Research Infrastructure Roadmap 2011 - 2020

Revision 2016

CONTENTS

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LIST OF ABBREVIATIONS

ARRS	Slovenian Research Agency
BBMRI	Biobanking and Biomolecular Resources Research Infrastructure
Belle 2	Belle 2
C-ERIC	Central-European Research Infrastructures Consortium
CERN	European Organisation for Nuclear Research
CESSDA	Council of European Social Science Data Archives
CLARIN	Common Language Resources and Technology Infrastructure
CTA	Cherenkov Telescope Array
DARIAH	Digital Research Infrastructure for the Arts and Humanities
EATRIS	European Advanced Translational Research Infrastructure in Medicine
ERDF	European Regional Development Fund
ELIXIR	The European Life-Science Infrastructure for Biological Information
eLTER	European Long-Term Ecosystem Research
EPOS	European Plate Observing System
ERA	European Research Area
E-RIHS	European Research Infrastructure for Heritage Science
ESFRI	European Strategy Forum on Research Infrastructure
ESS	European Social Survey
EuroBioImaging	European Research Infrastructure for Imaging Technologies in Biological and Biomedical Sciences
European XFEL / EuroFEL	X-ray Free Electron Laser European Free Electron Lasers
FAIR	Facility for Antiproton and Ion Research in Europe
ILL	Institute Laue Langevin
ISBE	Infrastructure for Systems Biology Europe
LifeWatch	e-Science and Technology European Infrastructure for Biodiversity and Ecosystem
METROFOOD	Metrology Promoting Objective and Measurable Food Quality and Safety
MIZŠ	Ministry of Education, Science and Sport
NRRI	Research Infrastructure Roadmap
PRACE	Partnership for Advanced Computing in Europe
RI	Research infrastructure(s)
RISS	Research and Innovation Strategy of Slovenia
SHARE	Survey of Health, Ageing and Retirement in Europe
S4	Smart Specialisation Strategy

1. INTRODUCTION

The basic purpose of the Research Infrastructure Roadmap 2011-2020 (the Roadmap), which was accepted by the Government of the Republic of Slovenia on 28th April 2011, was to present and set the priorities of the Republic of Slovenia in the field of research infrastructure. The Roadmap for 2011-2020 identified priority international projects and indicated national priority areas in which it is necessary to develop the research infrastructure as a priority to further the attainment of scientific excellence in Slovenia in order to achieve critical mass in medium or large scale research infrastructures. It was planned to assess and keep the selection of the national priority areas up to date in the process of smart specialisation, while the Roadmap implementation was to be monitored in the context of monitoring the Research and Innovation Strategy of Slovenia 2011-2020 (RISS) implementation and be updated in 2015 if necessary.

Due to the delay of implementation at the international level, mainly due to the necessary harmonisation of national procedures to audit the European Strategy Forum for Research Infrastructures Roadmap (also known as the "ESFRI Roadmap"), which was concluded in March 2016, the Roadmap review was carried out in 2016. The aim of the revision is to assess the status of implementation of priority international projects on the original list, including information on investments in research infrastructure for the period 2011-2015, to present the updated list of priority international projects and, ultimately, to connect the areas in accordance with the adopted Smart Specialisation Strategy (S4) considering regional and national needs critical mass and scientific excellence. The Roadmap revision 2016 provides an updated list of international RI projects while the Roadmap 2011-2020 timing, national priority areas and other basic principles remain unchanged. National priority areas follow the priority areas of the Smart Specialisation Strategy. After 2020, the preparation of a new strategy for the next period is envisaged; depending on the intended ESFRI timing, the Roadmap update revision could be carried out in 2018 if necessary.

The Roadmap as a regional executive document of the RISS sets the priorities of the Republic of Slovenia in the field of research infrastructure and, as such, serves as a guide and a reference point for the implementation in this area. The access of Slovenian researchers to large European and global research infrastructures is essential to achieve and maintain the level of science in the state at a comparable European or global level. Due to the complementarity and rationalisation costs, it is reasonable to include larger national research infrastructures in the relevant European or global network of research infrastructures. Key criteria for the inclusion of a project in the Roadmap were, in addition to the scientific relevance, the achievement of the critical mass or involvement of key actors at the national level, the possibility of upgrading the existing research infrastructure, its impact on regional cooperation, comparability at European and global level and placement in the ERA.

In the first years of the Roadmap implementation, the rate and the achievement of objectives depended primarily on the capacities of annual budgets or fiscal circumstances in the state and on the available human resources and organisation of the scientific communities. The development of the national research infrastructure was co-financed primarily through the Slovenian Research Agency (ARRS); in addition, there was a significant direct contribution to the national research infrastructure by ERDF funds within the framework of eight centres of excellence in the years 2010-2013. In the period 2013-2015, the ERDF funds financed the connecting and creation of the critical mass of highly qualified personnel in Slovenian regions for the purposes of economic development and competitiveness (the so-called "creative cores"). Unfortunately, the above listed is not sufficient for achieving all strategic objectives in the field of research infrastructures in the state. To achieve and maintain the level of science in the state at a comparable European or global level, it is necessary to increase the funding of scientific and research equipment since this is rapidly becoming old and no longer meets modern standards.

The priority international projects, in which Slovenia participates as a member and has as such made international and national commitments for their construction or operation, included in the current revision, are treated as implemented projects. According to the ESFRI methodology, they are named as "landmarks" and removed from the current list of priority projects. However, they still need to be properly monitored and evaluated periodically to ensure their continued operation. "Landmarks" are therefore projects which as such show a clear reference for a successfully managed project, scientific excellence, national relevance and competitiveness in the relevant area. In the previous period of the Roadmap implementation, the rate and the achievement of objectives depended primarily on the capacities of annual budgets or fiscal circumstances in the state and on the available human resources and

organisation of the scientific communities. Despite the difficult financial situation in the previous few years, Slovenia already participates in 10 priority international projects from the Roadmap: CESSDA, CLARIN, DARIAH, ESS, SHARE, CERIC, ELIXIR in EATRIS; in addition to these, Slovenia also participates in the construction of Belle II in Tsukuba, Japan, and the FAIR Centre in Darmstadt, Germany. The completion of procedures for associate membership in CERN and for membership in the LifeWatch project is envisaged by the end of 2016. Unrealised projects of the Roadmap: ILL, XFEL or EuroFEL and PRACE currently remain on the list of priority international projects.

The basic criteria for the inclusion of a new project on the list are a positive assessment of the situation at the national level (Study in the field of research infrastructure in the context of the ESFRI Roadmap for the needs of revision of the Research Infrastructure Roadmap 2011-2020, MK project d.o.o, 2015) and the placement of the project on the list of the updated ESFRI Roadmap 2016, which confirms the scientific excellence and organisational and financial maturity of a project in an international context. Promising but not yet implemented old projects may be placed on the list again or remain on it (according to the ESFRI methodology, a project may remain on the list for 10 years at most, then it has to reapply). Thus, the new list contains 5 new projects: E-RIHS, CTA, Euro-BioImaging and, in addition to these three, also EPOS and BBMRI from the reserve list of the initial Roadmap; 3 uncompleted projects from the initial Roadmap also remain on the list: XFEL or EuroFEL, ILL and PRACE. Projects with a positive assessment at the national level and labelled as emerging projects within the framework of the ESFRI are included in the list for further updates (reserve list). Within the framework of the ESFRI, they were recognised as scientifically excellent in the areas of strategic importance in the process of assessment but they were not yet ready for inclusion in the ESFRI 2016. Such projects are encouraged to operate in order to achieve a higher level of maturity and competitiveness and be prepared for inclusion in a future ESFRI Roadmap. Among them, there are two projects that are interesting for Slovenia, namely e-LTER and METROFOOD.

Also, international projects are prioritised according to priority areas of the Smart Specialisation Strategy, which defines the following as priority areas: Healthy living and working environment with subsections smart cities and communities, and Smart buildings and homes including wood chain, Natural and traditional resources for the future with subsections: Networks for transition to circular economy, Sustainable food production and Sustainable tourism and (S)industry 4.0 with subsections: Factories of the future, Health - medicine, Mobility and Development of materials as final products. Activities for the establishment of the European Research Area, Innovation Union and Horizon 2020, national priority areas and areas defined as priorities by the Smart Specialisation Strategy will be followed by complementary projects funded from EU programmes and other infrastructure projects at the national level.

In accordance with the ESFRI methodology, individual international projects are presented in detail below in the context of three categories: implemented projects from the Roadmap ("landmarks"), priority international projects ("projects") and emerging projects ("emerging projects"). In the document, the projects are now, as in the ESFRI Roadmap and unlike the initial Roadmap, listed in alphabetical order in six main thematic areas or ESFRI pillars: Social and Cultural Innovation, Energy, Materials and Analytical Capacities and Natural Sciences and Engineering, Environmental Sciences, Health and Food and E-infrastructure.

The previous period of implementation is assessed as successful, since Slovenia, despite the deteriorating financial situation in recent years, participated in most of the major international projects of the Roadmap and substantial ERDF resources were provided to the national infrastructure. In the case of international projects, further provision of sustainable funding for adequate upgrade and the smooth operation of national centres (hubs) will be needed in addition to the membership fees, which are expected to be further strengthened by the Cohesion Policy funds. Priority ESFRI projects and the Roadmap projects are placed in the Operational Programme for the implementation of the European cohesion policy in the period 2014-2020. At the same time, it shall be necessary to continue the provision of direct inputs into the research infrastructure in national priority areas and to increase contributions in research equipment for achieving and maintaining the research excellence according to the Roadmap.

Table 1: Projects of the NRRI 2016

	Social and Cultural innovation	Materials and analytical capacities and Natural sciences and engineering	Environmental sciences	Health and Food	e-infrastructure
LANDMARKS	CESSDA	Belle 2	LifeWatch	EATRIS	
	CLARIN	CERIC		ELIXIR	
	DARIAH	CERN			
	ESS	FAIR			
	SHARE				
PROJECTS	E-RIHS	CTA	EPOS	BBMRI	PRACE
		European XFEL in EuroFel		EuroBioimaging	
		ILL			
EMERGING PROJECTS			eLTER	METROFOOD	

2. IMPLEMENTED INTERNATIONAL PROJECTS FROM THE ROADMAP - "LANDMARKS"

2.1 Social and Cultural Innovation

2.1.1 CESSDA

cessda
Consortium of European Social Sciences Data Archives

Council of European Social Science Data Archives

http://cessda.net/

Status
By signing the Memorandum of Consent as of 19th January 2011, Slovenia has from the very beginning participated in the drafting of founding documents and the strategic direction of the operation and financing of the CESSDA. It became a founding and full member of the CESSDA by signing the Memorandum of Cooperation on 13th June 2013. In the activities of the CESSDA, Slovenia is represented by the Social Science Data Archives, which operate at the Faculty of Social Sciences, University of Ljubljana.

Infrastructure description
The CESSDA project presents an organisational and professional upgrade of the existing data infrastructure in the field of social sciences. The essence of the project is to exploit the potential of cooperation between national organisations (in our case the Social Science Data Archives) which are territorially responsible for the data at the European level by linking work on development projects, in the implementation of standardised solutions in dealing with data materials and by standardising the level of quality of the provision of services. Thus, cheaper joint operation, a larger amount of freely accessible data, user friendly access from one spot and simplified procedures for work and cooperation are achieved.

As the most appropriate legal form for this research infrastructure, the establishment of the CESSDA-ERIC was envisaged as soon as the obstacles to the application of the Council Regulation (EC) no. 723/2009 on the Community legal framework for the European Research Infrastructure Consortium (ERIC) (Official Gazette of the EU L 206/1 as of 8th August 2009) for Norway as its host are removed; until then, the administrative support to the project bodies was a limited liability company established specially for this purpose in Norway (CESSDA AS). Currently, no legal obstacles exist and the application for the CESSDA-ERIC is in progress, which will be established at the beginning of 2017.

Analysis of the benefits of inclusion
For Slovenia, the CESSDA is important because it ensures the establishment of a modern and quality service of data access for social sciences with minimum investment, since the member states will lean on jointly established solutions instead of developing them themselves from the start. The solid inner organisational structure and rules of the CESSDA will ensure member states the usage of common services that will be based on uniform rules of operation, both in substance regarding the usage of protocols, and by method upon assuring high quality and effectiveness of operation.

In addition to publications in the form of articles, the research data has an independent value as one of the results of scientific projects. The existing data from the field of social sciences, which are securely stored in the Social Science Data Archives data centre and easily accessible to users, represent alone or in combination with other data a source for a variety of social science and interdisciplinary designed research. The membership in the CESSDA represents investments in increasing internal efficiency of the Social Science Data Archives, more transparent internal organisation through documentation and controlled management of work processes. The Social Science Data Archives are fully involved in the operation of the CESSDA by contributions to the programme and joint solutions and by training. By the partnerships in the CESSDA, they are included in applications for joint European projects; thereby the international recognition of the Social Science Data Archives is strengthened. This includes the already realised connections and initiatives for the creation of social sciences data services in the Balkans (projects SERSCIDA and SEEDS).

Financial aspect
According to the Roadmap, the estimated value of the total cost of participation in the CESSDA or CESSDA-ERIC project for Slovenia (mostly national activities) amounts to 110,000 EUR annually, of which the membership fee represents approximately 2,000 EUR. Slovenia started to finance the planned development of the national infrastructure and the implementation of national activities within the CESSDA in 2011.

2.1.2 CLARIN

Common Language Resources and Technology Infrastructure

http://www.clarin.eu/

Status
Slovenia participated in the preparatory phase of the CLARIN ERIC, which lasted until the decision of the European Commission on the establishment of the CLARIN ERIC as of 29th February 2012, as an observer but it was planned to be included as a full member as soon as possible after its establishment. Slovenia sent the letter of accession on 29th April 2016 and became a full member of the CLARIN ERIC in May 2015. The consortium "CLARIN.SI" with the seat at the Jožef Stefan Institute (IJS) was established in June 2014 to implement national commitments pertaining to the CLARIN.

Infrastructure description
The CLARIN is a research infrastructure intended for the extensive and easily accessible storage of language sources and technologies, encompassing languages of the member states and languages taught in the member states or those which are important for reasons resulting from migration flows. The basic purpose of the CLARIN project is to make the existing tools and solutions available in the unified European infrastructure, to enable counselling and teaching activities on how to adapt the tools

and sources to specific research needs and to contribute to the standardisation of sources and tools. The CLARIN is the second international research infrastructure in the ESFRI Roadmap, which was established by a procedure in accordance with the Council Regulation (EC) for the European Research Infrastructure Consortium (ERIC).

Analysis of the benefits of inclusion
Due to the increasingly rapid development of the internet and other e-technologies, technological support to individual languages is extremely important, particularly for languages with a smaller number of speakers, such as Slovenian. In the field of language technologies, several companies and research organisations operate at the national level. These joined the national consortium "CLARIN.SI" in accordance with the requirements of the CLARIN project. Thus, the consortium connects all major public institutions and companies and associations in Slovenia dealing with linguistics and language technologies; currently, it has twelve members.
Due to membership, Slovenian researchers have the possibility of authenticated access to all repositories of European members of the consortium. This means mainly the dissemination of resources and the exchange of researchers. The established Slovenian repository of linguistic resources has been developed on the basis of the Czech CLARIN, while the WebAnno platform has been developed in the framework of the German CLARIN and they did not need to be developed locally; thus the costs have been significantly reduced. A legal group operates within the framework of the CLARIN-ERIC, which has developed standard licences for the transfer and use of language resources at the level of the entire international consortium. In addition, by participation in the ERIC, the Slovenian CLARIN has the possibility of participation in projects applied to tenders of the European Commission by the CLARIN-ERIC. The first national funds for the establishment of a Slovenian infrastructure of the CLARIN were received by the IJS in October 2013. Using these funds, it started building the website and repository. The first task was to transfer the project portal "Communication in the Slovenian language" to IJS servers.

Financial aspect
Investments in the appropriate development of a national infrastructure for the storage of linguistic resources and the development of language resources and tools for Slovenia's participation in the CLARIN were estimated at approximately 250,000 EUR annually in the Roadmap. The annual membership fee for Slovenia amounts to approximately 12,000 EUR. Slovenia started to finance the planned development of the national infrastructure and the implementation of national activities in 2013. This is currently sufficient to maintain the repository and to collect resources, but not for the establishment of the infrastructure for language resources and technologies for the Slovenian language as planned.

2.1.3 DARIAH

DARIAH-EU | Digital Research Infrastructure for the Arts and Humanities

Digital Research Infrastructure for the Arts and Humanities

https://www.dariah.eu/

Status
Slovenia has been participating in the DARIAH project from its beginning in 2008. It has also participated in the preparation of the founding documents and strategic directions of the operation and financing of the DARIAH-ERIC. It signed the Memorandum of Consent on 28th February 2011 and sent the letter of accession to DARIAH-ERIC on 4th October 2014. Since the establishment of the DARIAH-ERIC on 6th August 2014, it participates in this research infrastructure as a founding and full member. Slovenia participates in the activities of the DARIAH through the Research Centre of the Slovenian Academy of Sciences and Arts (ZRC SAZU) and the Institute of Contemporary History (INZ), which also coordinates the operation of the DARIAH in Slovenia.

Infrastructure description
The DARIAH is the first digital research infrastructure in the field of arts and humanities in Europe to enable and encourage comparative international and interdisciplinary digital research in these fields. The DARIAH connects diverse knowledge, methodologies, analytical and interpretative tools of different disciplines by means of digital databases and researchers. It establishes a uniform technological

platform that provides access to this material and integrates very different forms of data (manuscripts, printed documents, texts, music notations, illustrative and verbal material, etc.) in an interoperable manner for research institutes and digital centres. It develops new methodologies, analytical and interpretative tools and new research modes. Digital or e-humanities means not only the creation of digitised databases, but also opens up new connections (with specific ways of structuring and organising knowledge) and thereby transforms analytical contexts and research methodologies.

Analysis of the benefits of inclusion
The participation in the DARIAH mainly brings homogenising of the national digital research infrastructure for the humanities and arts (DARIAH-SI), the implementation of European norms and guidelines in the national space and cooperation in coordinating and determining standards in the field of digital humanities. The programme and content upgrade of systems, which promotes the work of researchers, offers a variety of content for research and directs the use of new technologies.
As a fundamental result of participation in the DARIAH, the portal for digital humanities and arts "SI-DIH" was set up at the beginning of 2012. This represents the backbone of the national digital infrastructure for the humanities and arts and is also the entry point to the emerging European infrastructure of the DARIAH.
Until now, participation in the DARIAH-ERIC required attendance at meetings, active participation in virtual competence centres, transfer of European best practices in the national space, exchange of experience with European researchers, integration of national results in the European network, quantitative analysis of the behaviour of researchers in the humanities and promoting the DARIAH network and its initiatives in the field of digital humanities and arts.
At the national level, the establishment of connections with two other ESFRI projects, CLARIN and the CESSDA, is essential. This promises a lasting and stable access to the research data and implementation of standards for recording the research data.

Financial aspect
The estimated cost of participation in the DARIAH for Slovenia amounts to 150,000 EUR annually (national activities) and an annual membership fee in the amount of approximately 3,000 EUR, which represents 10% of the total fee, while the rest is covered by the nature of the ongoing activities within the framework of the project. Slovenia started to finance the planned development of the national infrastructure and the implementation of national activities in 2011.

2.1.4 ESS

European Social Survey

http://www.europeansocialsurvey.org/

Status
By signing the Memorandum of Consent as of 23rd February 2011, Slovenia has from the very beginning participated in the drafting of founding documents and the strategic direction of the operation and financing of the ESS ERIC. It sent the letter of accession to ESS ERIC on 26th April 2013; since its establishment on 22nd November 2013, it has participated in this research infrastructure as a founding and full member. The ESS project has been implemented since 2001. Through the Centre for Research of Public Opinion and Mass Communication at the Faculty of Social Sciences, University of Ljubljana (FDV UL), Slovenia has been included in it from the start. Since 2004, this Slovenian institution is also a member of the management consortium and one of seven senior partners of the project, which is more or less continuously carried out by 35 countries. In this context, the employees of the Faculty of Social Sciences carry out relevant research and management activities that are assigned to them within the project (participation in the management of the consortium, planning communication strategies, bibliographic monitoring, and preparation of sample weights). In this way, Slovenia will be included at least until 2018, when the work programme for the next five-year period will again be decided upon.

Infrastructure description
The ESS is the youngest among the largest comparative social surveys of the general social type and is intended for the analyses of social trends and the guidance of social systems. Its most recognisable

characteristics are high standards regarding the quality of all the aspects of preparation and implementation of the research procedure. With repeated survey measurements, it creates a time series of social data. Thus, this data is becoming an increasingly useful basis for the academic community and policy makers to ensure the quality analysis of social trends and the guidance of social systems. The content of ESS surveys is general and also diverse from a disciplinary perspective. It is intended for the diverse scientific and management profiles of users in the fields of sociology, psychology, political science, economics, criminology, etc.

Analysis of the benefits of inclusion
By participating in the ESS, the researchers, lecturers and students acquire access to the new generation of social indicators and thus to an empirical basis for the verification of their scientific hypotheses and Slovenian indicators in an internationally comparative context. In the Slovenian context, the importance of the ESS research is, in addition to substantive benefits, also in the transfer of methodological knowledge in the research and educational spheres. The ESS has established a permanent network of approximately 150 methodological specialists and a network for knowledge transfer to the wider research area. This transfer is implemented primarily through methodological seminars, meetings, conferences, on-line training packages, individual exchanges between institutions and numerous publications. Under the auspices of the ESS, methodological research and experiments in the field of comparative research are carried out. The ESS knowledge and databases are also of interest to the researchers from the private sector. They are directly usable in the fields of marketing, advertising, all kinds of quantitative research of public opinion and in various analytical sections of other industrial activities where data analyses are carried out (human resources departments, analyses of employee satisfaction, internal departments for market analysis, etc.).

Financial aspect
The estimated cost of participation in the ESS for Slovenia amounts to 150,000 EUR annually (national activities); in addition, the annual membership fee amounts to approximately 20,000 EUR. Slovenia started to finance the planned development of the national infrastructure and the implementation of national activities in 2011.

2.1.5 SHARE

Survey of Health, Ageing and Retirement in Europe

http://www.share-project.org/

Status
Slovenia sent the letter of accession on 29th May 2013 and became a full member of the SHARE ERIC in September 2013. Through the Institute for Economic Research (IER), Slovenia has been actively involved in the activities of the SHARE since 2008. The IER as the main scientific partner institution manages the activities in the SHARE-ERIC. Slovenia joined the SHARE in the third wave of the questionnaire (periodic two-year thematic preparation and implementation of research among the population over 50 years of age); currently, the completion of the sixth wave implementation (2015/16) is being carried out and also the preparation for the activities pertaining to the seventh wave (2017/18).

Infrastructure description
The SHARE is an international multidisciplinary longitudinal research establishing economic, health and social conditions of the population over 50 years of age. The SHARE-ERIC is an upgrade of the SHARE project and is the first international research infrastructure in the ESFRI Roadmap, which was established by the European Commission decision of 17th March 2011 in accordance with the Council Regulation (EC) no. 723/2009 on the Community legal framework for the European Research Infrastructure Consortium (ERIC).

Analysis of the benefits of inclusion
Slovenia is one of the countries that are exposed to the process of population ageing and many of its consequences. The participation in the SHARE, on one hand, enables Slovenia to obtain knowledge

and experience from an international pool of experienced researchers from the previous operation of the project; on the other hand, it helps to identify new business opportunities for the Slovenian economy. Benefits for Slovenia are related to issues that accompany the ageing of the population, which is recognised as one of the greatest challenges of the 21st century in Europe. The participation represents a bridge to many excellent scientists and scientific institutions in Europe. It provides the researchers with free access to all survey data, which means 285,000 surveys per more than 110,000 covered individuals in 2015. In September 2015, the SHARE infrastructure was already used by 4,854 scientists from around the world. There were 58 Slovenians among them. The research group at the IER has developed technical support for all those who have started to use the SHARE data. The organised data is available to the interested public. The inclusion in the SHARE was followed by new international scientific publications and the efforts of the research group at the IER to promote the use of the SHARE data.
The SHARE infrastructure in Slovenia has been intensively used, for example in the preparation of analytical bases for reforming long-term care, healthcare and in the preparation of the White Paper within the framework of preparing the future reform of the pension system in Slovenia. The analyses will assist in the integration of informal forms of long-term care in the existing funding model and to assess the impact thereof on the total expenditure.

Financial aspect
Total two-year costs (a period of one wave) of the implementation of the SHARE activities currently amount to 638,000 EUR. Of this amount, the field part of the survey of a sample of individuals amounts to 444,000 EUR, while the rest are the costs of the IER. The cost of the annual membership fee (for the needs of the central SHARE-ERIC organisation) was initially estimated at approximately 80,000 EUR per year, but in fact, it depends on the co-financing of the project and has been largely or even fully covered by EU funds until now. Slovenia started to finance the planned development of the national infrastructure and the implementation of national activities in 2011.

2.2 Materials and Analytical Capacities and Natural Sciences and Engineering

2.2.1 Belle 2

https://www.belle2.org/Status

The Slovenian research group based at the Jožef Stefan Institute (IJS) is one of the project promoters. During the preparation stage, it was the holder of some key activities. In the period from 2011 to 2015, the Slovenian group made contributions to the following areas: ARICH detector system, TOP detector system, ECL detector system, distributed computer data processing; data analysis, physical programme, project management - the project leader has been a member of the Executive Committee since 2013 and technical coordinator since July 2015 (coordinator of the detector construction in the crucial phase).

Infrastructure description
The research infrastructure Belle II is intended for experiments in basic particle physics. The upgrade will provide essential improvement of the precision of measurements enabled by the Belle II, both by improving detection capabilities and by a substantial increase in the size of the recorded pattern. Thirteen countries (including Slovenia) with approximately three hundred researchers participated in the initial phase of the upgrade of the Belle II (Tsukuba, Japan) research infrastructure at a total value of approximately 400 million EUR. During the time of project management, the number of partners increased with the inclusion of three new states. The accelerator, at a total value of approximately 300 million EUR, is mostly ready. Most systems will be built by summer 2016 and the first measurements will begin in 2017. In 2018, the missing detector system will be added.

Analysis of the benefits of inclusion
By combining experimental approaches on the limit of achievable energies (CERN and LHC) and on the limit of achievable precision (the KEK and Belle II), it will be possible to discover and identify new types of particles and corresponding theories that will change our understanding of the very roots of the basic

forces in nature. Discovery of possible new processes in basic particle physics would have a revolutionary impact on the development of science. Regarding the key role of Slovene researchers in the project, this would, in addition to being an exceptional scientific achievement, also have a significant influence on the worldwide position and reputation of Slovenia.
Within the framework of the Belle project, ten doctoral degrees have been obtained and 5 doctoral dissertations are being prepared The prestigious role that Slovenian researchers have in the project has also helped in promoting the Slovenian high-tech industry in the search for technological solutions and preparation of components for the experimental apparatus (KENS d.o.o., Prebold), and in equipping the SuperKEKB accelerator (Cosylab d.d., Ljubljana, and Instrumentation Technologies, d.d., Solkan). An example of knowledge transfer in basic particle physics is the development of new methods for healthcare, particularly, improvements related to imaging in medical diagnostics (positron tomography – PET). Important contributions in the field of knowledge transfer in the so-called grid technologies in computing are also possible.
Financial aspect
According to the Roadmap, Slovenia will contribute approximately 1.5 million EUR to the upgrade of the Belle II, the total value of which amounts to approximately 400 million EUR according to recent estimates. The financing began in 2011. When the infrastructure starts operating in 2016, Slovenia will bear a proportional part of the operating costs of the entire experimental apparatus to an estimated amount of approximately 100,000 EUR annually; to finance the operating costs of Slovenian scientists, an additional 150,000 EUR, approximately, will be needed.

2.2.2 CERIC

Central-European Research Infrastructures Consortium

http://www.ceric-eric.eu/
Status
From the very beginning (by signing the Memorandum of Consent on 26th June 2011), Slovenia has participated in the drafting of the founding documents and strategic direction of the operation and financing of the CERIC-ERIC. It sent the letter of accession on 29th November 2012; since its establishment on 24th June 2014, it has participated in this research infrastructure as a founding and full member. Slovenia is represented in the CERIC-ERIC by the NMR Centre of the National Institute of Chemistry.

Infrastructure description
CERIC-ERIC is designed as a link between the existing regional capacities in Central Europe to facilitate more comprehensive research and infrastructure services in regard to the science of materials. The cooperation initiative was given by Italy (Elettra - Synchrotron Trieste) that strives to integrate the capabilities in the region and beyond. In addition to Slovenia and the host Italy, also Austria, Croatia, Hungary, Serbia, Czech Republic, Romania and Poland participate in the project. The project optimises the use of existing capacities. The international cooperation will increase the knowledge base in partner institutions and their recognisability and reduce the application price.

Analysis of the benefits of inclusion
Inclusion in the CERIC-ERIC opens up possibilities for integration at several levels. The NMR Centre contributes complementary equipment to the capacities of other partners. Through the NMR, Slovenian researchers have the possibility of access to a wide range of techniques that are important for the analysis and characterisation of materials and in life sciences.
Within the CERIC-ERIC, Slovenian researchers have access to modern research equipment at the synchrotron in Trieste, neutron reactor in Budapest, SAXS methods in Graz, methods for characterisation of materials in Prague, a variety of microscopic methods in Bucharest, etc. In the first year of formal operation, the NMR mainly got to know the potentials of the individual infrastructure units in the neighbouring countries. Also, the possibility of connecting in the applications for international tenders opens up. The number of users is increasing.

Financial aspect
The project was set to link the existing capabilities and, initially, the construction of new capabilities or larger collective upgrading of the existing ones was not foreseen. Thus, non-cash contributions of the partner states are envisaged in the form of services or making available the existing research capacities which are usually already funded from other sources. An annual membership fee is not envisaged. If Slovenia upgrades its national research infrastructure, these investments will constitute a non-cash contribution in the CERIC ERIC. The co-financing of the NMR Centre activities within the CERIC ERIC started in 2015.

2.2.3 CERN

European Organisation for Nuclear Research

http://home.web.cern.ch/

Status
The first initiatives for the membership of the Republic of Slovenia in the CERN date back to the year 1992; Slovenia sent the preliminary letter of intent as the first formal step towards CERN in May 2009. In 2011, the conditions for the inclusion of the Republic of Slovenia in the CERN were agreed. The reactivation of the stopped process occurred in the second half of 2015. Currently, Slovenia and the CERN are in the final stage of harmonising the text of the draft Agreement between the Government of the Republic of Slovenia and the CERN on the status of the associate member as the pre-stage of membership in the CERN. Signing of the agreement is scheduled by the end of 2016 and the ratification process in the National Assembly at the beginning of 2017. In Slovenia, there are about thirty scientists working in the field of experimental particle physics. Organisationally, they are connected within the Department of Experimental Particle Physics of the Jožef Stefan Institute, headed by prof. dr. Marko Mikuž; about a third of the researchers are employed as academic staff at the University of Ljubljana, University of Maribor and University of Nova Gorica. Up to now, Slovenian scientists in this field and other interested parties in Slovenia worked in the CERN primarily in the framework of the ATLAS experiment (the Memorandum of Consent was signed in December 1999) and in some smaller collaborations.

Infrastructure description
The CERN was established in 1954 in Geneva and represents the central world laboratory for particle physics. Its purpose is to ensure the research infrastructure - accelerators of protons, antiprotons, heavy ions, electrons and positrons. The CERN belongs among the most elite institutions in the world since the use of its facilities often enables the development of new technologies.

Analysis of the benefits of inclusion
From the research conducted in the CERN, Slovenian scientists have published about 800 scientific papers in reputable international journals, which have brought about 20,000 citations to Slovenian science. While working in the CERN, 19 bachelor's, 12 master's and 20 doctoral theses were written. The apparatus for positron tomography with a detector based on multi-wire proportional chambers was produced. Prototypes of the portable detector of radiation in the environment on the basis of proportional chamber and the detector of strontium in the environment on the basis of the Čerenkov detector were also made. A new type of detector for medical imaging based on silicon position sensitive sensors and the apparatus for the PET investigation operating in a strong magnetic field and therefore compatible with magnetic resonance imaging (MRI) are being developed. The computer technology "grid" has been transferred to Slovenia. Its first implementation was a cluster dedicated to computations for ATLAS; the extensions are available to the entire scientific sphere in cooperation with ARNES.
Associate and consequently full membership in the CERN will bring Slovenia numerous additional benefits in the fields of science, education and economics
1. Science: The membership shall bring Slovenian scientists full access to all programmes and projects running in the CERN or research infrastructure and technological projects of the CERN, which take place in the presence of top experts from around the world, unlimited access to the programmes of the CERN for the education of young engineers, training postgraduate and post-doctoral associates upon

the competition and collaboration with colleagues from the most developed countries, having access to and working with apparatus of the highest level of technology, employment of scientists in the CERN and participation in training programmes. This means widening and deepening the cooperation of Slovenian researchers in the CERN projects, the creation of a network of top Slovenian knowledge in the field of particle physics and opportunities to participate in educational programmes, which leads to new discoveries, new publications and, of course, to the improvement of the quality and competitiveness of scientific work.
2. Education: The CERN also invests in educational and general dissemination activities. Member states have the opportunity to attend and participate in events and programmes aimed at all levels of education, from secondary to post-doctoral levels. Thus, the CERN offers a wide range of possibilities for education and training programmes at all levels, second-cycle programmes for students and teachers, doctoral and post-doctoral study programmes, which are mainly carried out at the headquarters of the organisation while some are also carried out in member states.
3. Industry: There is also an important technological and economic motive for membership in the CERN since this will allow the full and first-class access of Slovenian industry to the requirements of the CERN and, thus, the related breakthrough to demanding markets with products with a high degree of embedded knowledge and added value. Thus, it opens up to Slovenian partners, especially high-tech companies, the possibility of accelerated development and access to new global markets or other positive multiplier effects for their long-term growth and development. The CERN will use a part of the Slovenian membership fee for the purchase of products, services, or materials offered by Slovenian companies. A great interest and concrete possibilities of business collaboration in the CERN are shown by internationally renowned high-tech companies, such as Cosylab d.d. for control systems, Instrumentation Technologies d.d. for instruments and Kyma d.o.o. for undulators - magnetic amplifiers of the synchrotron light; the companies Apel d.o.o., Balder d.o.o., FDS-Research d.o.o. and Elgoline d.o.o. have already participated within the framework of ATLAS; the potential is also shown by strong IT companies, such as NIL d.o.o., Comtrade d.o.o. as well as Competence Centres and Centres of Excellence in the fields of IT, new materials and biosensors. For the successful implementation of the benefits of inclusion in the CERN, Slovenia will have to appoint a competent so-called "Industry Liaison Officer" (ILO) whose task is to identify the needs and opportunities in the CERN and the transfer of such information to interested Slovenian companies.

Financial aspect
The agreed amount of the full membership fee for the CERN amounts to 2.5 million EUR. For the period of the membership pre-phase 2017 - 2021, the gradual financial dynamics of the obligation payment is agreed, with the initial commitment of 25% of the full membership fee due in 2017.

2.2.4 FAIR

Facility for Antiproton and Ion Research in Europe

http://www.fair-center.eu/

Status
On 24th May 2011, Slovenia ratified the International Convention on the construction and operation of the Facility for Antiproton and Ion Research in Europe (FAIR GmbH) and, on this basis, became one of the founders and, consequently, on 3rd September 2012, also a partner of FAIR GmbH, namely in the proportion of approximately 1.2% of its nominal capital. On 14th November 2014, an international convention on the non-cash contribution of the Republic of Slovenia in the construction of the FAIR Centre was signed. Slovenia fulfils its obligations under this convention with a non-cash contribution to the FAIR Centre, i.e. by the development and supply of high-tech research equipment in accordance with the FAIR Centre specifications. For this purpose, a tripartite agreement between the partner (the Republic of Slovenia), the consortium of business companies (Tehnodrom d.o.o.) and the FAIR company was signed for the non-cash contribution in the construction of the FAIR Centre (FAIR IKC), which forms the basis for the realisation of all commitments under the Convention. Thus, the Republic of Slovenia participates in the development and construction of the research equipment (components of the system for the beam diagnostics and control system in the accelerator). A group of researchers from the Jožef Stefan Institute (IJS) was included in the NUSTAR collaboration in 2015.

Infrastructure description
The Facility for Antiproton and Ion Research in Europe (FAIR Centre) is one of the first and financially the largest projects in the ESFRI Roadmap. Once it is built (scheduled for 2022), it will be intended for the study of the elementary constituents of matter and the development of the universe. In addition to Slovenia and Germany, also Finland, France, India, Poland, Romania, Russia, Spain, Sweden and Great Britain are included in the construction project of this large international research infrastructure, which will be located in Darmstadt in Germany. The overall value of the project exceeds 1.3 billion EUR. More than half of this value will be contributed by Germany as the host of the infrastructure. According to the commitments under the international convention, Slovenia's contribution is at least 1% of the estimated construction cost of the FAIR Centre and amounts to 12,005,700.00 EUR (according to prices in 2005 and excluding VAT).
The FAIR Centre is currently in the construction stage. Preparations for the construction work began in 2012, followed by the construction of the foundations for the main building with the accelerator and other accompanying facilities. According to the plans, the construction should be completed in 2022. In parallel to this, the construction of basic research equipment is carried out, which is almost entirely covered by non-cash contributions of partner states (accelerators, magnetic systems), and the preparation of experiments: APPA, CBM, NUSTAR and PANDA.

Analysis of the benefits of inclusion
The objectives of the long-term participation of Slovenia in the FAIR are: implementation of direct benefit to the economy in terms of orders for the production of high-tech equipment for the FAIR, benefits for the development of Slovenian science by the participation in experiments within the research infrastructure provided by FAIR and benefits to society due to scientific and technological breakthroughs in the implementation of research activities in the fields of particle physics, biochemistry, biomedicine and related areas.
For the participating Slovenian companies, the participation in the FAIR project represents, in addition to income, an important competence reference for performance in the international market, access to state-of-the-art technologies and participation in other similar international projects. The project also promotes cooperation between the economy and Slovenian research and development institutions in order to transfer the theoretical knowledge to the economy and, at the same time, transfer market requirements and needs to the scientific sphere. The access of Slovenian scientists to the latest high performance equipment reduces the need for additional investment in equipment at the national level.

Financial aspect
The total value of the international convention from 2014 amounts to 21,480,941.91 EUR, taking into account the price rise of material costs and labour costs and including VAT. From 2011 up to and including 2016, the realised contributions in the total amount to 12,819,914.90 EUR (including VAT). The realisation of the remaining obligations is provided in the contract with the dynamics until the end of 2018. After the start of the operation of the infrastructure (scheduled after 2022), Slovenia as a partner will be obliged to provide funds for basic operating costs, which are currently estimated at approximately 2 million EUR annually. According to the interests and needs, it will be necessary to provide additional funds to finance the participation of researchers in experiments.

2.3 Environmental Sciences

2.3.1 LifeWatch

e-Science and Technology European Infrastructure for Biodiversity and Ecosystem

http://www.lifewatch.eu/

Status
Slovenia sent the letter of accession on 4th May 2016. It is expected that Slovenia will become a full and founding member of the LifeWatch ERIC by the end of 2016 when the LifeWatch research infrastructure is established at the international level. Formally, Slovenia did not participate in the preparatory phase of the LifeWatch but it was constantly in contact with the coordinators through the Research Centre of the Slovenian Academy of Sciences and Arts (ZRC SAZU).

Infrastructure description
The LifeWatch is an international research infrastructure designed to support research into the protection, management and sustainable use of biodiversity and ecosystems. It will combine the system of marine, terrestrial and freshwater observatories, common access to a large volume of related data from different databases and observatories and computing facilities in virtual laboratories with customer support. The LifeWatch supports the access to integrated databases in an innovative manner, and thus sheds light on shortcomings in our knowledge and understanding of life on Earth. The project complements the content of the eLTER project (European Long-Term Ecosystem and Socio-ecological Research Infrastructure) which is on the reserve list of the ESFRI Roadmap 2016 and the revised Roadmap and 28 partners from 22 national networks, including Slovenian, participate in it. The synergies between the two projects are also provided by the signing of the MoU at the international level. Within the framework of the eLTER, in situ ecosystem and biodiversity research and monitoring is carried out while the LifeWatch e-infrastructure supports such research on the level of protection, management and sustainable use of biodiversity.

Analysis of the benefits of inclusion
The technology network for integrating ecological and biodiversity data in Slovenia has connected researchers and experts from different scientific disciplines and institutions to a national consortium; "LifeWatch-SI". The objective of inclusion in this research infrastructure is the long-term biodiversity research which will also enable the determination of the most important factors that influence biodiversity and the assessment of the impact of various factors on the processes in ecosystems. Participation in the LifeWatch will enable Slovenia to develop and use the most advanced research methods, as it will be possible to use the experiences and solutions of other national networks. The LifeWatch will enhance the participation of national partners in the substantively complementary RI project on the environment, eLTER.

Financial aspect
In the Roadmap, the investment in the proper development of the LifeWatch is estimated at a total of approximately 550,000 EUR annually (including non-cash contributions and other existing investments in the support infrastructure). In this context, the annual membership fee for Slovenia is estimated at 75,000 EUR. Slovenia started to finance the planned development of the national infrastructure and the implementation of national activities in 2013. In the coming years, the financing of the national hub will be enhanced by the resources from the Structural Funds as soon as possible.

2.4 Health and Food (Biological and medical sciences)

2.4.1 EATRIS

European Advanced Translational Research Infrastructure in Medicine

http://www.eatris.eu/

Status:
Slovenia sent the letter of accession on 2nd March 2016 and became a full member of the EATRIS ERIC in May 2016. Slovenia did not formally participate in the preparatory phase for the EATRIS ERIC, which lasted until the European Commission decision on the establishment of the EATRIS ERIC on 7th November 2013, but it has always been in contact with the coordinators of the project through the Faculty of Pharmacy, University of Ljubljana (FFA UL). The letter of intent dated 16th May 2013 further strengthened the ties between Slovenia or its research community in this field and the EATRIS, and at the same time expressed the intention of Slovenia to become an observer or member state in the future.

Infrastructure description
The objective of the EATRIS project is to establish a cutting-edge international infrastructure for translational research in biomedicine, including pharmacy. It encourages innovation and the vision of finding new business opportunities in the field of biomedical research, medicines development and the optimisation of the efficiency of medicine use, and enables easier, better and more effective integration of individual researchers and research centres across Europe. By connecting partners from different spheres (academic, research, medical and business), it seeks to achieve the consistent introduction of

the principles of translational research into practice and thus facilitate the better and faster transfer and exchange of knowledge, new developments and expressed needs between various partners: from basic research laboratories to clinic or industrial environment and the transfer of complex clinical and developmental problems to laboratories for basic research.

Analysis of the benefits of inclusion
In 2007 and 2008, the Faculty of Pharmacy, University of Ljubljana (FFA UL) sent an expression of its interest in participating in the EATRIS activities to the EATRIS coordinators. For this purpose, the National centre (hub) »EATRIS-TRI.si" has been established at the FFA UL, which has the status of the Slovenian EATRIS hub and offers support to Slovenian research institutions in this field. The inclusion in the EATRIS provides integration and exchange of experts from various institutions, EATRIS members and consultants, it provides opportunities for active participation in the bodies and activities of the EATRIS and the inclusion of experts from Slovenia in the EATRIS structure and beyond, and the organisation and expansion of educational activities. In the framework of EATRIS, additional opportunities for the application of joint international projects H2020 and to offer services in the market open up.

Financial aspect
In the Roadmap, the investments for the proper development of the EATRIS were estimated at approximately 500,000 EUR annually. Slovenia started to finance the planned development of the national infrastructure and the implementation of national activities in 2013. The contribution of Slovenia to the annual membership fee for the EATRIS ERIC is estimated at 100,000 EUR, which is expected to decrease to approximately 50,000 EUR in the coming years due to the accession of new members and the reformation of the financial structure of the EATRIS ERIC. In the coming years, the financing of the national centre will be enhanced by the resources from the Structural Funds as soon as possible.

2.4.2 ELIXIR

The European Life-Science Infrastructure for Biological Information

http://www.elixir-europe.org/

Status
From the very beginning (by signing the Memorandum of Consent on 19th October 2011), Slovenia has participated in the drafting of the founding documents and strategic direction of the operation and financing of the ELIXIR. On 13th February 2016, Slovenia ratified the International Consortium Agreement ELIXIR (ELIXIR Consortium Agreement ECA); the ELIXIR Council confirmed its full membership on 23rd February 2016. At the invitation of the ELIXIR to express an interest in the construction of hubs as national ELIXIR platforms, the Centre for Functional Genomics and Bio-Chips, Institute of Biochemistry, Faculty of Medicine, University of Ljubljana (CFGBC) applied, and joined a consortium of 16 members from the academic field, representatives of research institutes, clinical institutes and the pharmaceutical industry.

Infrastructure description
The ELIXIR project presents the construction and maintenance of a permanent distributed infrastructure for biological information in Europe, for support to research and life sciences, their transfer into medicine and the environment, in bio-industry and in society in general. The ELIXIR was established as a special project of the European Molecular Biology Laboratory (EMBL) by the conclusion of the Consortium Agreement ELIXIR (ELIXIR Consortium Agreement - ECA) which entered into force on 13th January 2014. Currently, the ELIXIR has 19 members.
The ELIXIR is organised as a network of European hubs connecting national (bio)informational resources in order to increase the total capacities of archiving, integration, analysis and exploitation of extensive and heterogeneous data produced by modern research in the field of life sciences. The mission of the ELIXIR is primarily the so-called "data science" (research concerning the data) which deals with long-term data management, examples of standards of good practice, tools, services and infrastructure of information and communication technologies (ICT), and promotion, training and education of personnel. For the management of information, it is, of course, necessary to provide an

adequate infrastructure that generates data, such as the most powerful devices for the next generations of sequencing. The coordination of the mission and activities of the ELIXIR and the integration of its hubs is carried out and managed in the collection centre, which is an integral part of the EMBL structure and initially located at the EMBL-EBI in Hinxton (UK). In addition to its coordination role, the ELIXIR collection centre is also the source of fundamental data and the home of the European data centre.

Analysis of the benefits of inclusion
The Slovenian objective in regard to the ELIXIR project is an upgrade of the national infrastructure for the central national data hub, which will serve to optimise the standard long-term storage of (extensive) data from the field of life sciences and will be complementarily integrated into the existing national ICT infrastructure (e-Infrastructures, data replication, use of existing computer clusters). The reason for the inclusion of Slovenia in the ELIXIR lies mainly in the fact that Slovenia has as yet no adequate national infrastructure in the field of life sciences. It is therefore reasonable to combine activities in the construction of the infrastructure for data management and the infrastructure for data acquisition. A part of the data hub is also the services of assistance to all life sciences researchers, particularly in the fields of training, bio(medical) informatics, bioinformatics analysis, data mining and biostatistics. The data hub will allow simple and standard data exchange and common use of tools and services together with the ELIXIR hubs in other European countries. Through the infrastructure of the next generation of sequencing and the ELIXIR-SI data hub, Slovenia will be able to provide appropriate reference genetic data on the Slovenian human population, as well as on plant and animal biodiversity. The established infrastructure will allow better quality (personalised) medical and nutritional care, concern for the preservation of the environment and environmentally friendly and renewable economy in all fields related to the biosphere.

Financial aspect
In the Roadmap, the investments for the proper development of the ELIXIR were estimated at approximately 500,000 EUR annually. Slovenia started to finance the planned development of the national infrastructure and the implementation of national activities in 2013. The annual membership fee for Slovenia currently amounts to approximately 12,000 EUR. In the coming years, the financing of the national hub will be enhanced by the resources from the Structural Funds as soon as possible.

2.5 Current investments in research infrastructure

Table 2: Investments in RI 2011-2015

Vlaganja v RI preko ARRS	**2011**	**2012**	**2013**	**2014**	**2015**
Raziskovalna oprema	**5.134.924,61**	**-**	**-**	**-**	**233.695,06**
Infrastrukturni programi – skupaj	**8.873.914,01**	**7.853.040,00**	**7.759.672,00**	**8.898.782,48**	**9.436.086,10**
- od tega EPDČ*	2.143.105,00	2.093.040,00	2.637.312,00	3.847.915,83	3.618.096,40
- od tega MSA**	6.730.809,01	5.760.000,00	5.122.360,00	5.050.866,65	5.817.989,70
- v okviru tega mednarodni NRRI projekti	995.000,00	854.705,00	872.250,00	725.730,00	820.230,00
Vlaganja v RI preko MIZŠ					
Centri odličnosti (ESRR)* **	**16.714.790,74**	**10.213.279,76**	**8.709.682,40**	**-**	**-**
Kreativna jedra (ESRR)			**1.140.177,27**	**1.101.755,57**	**1.677.516,42**
Mednarodni NRRI projekti - članarine			**27.518,00**	**51.794,00**	**56.350,50**
Projekt FAIR	**3.000.000,00**	**800.000,00**	**2.105.820,00**	**1.020.402,00**	**2.520.402,00**
Projekt SHARE - anketiranje				**146.520,00**	**297.480,00**
Skupaj	**33.723.629,36**	**18.866.319,76**	**19.742.869,67**	**11.219.254,05**	**13.645.769,23**

* FTE - full-time equivalent
** MCA - material costs and amortisation
*** ERDF - European Regional Development Fund. The financing of Centres of Excellence began in 2010 in the amount of 7,888,548.30 EUR, which means that a total of 43,526,301.20 EUR was allocated to this instrument in the period 2010-2013.

Table 3: Membership fees in international Roadmap Projects (Ministry of Education, Science and Sport)

	2011	2012	2013	2014	2015
FAIR	-	-	-	-	-
CERN	-	-	-	-	-
Belle II	-	-	-	-	-
ILL	-	-	-	-	-
X-FEL	-	-	-	-	-
C-ERIC	-	-	-	-	-
ESS	-	-	20.000,00	20.600,00	21.218,00
DARIAH	-	-	-	-	3.766,50
CESSDA	-	-	990	1.924,00	1.924,00
SHARE	-	-	-	21.735,00	10.000,00
CLARIN	-	-	-	-	8.348,00
LIFEWATCH	-	-	-	-	-
ELIXIR	-	-	6.528,00	7.535,00	11.094,00
EATRIS	-	-	-	-	-
PRACE	-	-	-	-	-
(EPOS)	-	-	-	-	-
(BBMRI)	-	-	-	-	-
Skupaj	**-**	**-**	**27.518,00**	**51.794,00**	**56.350,50**

Table 4: Financing of international Roadmap projects through the Slovenian Research Centre and the Ministry of Education, Science and Sport (italic)

	2011	2012	2013	2014	2015
FAIR	*3.000.000,00*	*800.000,00*	*2.105.820,00*	*1.020.402,00*	*2.520.402,00*
CERN	-	-	-	-	-
Belle II	250.000,00	214.750,00	187.280,00	200.730,00	130.000,00
ILL - KI	-	-	-	-	-
X-FEL	-	-	-	-	-
C-ERIC	-	-	-	-	35.000,00
ESS - FDV	100.000,00	85.900,00	74.905,00	82.000,00	145.000,00
DARIAH - INZ (SISTORY)	69.500,00	59.700,00	52.058,00	56.000,00	62.500,00
DARIAH - INZ (SI-DIH)	27.500,00	23.620,00	20.597,00	22.500,00	22.500,00
DARIAH - ZRC SAZU	43.000,00	36.940,00	32.212,00	34.500,00	34.500,00
CESSDA - FDV/ADP	110.000,00	94.490,00	82.395,00	88.000,00	88.000,00
SHARE - IER	120.000,00	103.080,00	89.886,00	97.000,00	97.000,00
SHARE - ANKETE	275.000,00	236.225,00	205.988,00	*146.520,00*	*297.480,00*
CLARIN	-	-	21.884,00	25.000,00	40.730,00
LIFEWATCH	-	-	30.638,00	35.000,00	35.000,00
ELIXIR	-	-	52.523,00	60.000,00	80.000,00
EATRIS	-	-	21.884,00	25.000,00	25.000,00
PRACE	-	-	-	-	-
(EPOS)	-	-	-	-	25.000,00
(BBMRI)	-	-	-	-	-
Skupaj ARRS	**995.000,00**	**854.705,00**	**872.250,00**	**725.730,00**	**820.230,00**
Skupaj (vse)	**3.995.000,00**	**1.654.705,00**	**2.978.070,00**	**1.892.652,00**	**3.638.112,00**

3. REVISED LIST OF PRIORITY INTERNATIONAL PROJECTS

3.1 Social and Cultural Innovation

3.1.1 E-RIHS

European Research Infrastructure for Heritage Science

Web page: www.e-rihs.eu

Status
The E-RIHS is a new project in the ESFRI Roadmap 2016 and is currently in the preparatory phase (2016-2019). The operation is expected to start in 2022.

Infrastructure description
The E-RIHS is a distributed research infrastructure project that will be used for the interpretation, preservation and management of cultural heritage. The project will establish a central international E-RIHS hub and national E-RIHS hubs with a related fixed and mobile national infrastructure of recognisable excellence, and accessible material collections, archives and virtual data pertaining to heritage. Both material and intangible heritage will be addressed. The knowledge and protection of heritage at the global level will be increased by the highest quality tools and services of interdisciplinary research networks. The realisation of the project will support collaborative research work, access to analytical equipment, methodologies, data and tools, highly trained staff and storage, processing, interpretation and the optimum utilisation of large amounts of data. Strategic planning will prevent duplication of equipment and research work and increase the competitiveness of European science dealing with cultural heritage. The E-RIHS project will join the efforts of many already connected infrastructure groups. The connection of the existing initiatives IPERION CH (E-RIHS core), ARIADNE, PARTHENOS and a cluster of projects that support the integration of the ERIC will serve as an example and the catalyst of the process.
The core of the E-RIHS project consists of four laboratories, namely ARCHLAB, which is an archive of museums and institutions of cultural heritage, FIXLAB is the platform of medium and large devices, MOLAB is a mobile laboratory for non-invasive in situ measurements and DIGILAB, which deals with the creation of digital methods for processing and storing data. At the national level, all these laboratories shall connect and simultaneously communicate with the European centre.

Analysis of the benefits of inclusion
In the research sense, the inclusion of Slovenia in the project will contribute mainly to the scientific excellence of Slovenian researchers, which leads to new scientific publications, development of new analytical methods and protection of cultural heritage, provides meta-analysis on databases with a large amount of data (big data), and possible patents and property rights. Moreover, it will also contribute to research efficiency and performance by standardising investigations into cultural heritage, thereby avoiding duplication of research infrastructure and work. It will increase the international activity, mobility, international recognition and visibility of Slovenian researchers due to cooperation with international partners. The number of existing research groups and users (galleries, museums, cooperation with institutes, institutions, faculties and companies) will also increase or new ones will be created.
The participation in the E-RIHS will also contribute to the strengthening of interdisciplinary research, since it covers the area of cultural heritage, various scientific disciplines (natural sciences, social sciences and humanities), and to the promotion of this field of science, and the integration of these contents for educational purposes.
In terms of education, it will encourage greater mobility and increased opportunities for foreign institutions and users, the integration of RI in the implementation of educational programmes, especially postgraduate programmes at the Biotechnical Faculty of the University of Ljubljana, Faculty of Arts of the University of Ljubljana, Faculty of Fine Arts, Faculty of Chemistry and Chemical Technology of the University of Ljubljana and the employment of researchers over the next three to five years. The inclusion will also bring economic benefits, namely an increase in the possibilities for market applications

of research results in this field and the transfer of new knowledge and services in the industry, the development of measurement techniques and new market products in partnership with companies, an increase of the potential for the development of new application technologies by improving conservation and restoration procedures and innovation in the field of measuring techniques and new materials analysis techniques.

Financial aspect
It is estimated that for the establishment of the national RI as an integral component of the distributed international RI an investment of at least 1 million EUR will be required. For the maintenance of this infrastructure approximately 100,000 EUR annually will be needed. Part of the funds could be obtained by the participation in international projects and inclusion of commercial partners.

3.2 Materials and Analytical Capacities and Natural Sciences and Engineering

3.2.1 CTA

Cherenkov Telescope Array

https://portal.cta-observatory.org

Status
The CTA project was first included in the ESFRI Roadmap in 2008. In 2014, it was among three priority ESFRI projects with appropriate financial support for implementation and remains on the priority list in the ESFRI Roadmap 2016. The project is reaching the construction phase (2017-2023); full operation is expected to start in 2023. Slovenia has been involved in the preparation of the project since 2013 through a group of researchers of the Laboratory for Astroparticle Physics, University of Nova Gorica and the Department of Experimental Particle Physics of the Jožef Stefan Institute (IJS). At the early stage, this group actively contributed to the planning of observatories and the study and simulations of possible research. In the construction phase, a contribution to the construction of two detector sets, detectors for detecting Cherenkov light and atmospheric control systems, is envisaged. Cooperation with relevant Slovenian economic partners is also envisaged. In the phase of the observatory utilisation, proposals for observations related to the research into extreme energy cosmic rays, gamma-ray bursts and dark matter in the universe are being prepared.

Infrastructure description
The CTA is aimed at studying phenomena at extreme energy and size ranges in nature. The infrastructure enables research into the universe at the wavelengths of high energy gamma rays. The CTA has great research potential for discoveries in the so-called '' new physics', i.e. processes that are not included in the standard model of elementary particles or in cosmological models. In the framework of the CTA project, two large observatories will be built, one in each hemisphere, which will allow the measurements of high energy gamma rays throughout the sky. Each observatory will consist of a network of approximately a hundred telescopes for detecting Cherenkov light. These will detect incident photons through atmospheric avalanches of charged particles. For the successful operation of the CTA observatories, grid technology is used, which has been developed to support experiments at the CERN and is based on the optimal exploitation of computer capacities distributed among a larger number of institutions in different physical locations to achieve common computing goals. The research infrastructure of the CTA observatories with all corresponding instrumentation is the worldwide leader in technological capabilities. The first scientific results from the partly built Southern CTA Observatory are expected in 2017. The CTA consortium connects more than 1,100 researchers from 28 countries in Europe, Asia, Africa and the Americas.

Analysis of the benefits of inclusion
Participation in the CTA is expected to strengthen the staffing of researchers and the formation of a new inter-institutional programme group in the field of astronomy and its contribution to the interdisciplinary nature of research. The CTA is expected to enable groundbreaking discoveries in the field of astrophysics, for which there is an enormous interest among the general public. This also means a great impact on the promotion of science.

The inclusion is also important for the economy, since it will be able to compete in tenders related to the construction of the observatories, which will be worth 200 million EUR. Mainly, this will provide economic advantages for the fields of information technology, electrical and electronic professions and high-tech companies involved in optics and remote sensing of atmospheric properties. Basic research of high-energy gamma rays is not directly market-oriented, but participation in the CTA offers opportunities for marketing the applications needed for the construction of the observatories. These include applications for monitoring and forecasting of atmospheric properties, for distributed data processing, for remote monitoring and management of the observatories and their detector sets and others.
The real possibility for a spin-off of basic CTA research is in the remote characterisation of the atmosphere as the detector medium of the observatory, which will be the task of the Centre for Atmospheric Research (CRA) at the University of Nova Gorica. The CRA has, together with the Environmental Agency of the Republic of Slovenia, built the first lidar observatory in Slovenia in Otlica above Ajdovščina; they have also developed the Raman lidar for remote measurements of water vapour profiles and, in cooperation with Slovenian industry, the three channel mobile lidar for tracking and identification of aerosols. They also examine the impact of ionospheric disturbances on GPS receivers and the possibility of their elimination, which was of great importance during the increased solar activity in 2012 and 2013.
Also important is the role of the CTA in the field of education for doctoral students of physics who are involved in the work of research collaborations or as young researchers.

Financial aspect
The preparatory phase of the CTA project has been largely funded by the 7th EU Framework Programme for Research and Development. It is estimated that the costs of development and construction of the CTA in the expected range of two observatories with approximately 100 telescopes each will exceed 200 million EUR. The costs of the necessary upgrades of the Slovenian research infrastructure in this area (during construction and operation of the CTA 2015-2020), including the costs of participation in the CTA, are estimated at 100,000.00 EUR annually. The costs of maintenance and operation of the functioning observatory after its construction are estimated at 60,000 EUR annually.

3.2.2 European XFEL or EuroFEL

X-ray Free Electron Laser or European Free Electron Lasers

www.xfel.eu/ or www.eurofel.eu

Status
These are projects from the initial Roadmap priority list. With their previous work on synchrotrons (ESRF, ELETTRA, DESY), Slovenian researchers have been involved primarily in structural analyses of diverse materials, but they also have experience in the field of X-ray absorption and emission spectroscopy, which will be one of the key techniques of the XFEL and EuroFEL. As many as 5 Centres of Excellence are included in the XFEL participation proposal: for Nanosciences and Nanotechnology (CO NIN), for Biosensors, Instrumentation and Process Control (CO BIK), for Low-Carbon Technologies (CO NOT), for Advanced Materials and Technologies for the Future (CO NAMASTE), and for Polymer Materials and Technologies (CO POLIMAT). The cooperation is also important in the context of the development of the new generation desktop XFEL source ("Surfotron") and time-resolved electronic electron microscopy, taking place in CO NIN. One of the FEL centres in EuroFEL will also be the FERMI@ELETTRA Centre within the framework of Trieste Synchrotron. Slovenia's participation in the EuroFEL is therefore possible within this context.

Infrastructure description
The free-electron lasers XFEL (now "European XFEL") and EuroFEL are partially replaceable in the field of their use; the consortium of free-electron lasers EuroFEL combines several such devices in Europe (existing or under construction), XFEL is a new device of higher capacity that is under construction. For Slovenian scientists, the importance of access to only one such device has been identified; therefore, the aspects of both projects should be considered before taking the final decision on cooperation. In the current period of the implementation of the Roadmap, there was no progress in

this respect and there have also been no initiatives or confirmed expressions of interest from the research community.
XFEL in Hamburg will be a new international centre for the production and scientific use of very bright and ultra-short pulses, spatially coherent hard x-rays. New opportunities that it will offer will be mainly interesting to materials science for the development of new advanced and complex multifunctional materials. The complex will comprise a 1.7 km long superconducting linear accelerator for accelerating electrons and 6 experimental stations with modern and advanced equipment for scientific use of the rays. The rays will allow the implementation of completely new and potentially revolutionary experiments for a large number of disciplines, from physics and materials chemistry to nanoscience and nanotechnology. Detailed understanding of chemical reactions and the manner of functioning of molecular systems will be essential for the design of new inorganic and organic (nano) materials. The XFEL will use the new technology of superconductivity for accelerating electrons with a high rate of repetitions, which will be the basis for the development of future accelerators.
The EuroFEL project connects national FEL centres which are already in operation or in the start-up phase into a uniform, distributed and internationally open infrastructure. Connecting the centres represents an efficient use of the complementary instruments available in each centre and thus enables the characterisation of materials from very different aspects. The EuroFEL will offer a wide range of beam lines and equipment which will be much richer than a single existing centre could offer. The laser light offered by the EuroFEL upon its establishment will comprise the range from far infrared wavelengths to soft X-rays. With a rich set of characterisation techniques offered by the EuroFEL, it will be possible to investigate the electronic, structural, optical and chemical properties of various materials from nanostructured to mesoscopic and macroscopic, both inorganic and organic and biological. It will be possible to monitor most properties as a function of time, since most FEL centres allow picosecond or femtosecond laser flashes enabling high-temporal resolution upon the availability of the appropriate data acquisition systems.

Expected benefits of inclusion
By the integration in the XFEL or EuroFEL, international cooperation will deepen or be newly established, both in the field of theoretical support to experiments and for the full usage of RI capabilities and making new discoveries. The usage of XFEL or EuroFEL capacities will enable Slovenian scientists to carry out research of exceptional quality. The users who can currently be identified in Slovenia will mainly take advantage of the opportunities that exist for research into 3D nanostructures, complex structures and systems, bio-molecules, monitoring of chemical reactions at the atomic level and in new time-scales, far exceeding current capabilities.
The XFEL and EuroFEL will enable scientific breakthroughs in several fields, and globally will hold a leading position in the ability to generate very intensive and extremely short pulses of X-rays for scientific research and for breakthroughs in a large number of disciplines, giving European, and therefore also Slovenian science, the possibility to take a leading role in new and innovative achievements in the fields of nanoscience, materials science, energy and sensors science and other key fields. By the usage of the infrastructure, Slovenian research groups will be included in other user groups and thus will be in direct contact with the most popular trends in individual research fields.
The understanding of materials and processes will be of key importance for their usage for engineering and biomedical purposes. New inorganic and organic (nano) materials with improved characteristics and systems with complex behaviour, originating in dynamic attributes, and closely linked with the development plans and visions of the Slovenian chemical industry, will be developed. Previous research on synchrotrons will be upgraded and upon carrying out the research, Slovene students and researchers will become further educated and will advance, and by creating new knowledge, will transfer it to others for the development of new products with high added value.
Therefore, in the long-term, the cooperation of Slovenia in the XFEL or EuroFEL will enable the transfer to, and usage of, the latest discoveries by Slovenian science and industry and thus, by means of the development of individual fields, the upgrade of basic knowledge and development of new products and technologies. The creation of new work posts in research organisations and industry and the establishment of new spin-off companies is expected. The research expected to be carried out in the XFEL or EuroFEL will also be strongly socially integrated since their results can be used for solving acute global social problems, such as improving quality of life and health, ensuring sustainable development and the development of a low-carbon society, introducing energy-saving technologies and fulfilling increasingly strict environmental requirements.

Financial aspect
Slovenia has not planned its own investment in the XFEL project in an amount that would enable the acquisition of an equity share (minimum 12 million EUR), therefore it will, above all, examine the possibilities of linking with other states to enable access to the XFEL capabilities for Slovenian scientists. The most realistic possibilities for cooperation in the EuroFEL are either access to its capabilities (mainly FERMI@ELETTRA) within the framework of cooperation with the Trieste Synchrotron or upgrading or construction of national capabilities that could be included in the EuroFEL.

3.2.3 ILL

NEUTRONS FOR SCIENCE®

Institute Laue Langevin

www.ill.eu/

Status
This is a project from the initial Roadmap priority list. In Slovenia, a strong interest of researchers in the use of facilities in the ILL has been identified, which was especially evident after the workshop organised by the Institute of Chemistry and the Jožef Stefan Institute in May 2008, which attracted many researchers from all of the most prominent research institutions in Slovenia. The strong interest of researchers assures adequate critical mass and, at the same time, encourages interdisciplinary research in the international environment. Upon the initiative of the Institute of Chemistry, the possibilities of direct full integration or to become a member in the consortium of Central European states of Austria, the Czech Republic, Hungary and Slovakia (CENI) are being investigated.

Infrastructure description
The Institute Laue Langevin (ILL) in Grenoble, France is the leading international research centre for neutron scattering. Due to their specific characteristics, the neutrons present a complementary approach to other diffraction and spectroscopic methods (X-ray diffraction, IR and NMR spectroscopy, etc.) and play an essential and, frequently, key role in modern research into the chemistry and physics of (nano) materials and in life sciences (biochemistry, biophysics and biology). The ILL research equipment includes approximately 40 ray lines with diverse characteristics for studying the structure and dynamics of matter on diverse space and time scales. The ILL is owned in equal equity shares by France, Germany and Great Britain and has been functioning since 1973. In addition to the listed states, it has several other partner states. On an annual basis, approximately 700 experiments are carried out at the institute and more than 450 scientific articles are published. The institute can pride itself on the largest number of scientific publications with a high impact factor among all the world's related institutions involved in neutron scattering.

Expected benefits of inclusion
The introduction of research with neutron scattering opens to Slovenian researchers a wide range of the most modern analytical methods in the fields of chemistry and materials physics and nanomaterials, structural biology and nuclear physics. The use of neutron scattering methods complements other methods of scattering (X-rays); therefore, such methods are an indispensable tool of modern science in regard to materials and life science. By the inclusion of Slovenia in the ILL, these methods would become easily accessible. Due to optimal organisation of the ILL operation, as evidenced by exceptional production of high-quality scientific publications and a very large number of international projects in which the ILL participates, Slovenian researchers would also acquire unique opportunities for inclusion in international scientific flows.
Also, numerous opportunities for advanced training and research for younger professional staff at the ILL would open up. Training for research with neutron scattering for all the participating researchers is part of the established practice at the ILL and is conducted by employees working on ray lines. Slovene doctoral students could also be trained for work on ray lines, thus acquiring important knowledge and skills for Slovenia.
Since the research with neutrons also enables the study of industrial materials (for example cracks in alloys) and the study of cocrystals of pharmaceutical substances that present a large challenge to the pharmaceutical industry, the wider interest of Slovenian industry can also be expected.

Financial aspect
The costs of inclusion of Slovenia within the CENI, which seems to be the most cost-effective and appropriate according to the needs of the research community and from the financial aspect, would amount to approximately 150,000 EUR annually. This is the payment for the annual operating costs normalised with respect to the scope of the research of Slovenian researchers performed at the ILL (10 to 12 beam days) and it also includes the one-time payment of the membership fee (entrance fee) in the amount of approximately 200,000 EUR.

3.3 Environmental Sciences

3.3.1 EPOS

European Plate Observing System

http://www.epos-eu.org/

Status
The EPOS was among the priority projects planned to update the Roadmap list. It has been in the ESFRI Roadmap since 2008. In 2014, it was among three priority ESFRI projects with appropriate financial support for the implementation and remains on the list in the ESFRI Roadmap 2016. Currently, the project is in the implementation phase (2015-2019) within which the establishment of the EPOS ERIC is planned. Slovenia is actively involved in the preparation of the project on the basis of a letter of support dated 3rd November 2011. In the preparatory phase, the key task, in addition to participation in international activities within the project, is to adequately connect relevant Slovenian institutions in this field, in particular the Karst Research Institute at the ZRC SAZU, Environmental Agency of the Republic of Slovenia (Institute of Geology and Seismology), University of Ljubljana (Faculty of Civil and Geodetic Engineering), Geological Institute of Slovenia and the Jožef Stefan Institute, which established the EPOS-SI consortium on 11th May 2016. The preparation of the contents of the project at the national level is coordinated by the Karst Research Institute at the ZRC SAZU.

Infrastructure description
The EPOS is a research infrastructure for the monitoring and observation of geophysical and seismic phenomena. Through the observation points and the development of infrastructure points, the processes in the fields of geology, geochemistry, seismology and volcanology will be monitored. The project will create a unified and sustainable infrastructure which will include surface geophysical monitoring networks, local observations (permanent terrain and volcanic observatories) and experimental laboratories in Europe. It will provide current, reliable and comparable data to users. By using a single portal, data will be provided to the public administration, for research purposes, for the purpose of prevention and rescue in cases of natural disasters, for education, etc.

Analysis of the benefits of inclusion
For Slovenia, which is located on tectonically active terrain, the EPOS will provide a good basis for the preparation of the appropriate research infrastructure and, consequently, for improving seismic safety in the region.
The expected benefits of Slovenia's inclusion in the EPOS are reflected in research, industry and education.
For Slovenian researchers, the cooperation in the project, on the one hand opens up the possibility of accessing data that are collected and processed to high standards of quality, integration in various working groups and participation in drawing up the rules for the collection and processing of relevant data for processing at the European level, and on the other hand provides many options for developing international connections. This also opens up the possibility of greater involvement in international and European projects.
The EPOS project has an indirect economic impact, since the primary activity of the project is data collection and processing. The analytical value of the data is of economic importance. For example, comparative analyses that draw attention to different kinds of changes in the environment and thereby

indicate possible developments that may harm economic activity. Particularly important may be the data that affect the field of civil engineering and infrastructure construction.
The EPOS also provides an important source of data, analyses and methodological elements that are required in the educational processes.

Financial aspect
The costs of the planned development and upgrade of the national research infrastructure in this field, including the costs of participation in the EPOS, are estimated at 400,000 EUR; the annual membership fee amounts to approximately 70,000 annually. The financing of the EPOS activities began in 2015. In the coming years, the financing of the planned development of the national infrastructure will be enhanced by the resources from the Structural Funds as soon as possible.

3.4 Health and Food (Biological and medical sciences)

3.4.1 BBMRI

Biobanking and Biomolecular Resources Research Infrastructure

http://www.bbmri-eric.eu

Status
The BBMRI was among the priority projects planned to update the Roadmap list. It has been in the ESFRI Roadmap since 2008; upon the last update it has been classified among the implemented ESFRI projects (ESFRI landmark). It was established as the BBMRI ERIC on 22nd November 2013. For participation in the BBMRI, an appropriate structure (hub) must be established at the national level, which connects the relevant actors in this field, such as: Institute of Microbiology and Immunology (IMI) of the Faculty of Medicine, University of Ljubljana, Department of Neurology of the University Medical Centre Ljubljana, Department of Pharmacology and Experimental Toxicology of the Faculty of Medicine, University of Maribor, and professional and organisational support from the already established national ELIXIR hub is expected.

Infrastructure description
BBMRI is one of the largest research infrastructures in the field of medical research in Europe, and provides coordinated access to biological banks and biomolecular resources through national hubs. These coordinated activities include the collection, management, distribution, and analysis of samples and data. The project aims to improve the accessibility and interaction of the existing comprehensive collection of biological samples of different populations of Europe, which must be linked with continuously updated data on the health status, lifestyle and environmental exposures of sample donors. The biobanks, biomolecular resources and technology centres which are members of BBMRI, are associated with their specific area hub. A variety of public and private partners (e.g. universities, hospitals, companies) that provide biological samples, data, technologies or services may be associated with them. The BBMRI users may come from different fields of science and industry. The BBMRI speeds up the development of personalised medicine and disease prevention and embraces some of the needs of basic research as well as of the biotechnological and pharmaceutical industries. Thus, it enables improvements in public healthcare and drug development. Both at the European and national levels, the BBMRI is linked with and complemented by other projects in the field of biomedicine, in particular the ELIXIR and EuroBioimaging.

Analysis of the benefits of inclusion
The biological resources in Slovenia are much dispersed and poorly connected; therefore, their integration and technological upgrade is a national priority. The inclusion of Slovenia in the BBMRI may significantly contribute to the internationally appropriate technical standardisation and methodological harmonisation, while providing access to the other samples in the BBMRI. The BBMRI supports both basic research and the transfer of results to applied research of biotechnological and pharmaceutical companies, thus enabling improvements in public healthcare. Potential RI users are research groups, educational institutions and in particular smaller companies, which require high-quality and diverse biological samples for determining the causes and courses of diseases in their research. The provision

of a large number of samples is necessary for biotechnological and pharmaceutical companies which are engaged in the development of diagnostic tests. Participation in the BBMRI will allow the creation of a larger group of relevant samples, which will ensure the effectiveness of research.
The BBMRI will be especially important for the development of small and micro-biotechnological companies, the main problem for which is often the access to biological samples and biomolecular resources. These are currently scattered throughout the country with no central register under the auspices of individual research groups and organisations.

Financial aspect
Full membership in the BBMRI will require an appropriate national contribution comparable to other projects in the field of biomedicine and amounting to approximately 3 million EUR for the period of the national centre (hub) upgrade. The membership fee amounts to 20,000 EUR annually.

3.4.2 Euro-BioImaging

European Research Infrastructure for Imaging Technologies in Biological and Biomedical Sciences

http://www.eurobioimaging.eu/

Status
The project has been included in the ESFRI Roadmap since 2008 and remains on the main list of the ESFRI Roadmap 2016. Currently, the project is in the construction phase (2014-2017); its operation will start in 2017 and will be established as ERIC. In Slovenia, the Centre for Clinical Physiology (CFK) and the Biomedical Centre for Microscopy (BMCM), both of the Faculty of Medicine, University of Ljubljana, strive for the inclusion in the EuBI. The IJS is also a potential partner. The inclusion is particularly important due to the complementarity with the ELIXIR project. Slovenia has not yet established formal contacts with the EuBI at the expert level.

Infrastructure description
The Euro-BioImaging (EuBI) is a research infrastructure connecting technologies in the field of biological, biomolecular and medical imaging.

Analysis of the benefits of inclusion:
The inclusion of Slovenia in the EuBI will enable better use of our data and easier access of our researchers to foreign image databases and archives. Coordinated cooperation with other related RI in Europe in the field of data management (permanent and secure storage, access security, high-speed network connections, use of computer clusters, e-learning) will increase research efficiency and effectiveness and make an important contribution to scientific excellence. The better quality equipment will significantly improve the possibilities for the practical training of graduate students in the domestic infrastructure. All equipment will be available to students and end/clinical users. The transfer of knowledge from more developed European centres to our country will be more effective. Complementary activities in the field of modern imaging technologies within the EuBI project will increase the opportunities for establishing new contacts and business transactions for economic entities; for example, they will enable the opening of spin-off companies.

Financial aspect
Conditions for membership in the EuBI will be defined at the latest until 2017. At the same time, it will be necessary to ensure sufficient resources for the upgrade of the national infrastructure, which will be comparable to other projects in the field of biomedicine and amount to approximately 3 million EUR for the period of the national centre (hub) upgrade.

3.4.3 ISBE

Infrastructure for Systems Biology Europe

http://project.isbe.eu/

Status

For the first time, the ISBE was included in the ESFRI Roadmap in 2010 and remains on the main list of the ESFRI Roadmap 2016. Currently, it is in the construction phase (2016-2018); its operation will start in 2018 and will be established as ERIC. The Faculty of Medicine, University of Ljubljana (since 2013) and the Ministry of Education, Science and Sport (since 2014) were included in the project preparatory phase (2012-2015). Slovenia has participated in the project preparatory phase since 2013. The ISBE hub will be based on the foundations of the Centre for Functional Genomics and Bio-Chips, the partners of which are research institutions from three research centres, namely Ljubljana, Maribor and Nova Gorica.

Infrastructure description

Systems biology is a discipline of life sciences, which leads to the understanding of the functioning of living beings through the integration of data in quantitative calculation models. These models can predict the behaviour of a biological system at the level of molecules, cells and tissues through space and time. Such a level of research may have a significant impact on the development of modes of treatment, building self-sufficient food production, and will launch various fields of bio-economy.

The purpose of the ISBE project is the establishment and accessibility of a regional network infrastructure of hubs throughout Europe that will change our understanding of life sciences, environment and our health. The project will enable European scientists from various fields of life sciences to explore complex biological problems from the system perspective. This project will establish a network of infrastructural hubs throughout Europe, which will provide multidisciplinary expertise, education, opportunities for experimentation and modelling, data repositories and models necessary for small or large programmes in systems biology. The use of the infrastructure will increase the basic knowledge from the level of molecules and cells to entire organisms and will lead to new applications in biomedicine, agriculture and the environment. It will positively affect the future healthcare and technological development related to the life sciences, which will be felt in European society, industry and economy.

Analysis of the benefits of inclusion

The inclusion of Slovenia in the ISBE will significantly contribute to the scientific excellence of Slovenian researchers. Systems biology enables the solving of complex biological problems which have not been adequately addressed by current approaches. In various fields, particularly in medicine, pharmacy, agriculture and environmental sciences, breakthroughs are expected as well as completely new biotechnological solutions. A great number of innovations is also expected. The national hub will provide to Slovenian researchers an overview of the activities in other European countries and open the possibility of facilitating the establishment of direct contact with potential European partners.

The access to knowledge and equipment within the ISBE will also complement the expertise from industrial partners. The participation in the ISBE will lead to faster development of new products, better preparation of documentation for the registration thereof for commercial purposes, and more successful commercialisation of research results or new high-tech products.

Renewed study programmes related to systems biology and links to a variety of resources for education in this field are being prepared. They will be implemented after the completion of doctoral studies. An important planned activity within the ISBE is the user training, which will take place at several levels. At the basic level, the training will be implemented in the context of the national hub. At the highly specialised level, the training will be organised with top scientists in a specific area, which will provide access to cutting-edge expertise for Slovenian scientists.

Financial aspect

Conditions for the membership in the ISBE will be defined at the latest until 2018. At the same time, it will be necessary to ensure sufficient resources for the upgrade of the national infrastructure, which will

be comparable to other projects in the field of biomedicine and amount to approximately 3 million EUR for the period of the national centre (hub) upgrade.

3.5 E-infrastructure

3.5.1 PRACE

Partnership for Advanced Computing in Europe

www.prace-project.eu/

Status
This is a project from the initial Roadmap priority list. On 24th January 2012, the University of Ljubljana, Faculty of Mechanical Engineering was included therein, but without ownership and financing at the governmental level. Upon the transition of the project to the next phase PRACE 2.0 (2015-2020), the Supercomputing Centre Slovenia (SRCS) consortium was established. In order to make a decision regarding Slovenia's inclusion, it is necessary to ensure proper consideration of the already established organisational and computer infrastructure and the needs of all relevant stakeholders.

Infrastructure description
The PRACE project is Europe's answer to the need for increased computing power in science and industry, which can no longer be optimally ensured only by purchasing more powerful computers. Since by the use of the current technology of electronic circuits it is no longer possible to increase computing power fast enough, the so-called parallel computing, involving a large number of interconnected units, is booming. Such a system is the PRACE e-infrastructure centre, which connects individual centres for high performance computing into a single infrastructure connected with national, regional and local centres, thus forming a world-class scientific computer network. Therefore, the aim of the PRACE is to build a European e-infrastructure with the ambition to become the best in the world and offer to users, in addition to high-performance computers, also virtual computer networks and data storages with information resources distributed across Europe and connected with high-speed communications networks. The PRACE closely cooperates with similar initiatives. These are the Distributed European Infrastructure for Supercomputing Applications (DEISA), Enabling Grids for E-sciencE (EGEE) and the European Grid Initiative (EGI).
The PRACE will be organised on three levels. At the highest level-0, there will be three to five PRACE super-computing (HPC) European centres. At level-1, there will be national centres interconnected with the grid or similar technologies. At level-2, local centres are envisaged. On the basis of mutual cooperation, the existing systems of level-2 in Slovenia, which are located at universities, research institutions and partly in the economy, could be connected and a national centre at level-1 established by the upgrade of the existing facilities according to the needs of the Slovenian scientific and research community

Expected benefits of inclusion
Slovenian researchers participate in several EU projects that are directly linked to the e-infrastructure and high-performance computing (HPC), but so far they do not have the sufficiently powerful equipment to establish the critical mass of the HPC knowledge by which they would be able to obtain computer time in major centres on the basis of the already tested code. Larger computer clusters are at the Institute of Chemistry, Jožef Stefan Institute and the Faculty of Mechanical Engineering, University of Ljubljana. The largest computer cluster is at Turboinštitut d.d. The ARNES network as the central national infrastructure for powerful distributed computing is also established. The SLING also operates within this and is open for use by all research and educational institutes in Slovenia and is the basis for the effective use of computer facilities in Slovenia. The integration and coordination of the free capacities of clusters in Slovenia could constitute the initial core of the Slovenian national infrastructure.
The inclusion of Slovenia in the PRACE would join and complement the existing infrastructure for the requirements of e-science and other disciplines, especially natural sciences or life sciences, and technologies that need high performance computing and communications systems for the processing and transmission of data and would provide them access to Europe's most powerful computer systems. The development and use of software tools for solving computationally demanding tasks in parallel and

distributed autonomous networks will be accelerated and optimised. In this context, not only the development of super computers is concerned but also the development of all mathematical knowledge for detailed numerical simulation in the fields of biotechnology, medicine, molecular structure, particle physics, fusion, hydromechanics, aerodynamics, environmental protection, economics, etc., and will contribute to the development of these and other sciences and various information technologies. In this case, a horizontal infrastructure that will be used for practically any scientific discipline.

Financial aspect
The estimated costs of the inclusion of Slovenia in PRACE 2.0 amount to approximately 110,000 EUR annually. Moreover, it would be necessary to integrate and upgrade the national infrastructure which could be included in the PRACE activities. Initially, this cost was estimated at approximately 1-2 million EUR.

4. EMERGING PROJECTS

4.1 Environmental Sciences

4.2.1 eLTER

European Long-Term Ecosystem Research

http://www.lter-europe.net

Status
The project is included in the ESFRI Roadmap as an emerging project. 28 partners from 22 national networks are included in the eLTER project. The Slovenian national network, which was founded in 2003 and currently comprises eight umbrella organisations under the coordination of the ZRC SAZ, is also included. Both a considerable level of interest and the potential for the inclusion of the national network in the European eLTER exist. Researchers have already expressed support by signing the letter of intent.

Infrastructure description
Connections in the field of ecosystems research have been organised in a network of various institutions in the form of the LTER network since 2003. Within the latter and in cooperation with the LifeWatch project, the initiative to transform the LTER network into an infrastructure project was given. The infrastructures complement each other since the LTER network includes high-tech equipped places where in situ ecosystem and biodiversity research and their monitoring is performed, while the LifeWatch supports such research on the level of the protection, management and sustainable use of biodiversity. The group that has given the initiative for the creation of the infrastructure project eLTER has obtained the funding for the preparatory phase 2015-2019 with the aim to develop national networks and socio-ecological platforms from the European LTER network towards the creation of a multi-purpose distributed research infrastructure.

Analysis of the benefits of inclusion
The emerging eLTER research infrastructure is complementary to the existing LifeWatch research infrastructure; therefore, benefits are expected in several areas.
For the research, it is vital that the LTER network and consequently the eLTER research infrastructure include high-tech equipped sites for data capture, which is the basis for research work in the field of ecosystems, especially in the study of biodiversity. Databases that will be established and processed according to the common methodology within the emerging research infrastructure enable complex biodiversity research. By membership in the eLTER, Slovenia accepts the obligation of providing data on speleobiology and karstology and thus further consolidates the important role in this field and opens the door for the inclusion of new international research into biodiversity and ecosystems. In the educational context, it is expected that the research infrastructure will contribute to the dissemination of knowledge, both within the research community and the educational process.

From the economic aspect, the environment and its protection present an important area of new business opportunities. The research infrastructure to be set up under the eLTER will allow open access to important data which are the basis for innovation and new technological solutions in the field of environment protection. The free access and the possibility of data dissemination are of special importance in terms of entrepreneurial activity.

Financial aspect
The ZRC SAZU is involved in the preparation of the eLTER project, which will be completed by 2019. During this time, the framework of the new research infrastructure operation will be prepared, including the financial parameters and definition of the costs of national participation.

4.2 Health and Food (Biological and medical sciences)

4.2.1 METROFOOD

Metrology Promoting Objective and Measurable Food Quality and Safety

www.metrofood.eu

Status
The project is included in the ESFRI Roadmap as an emerging project. In Slovenia, the Laboratory for Oil Testing (UP ZRS), Department of Environmental Sciences (IJS) and Department of Biotechnology and Systems Biology (NIB) have expressed an interest in participation. All three are recognised as holders of national standards and provide superior personnel and equipment, which allows international comparability of results in the field of food and nutrition according to the strategy of Slovenian metrology.

Infrastructure description
The METROFOOD project is intended to provide metrological traceability in the field of nutrition, which will upgrade the existing infrastructure in partner states. For this purpose, a network of laboratories, research groves, experimental fields and farms will be established. The project includes both the physical and e-infrastructure. Within the project, the existing capacities of the participating research centres will be particularly exploited. It will enhance scientific excellence in the field of food quality and safety, thus enabling an increase in opportunities for market analyses to be carried out by laboratories. The market value is also reflected in the development of new products and innovative approaches. One of the priorities of the research work is the orientation towards the various sources of financing of the research and development work by marketing new knowledge and products.

Analysis of the benefits of inclusion
For the research activity, the inclusion in the METROFOOD project will be of great scientific importance; in addition to scientific events and publications, patent applications are also being prepared.
An important aspect of this project is the enhancement of the interdisciplinary research due to the integration of disciplines (chemistry, biology, microbiology, agriculture, tourism and the economy) and promotion of science by dissemination activities, informing the public and integration with the international professional public and leading institutions in Europe.
From the economic aspect, the inclusion will supplement the research and development capabilities of industrial partners which themselves do not have the critical amount of necessary knowledge and experience, e.g. cost viable and cheaper production of plant and animal raw materials in the manufacture of new products Domestic producers will be able to exercise Slovenian origin and quality of produce and food products. The systems for tracking the food from producer to consumer, monitoring of environmental conditions, the system for determining the geographical origin of food and the identification of biological species will provide a comprehensive system that will consider buyer's wishes and needs.
The development of new sensor technologies will reduce the costs of monitoring and thereby increase the possibilities for the control of food quality. In recent years, additional income due to the provision of traceability (protected designation of origin) and quality has already been recorded e.g. in the field of olive growing. Other examples of the return of the investment to the economy have also been recorded,

as well as the impact of the use of such research infrastructure on the creation of new spin-off companies that are globally marketing the information technology in food production for new products with high added value.
In terms of education, the use of top equipment will enable better working conditions, promote the interest in the study of natural science and technology and thus contribute to the higher education of the Slovenian population and a greater link with the economy, while also attracting talents to our country. It is planned to set up a new programme in the field of food technology, which will be implemented within the framework of the ERA Department (IJS) ISO-FOOD.

Financial aspect
The framework of METROFOOD operation, including financial parameters and definition of costs of national participation, has not yet been defined.

5. CONNECTIONS BETWEEN THE ROADMAP AND THE SMART SPECIALISATION STRATEGY (S4)

Research infrastructures are one of the fundamental preconditions for research work and the connecting link in the knowledge triangle of research, education and innovation. Medium and large research infrastructures are especially essential in providing the excellence of research that raises the standard of science in the country to an internationally comparable level; therefore, it is imperative to provide access to the best research infrastructures for Slovenian researchers, either by building or upgrading domestic research infrastructures or, where it is more reasonable, by integrating into the existing facilities and international research infrastructure projects.

In 2015, the Government of the Republic of Slovenia adopted the Slovenian Smart Specialisation Strategy (S4) which is the foundation for focused development investments in the areas where Slovenia has a critical mass of knowledge, capacities and competences and innovation potential for placement on global markets and thereby for strengthening its visibility. S4 strategic orientation is focused on sustainable technology and services for healthy life, which will position Slovenia as a green, active, healthy and digital region which has the optimum conditions for creation and innovation and is focused on the development of medium and high technological solutions in niche areas. Achievement of the objectives is set by a package of measures, including research, development and innovation with the emphasis on the complementarity with Horizon 2020 and international initiatives and better use and development of research infrastructure. Operational Programme 2014-2020 and the S4 determine that investment in research infrastructure will focus on priority areas which are a prerequisite for the international competitiveness of the Slovenian RDI space.

In connection with the Horizon 2020 and international initiatives, the measure is designed to support the integration of Slovenian partners in international networks, promote research and attract the leading foreign experts to Slovenia, mainly through schemes complementary to highly competitive international tenders. Activities for the establishment of the European Research Area, Innovation Union and Horizon 2020 will also be supported, which will focus on co-financing of instruments for spreading participation in Horizon 2020, such as Teaming, ERA Chair and Twinning.

Development of the research infrastructure will follow the ESFRI plans and the Roadmap, especially in terms of the establishment of central centres and partner facilities, which represent the functional integration of Slovenian infrastructure into the international infrastructure. Infrastructure investments will focus on priority areas which are a prerequisite for the international competitiveness of the Slovenian RDI space. The upgrade of the existing and, where relevant, construction of new research infrastructure in priority areas of the S4 use and projects defined in the Roadmap will be supported, whereby the emphasis will be given to the ESFRI projects.[1]

National priority areas, where it is necessary from the aspect of achievement of critical mass and scientific excellence in Slovenia to preferentially develop research infrastructures, have been designed based on various studies and national strategic documents listed and described in the RISS and ESFRI. Thus, the Roadmap defines the following areas: advanced materials, energy efficiency and sustainable construction, renewable energy sources and environmental technologies, biotechnology, biomedicine and biological sources, high performance computing and networks, analytical capacities, national

[1] Smart Specialisation Strategy, 2015

resources (digital, geo-information), social and humanistic research infrastructure, research infrastructure for space applications and safe and healthy food.

The S4 lists the following priority areas: a) Healthy living and working environment with subsections smart cities and communities and Smart buildings and homes including wood chain, b) Natural and traditional resources for the future with subsections: Networks for transition to circular economy, Sustainable food production and Sustainable tourism and c) (S)industry 4.0 with subsections: Factories of the future, Health - medicine, Mobility and Development of materials as final products.

However, despite the different nomenclature, the research areas of the ESFRI, Roadmap and S4 overlap and strive for the same goal, which is the prioritisation of priority areas considering the effective use of research infrastructure where conditions are established for a transparent and non-discriminatory manner of access to the infrastructure for other research organisations and partners, execution of independent research, development of knowledge and understanding, broad access and effective transfer of research results, acquisition of competences for effective participation in international research networks and programmes, attracting top foreign researchers to Slovenia and economic growth.

Table 5: Overlapping of priority areas between the Roadmap and S4

ESFRI projects where participated by area	ESFRI scientific areas	Priority areas for the NRRI establishment	S4 priority focus areas of technologies
CESSDA, CLARIN DARIAH, ESS SHARE, E-RIHS	Social and Cultural Innovation	RI for social sciences and humanities	Smart cities and communities
		Digital national sources	Sustainable tourism
Belle2, CERIC CERN, FAIR, CTA European XFEL EuroFel, ILL	Physical sciences & Engineering	Advanced materials and nanotechnology	Development of materials as end products
			Mobility
		Analytical capabilities	Factories of the future
		RI for space applications	Smart cities and communities
LifeWatch, EPOS eLTER	Environmnet	Sustainable energy resources and environmental tec hnologies	Networks for the transition to circular economy
EATRIS, ELIXIR BBMRI EuroBioimaging METROFOOD	Health & Food	Biotechnology, biomedicine and biological sources	Health - medicine
		Safe and healthy food	Sustainable food production
PRACE	e-infrastructure	High-performance computing and grids	Factories of the Future
	Energy	Energy efficiency and sustainable construction and geo-information	Smart buildings and homes, including wood chain

* In addition to the overlapping of research areas indicated, the table also shows related projects.

The Roadmap at the national level provides the development of medium-sized and large Slovenian infrastructure centres with the vision of achieving critical mass and scientific excellence in at least one area of science. Thus, it will be possible to connect international partners in the area of the Republic of Slovenia in the establishment of a large infrastructural centre at the highest global level and, thus, place this research infrastructure on the agenda of the research infrastructure development in Europe. Within the instruments for spreading the participation in Horizon 2020, such as Teaming, Slovenia has the opportunity to establish a strong research centre that impacts the strategic positioning of the country (region) in the global environment.

According to the RISS 2011-2020, the financing of the construction and operation of research infrastructure is anticipated or ensured both by the European Structural Funds and by increasing the national integrated budget. In the previous programming period 2007-2013, the construction of large national infrastructure was financed with cohesion policy funds; in the 2014-2020 programming period, investments in national and international infrastructure according to the Roadmap, S4 and ESFRI Roadmap are envisaged within the investment priorities 1.1 of the Priority Axis 1 within the measure "development of research infrastructure".
Construction in the context of the international research infrastructure is provided according to the available resources, considering the preparedness of the project and cohesion regions.

Table 6: Indicative costs of the implementation of the Roadmap 2017-2020/2022 and the sources of funding (in 1000 EUR)

	2017	2018	2019	2020	2021	2022	Total
Construction of international projects	1.278.204,08	2.414.385,47	2.414.385,47	1.393.024,98			7.500.000,00
Operation of international projects	5.466.329,07	7.102.510,48	5.769.385,48	4.361.774,98	737.500,00	937.500,00	24.375.000,00
Construction of national projects	14.507.966,85	17.735.604,05	13.736.229,05	11.024.434,44	2.212.500,00	2.812.500,00	62.029.234,40
Operation of national projects	9.600.000,00	9.800.000,00	10.000.000,00	10.200.000,00	10.400.000,00	10.600.000,00	60.600.000,00
Total	30.852.500,00	37.052.500,00	31.920.000,00	26.979.234,40	13.350.000,00	14.350.000,00	154.504.234,40
Cohesion funds (SLO part)	4.250.500,00	5.450.500,00	4.384.000,00	3.355.846,88	590.000,00	750.000,00	18.780.846,88
Cohesion funds (EU part)	17.002.000,00	21.802.000,00	17.536.000,00	13.423.387,52	2.360.000,00	3.000.000,00	75.123.387,52
Budgetary funds (ARRS+memberships	9.600.000,00	9.800.000,00	10.000.000,00	10.200.000,00	10.400.000,00	10.600.000,00	60.600.000,00

Notes: In the table, the actual funds according to the approved INOP are taken into account under the item of national and cohesion funds. The dynamics of budgetary funds is based on previous investment within the infrastructure programmes (Slovenian Research Agency) and international fees (Ministry of Education, Science and Sport).

If Slovenia wishes to achieve the objectives set in the strategic documents and use the existing opportunities according to the current national investments and investment in international cooperation, it should provide the upgrade or construction of new research infrastructure and further develop the research-innovation potential. The Operational Programme 2014-2020, Roadmap and S4 identify projects of national and international importance. Regarding the investments in projects of national importance, it is also reasonable to invest in infrastructure projects that will contribute to the reduction of the development gap between the cohesion regions of Eastern Slovenia and Western Slovenia and to pursue the objective of a balanced regional development. This means the implementation of measures 6 and 7 of the RISS. Regarding the investments in international projects, it is reasonable for Slovenia to continue the investments in existing projects that have a positive impact at the national and international level.