zagreb)	1,201,000	2011	10	10
High-speed cell analyzer and sorter BD FACSAria TM	University of Rijeka, Faculty of Medicine	Mirjana Kunišek	2007	Becton Dickinson (supplier Medias d.o.o., Zagreb)	2,040,550	2007	10	30
DLOV tunnel autoclave	University of Rijeka, Faculty of Medicine	Mirjana Kunišek	2004	De lama spa, Italy (import)	1,026,984	2004	10	40
Transas ERS 4000 ver.7.3	University of Rijeka, Faculty of Maritime Studies	Josip Orović	2007	Transas St Petersburg	1,000,000	2007	10	68
Inductively coupled plasma mass spectrometry (ICP - MS) Agilent	Institute for Medical Research and Occupational Health, Zagreb	Jasna Jurasović	2008	Agilent Technologies	925,501	2008	20	15

Equipment	Institution	Contact	Year of Purchase	Manufacturer	Purchase Price	Year of Manufacture	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Digital Gamma ray spectrometer with detector and adequate electronic equipment	Institute for Medical Research and Occupational Health, Zagreb	Gordana Marović	2002	ORTEC, USA	1,161,094	2002	20	20
Liquid chromatograph IC-ms/ms	University of Osijek, Faculty of Food Technology and Biotechnology	Jurislav Babić	2006	APPLIEDEF BIOSYSTEM	996,903	2006	10	53
Femtosecond laser system	Institute of Physics, Zagreb	Ticijan Ban	2004	Laser Systems-Spectra Physics, USA	2,387,538	2003	15	11
Scanning tunneling microscope system - STM	Institute of Physics, Zagreb	Marko Kralj	2010	SPECS GmbH	1,112,000	2006	10	20
FPG 7100 2 L	University of Zagreb, Faculty of Food Technology and Biotechnology	Sven Karlović	2009	Stansted Fluid Power, United Kingdom	1,475,410	2009	10	10
Mission control station (MCS)	Pastor grupa d. d.	Domagoj Milošević	2008	SOKO	1,021,579	2008	10	

Equipment	Institution	Contact	Year of Purchase	Manufacturer	Purchase Price	Year of Manufacture	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Liquid chromatograph-mass spectrometer (LC/MS/MS) LCMS 6410	Croatian Veterinary Institute, Zagreb	Dražen Štefanović	2007	Agilent Technologies	1,519,173	2007	15	3
Liquid chromatograph with mass detector (LC/MS/MS)	Croatian Veterinary Institute, Zagreb	Dražen Štefanović	2011	Agilent Technologies	1,429,195	2011	15	3
UHPLC instrument with LC/MS triple quadrupole spectrometer	Croatian Veterinary Institute, Zagreb	Dražen Štefanović	2013	Agilent Technologies	1,878,478	2013	15	3
Reference force standard KBNM-500 kn	University of Zagreb, Faculty of Mechanical Engineering and Naval Architecture	Željko Alar	2005	GTM Gassmann Theiss Messtechnik GmbH	1,605,306	2005	15	260
Experimental greenhouse	Institute for Adriatic Crops and Karst Reclamation, Split	Mira Radunić	2003	Schwarzman, Slovenia	1,438,398	2003	20	29
Scanning electron microscope: SEM - TESCAN VEGA TS5136LS	University of Zagreb, Faculty of Metallurgy, Sisak	Mirko Gojčić	2008	SEM-TESCAN VEGA – Czech Republic	827,992	2007	10	35

Equipment	Institution	Contact	Year of Purchase	Manufacturer	Purchase Price	Year of Manufacture	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Affymetrix GeneChip System 3000 7G	University of Zagreb, School of Medicine	Fran Borovečki	2003	Affymetrix	1,531,566	2003	15	50
BD FACS ARIA 3L	University of Zagreb, School of Medicine	Drago Batinić	2007	Becton Dickinson	2,908,960	2007	15	2
FTIR and Raman spectrometer	University of Zagreb, School of Medicine	Ozren Gamulin	2003	Perkin Elmer	1,600,000	2003	20	26
Advanced MR image acquisition and analysis module	University of Zagreb, School of Medicine	Petra Kalember	2007	Siemens d.d.	3,531,800	2007	10	36
Hamamatsu Histologic Glass Slide Scanner	University of Zagreb, School of Medicine	Željko Krsnik	2012	Hamamatsu	645,000	2011	unlimited	10
Micro CT device	University of Zagreb, School of Medicine	Igor Erjavec	2009	SkyScan, Bruker, Belgium	1,818,487	2009	7	12
Mass spectrometer Orbitrap Discovery	University of Zagreb, School of Medicine	Ruder Novak	2008	Thermo Fisher Scientific	2,623,300		10	7
LC-MS system	Institute of Oceanography and Fisheries, Split	Josip Poljak	2009	Agilent echnologies		2009		

Equipment	Institution	Contact	Year of Purchase	Manufacturer	Purchase Price	Year of Manufacture	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Oceanographic beacon - 3 pieces	Institute of Oceanography and Fisheries, Split	Josip Poljak	2004		4,201,631	2004		
Polaris ship bridge simulator	University of Dubrovnik	Ivo Domijan Arneri	2012		1,057,350		15	
Engine room simulator	University of Dubrovnik	Ivo Domijan Arneri	2013		1,876,250			218
Cloud infrastructure servers	University Computing Center (SRCE)	Dubravka Klibert Dobrić	2011	HP	910,996	2011	6	135
CRO NG/EGI grid infrastructure servers	University Computing Center (SRCE)	Dubravka Klibert Dobrić	2009	SUN	1,450,271	2009	6	123
Isabella computer cluster servers(HPC)	University Computing Center (SRCE)	Dubravka Klibert Dobrić	2007	SUN	1,005,596	2007	4	182
Isabella computer cluster servers(HPC))	University Computing Center (SRCE)	Dubravka Klibert Dobrić	2012	HP	825,055	2012	4	182
Broadband NQR spectrometer	University of Zagreb, Faculty of Science	Miroslav Požek	2009	Tecmag, Janis, Messer, LeCroy	1,600,000	2009	10	40

Equipment	Institution	Contact	Year of Purchase	Manufacturer	Purchase Price	Year of Manufacture	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Broadband NMR spectrometer	University of Zagreb, Faculty of Science	Miroslav Požek	2010	Oxford Nanoscience, Techmag, RohdeSchwarz	2,000,000	2010	10	50
18T Superconducting magnet with VTI and He3 cryostat	University of Zagreb, Faculty of Science	Mario Basletić	2003	Oxford instruments, Oxfordshire, United Kingdom	1,000,000	2002	12	23
Oxford Diffraction Xcalibur 3	University of Zagreb, Faculty of Science	Dubravka Matković-Čalogović	2002	Oxford diffraction	2,211,681	2002	10	700
Bruker Equinox 55 spectrometer with Raman FRA 106-s module	University of Zagreb, Faculty of Science	Snežana Miljanić	2002	Bruker Oprit GMBH	1,051,966	2001	10	70
Isabella computer cluster servers(HPC))	University Computing Center (SRCE)	Dubravka Klibert Dobrić	2012	HP	825,055	2012	4	182
PALM MicroBeam laser microdissector with LMOC technology	University of Zagreb, Faculty of Science	Vedrana Vičić	2006	Carl Zeiss d.o.o.	1,022,440	2006	10	35

Equipment	Institution	Contact	Year of Purchase	Manufacturer	Purchase Price	Year of Manufacture	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
FEI-PHILIPS EO-MORGAGNI transmission electron microscope	University of Zagreb, Faculty of Science	Petra Peharec Štefanić	2002	FEI, Eindhoven, Netherlands	1,639,344	2002	20	30
Applied biosystems 4800 plus maldi tof/tof analyzer with protein pilot workstation	Ruđer Bošković Institute, Zagreb	Mario Cindrić, Anita Horvatić	2008	Applied Biosystems	2,624,835	2008	10	1280
Confocal laser scanning microscope	Ruđer Bošković Institute, Zagreb	Igor Weber	2003	Leica Microsystems	2,100,000	2003	15	36
Model 9501 Cockcroft-Walton accelerator - neutron generator	Ruđer Bošković Institute, Zagreb	Saša Blagus	1970	Texas Nuclear Corporation, Austin, USA		1968	43	
Philips PW 1730/10 X-ray diffractometer	Ruđer Bošković Institute, Zagreb	Biserka Gržeta	2002	Philips, Netherlands	1,100,000	2000	4	30
Philips MPD 1880 X-ray diffractometer	Ruđer Bošković Institute, Zagreb	Biserka Gržeta	1990	Philips, Netherlands	2,000,000	1990	4	30
Raman Spectrometer Horiby Jobin Yvon T64000 and Coherent Innova Argon ion laser 400	Ruđer Bošković Institute, Zagreb	Mile Ivanda	2007	Horiby Jobin Yvon	2,250,000	2007	15	80

Equipment	Institution	Contact	Year of Purchase	Manufacturer	Purchase Price	Year of Manufacture	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
1.0 MV HVE Tandatron accelerator	Ruđer Bošković Institute, Zagreb	Milko Jakšić	1987	High Voltage Engineering, NEC, HVEE, Danfysik, Pfeiffer, etc.	30,000,000	1962	20	81
1.0 MV HVE Tandatron accelerator	Ruđer Bošković Institute, Zagreb	Milko Jakšić	2004	HVEE, NEC, Danfysik, Pfeiffer, etc.	7,500,000	2004	20	81
Liquid chromatography-mass spectrometry HPLC-MS	Ruđer Bošković Institute, Zagreb	Ivanka Jerić	2008	Agilent Technologies	981,841	2008	10	112
Liquid chromatography-mass spectrometry	Ruđer Bošković Institute, Zagreb	Saša Kazazić	2011	Bruker Daltonik	2,241,560	2011	7	50
Xcalibur Nova R X-ray diffractometer	Ruđer Bošković Institute, Zagreb	Marija Luić	2007	Oxford Diffraction Ltd.	2,300,000	2007	10	63
Panoramic cobalt-60 gamma irradiator	Ruđer Bošković Institute, Zagreb	Branka Mihaljević	2000	TECHNABSEXPORT		2000	0	100
High-resolution inductively coupled plasma mass spectrometer	Ruđer Bošković Institute, Zagreb	Nevenka Mikac	2002	Thermo Finnigan, Bremen, Germany	2,400,000	2002	15	8
KJLC CMS-18 Sputtering system	Ruđer Bošković Institute, Zagreb	Nikola Radić	2003	Kurt J. Lesker Co.	1,800,000	2003	15	55

Equipment	Institution	Contact	Year of Purchase	Manufacturer	Purchase Price	Year of Manufacture	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Bruker FT-EPR 580 E	Ruđer Bošković Institute, Zagreb	Boris Rakvin	2002	Bruker	2,968,903	2002	20	30
High-resolution scanning electron microscope	Ruđer Bošković Institute, Zagreb	Mira Ristić	2005	Jeol, JAPAN	3,241,146	2004	15-20	300
MALDI Biotyper	Ruđer Bošković Institute, Zagreb	Snježana Kazazić	2011	Bruker Daltonik	1,006,873	2011	7	100
ClearPet	Ruđer Bošković Institute, Zagreb	Alfred Švarc	2011		3,000,000	2011	6	20
Atomic force microscopy (AFM) system	Ruđer Bošković Institute, Zagreb	Vesna Svetličić	2003	VEECO INSTRUMENTS GmbH, now BRUKER NANO Inc.GmbH		2003	10	125
Coupled liquid chromatography and tandem mass spectrometry TSQ Quantum AM	Ruđer Bošković Institute, Zagreb	Senka Terzić	2002	Thermo Electron, USA	2,395,085	2002	15	7
Bruker Avance 600 MHz FT NMR	Ruđer Bošković Institute, Zagreb	Dražen Vikić-Topić	2002	Bruker BioSpin GmbH, Germany	5,347,147	2001	5	312
Bruker Avance 300 MHz FT NMR	Ruđer Bošković Institute, Zagreb	Dražen Vikić-Topić	2002	Bruker BioSpin GmbH, Germany	1,343,278	2001	5	312