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A FRAMEWORK FOR RESEARCH INFRASTRUCTURE ROADMAP OF BOSNIA AND HERZEGOVINA

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EXECUTIVE SUMMARY

A Framework for Research Infrastructure (RI) Roadmap of Bosnia and Herzegovina (henceforth: Framework for RI Roadmap) is a policy document that summarises the existing research potential of the scientific research system of Bosnia and Herzegovina through the identification of research facilities, equipment, instrumentation and international cooperation, including the involvement of Bosnia and Herzegovina in large European RIs and projects. This document provides decision-makers, research and business sectors with an insight into the current state of research infrastructure of Bosnia and Herzegovina in order to make more efficient decisions at all levels. It assists policymakers to leverage investments in RIs more efficiently according to the domestic and international relevance of identified RIs and to become aware of the main advantages, strengths and trends of domestic research. Establishing new RIs, upgrading existing ones, or joining international, requires additional investments from public budget, and thus evidence-based decisions are needed to improve the efficiency of spending public money. Also, it helps the business sector to have a better insight into the research potential of the economy, providing a basis for establishing stronger cooperation between the business and research sector. In addition, a Framework for RI Roadmap may also be of interest to a wider audience and may therefore increase the visibility and acknowledgement of domestic scientific research.

A Framework for RI Roadmap consists of two parts:

- RI Roadmap of the Federation of Bosnia and Herzegovina (FBiH RI Roadmap);
- RI Roadmap of Republika Srpska (RS RI Roadmap).

Generally speaking, the awareness on the relevance of internationally attractive RIs is increasing. In particular, the role of RIs for international research co-operation and their contribution to international competitiveness is increasingly acknowledged. The RI Roadmaps build upon a reliable knowledge base, which takes the developments beyond the economy's territory into consideration. This includes information about the existing RIs.

Regarding the existing initiatives to support research infrastructures at European level, three general levels of activities can be distinguished:

- Support to a new state-of-the-art research infrastructure defined in the ESFRI roadmap. The European Strategy Forum on Research Infrastructures (ESFRI)[1] is a strategic instrument created in 2002 by the Member States and the European Commission to develop the scientific integration of Europe and to strengthen its international outreach. These activities are aimed at supporting the preparatory phase of new ESFRI projects as well as the implementation and operational phases of ESFRI projects according to the identified priorities.
- Support the use of domestic research facilities by integrating them into larger European networks. These activities are implemented through the support provided by H2020 programme within the thematic priority "Research Infrastructure". The support to RIs was also provided by the previous Framework Programme 7.

1 http://ec.europa.eu/research/esfri

- Support provided to the development of e-infrastructures. E-infrastructures are recognised as crucially important for enabling access to remote resources, remote cooperation and processing of large amounts of data in all scientific fields.

Considering the fact that currently Bosnia and Herzegovina is not present in ESFRI Roadmap, the focus of this document is on the other two sets of activities i.e. on discovering research potential of domestic research facilities, RI projects and the current development of e-infrastructure.

Finally, the importance of adopting this document arises also from the EU Progress Report (2020), which clearly emphasises the need to create a Framework for RI Roadmap of Bosnia and Herzegovina.

What are Research Infrastructures?

According to the Regulation (EU) No 1291/2013 of 11 December 2013, Research Infrastructures are defined as follows: "Research Infrastructures are facilities, resources and services that are used by the research communities to conduct research and foster innovation in their fields. They include: major scientific equipment (or sets of instruments), knowledge-based resources such as collections, archives and scientific data, e-infrastructures, such as data and computing systems and communication networks an any other tools that are essential to achieve excellence in research and innovation".

The current legal and policy context

The current legal and policy framework of Bosnia and Herzegovina in research and development (R&D) reflects the organisation of the economy defined by the Constitution, constitutions of entities, cantons, and the Statute of the Brcko District of BiH. Regarding the competences for R&D policy, the situation is as follows:

- The Ministry of Civil Affairs of Bosnia and Herzegovina is responsible, inter alia, for science and education at the level of Bosnia and Herzegovina through defining basic coordination principles, aligning plans of authorities at entity levels and defining strategies at international level.
- The Federation of Bosnia and Herzegovina has a decentralised government and consists of ten cantons, with each canton having its own ministry in charge of R&D, meaning that the authority for normative arrangement in the field of science belongs to the cantons. The Federal Ministry of Education and Science has a coordinating role in the Federation of BiH.
- Republika Srpska has a centralised government and one ministry in charge of R&D.
- The Brcko District of Bosnia and Herzegovina has a government with departments. One of these departments is in charge of R&D.

Although competencies are clearly defined, R&D is not regulated in all cantons. Only four out of ten Cantons have regulated the field of R&D: the Sarajevo Canton, Tuzla Canton, West Herzegovina Canton and Canton 10. As a result of insufficient regulation in this area, the term Scientific Research Organisation is not legally defined in a unique way across the Federation of

Bosnia and Herzegovina. Only Sarajevo Canton, Tuzla and Zenica-Doboj Cantons have regulations governing this area, while other cantons, and Federation of BiH level have not regulated which organisations are considered as scientific research organisations.

The Strategy for Development of Science in Bosnia and Herzegovina (2017-2022)

The Strategy for Development of Science in Bosnia and Herzegovina from 2017 to 2022 (Science Strategy) is a document that provides the strategic guidelines and action plan for development of scientific research and research-development activities and innovations in Bosnia and Herzegovina. The purpose of the Science Strategy is to contribute to the economic, educational and cultural development in Bosnia and Herzegovina in accordance with the European and global scientific trends. The Science Strategy defines the strategic directions and activities in the area of R&D. The importance of this Strategy lies in the necessity of Bosnia and Herzegovina integration into the European Research Area (ERA), accessing various European networks and funds, applying for European funds and similar. The owner of the Science Strategy is the Council of Ministers of Bosnia and Herzegovina.

Cooperation within European Research Area

As regards international cooperation, Bosnia and Herzegovina participates in the EU Research and Innovation programmes since 2009. Bosnia and Herzegovina is also active in COST actions, EUREKA and cooperates at regional level. The economy has made significant progress in international cooperation in the field of R&D by doubling the total acquired sum in H2020 compared to the previous Framework Programme 7 (FP7).

Within the H2020, until March 2021, organisations from Bosnia and Herzegovina have applied for a total of 699 projects, of which 558 were eligible. They have signed 67 grant agreements (including suspended, terminated and closed) achieving success rate of 12.19%. The total funding received by the project participants from Bosnia and Herzegovina was 8.57 million euro (net EU contribution). The total number of different organisations that have been participating in the programme so far is 55.

Regarding the participation in thematic priorities, the largest number of projects (26) has been implemented within the Innovation in SMEs priority, which shows active participation of business sector in H2020. In total, 4 projects aimed at developing Research Infrastructures have been implemented.

POLICY RECOMMENDATION FOR RESEARCH INFRASTRUCTURES IN BOSNIA AND HERZEGOVINA

Given the decentralised system and the level of competence for R&D, the text below contains recommendations for RIs related to Bosnia and Herzegovina:

- Consider ways to establish a new research and education network for the entire Bosnia and Herzegovina or re-establish National Research and Education Network (BIHARNET) by leveraging, inter alia, on the existing resources at the entity levels (ex. SARNET). By providing financial resources for normal operations of such a network, Bosnia and Herzegovina would support research and education institutions and provide connectivity and services to universities, research institutes, schools, libraries, museums and other public institutions, including connectivity with GEANT (Bosnia and Herzegovina is the only economy in Europe that is not a member of GEANT).
- Finalisation of the Smart Specialisation Strategy (S3) development process. The S3 in Bosnia and Herzegovina is currently in preparation, following a decision by the Council of Ministers. Given the complexity of the S3 process, it is important that all political actors in charge of research and innovation in Bosnia and Herzegovina are committed to the common goal of finalising the S3 Strategy document. The final selection of S3 priority domains should take into account the research infrastructure potential identified in this document, as an important input for deciding on final priorities.
- Consider the possibility of participating in pan-European RIs. Certain progress in increasing participation in large RIs has already been made. Bosnia and Herzegovina has officially become a member of DARIAH and launched an initiative to join two more RIs: Consortium of European Social Science Data Archives (CESSDA) and European Social Survey (ESS). As an associate member of ESFRI, Bosnia and Herzegovina should stay on this path and accelerate this process that should enable researchers to participate in large European RIs.
- Support Open Access to RIs. Building on the experience gained in Open Access Research Infrastructure in the Western Balkans Support Programme implemented by RCC Secretariat in 2020, the Council of Ministers in close cooperation with the Federal Ministry of Education and Science and the Ministry of Scientific and Technological Development, Higher Education and Information Society of Republika Srpska should encourage remaining research institutions in Bosnia and Herzegovina to adopt their own Open Access Policy documents.

EXECUTIVE SUMMARY I: RI ROADMAP OF THE FEDERATION OF BOSNIA AND HERZEGOVINA

FBiH RI Roadmap summarises the existing research potential of the Federation of Bosnia and Herzegovina with a particular focus on identification of research facilities, equipment, instrumentation and international cooperation, including the involvement of the Federation of Bosnia and Herzegovina in large European Research Infrastructures and projects. The preparation of this document was supported by the Regional Cooperation Council that provided technical assistance to the Federal Ministry of Education and Science.

Federation of Bosnia and Herzegovina has a decentralised government and consists of ten cantons, with each canton having its own ministry in charge of R&D. Although competencies are clearly defined, R&D is not regulated in all cantons.

As a result of the analysis of the current situation of research infrastructures in the Federation of Bosnia and Herzegovina, the following policy recommendations are provided with the aim to improve the quality of the existing research infrastructure:

1. **Increase investments in R&D. This could be achieved through reallocations of public budget to R&D and through introducing measures aiming at encouraging private business investments in R&D. Regarding the financing of research infrastructures, the Federation of Bosnia and Herzegovina should follow a good example of the implemented Modernisation of the University of Bihać project aimed at equipping the higher education institutions at the University of Bihać with modern research and teaching equipment. This project raised the standards of the teaching process and laboratory exercises to a higher level by supporting research laboratories operating within the University with the state-of-the-art research instruments and equipment.**
2. **Make distinction between teaching and research activities-enable higher engagement of teaching staff in research activities. The university teachers are mainly engaged in education activities, often in several higher education institutions. As a consequence, most of them are not engaged in R&D projects. The Ministries in charge of education and science should encourage the higher level of engagement of teaching staff in research activities. This can be achieved by revising the rulebook on the evaluation of scientific research activities.**
3. **Establish conditions for re-launching of BIHARNET. By re-establishing BIHARNET, Bosnia and Herzegovina would move closer to EU standards in the integration process. The BIHARNET is important for several reasons: it provides services on the internal and international connectivity of academic research network and educational community and supports their research and educational activities; its role is important in: promoting and disseminating the use of information and communication technologies particularly in the academic and research sector, maintenance and management of the domestic domain system, international representation and membership, etc.**
4. **Create a Smart Specialisation Strategy taking into account the research potential identified in FBiH RI Roadmap. The Smart Specialisation (S3) process in Bosnia and Herzegovina is currently in preparation, following a decision by the Council of Ministers. The process of mapping research infrastructures provides the basis for the analysis of research potential and selection of research areas in which Bosnia and Herzegovina has the strongest potential. Therefore, the final selection of S3 priority domains should consider the research infrastructure potential identified in the Framework for the RI Roadmap, as an important indicator for deciding on final priorities.**
5. **Intensify activities for participation in DARIAH infrastructure and consider the possibility of participating in other large pan-European infrastructures. The Council of Ministers of Bosnia and Herzegovina should consider the participation in large pan-European RIs. By enabling researchers to participate in major European RIs, Bosnia and Herzegovina would take an important step towards retaining researchers in the economy. FBiH RI**

Roadmap is important step toward this initiative. However, further research is needed to identify research infrastructures that are currently a priority. Having in mind that the Council of Ministers of Bosnia and Herzegovina has already supported the initiative of the Ministry of Civil Affairs for the accession of Bosnia and Herzegovina to the DARIAH-ERIC infrastructure, it is important to continue with this initiative – take the concrete steps necessary to make this initiative a reality.

6. **Improve the legal and policy framework. Analysis of the current legal and policy framework has shown insufficient regulation in the area of R&D in the Federation of Bosnia and Herzegovina. Only a few Cantons have regulated this area, while others do not have legal and policy documents that regulate R&D. In the context of the development of RIs, it is important to clearly define which organisations are considered as scientific research organisations. Additionally, the terms Research Infrastructures and Research Infrastructure Roadmap should be defined within legal and policy documents on the Cantonal and Federation level.**
7. **Encouraging Open Access to RI. As a result of the Open Access Research Infrastructure in the Western Balkans Support Programme implemented by RCC Secretariat in 2020, the University of Sarajevo, the University of Zenica and the University of Bihać adopted an Open Access Policy to Research Infrastructures. Building on the experience gained in this programme, the Federal Ministry of Education and Science should encourage other research institutions to adopt their own Open Access Policy documents. In order to make RIs transparent and available for a wide range of users, we recommend that the access offered to external users and the rules and mechanisms of access should be included in the selection criteria for the next funding calls to research institutions.**

EXECUTIVE SUMMARY II: RI ROADMAP IN REPUBLIKA SRPSKA

The Ministry of Scientific and Technological Development, Higher Education and Information Society is responsible for preparation and implementation of the RS RI Roadmap.

The overview of research infrastructure in Republika Srpska suggests that there is a potential that needs to be thoroughly investigated in the process of mapping of research infrastructures. The Ministry for Scientific and Technological Development, Higher Education and Information Society invests in research equipment through the Programme for ensuring and maintaining research equipment and space for scientific research. Participation in consortia for research projects financed from the EU sources (FP7, H2020, etc.) is considered as potential RI, particularly if such projects focus on investments in establishment of wider EU platform for integration of research resources in specific fields of science and technology. Republika Srpska has 4 projects implemented under FP7 and H2020 that have been important in the context of development of research infrastructures in Republika Srpska.

Important part of the RS RI Roadmap is policy recommendations for decision / policy makers with activities, instruments and procedures necessary for adoption and successful implementation of the RS RI Roadmap:

1. **The RS RI Roadmap should be treated as a key strategic document for improvement of scientific and research system in Republika Srpska and as a tool for identification of research potential in order to direct further development of research infrastructures.**
2. **Republika Srpska should work to progress with other Western Balkan economies in the process of opening up to the international scientific research community as well as in activities undertaken on the path to integration into the European Research Area (ERA).**
3. **The Ministry of Scientific and Technological Development, Higher Education and Information Society should continue the process of establishing the e-CRIS system in Republika Srpska.**
4. **Republika Srpska should consider options for accessing large European research infrastructures.**
5. **Republika Srpska should provide stronger support to organisations providing infrastructure support to innovation and research activities. It is particularly important to support opening up new business incubators, innovation centres, as well as to consider establishing Science and Technology Park.**
6. **Potential changes in Scientific and Technological Development Strategy of Republika Srpska or the text of a new Strategy should include explicate positioning of the policy and decision makers towards priorities of Republika Srpska in the area of research and innovation. The precisely defined future priorities should pay particular attention to the position of the Research Infrastructures in Republika Srpska.**
7. **Potenial amendments to the Science Law in future should include separate article(s) directly related to the establishment and use of Research Infrastructures Roadmap in Republika Srpska; directly related to collection of necessary data, creation of data bases, data and information security and exchange, analysis and statistical treatment – all these in relation to establishment and use of the RS RI Roadmap; directly related to integration of the RS RI Roadmap into the European Strategy Forum on Research Infrastructures (ESFRI) Roadmap.**
8. **Further public source investments in entity/regional level RIs in Republika Srpska should be clearly planned within and derive from the RS RI Roadmap. These investments should be prioritised as capital investments with adequate support of human, institutional and financial resources. In addition, future investments should be based on results of regular monitoring and evaluation of research and academic sector in Republika Srpska, with identified level of use of RIs and cost-benefit analysis of investments and use of RIs.**

INTRODUCTION

1.1. Scope and purpose of the document

A Framework for Research Infrastructure (RI) Roadmap of Bosnia and Herzegovina (henceforth: Framework for RI Roadmap) is a policy document that summarises the existing research potential of the scientific research system of Bosnia and Herzegovina through the identification of research facilities, equipment, instrumentation and international cooperation, including the involvement of Bosnia and Herzegovina in large European RIs and projects. This document provides decision-makers, research and business sectors with an insight into the current state of research infrastructure of Bosnia and Herzegovina in order to make more efficient decisions at all levels. It assists policymakers to leverage investments in RIs more efficiently according to the domestic and international relevance of identified RIs and to become aware of the main advantages, strengths and trends of domestic research. Establishing new RIs, upgrading existing ones, or joining international, requires additional investments from public budget, and thus evidence-based decisions are needed to improve the efficiency of spending public money. Also, it helps the business sector to have a better insight into the research potential of the economy, providing a basis for establishing stronger cooperation between the business and research sector. In addition, a Framework for RI Roadmap may also be of interest to a wider audience and may therefore increase the visibility and acknowledgement of domestic scientific research.

A Framework for RI Roadmap of Bosnia and Herzegovina consists of two chapters:

- **RI Roadmap of the Federation of Bosnia and Herzegovina (FBIH RI Roadmap);**
- **RI Roadmap of Republika Srpska (RS RI Roadmap).**

Generally speaking, the awareness on the relevance of internationally attractive RIs is increasing. In particular, the role of RIs for international research cooperation and their contribution to international competitiveness is increasingly acknowledged. A Framework for RI Roadmap builds upon a reliable knowledge base, which takes developments beyond the economy's territory into consideration. This includes information about the existing RIs.

Regarding the existing initiatives to support research infrastructures at European level, three general levels of activities can be distinguished:

- Support to a new state-of-the-art research infrastructure defined in the ESFRI roadmap. The European Strategy Forum on Research Infrastructures (ESFRI)[2] is a strategic instrument created in 2002 by the Member States and the European Commission to develop the scientific integration of Europe and to strengthen its international outreach. These activities are aimed at supporting the preparatory phase of new ESFRI projects as well as the implementation and operational phases of ESFRI projects according to the identified priorities.
- Support the use of domestic research facilities by integrating them into larger European networks. These activities are implemented through the support provided by H2020

2 http://ec.europa.eu/research/esfri

programme within the thematic priority "Research Infrastructure". The support to RIs was also provided by the previous Framework Programme 7.

- Support provided to the development of e-infrastructures. E-infrastructures are recognised as crucially important for enabling access to remote resources, remote cooperation and processing of large amounts of data in all scientific fields.

Considering the fact that currently Bosnia and Herzegovina is not present in ESFRI Roadmap, the focus of this document is on the other two sets of activities i.e. on discovering research potential of domestic research facilities, RI projects and the current development of e-infrastructure.

Finally, the importance of adopting this document arises also from the EU Progress Report (2020), which clearly emphasises the need to create a Framework for RI Roadmap of Bosnia and Herzegovina.

1.2. What are Research Infrastructures?

There are different definitions of RIs due to the fact that RIs come in many different forms. RIs could be considered as facilities, tools, instrumentations, physical resources (e.g. electron microscope) or virtual resources (e.g. data sets). No matter the form, they all require skills and expertise and operational resources to function.

According to the Regulation (EU) No 1291/2013 of 11 December 2013, Research Infrastructures are defined as follows: "*Research Infrastructures are facilities, resources and services that are used by the research communities to conduct research and foster innovation in their fields. They include: major scientific equipment (or sets of instruments), knowledge-based resources such as collections, archives and scientific data, e-infrastructures, such as data and computing systems and communication networks and any other tools that are essential to achieve excellence in research and innovation*".

Infrastructures also vary by their access mechanism and structure. They may be accessed in person, used remotely, or accessed via virtual mechanisms. Some may offer multiple options. In accordance with the EU definition, RIs may be 'single-sited' (a single resource at a single location), 'distributed' (a network of distributed resources), or 'virtual' (the service is provided electronically).

RIs are used by the research community to conduct top-level research in many research fields. They play important role in advancing knowledge and technology as an important instrument in bringing together different research groups working to solve specific research and societal problems. RIs offer unique research services to research society in the economy and wider, helping to shape the scientific community through attracting young people to engage in science.

Considering the content of this document it is important to note the approach that was applied in mapping RIs in Bosnia and Herzegovina. Unlike most developed EU member states that usually, within their RI Roadmaps include only those RIs that are of pan-European significance, we have considered the actual state of research infrastructure development and the final structure of the document is adjusted to the current situation in this area. Therefore, while developed economies in their RI Roadmaps focus on large facilities, usually built, operated and used in international collaboration, the main focus of this document is on research facilities operated within research intensive organisations. Regional or domestic collaboration agreements and smaller RIs of sufficient quality operated by individual research groups have been also considered.

THE CURRENT LEGAL AND POLICY CONTEXT

The current legal and policy framework in research and development (R&D) is a reflection of the organisation of the economy defined by the Constitution of Bosnia and Herzegovina, and Constitutions of entities and cantons. Regarding the competences for R&D policy, the situation is as follows:

- Ministry of Civil Affairs of Bosnia and Herzegovina is responsible, inter alia, for science and education at the level of BiH by defining basic coordination principles, aligning plans of authorities at entity levels and defining strategies at international level. Furthermore, it participates in the work of international organisations that deal with science; ensures execution of international obligations of Bosnia and Herzegovina; participates in the procedure of preparation of international agreements; monitors application of local agreements and strategic documents, and proposes activities in relation to it; keeps up with the European integration processes and initiates their implementation; monitors application of adopted European conventions and declarations; prepares participation of Bosnia and Herzegovina representatives at the international and European conferences; leads and coordinates cooperation with the organisations, bodies and authorities of the European Commission; keeps up with the EU programmes and those of other international associations and launches application process, etc.
- Federation of Bosnia and Herzegovina has a decentralised government and consists of ten cantons, with each canton having its own ministry in charge of R&D, meaning that the authority for the normative arrangement in the field of science belongs to the cantons. The Federal Ministry of Education and Science has a coordinating role in the Federation of Bosnia and Herzegovina.
- Republika of Srpska has a centralised government and one ministry in charge of R&D.
- Brcko District of Bosnia and Herzegovina has a government with departments. One of these departments is in charge of R&D.

Although competencies are clearly defined, R&D is not regulated in all cantons. Only four out of ten Cantons have regulated the field of R&D: the Sarajevo Canton, Tuzla Canton, West Herzegovina Canton and Canton 10. As a result of insufficient regulation in this area, the term Scientific Research Organisation is not legally defined in a unique way across the Federation of Bosnia and Herzegovina. Only Sarajevo Canton, Tuzla and Zenica-Doboj Cantons have regulations governing this area, while other cantons, and Federation of Bosnia and Herzegovina level have not regulated which organisations are considered as scientific research organisations.

2.1. The Strategy for Development of Science in Bosnia and Herzegovina (2017-2022)

The Strategy for Development of Science in Bosnia and Herzegovina from 2017 to 2022 (Science Strategy) is a document that provides the strategic guidelines and action plan for development of scientific research and research-development activities and innovations in Bosnia and Herzegovina. The purpose of the Science Strategy is to contribute to the economic, educational and cultural development in Bosnia and Herzegovina in accordance with the European and global scientific trends. The Science Strategy defines the strategic directions and activities in the area of R&D. The importance of this Strategy lies in the necessity of Bosnia and Herzegovina integration into the European Research Area (ERA), accessing the various European networks and funds, and similar. The owner of the Science Strategy is the Council of Ministers of Bosnia and Herzegovina.

The overall goals of the Science Strategy with regards to research infrastructures are the following:

- Enabling larger participation of researchers and institutions in the ERA,
- Providing access to the electronic scientific databases, strengthening the library system and local scientific journals, establishment of researchers and scientific institutions database,
- Development of research infrastructures according to the international standards.

The general priorities of the Science Strategy are:

1. Improving the legal regulation of R&D and technological activities,
2. Strengthening the R&D staff,
3. Establishment of a system for evaluation and monitoring of scientific research activities,
4. Defining and unifying the criteria of election into the research and teaching occupations,
5. Establishment of scientific and technological database-statistical parameters (indicators),
6. Strengthening the research infrastructure (experimental equipment, IT equipment, library, publishing),
7. Construction and maintenance of the academic and research network,
8. Stimulating and increasing the level of integration of science at the universities, institutes and research centres in the economy,
9. Rational use of the scientific potentials,
10. Intensifying the participation in the EU research and development projects and participation of Bosnia and Herzegovina in the system of international knowledge exchange-international collaboration,
11. Inclusion into the global scientific trends,
12. Creation of technological base of the society (innovation, transfer of technologies, intellectual property protection, commercialisation and application of the scientific achievements),
13. Strengthening of scientific and academic community collaboration,
14. Improvement of the sources of financing and distribution of assets,

15. Promotion of R&D and raising public awareness and trust in the science and technology.

The aim of these general priorities is to create prerequisites for the improvement of research sector in Bosnia and Herzegovina. Additionally, it is intended to reduce the discrepancy between Bosnia and Herzegovina and developed countries with regards to the contemporary understanding of the importance and the role of science. At the same time, it should enable Bosnia and Herzegovina to keep the pace and connection with the European science.

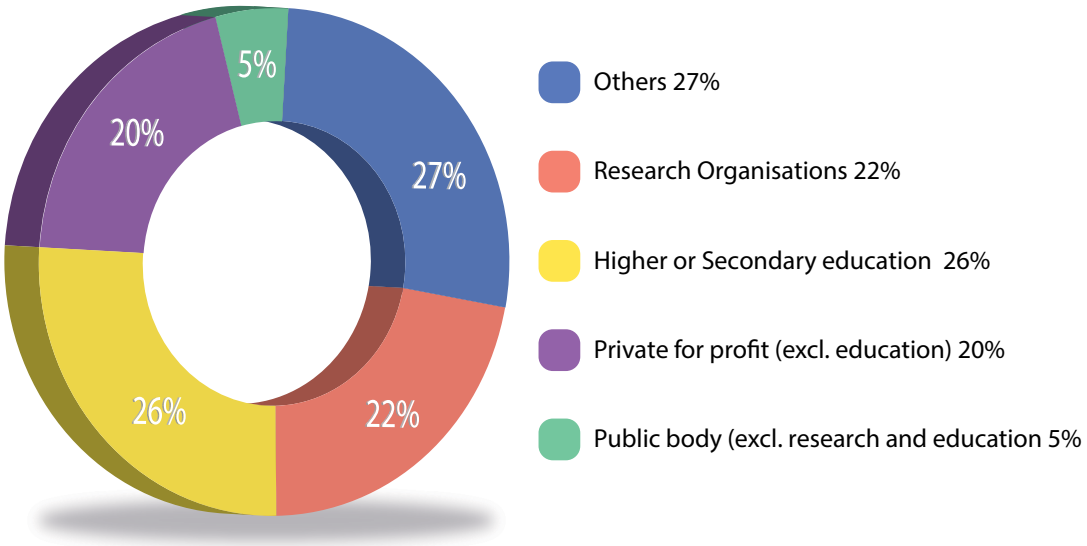
COOPERATION WITHIN EUROPEAN RESEARCH AREA

As regards international cooperation, Bosnia and Herzegovina participates in the EU Research and Innovation programmes since 2009. Bosnia and Herzegovina is also active in COST Association, EUREKA and cooperates at regional level. The economy has made significant progress in international cooperation in the field of R&D by doubling the total acquired sum in H2020 compared to the previous Framework Programme 7 (FP7).

Within H2020, until March 2021, organisations from Bosnia and Herzegovina have applied for a total of 699 projects, of which 558 were eligible. They have signed 67 grant agreements (including suspended, terminated and closed) achieving success rate of 12.19%. The total funding received by the project participants from Bosnia and Herzegovina was 8.57 million euro (net EU contribution). The total number of different organisations that have been participating in the programme so far is 55.

The higher education institutions and research organisations have received approximately 48%, while private organisations received 20% of the total Net EU Contribution (Figure 1).

Figure 1: Types of organisations participating in Horizon 2020 based on the net EU contribution



Regarding the participation in thematic priorities, the largest number of projects (26) has been implemented within the Innovation in SMEs priority, which shows active participation of the business sector in H2020. In total, 4 projects aimed at developing Research Infrastructures have been implemented.

CHAPTER I:
RESEARCH INFRASTRUCTURE ROADMAP OF FEDERATION OF BOSNIA AND HERZEGOVINA

EXECUTIVE SUMMARY I: RI ROADMAP OF THE FEDERATION OF BOSNIA AND HERZEGOVINA

FBiH RI Roadmap summarises the existing research potential of the Federation of Bosnia and Herzegovina with a particular focus on the identification of research facilities, equipment, instrumentation and international cooperation, including the involvement of the Federation of Bosnia and Herzegovina in large European Research Infrastructures and projects. The preparation of this document was supported by the Regional Cooperation Council that provided technical assistance to the Federal Ministry of Education and Science.

The Federation of Bosnia and Herzegovina has a decentralised government and consists of ten cantons, with each canton having its own ministry in charge of R&D. Although competencies are clearly defined, R&D is not regulated in all cantons. Only four out of ten Cantons have regulated the field of R&D. The gross expenditure on research and development is significantly below the average of EU member states and even some Western Balkan economies.

As regards international research cooperation, Bosnia and Herzegovina has made significant progress in international co-operation in the field of R&D by doubling the total acquired sum in H2020 compared to the previous Framework Programme 7 (FP7).

The final questionnaires for mapping Research Infrastructures in the Federation of Bosnia and Herzegovina were completed at the level of faculties, research laboratories and institutes operating within the public and private universities. 3 out of 6 public universities and 2 out of 6 private universities responded to the questionnaire. Despite the fact that the mapping exercise is incomplete as not all universities in the Federation of Bosnia and Herzegovina responded to the call to submit their data, the final document does give a relatively detailed overview of the existing RIs in the Federation of Bosnia and Herzegovina.

As a result of the Open Access Research Infrastructure in the Western Balkans Support Programme, supported and implemented by RCC Secretariat in the period of May-December 2020, the the University of Sarajevo, the University of Bihać and the University of Zenica adopted an Open Access Policy to Research Infrastructures in January 2021, providing detailed information on types of users and access to research infrastructures. However, it was evident that most of faculties/ research laboratories do not have an official access policy to research infrastructures. This is due to fact that an Open Access Policy to Research Infrastructures has been adopted at the university level and has not yet been implemented at the level of faculties and research laboratories.

Bosnia and Herzegovina is an associate member of the ESFRI. Research institutions from Bosnia and Herzegovina have not participated in large pan-European RIs and have not been included in

the ESFRI Roadmap. However, it is important to note that the Council of Ministers of Bosnia and Herzegovina supported the initiative of the Ministry of Civil Affairs for the accession of Bosnia and Herzegovina to the Digital Research Infrastructure for the Arts and Humanities (DARIAH). The full membership of Bosnia and Herzegovina in DARIAH will be activated as of 1st July 2021. Accession of researchers from Bosnia and Herzegovina to DARIAH-ERIC infrastructure will enable researchers to find and use digital research data from across Europe, to exchange knowledge and research practice in various fields, and to follow the best applicable research standards. In addition, an initiative has been launched to join two more European research infrastructures: Consortium of European Social Science Data Archives (CESSDA) and European Social Survey (ESS). With regards to RIs projects, organisations from the Federation of Bosnia and Herzegovina are participating in 2 ongoing H2020 projects aimed at developing research infrastructures.

The current level of e-infrastructure development in Bosnia and Herzegovina is not at a satisfactory level. Unlike other Western Balkan economies, Bosnia and Herzegovina has not been involved in South-East European e-Infrastructure initiatives aimed at equal participation of the less-resourced economies of the region in the development of public e-infrastructures. The Academic and Research Network of Bosnia and Herzegovina, established in 1998, was shut down at the end of 2000 due to the lack of financial resources.

E-CRIS.BH is the information system on research activities in Bosnia and Herzegovina which allows users a direct insight into the bibliographies of researchers, research organisations, departments and projects in Bosnia and Herzegovina. Currently, the information system on research activity in Bosnia and Herzegovina E-CRIS.BH contains data on 86 research organisations and 2,183 researchers.

Federal Ministry of Education and Science is responsible for preparation and implementation of the Research Infrastructure Roadmap in the Federation of Bosnia and Herzegovina.

As a result of the analysis of current situation of research infrastructures in the Federation of Bosnia and Herzegovina, the following policy recommendations are provided with the aim to improve the quality of the existing research infrastructure:

1. **Increase investments in R&D. This could be achieved through reallocations of public budget to R&D and introducing measures aimed at encouraging private business investments in R&D. Lack of capital research equipment restricts more intensive growth of research sector reflecting in a low level of excellence in science. Regarding the financing of research infrastructures, the Federation of Bosnia and Herzegovina should follow a good example of the implemented Modernisation of the University of Bihać project aimed at equipping the higher education institutions at the University of Bihać with modern research and teaching equipment. This project raised the standards of the teaching process and laboratory exercises to a higher level by supporting research laboratories operating within the University with the state-of-art research instruments and equipment.**
2. **Make distinction between teaching and research activities-enable higher engagement of teaching staff in research activities. The university teachers are mainly engaged in education activities, often in several higher-education institutions. As a consequence, most of them are not engaged in R&D projects. The Ministries in charge of education and science should encourage higher level of engagement of teaching staff in research**

activities. This can be achieved by revising the rulebook on the evaluation of scientific research activities.

3. Establish conditions for re-launching BIHARNET. The Council of Ministers of Bosnia and Herzegovina in cooperation with entity ministries in charge of science should provide financial resources for the re-establishment and normal operation of the public academic and research network BIHARNET. By re-establishing BIHARNET, Bosnia and Herzegovina would move closer to EU standards in the integration process. The BIHARNET is important for several reasons: it provides services on the internal and international connectivity of academic research network and educational community and supports their research and educational activities; its role is important in: promoting and disseminating the use of information and communication technologies particularly in the academic and research sector, maintenance and management of the domestic domain system, international representation and membership, etc.
4. Create a Smart Specialisation Strategy taking into account the research potential identified in FBiH RI Roadmap. The Smart Specialisation (S3) process in Bosnia and Herzegovina is currently in preparation, following a decision by the Council of Ministers. In the process of mapping research potential to identify potential priority domains, a Framework for the RI Roadmap should be considered as an important input. The process of mapping research infrastructures provides the basis for the analysis of research potential and selection of research areas in which Bosnia and Herzegovina has the strongest potential. Therefore, the final selection of S3 priority domains should take into account the research infrastructure potential identified in a Framework for the RI Roadmap, as an important indicator for deciding on final priorities.
5. Intensify activities for participation in DARIAH infrastructure and consider the possibility of participating in other large pan-European infrastructures. The Council of Ministers of Bosnia and Herzegovina should consider participation in large pan-European RIs. By enabling researchers to participate in major European RIs, Bosnia and Herzegovina would take an important step towards retaining researchers in the economy. The RI Roadmap is important step towards this initiative. However, further research is needed to identify research infrastructures that are currently a priority. Having in mind that the Council of Ministers of Bosnia and Herzegovina has already supported the initiative of the Ministry of Civil Affairs for the accession of Bosnia and Herzegovina to the DARIAH-ERIC infrastructure, it is important to continue with this initiative – take concrete steps necessary to make this initiative a reality.
6. Improve the legal and policy framework. Analysis of the current legal and policy framework has shown insufficient regulation in the area of R&D in the Federation of Bosnia and Herzegovina. Only a few Cantons have regulated this area, while others do not have legal and policy documents that regulate R&D. In the context of development of RIs, it is important to clearly define which organisations are considered as scientific research organisations. Additionally, the terms Research Infrastructures and Research Infrastructure Roadmap" should be defined within legal and policy documents on the Cantonal and Federation of Bosnia and Herzegovina level.
7. Encouraging Open Access to RI. As a result of the Open Access Research Infrastructure in the Western Balkans Support Programme implemented by RCC Secretariat in 2020,

the University of Sarajevo, the University of Zenica and the University of Bihać adopted an Open Access Policy to Research Infrastructures. Building on the experience gained in this programme, the Federal Ministry of Education and Science should encourage other research institutions to adopt their own Open Access Policy documents. In order to make RIs transparent and available for a wide range of users, we recommend that the access offered to external users and the rules and mechanisms of access should be included in the selection criteria for the next funding calls to research institutions.

I-1. INTRODUCTION

FBiH RI Roadmap is a policy document that summarises the existing research potential of the scientific research system of Federation through the identification of research facilities, equipment, instrumentation and international cooperation, including the involvement of Bosnia and Herzegovina Federation in large European RIs and projects. This document provides decision-makers, research and business sectors with an insight into the current state of research infrastructure of FBiH in order to make more efficient decisions at all levels. It assists policymakers to leverage investments in RIs more efficiently according to the domestic and international relevance of identified RIs and to become aware of the main advantages, strengths and trends of domestic research. Establishing new RIs, upgrading existing ones, or joining international, requires additional investments from public budget, and thus evidence-based decisions are needed to improve the efficiency of spending public money. Also, it helps the business sector to have a better insight into the research potential of the economy, providing a basis for establishing stronger cooperation between the business and research sector. In addition, the RI Roadmap may also be of interest to a wider audience and may therefore increase the visibility and acknowledgement of domestic scientific research.

Generally speaking, the awareness on the relevance of internationally attractive RIs is increasing. In particular, the role of RIs in international research cooperation and their contribution to international competitiveness is increasingly acknowledged. The RI Roadmaps build upon a reliable knowledge base, which takes the developments beyond economy's territory into consideration. This includes information about the existing RIs.

RI roadmaps of EU MS usually include only those RI that are of pan-European significance, meaning that they are selected as strategic in terms of size and uniqueness, and provide open access services to users from other regions/countries/economies. Considering that the research institutions from Federation of Bosnia and Herzegovina are not members of large RIs, the finale structure of the document is adjusted to the current situation in this area. The main focus of the chapter is on the identification of research equipment within research institutions, indicating the research potential that exists within the universities located in the Federation of Bosnia and Herzegovina.

I-1.2. Background and methodology of creating the FBIH RI Roadmap

The FBiH RI Roadmap has been developed in close cooperation with the Regional Cooperation Council (RCC) that provided technical assistance to the Federal Ministry of Education and Science

in this assignment. Technical assistance was provided as part of a broader action that included the provision of assistance to other Western Balkan economies with the final goal to contribute to creating the Western Balkans' Roadmap of Research Infrastructures (WBRRI).

The mapping exercise in the Federation of Bosnia and Herzegovina was conducted between February and March 2021. The final analysis of current research infrastructures of FBiH has drawn heavily on data collected through questionnaires complemented by knowledge gained from public policy documents and reviews of existing reports. The questionnaire was administered to gather a wide range of descriptive information on infrastructures, data on research equipment, information on access, collaboration and impact, data on the integration into larger RIs, etc. The full survey questionnaire is provided in Appendix 2 and detailed instruction for launching and conducting survey is provided in Appendix 3. The guide comprises detailed instructions for launching questionnaire to the research community, gathering necessary data processing, and integration of all responses that served as the main input for the selection and mapping of research infrastructures in the Federation of Bosnia and Herzegovina.

The target audience for the questionnaire was the research community of the Federation of Bosnia and Herzegovina. Public and private universities and other higher education institutions were invited to complete the questionnaire by theFederal Ministry of Education and Science. The completed survey questionnaires served as an input for the identification and evaluation of research infrastructure potential.

Additionally, the existing policy settings for research and innovation have been analysed with the particular emphasis on the following: the ongoing reforms of the research sector; the legal framework for research infrastructures; reviewing the existing strategic documents on research and innovation and the current status of the process of developing Smart Specialisation Strategy.

I-2. CURRENT LEGAL AND POLICY CONTEXT

The current R&D legal and policy framework of the Federation of Bosnia and Herzegovina is a reflection of the organisation of the economy defined by the Constitution of Bosnia and Herzegovina, and Constitutions of entities and cantons. Regarding the competences for R&D policy, the situation is as follows:

- Ministry of Civil Affairs of Bosnia and Herzegovina is responsible, inter alia, for science and education at the level of Bosnia and Herzegovina by defining basic coordination principles, aligning plans of authorities at entity levels and defining strategies at international level. Furthermore, it participates in the work of international organisations that deal with science; ensures execution of international obligations of Bosnia and Herzegovina; participates in the procedure of preparation of international agreements; monitors application of local agreements and strategic documents, and proposes activities in relation to it; keeps up with the European integration processes and initiates their implementation; monitors application of adopted European conventions and declarations; prepares participation of Bosnia and Herzegovina representatives at the international and European conferences; leads and coordinates cooperation with the organisations, bodies and authorities of the European Commission; keeps up with the EU programmes and those of other international associations and launches application process, etc.

- Federation of Bosnia and Herzegovina has a decentralised government and consists of ten cantons, with each canton having its own ministry in charge of R&D, meaning that the authority for the normative arrangement in the field of science belongs to the cantons. Federal Ministry of Education and Science has a coordinating role in the Federation of Bosnia and Herzegovina.

Although competencies are clearly defined, R&D is not regulated in all cantons. Only four out of ten Cantons have regulated the field of R&D: the Sarajevo Canton, Tuzla Canton, West Herzegovina Canton and Canton 10.

As a result of insufficient regulation in this area, the term Scientific Research Organisation is not legally defined in a unique way across the Federation of Bosnia and Herzegovina. Only Sarajevo Canton, Tuzla and Zenica-Doboj Cantons have regulations governing this area, while other cantons and Federation of Bosnia and Herzegovina level did not regulate which organisations are considered as scientific research organisations.

I-2.1. Development Strategy of the Federation of BiH 2021-2027

The Development Strategy of the Federation of Bosnia and Herzegovina 2021-2027 (DSFBIH) was adopted in February 2021 by the Government of the Federation of Bosnia and Herzegovina. The DSFBIH is one of the most important policy documents in theFederation covering a wide range of areas. It defines 4 strategic goals, 18 priorities and 78 measures.

With regards to R&D, the first strategic goal: Accelerated Economic Development and Priority 1.1: Increase the digitisation of the economy envisage establishing the Federation of Bosnia and Herzegovina Fund for Technology Development, Research and Innovation. The aim is to provide adequate financial support for innovation and R&D activities in both the private and public sectors of the Federation of Bosnia and Herzegovina.

Further, the DSFBIH stresses the importance of supporting R&D and innovation activities in the private and public sectors and creating an environment that enables and encourages cooperation between the economy and the research community. The DSFBIH highlights the necessity of encouraging private companies to use research and development infrastructure, and to develop new products and technologies through strategic partnerships with research and development institutions, but also to participate together in EU projects.

Also, the necessity of supporting the establishment of Science and Technology Parks and stronger connection with the European business and research networks has been outlined. According to the DSFBIH, the legal and strategic framework on R&D and innovation needs to be improved to strengthen the development of R&D and industry and stimulate the establishment of development centres and institutes in the economy.

Finally, it was emphasised that the process of developing the Smart Specialisation Strategy needs to be intensified.

I-2.2. Current state of development of Smart Specialisation Strategy

The Smart Specialisation (S3) process in Bosnia and Herzegovina is currently in preparation, following a decision by the Council of Ministers. In June 2019, the Council of Ministers of Bosnia and Herzegovina appointed the Directorate for Economic Planning (DEP), together with the Ministry of Civil Affairs and Ministry of Foreign Trade and Economic Relations, to propose a working group for drafting a Strategy for Smart Specialisation in Bosnia and Herzegovina. Relevant ministries from Bosnia and Herzegovina level of government, as well as the Government of Republika Srpska, Federation of Bosnia and Herzegovina and Brcko District appointed their representatives in inter-institutional working body aimed at starting the development of S3 Strategy in Bosnia and Herzegovina.

In November 2020, the Council of Ministers of Bosnia and Herzegovina adopted a Decree on Nomination of Working Group for Smart Specialisation Strategy in Bosnia and Herzegovina. The deadline for strategy preparation stated in the Decree is 3 years.

In February 2021, DEP sent a Letter of Intent to JRC for signing a Memorandum of Understanding regarding support for S3 process. It is underlined that S3 strategy is of great relevance for Bosnia and Herzegovina.

I-2.3. Financing Research Infrastructures in the Federation of Bosnia and Herzegovina

Financial investments in science and research are low and according to the data of the Statistical Agency of Bosnia and Herzegovina, gross expenditures for research and development (GERD) in 2019 amounted to 0.20% of GDP. Considering the low level and even the declining trend of total investments in R&D recorded in the period from 2013 to 2018, it follows that the Federation of Bosnia and Herzegovina needs to increase R&D expenditures to join the ranks of more advanced European economies. The gross expenditure on research and development is significantly below the average of EU member states and even some Western Balkan economies.

Regarding the financing of research infrastructures, it is important to note that the Government of Federation of Bosnia and Herzegovina approved the loan agreement between Bosnia and Herzegovina and Raiffeisen Bank International AG in 2013, in the amount of EUR 5 million, for the implementation of Modernisation of the University of Bihać project. The Project aimed at equipping the higher education institutions at the University of Bihać with modern research and teaching equipment. The main goal was to raise the standards of the teaching process and laboratory exercises to a higher level by supporting research laboratories operating within the University with the state-of-art research instruments and equipment.

However, despite a good example of this project, the financial support for the procurement of research equipment in research laboratories has not been implemented in other public universities. The lack of financial support to research laboratories forces public universities to finance RIs from their own funds, which greatly limits their functioning. Limited financial allocations for the support of R&D represent a fundamental weakness to the development of RIs in the entire Bosnia and Herzegovina.

I-3. ANALYSIS OF THE EXISTING RESEARCH INFRASTRUCTURES IN THE FEDERATION OF BOSNIA AND HERZEGOVINA

The existing RIs in the Federation of Bosnia and Herzegovina are located at public universities, where the most scientific research work is performed. There are 6 public universities in the Federation of Bosnia and Herzegovina: University of Sarajevo, University of Tuzla, University of Mostar, Džemal Bijedić University in Mostar, University of Bihać and University of Zenica.

The questionnaire for providing data on research infrastructures was sent in February 2021 by the Federal Ministry of Education and Science to all relevant public and private universities in Federation of Bosnia and Herzegovina. Questionnaires were completed at the level of faculties, research laboratories and institutes operating within the public and private universities. 3 out of 6 public universities located in the Federation of Bosnia and Herzegovina responded to the questionnaire: University of Sarajevo, University of Bihać and University of Tuzla. With regards to the private higher-education institutions, 2 out of 6 private universities responded to the questionnaire: University Sarajevo School of Science and Technology and International University of Sarajevo. As expected, the largest number of answers came from the University of Sarajevo since it is the most important University in the Federation of Bosnia and Herzegovina. It has to be noted that the mapping is unavoidably incomplete since all universities in the Federation of Bosnia and Herzegovina have not responded to the call to submit their data. However, the mapping does give a relatively detailed overview of the existing RIs in the Federation of BiH.

In the context of research infrastructure in social sciences, humanities and arts, research institutions in Bosnia and Herzegovina hold valuable archives whose value cannot be expressed in the value of the equipment. Accession of Bosnia and Herzegovina to DARIAH was possible thanks to research institutions in the fields of humanities and arts that hold invaluable cultural archives (documents, audio archives, etc.) that are important for research in humanities, arts, and social sciences.

I-3.1. Overview of research infrastructures

The sub-sections below provide basic information on research institutions in which the greatest research potential and capital research equipment has been identified. In addition, the information on the services provided by each research laboratory/institute is presented.

I-3.1.1. University of Sarajevo

The University of Sarajevo is the largest and most important higher-education institution in the Federation of Bosnia and Herzegovina. It consists of twenty-five faculties, three academies and five research institutes with the status of full members, internally organised within six science/arts groups from the fields of: Social Sciences, Humanities, Medical Sciences, Natural, Mathematical and Bio-technical Sciences, Technical Sciences, and Arts. As a result of Open Access Research Infrastructure in the Western Balkans Support Programme, supported and implemented by RCC Secretariat in the period from May to December 2020, the Senate of the University of Sarajevo

adopted an Open Access Policy to RIs in June 2021, providing detailed information on types of users and access to research infrastructures. The document is to be applied by all university members – faculties and research institutes.

Faculty of Electrical Engineering

The Research Infrastructure of the Faculty of Electrical Engineering consists of the equipment from the following subfields: automatic control, electronics, power engineering, telecommunications, and computer science. The RI is intended to be used for different research projects in different areas.

Services provided: Users of RI may use the equipment for their research projects, doctoral dissertations, and for professional projects. The RI can also be rented to other subjects for their own activities.

Research equipment: The Faculty has single capital research equipment worth over 50.000 euro. A total estimated value of research capital equipment is 113.000 eur (the total purchase value was 520.000 eur).

Access Policy: The equipment is grouped in different laboratories. Each laboratory has an administrator responsible for proper functioning of all equipment in the laboratory. Internal users (students, lecturers, researchers) need to get a permission of the administrator to access the lab.

External users need to seek formal permission to access the laboratory. The permission is granted by the Faculty's Dean, and precise conditions for usage are defined. Depending on the purpose of use, the service may be charged or not. After the permission is granted the procedures are similar to that for internal users.

Faculty of Mechanical Engineering

Research and teaching activities at the Faculty of Mechanical Engineering include: application of basic science, fundamentals of technical systems design and analysis, mechanical design; CAD; 3D modelling; 3D scanning; 3D printing; experimental and numerical analyses; structural optimisations; design and testing of power transmission devices, transportation devices and other mechanical constructions, vehicle engineering, etc.

The text below shows the most important research activities and services provided within the laboratories operating within the Faculty:

- **Laboratory scale counter-flow, direct contact cooling tower**

Services provided within the Laboratory include: measurement of water and humid air parameters (temperature, flow rate, humidity) and environmental conditions (temperature and pressure); analysis of direct contact heat and mass transfer process; hydrodynamic of water and humid air streams, when flowing in the cooling tower; thermal properties of the cooling tower; data analysis.

♦ **Laboratory for heating, ventilation, air conditioning (HVAC) and renewable energy (RE)**

The laboratory is intended for education and research in the field of HVAC technology and renewable energy. It is equipped with two test lines intended for research in the field of solar energy use: test line for determination of thermal characteristics of flat plate water cooled solar collectors and test line for determination of characteristics of hybrid domestic hot water systems. The laboratory is equipped with modern equipment for the provision of training services for refrigeration and air conditioning service technicians with the aim of their certification.

♦ **Laboratories of the Department of Process Engineering**

Measuring equipment in the field of process technology, environment and energy of the Department of Process Engineering is used for students' practical exercises, scientific research and partly for commercial purposes. The available equipment can measure and analyse the potential of energy sources, the efficiency of energy conversion and storage equipment and various process parameters such as pressure, temperature, speed, etc.

The total estimated value of research equipment is 138,100 euros. The Laboratory does not have single capital research equipment worth over 50,000 euros.

♦ **Laboratory for testing automotive turbo-compressors (turbochargers)**

The Laboratory is designed for testing turbochargers intended for use on engines of passenger and cargo motor vehicles. The turbocharger test can be performed through hot and cold test modes. The measurement of the appropriate operating parameters of the turbocharger is performed by measuring devices that provide, according to the measured size, the requirements in terms of accuracy.

♦ **Laboratory for testing vehicle performance**

The laboratory has various devices for determining the dynamic characteristics of the vehicle used to conduct certain tests in road conditions. The basic devices are GPS modules and accelerometers for determining longitudinal and lateral acceleration, both in the process of driving and when breaking the vehicle. By using these devices, it is possible to obtain a large number of characteristic parameters when examining the dynamics of vehicle movement.

♦ **Laboratory for physical measurements in mechanical engineering**

The laboratory provides users of its research infrastructure with services for sampling, measurement and analysis of particular matter samples in the air, calibration services for measuring instruments, computer infrastructure including specialised software for advanced modelling and data science.

♦ **Laboratory for Mechatronics, Robotics and Automation – LAMRA**

The Laboratory owns the following research equipment:

- Industrial robots ABB IRB 1600: ABB IRB 1600 is industrial robot with six rotation joints for welding, painting, assembly, machine feeding, etc.

- *Flexible manufacturing cell (EMCO F1 milling machine, EMCO Compac 5 Lathe and Industrial robot RV-M1 Mitsubishi):* Flexible manufacturing cell is composed of two CNC machines, one for turning and the other for milling, and the industrial robot Mitsubishi RV-M1.
- *Experimental line for closed-loop pneumatics:* The system provides experimental investigations of pneumatic systems: non-dynamic pressure regulation, dynamic pressure regulation and position control. System deals with analogue closed-loop control technology. It consist of analogue pressure sensor, One-way flow control valve, Comparator, 3/2-way solenoid valve with push button, 3/2-way solenoid valve, 5/3-way solenoid valve, 5/3-way proportional valve, PID controller, Linear actuator 450 mm Reservoir, etc. Actuators are activated via electrical open and closed-loop components.
- *Electrohydraulics experimental line:* The system provides experimental investigations of the physical interrelationships and the most important basic circuits in hydraulic and electrohydraulic systems, comparison of the use of different components, assembly of various basic circuits and control of the system by PLC.
- *Electropneumatics experimental lines controlled by SIEMENS PLC (TIA S7-1200, S7-300, S7-200):* There are several pick and place robots and other experimental lines controlled by SIEMENS programmable logic controllers. It is used to gain knowledge for assembly of different pneumatic and electropneumatic product system solutions using different components as well as an introduction into PLC programming.
- *Mobile robot FESTO Robotino:* Mobile robot Robotino is equipped with complex sensor system providing experimental investigations and finding of the optimal path in environment (structural and non-structural).

♦ **Laboratory for Material Removal Machining Processes – LaTOOS**

The Laboratory is providing the following services:

- Measuring and analysing some of performances of cut quality during the conventional machining processes (turning, milling, etc.) and during non-conventional machining process (laser cutting, plasma cutting, abrasive water jet cutting, electro-discharging machining) by using different measuring equipment.
- Creating mathematical models to predict the performance of machining processes based on experimental data.
- Optimisation of process parameters by using different multi-response methods.
- Creating 3D model using available programmes (CATIA, SolidWorks) and making own products or some souvenirs, toys, etc., by using the CNC lasers.

♦ **Laboratory for additive technologies**

The aim of the laboratory is to educate students through practical exercises as part of Additive Technology subject, conducting experimental research within final papers and doctoral dissertations, etc. The following services are provided: production of prototypes, tools, mold parts as well as small series of products by various additive production processes; creating a

CAD model directly based on a physical 3D model using reversible engineering procedures; dimensional measurements using modern 3D scanning techniques.

- **Laboratory for testing polymeric materials**

The primary task of the laboratory is the testing of polymeric materials using the equipment such as universal testing machine, Shimadzu AGS-X 10kN. In addition to devices for testing materials, the laboratory also has 3D printers for making testing samples of polymeric materials, as follows: Formlabs Form 3B, SLA technology; Ultimaker S5 pro, FDM technology; Ultimaker S3, FDM technology; Ultimaker 3, FDM technology and Ultimaker 2+ extended, FDM technology.

- **Tensometric equipment for analysis of stress-strain states on products and structures**

Tensometric equipment is used for detection and analysis of stress-strain states of products and machine structures, as well as analysis of displacement, vibration, acceleration, force, temperature, torque and speed.

- **3D scanner Atos Core 200**

Atos Core 200 is a 3D scanner that uses the blue light technology to gather information related to the scanned object shape and dimensions. The main objective of the RI is to provide equipment to scan objects with regular or irregular shape and perform reverse engineering. Services provided include: scanning objects with irregular shape; parameterising the object's dimensions; determining deformations and performing reverse engineering.

- **3D Scanner Artec Eva**

3D scanner Artec Eva is used for: reverse engineering in mechanical engineering (mechanical design/product development and design) and digitalisation in several fields like veterinarian or archaeological sciences.

- **Atomic Force Microscope ezAFM+**

Atomic Force Microscopy (AFM) is a type of scanning probe microscopy (SPM), with demonstrated resolution on the order of fractions of a nanometer, more than 1000 times better than the optical diffraction limit. The information is gathered by feeling or touching the surface with a mechanical probe. It can be used to observe material samples at nanoscale.

Research equipment: The total purchase value of research equipment owned by the Faculty of Mechanical Engineering is about 1 mil. euros. The Faculty owns single capital research equipment worth over 50,000 euro (spectrometer with accompanying equipment at the Laboratory for physical measurements in mechanical engineering). Most of research equipment purchase value ranges from 10,000 to 40,000 euro.

Access Policy: Internal procedures for access to research equipment vary slightly between different laboratories. Teaching and research staff have open access to research equipment. Students can access the equipment in the presence of the responsible teacher. External users, including business sector and university staff from other universities in Bosnia and Herzegovina might get access, having agreed upon the usage terms and conditions, and after they get familiar with the use of the equipment. It is necessary to contact the responsible person in order to

coordinate the resources, time and presence of the laboratory-responsible staff. The laboratory-responsible staff checks the availability of equipment at the proposed time and agrees on the date of use. Through communication with the head of the laboratory, it is checked whether, and to what extent, the potential user is familiar with the operation and using the equipment, and if necessary, appropriate training is agreed. A laboratory-responsible person must be present in laboratory during the use of the equipment.

Institute for Genetic Engineering and Biotechnology

The RI of the Institute for Genetic Engineering and Biotechnology consists of the equipment and specific software packages necessary for life science research. In addition to physical equipment, the RI also includes soft elements such as cell, oligonucleotide, and probe collections. RI is utilised in a modular manner where basic methods are hierarchically organised towards a problem-solving process. Specifically, RI serves basic procedures such as: cell cultivation in vitro, DNA/RNA extraction, quantitative and qualitative analysis of DNA, microscopic analysis, PCR/qPCR, de novo genome sequencing, re-sequencing, DNA hybridisation, and fragment analysis. By implementing the basic modules, researchers can study cytotoxic and mutagenic effects of various substances, molecular mechanisms of cell damage repair, population structure of contemporary and archaeological populations of living organisms, molecular mechanisms underlying complex genetic disorders, cellular and molecular mechanisms underlying response to various chemicals including medications, plant-microbe interactions, and utilise DNA barcoding to resolve taxonomic dilemmas.

Services provided: RI is used for a wide array of experiments which provide cellular and genetic data. Bioinformatic and biostatistical support is provided to analyse the data and put them in the context. It is also the basis for consultations provided to external researchers in planning their own research.

Research equipment: A total estimated value of research capital equipment is 250,000 eur (the purchase value was 470,000 eur). The Institute has single capital research equipment worth over 50,000 euros. There are two major problems related to RI (capital equipment in particular):

- operating environment conditions and power supply are frequently inadequate and cause premature equipment breakdown,
- professional maintenance and repairs of capital equipment are prohibitively high for individual organisational units to sustain and frequently they are not available within the economy,
- calibration service is not available within the economy.

Access Policy: RI is available to both internal and external users. All the users are given adequate training as to the handling and routine maintenance of the equipment (i.e. cleaning, buffer replacement, etc.). Internal users have unlimited access to RI once they complete necessary handling and maintenance training. The utilisation of RI by external researchers is under the authority of the Science Council of the Institute. They can access RI either by participating in a joint research project or by a formal request for service.

Faculty of Dentistry with Clinics

The Faculty of Dentistry with Clinics is mainly focused on education. Its main goal is to educate students, provide high-level educational courses to the students and enable its teaching staff to use modern equipment.

Services provided: Research infrastructure is available primarily for faculty members, and students under the supervision of teaching staff.

Research equipment: The Faculty of Dentistry with Clinics is equipped with modern equipment. A total estimated value of research equipment is 1.3 million eur (purchase value is 3.3 million eur). The purchase of the latest equipment from all domains of dentistry is planned in the future.

Access Policy: All equipment owned by the Faculty of Dentistry with Clinics is available to research infrastructure users. In case of using the equipment for scientific-research purposes, the user goes through all the procedures of the Ethic Committee and Teaching-Scientific Council. External users go through the same procedures as internal ones.

Faculty of Agriculture and Food Sciences

The research infrastructure of the Faculty of Agriculture and Food Sciences aims to provide answers to the questions of how to produce food of the highest quality, which soil properties ensure good food quality and how agriculture practices affect the environment. Additionally, the research infrastructure is slowly enabling the introduction of new technologies in agriculture and food production which provides the basis for smart agriculture.

Services provided: The Faculty owns 19 research laboratories, conducting a whole spectrum of research activities in the area of food sciences: water analysis; soil analysis; plant material analysis with primary focus on fruits and vegetables; food analysis; food contaminants analysis; production of food, fruit, vegetable, dairy and grain products; milk production; smart and precise agriculture; phytomedicine and plant protection; agroeconomics; honey analysis; nutrition; plant nutrition; etc.

Research equipment: The Faculty of Agriculture and Food Sciences does not have single capital research equipment worth over 50,000 euro. However, they are equipped with more than 300 pieces of small research equipment and instruments that are used for everyday research activities.

Access policy: There is no set procedure. External access to the research infrastructure is mainly based on personal acquaintances and personal contacts.

Sarajevo Academy of Performing Arts

The Research Infrastructure of Sarajevo Academy of Performing Arts mainly consists of high value production technology and equipment needed for entire preproduction, production and postproduction of film, theatre performances, television formats and radio productions. The students, teachers and researches can access the equipment to make films, theatre performances or any kind of performances on stage, as well as television and radio formats for their school and extra-curriculum work at the Academy.

Services provided include: preproduction of films; production of films-shooting of video material in professional conditions; editing of films and video material; sound design for film and theatre; colour correction, final mastering; production of stage performances; equipment rental (camera, lenses, postproduction facilities, stage with light and sound equipment); film and theatre history research (books, films, screening facilities and online resources); etc.

Research equipment: The Academy does not have single capital research equipment worth over 50,000 euro. It is equipped with the small research equipment and instruments (cameras, monitors, audio recorders, projectors, etc.)

Access policy: The entire infrastructure has a responsible person in charge. The external requests are filed to the Dean's Office (Vice Deans of particular department in charge) and also to in-house Production Manager. According to the schedule, the Production Manager makes the infrastructure available to all potential external users after meeting the relevant conditions.

Faculty of Sports and Physical Education

The Institute of Sports was established in 2006 within the Faculty of Sports and Physical Education as the first institution for sports diagnostics at the level of Bosnia and Herzegovina. The Institute conducts scientific and developmental research in the field of sports and provides specialised diagnostic and counselling services and specialised training programmes for all categories of its users.

Services provided: The current diagnostic equipment of the Institute of Sports enables the following diagnostic procedures: anthropometric measurements; kinetic measurements; equilibrium level measurements; postural status testing-3D analysis; biomechanical measurements on the conveyor belt; body composition and composition; measurement of blood lactate levels; spirometry; measurement of segmental speed response and motion frequency; measurement of basic motor skills; etc.

Research equipment: A total purchased value of research capital equipment is 123,159.50 euros. In the future, the Faculty's management is planning to procure the following equipment: cardio line providing full COVID19 recovery options; orthepaedic rehab equipment and various sport & movement diagnostic equipment.

Access Policy: Faculty academic staff has to apply with their project proposals to the Teaching-Scientific Council if they want to use the research infrastructure without any fee. If not, regular fee discount is used. External users usually pay for the use of RI.

Faculty of Pharmacy

Research activities of the Faculty of Pharmacy have been conducted within the following Faculty departments: Department of Clinical Pharmacy; Department of Biochemistry and Clinical Analysis; Department of Pharmacognosy; Department of Pharmaceutical Analysis; Department of Natural Sciences in Pharmacy; Department of Pharmaceutical Technology; and Department of Pharmaceutical Chemistry.

Services provided: The following research activities/services are conducted at the Faculty:

- high pressure liquid, gas and counter-current chromatography-separation, identification and quantification of different types of compounds, spectrophotometry-identification of chromophore-containing compounds and quantitative analysis of solutions, spectrofluorimetry-measurement of fluorescence intensity of fluorophore-containing samples, preparation of ultrapure water for chromatographic analysis, characterisation of samples in solid and semi-solid state, refractometry-measurement of refractive index of liquid and solid compounds and solutions, polarimetry-measurement of specific rotation value and qualitative and quantitative analysis of optically active compounds, induction and control of solvent evaporation by reducing vapour pressure, sample visualisation and preparation for further analysis, measurement of pH value, conducting chemical reactions at constant and elevated temperatures, separation of solid and liquid phases, separation of particles in the same phase but of different size, homogenisation of solutions by heating or rotating magnetic field-based mixing;
- forensic quantification of DNA (genetic analysis), amplification of nucleic acids, gene cloning, gene expression analysis, analysis of mutations, cyclic sequencing, testing the concentration of nucleic acids in small sample amounts, SNP genotyping, spin-mix-spin algorithm, kinetic measurements, scanning and measurement of samples on microplates, immunoenzymatic analysis, sterilisation of liquids, storage and preservation of different types of samples at temperatures of -20 to -80 °C;
- high-speed counter-current chromatography (HSCCC)-liquid-liquid partition chromatography, efficient approach for isolation and purification of natural products, microscopic analysis of samples;
- in vivo testing of anti-inflammatory and anti-edematous activity in rats and mice, in vivo testing of acute, subacute and chronic pain in rats and mice;
- determination of particle size distribution, as well as fractionation of certain particle size of material and quantification, mixing creams, ointments, pastes, powders, and liquids; tablet quality control: tablet strength testing, and tablet friability testing;
- evaluation of drug permeability (in vitro using artificial membranes);
- testing the melting temperature in glass capillaries.

Research infrastructure of the Faculty is mainly used for employees' scientific projects and conducting experiments for students' Master and Doctoral theses.

Research equipment: A total estimated value of research capital equipment is 101,484.37 eur (the purchase value was 283,018.63 eur). The Faculty does not have single capital research equipment worth over 50,000 eur.

Access Policy: Research infrastructure is located at departments and users are the employees of each department or MSc/PhD students of the Faculty of Pharmacy. The Faculty does not have any procedures of accessing the research infrastructure for external users. They have not had any formal requests from external users to access the research infrastructure so far.

Faculty of Science

Within the Faculty of Science, scientific research activities are carried out in the following research centres and laboratories:

♦ Centre for Ecology and Natural Resources "Akademik Sulejman Redžić"

The premises used for the implementation of research projects within the Centre are part of the Department of Biology of the Faculty of Science. They include:

- Laboratory for palynology, equipped with modern devices for sampling pollen in the air, microscopes and IT equipment
- Laboratory for systematics of algae and fungi, equipped with basic laboratory equipment for research of systematics and ecology of algae
- Practicum for performing laboratory exercises
- Herbarium, arranged on the basis of the ecosystem affiliation of plant species
- *Research equipment:* The Centre does not have capital research equipment worth over 50,000 euro. In their research activities, they use devices for measuring concentration of pollen and two microscopes.

♦ The Ichthyology and Fishing Centre

The Ichthyology and Fishing Centre (CIR) of the Faculty of Science is engaged in a range of studies including fish populations and communities, aquatic habitats, and the biological processes that occur in complex aquatic ecosystems. Through field and laboratory research and technical knowledge, they provide necessary information and advice of crucial importance to protect, conserve, and manage aquatic resources of Bosnia and Herzegovina.

Services provided: The Ichthyology and Fishing Centre offers a wide spectrum of expertise which include fisheries management studies, plans for revitalisation of fish communities, expertise in the case of ecological accidents, and educative workshops. In addition to analyses of biological quality elements, they carry out physical-chemical water analyses, microbiological analyses and eco-toxicological analyses.

Research equipment: The Centre does not have capital research equipment worth over 50,000 euro. In their research activities, they use research instruments (microscope, incubator, Spectrophotometer, etc.) worth less than 50,000 euro.

♦ GIS Centre

The GIS Centre of Department of Geography provides training on GIS software, remote sensing, space and process modelling and their 3D and 2D visualisation. The highly qualified teaching staff provides training for students on numerous possibilities of applying GIS technology for various aspects of space and process modelling. Students in the GIS Centre discover and improve methods of detection, analysis, monitoring, manipulation and visualisation of spatial data.

Services provided: The centre offers the following services: visual interpretation and geoprocessing of spatial data; creation of extensive databases, their processing and geo-visualisation; 3D

visualisation and optimisation of spatial content; management, monitoring and analysis of natural resources; Environmental impact analysis; analysis of hazards, natural disasters and conflicts in space and mitigation of their consequences; monitoring and planning of energy and water supply systems; visualisation and planning of public infrastructure facilities and response to emergencies and disasters; etc. The centre also provides GIS training services, including user needs analysis, customised GIS programming, customised spatial content mapping, etc.

Research equipment: The Centre does not have capital research equipment worth over 50,000 euro. It has 5 computers and multimedia equipment.

- **Laboratory for Microbiology**

Services provide: Testing of antimicrobial activity of substances of plant and animal origin, testing of bacterial resistance to antibiotics, and research of plant viruses.

Research equipment: Incubator, autoclave, dry steriliser, membrane filtration apparatus, PCR apparatus.

- **Genetics Laboratory**

Services provided: DNA isolation and amplification, molecular genetic analysis for research in pharmacy, medicine, forestry and agriculture.

Research equipment: Cabinet with laminar flow, UV transilluminator, system for horizontal gel electrophoresis, pH meter, centrifuge, microcentrifuge, water bath, PCR device, autoclave.

- **Laboratory for water microbiology and bioremediation**

Services provided: Microbiological analysis of all types of water, including pond water, is also aimed at developing a method of bioremediation in the processes of purification of polluted water and soil.

Research equipment: Dry steriliser, autoclave, incubator, membrane filtration system.

- **The Laboratory of Metal Physics**

The Laboratory of Metal Physics performs production of metallic glasses in the form of ribbons by melt-spinning method. It can also perform microhardness measurements by Vickers method and metallographic analysis.

Services provided: Production of metallic glasses, microhardness measurements and metallographic analysis. The Laboratory supports bachelor and master's thesis in the field of solid state physics and conducts activities within scientific research projects.

Research equipment: The Laboratory owns a couple of home-made devices, namely melt-spinner and argon arc melting furnace. It also owns a microhardness device and metallographic microscope approximately worth 10,000 euro.

- **High performance computing server**

The server is primarily used for high-performance calculations in the field of atomic, molecular and optical physics.

The research equipment consists of a Dell PowerEdge 940 server consisting of four Intel Xeon Gold 6230 processors, each with 20 processor cores with a total of 256 GB of available RAM and about 1.7 TB of SSD memory. The server is located at the Department of Physics of the Faculty of Science in Sarajevo and has been acquired as part of the scientific research project "New methods of generating soft X-rays and scattered electrons using complex laser fields" funded by the Ministry of Education, Science and Youth of Sarajevo Canton. A total purchase value of research equipment is 33,000 euro.

- **Laboratory for samples of water and air**

Physico-chemical and chemical parameters of water analysis can be performed within this laboratory, such as: pH, electrical conductivity, hardness, alkalinity, acidity, chemical oxygen demand (HPK), determination of dissolved oxygen in water, consumption of KMnO4, determination of anion content (nitrate, sulfate, chloride, phosphate) and metals. It is also possible to concentrate liquid samples to determine the content of heavy metals. The laboratory also has methods for the removal of heavy metals as well as organic dyes from water samples using various sorbents.

In terms of air analysis, the laboratory performs:

- Determination of the PM10 mass concentration of suspended particulate matter (gravimetric measurement method)
- Measurement of selected elements in the PM10 fraction of suspended particulate matter
- Biomonitoring of air quality using lichen and moss

Research equipment: Atomic absorption spectrometer, UV/ViS spectrophotometer, Air sampler, Polarograph, JAR-test, pH-meter, Conductometer, Analytical balance (±0.01 mg), High-performance liquid chromatography with a diode-array detector.

- **Laboratory for metals 1**

Services provided: Electrolysis, galvanisation, determination of pH, conductivity, viscosity, refractive index and density of liquid samples, dry cleaning of boilers, testing of corrosion properties of metals and alloys, determining the freezing point and the boiling point of custom samples, refining and refining of precious metals, preparation of solutions for different purposes, custom synthesis of chemical compounds, etc.

Research equipment: Potentiostat / galvanostat EG&G 263A

- **Laboratory for metals 2**

Services provided: Chemical analysis of different types of alloys, chemical analysis of samples of melt, hard and zinc sawdust, chemical analysis of flux solution, chemical analysis of passivation solution, determining the thickness of the metal coating, recycling of silver from a nitric acid solution of silver.Determination of total, pseudo-total, and accessible quantities of heavy metals (macro, micro, and traces) are performed by atomic absorption spectrometry techniques, such as:

- flame technique (FAAS),
- electrothermal (ET AAS),
- hydride technique (HG AAS).

Mercury determination by the cold vapour technique (CV AAS) can be also performed. Also, the content of some other elements can be determined using UV/ViS spectrophotometry.

The preparation of samples for analysis for instrumental measurements is carried out following the steps of standard and/or internationally recognised procedures.

Research equipment: Atomic absorption spectrometer, UV/ViS spectrophotometer, Air sampler, Polarograph, JAR-test, pH-meter, Conductometer, Analytical balance (±0.01 mg), High-performance liquid chromatography with a diode-array detector, HPLC-DAD.

♦ **Laboratory for inorganic and bioinorganic chemistry**

Services provided: Synthesis and purification of know compounds; design, synthesis, characterisation and purification of new compounds; determinations that require spectroscopic methods (electronic and infrared spectroscopy); analysis of different types of solid and liquid samples; electrochemical determinations and measurements; monitoring of heavy metals; interaction of drugs with proteins and nucleic acids

Research equipment: Perkin Elmer BX FTIR spectrophotometer, Perkin Elmer BioLambda 35 spectrophotometer, Potentiostat / galvanostat AutoLab

♦ **Laboratory for natural products**

Services provided: Analysis of the chemical composition of different plant extracts; analysis of the chemical composition of honey and royal jelly; analysis of antioxidant activity; synthesis of new bioactive compounds; organic analytics (pollutants, pesticides, amino acid composition, products of primary metabolism, Vitamin C, etc.; exploring the interactions of bioactive components with proteins; enzyme-inhibitory activity assays; analysis of artefacts.

Research equipment: UV-Vis spectrophotometer, Lambda 25 Perkin Elmer, Spectrophotometer Vis, LAB DEX LX 101 VS, LS55 luminescent spectrometer, Perkin Elmer, Ultrasound bath, Branson, Ultrasonic bath, Sonic, Analytical balance, KERN ABJ 120-4NM, Analytical balance, Metler Toledo AB 104, Lab Stirrer, Neuation istir HP550, Rotavapor System, Yamato RE200 Nahita, Hot Stirrer 690-5, Thermostat Lauda K20, Heating mantle, ISO Lab, Heating mantle, Boeco, Lab Heat, Microwave oven, Merck MW500, Ultrapure water distiller, TKA, Smart 2 Pure.

♦ **Laboratory for Radiochemistry**

The laboratory for Radiochemistry performs environmental radioactivity monitoring, preparation and analysis of a samples using Gamma-ray spectrometric technique.

Services provided: Low-level gamma-ray spectrometry system is used for the identification and quantitative determination of natural and artificial radionuclides content in different samples (soil, water, biota, etc.). The Laboratory supports bachelor, master's and doctoral thesis in the field of radiochemistry and conduct activities within scientific research projects.

Research equipment: The Laboratory owns one instrument, gamma spectrometer, worth 48,000 euros. A total purchase value of research equipment is 55,000 euro.

- **Centre for Theoretical and Applied Mathematics and Computer Science**

Centre for Theoretical and Applied Mathematics and Computer Science brings together several research groups in analytic number theory, algebra, difference equations and discrete dynamical systems, mathematical biology, optimisation, and algorithms. Theoretical computer science acts as a natural bridge between (pure and applied) mathematics and computer science, while the recent research within analytic number theory reduced the error terms and widened their applicability. In addition to theoretical research in difference equations and discrete dynamical systems, the group in difference equations and discrete dynamical systems also applies the obtained theoretical results, mainly to mathematical biology, focusing on population theory. Research also includes computational biology.

Services provided: Theoretical research in various mathematical disciplines, computer simulations, and visualisations, mathematical biology modelling, and optimal solutions based on heuristic algorithms techniques.

Research equipment: The Centre does not have capital research equipment worth over 50,000 euro. Their research activities use the Computer Centre of the Department of Mathematics (50 computers), access to scientific databases, and a laboratory for virtual reality.

Faculty of Forestry

The research infrastructure of the Faculty of Forestry is primarily used to educate students. It is also used for scientific research purposes as well as in providing services to third parties.

Services provided:

- Seed analysis of planting material
- Quality analysis of tree seedlings
- Analysis of forest and hot crop diseases
- Microscopic analyses of forest tree diseases and identification of harmful insects
- Providing design services in forestry
- Analysis of the health status of individual trees
- Development of GIS projects

Research equipment: The Faculty does not have single capital research equipment worth over 50,000 euro. A total estimated value of research equipment is 29,000 euro (the purchase value was 390,114.79 euro).

Access Policy: Research infrastructure is available primarily for faculty members, students under the supervision of faculty and other persons who use research equipment with the consent of the head of the faculty. External users could access research infrastructure with a written request.

The consent is given by the Dean of the Faculty with the obligatory supervision of the person in charge of a certain research infrastructure.

Veterinary Faculty

The research activities of the laboratories operating within the Veterinary Faculty are focused on improvement of current scientific methods of food and environmental safety control. The existing equipment is of crucial importance for food and environmental control and, therefore, has significant importance for security items at different governmental levels (cantonal, federal, central).

Services provided:

- Education (Degrees: BSc, specialisation, MSc, PhD)
- Food Control (food production, veterinary inspection, import and export of food)
- Environmental Control (environmental impacts assessments for production facilities)
- Consulting

Research equipment: The Faculty does not have single capital research equipment worth over 50,000 eur. Some of the equipment items consist of several pieces (the older ones – but still useful and the new ones) which make the estimation almost impossible.

Access Policy: Access to research infrastructure is open and based on the contract between institutions and university and individuals. The internal users must be appointed as persons authorised for handling the appropriate equipment which means they are well trained and educated for that purpose. The rules of access for external direct users are described in relevant contracts.

I-3.1.2. University of Tuzla

The University of Tuzla comprises 12 faculties and one academy: The Faculty for Special Education and Rehabilitation; the Faculty of Economics; the Faculty of Electrical Engineering; the Faculty of Physical Education and Sport; the Faculty of Pharmacy; the Faculty of Philosophy; the Faculty of Mechanical Engineering; the Faculty of Medicine; the Faculty of Law; the Faculty of Natural Sciences and Mathematics; the Faculty of Mining, Geology and Civil Engineering; the Faculty of Technology; and the Academy of Dramatic Arts.

Faculty of Electrical Engineering

The Faculty of Electrical Engineering has seven laboratories: Electrical Engineering and Electrical Measurements; Electric machines and Electric motor drives; Sequential circuits; Electronics and Signal Processing; Automation and robotics; VOIP services and Renewable energy sources and energy converters. The purpose of the research infrastructure is to enable research exercises

of bachelor, master's and PhD students and to support the solution of practical problems in cooperation with industrial partners.

Services provided: the following services are provided within the laboratories:

- testing the functionality of electric power plants, electrical devices and electrical installations
- test for protection against direct contact of live parts
- measurements of insulation resistance of electric power plants, electrical devices, electric transformers, electric generators, electric motors, etc.
- measurement of resistance of drive and protective earthling, insulating walls and floors, galvanic connection on installations
- measurement of brightness intensity
- inspection and testing of welding devices
- measurement of electric quantities (voltage, current, power, energy, frequency, power factor, intensity of electric and magnetic fields, capacitance, inductance), electrostatic charge, low-frequency electromagnetic fields in the vicinity of electric power facilities and devices

Research equipment: The Faculty does not have single capital research equipment worth over 50,000 euro. A total estimated value of research equipment is 80,200 euro (purchase value was 333,000 euro).

Access Policy: The formal access policy does not exist. However, there are internal procedures to access research equipment in place under which external users submit a request to the Dean of the Faculty, and after considering the request, the agreement on the use of research infrastructure is signed.

Faculty of Pharmacy

The research infrastructure of the Faculty of Pharmacy is focused on research of new potential active principles and testing of their properties within the Laboratory for pharmaceutical analytics, and their effects on cell cultures within a single cell laboratory. An important aspect is biochemical research in the field of proteomics, immunochemistry and tumor biochemistry.

Services provided include: Spectrophotometric analyses (UV-VIS, fluorescent and FTIR); ELISA; cultivation and manipulation of cell cultures; HPLC analysis; electrophoretic analyses and PCR analysis.

Research equipment: The Faculty does not have single capital research equipment worth over 50,000 euros. However, they have a total of 66 research instruments used for research purposes. The detailed list of all research equipment is provided on the website of the Faculty. The users of research instruments are mostly teachers and students.

Access Policy: The formal access policy does not exist. All users are teachers, associates and students at the Faculty of Pharmacy. External users are allowed to access RI upon official permission issued by the Vice Dean for Scientific Research.

Faculty of Mechanical Engineering

The research infrastructure at the Faculty of Mechanical Engineering includes several laboratories and the communication network. The laboratory complex comprises ten laboratories: Laboratory for CNC technologies; CAD and CAM systems; Production systems and robotics; Welding and heat treatment; Reversible engineering and rapid prototyping; Research and development in thermo-fluid technology; energy systems; material testing; mechatronics and Machine construction and CAD. The communication network of the Faculty is part of the unique communication network of the University of Tuzla. The purpose of the research infrastructure is to provide grounds for conducting practical tests, measurements, analyses and other activities that rely on theoretical research carried out as part of the teaching process.

Services provided: The research infrastructure is used for testing, measurements, analysis and other activities within the implementation of research and commercial projects implemented in cooperation with the business sector. It is also used as part of the teaching process for the preparation of master's and doctoral theses and laboratory exercises.

Research equipment: The Faculty does not have single capital research equipment worth over 50,000 euros. A total estimated value of research equipment is 150,000 euro (the purchase value was 200,000 euro).

Access Policy: The formal access policy does not exist. Research equipment can be used by all researchers (teachers, assistants and associates) of the Faculty, and researchers from other faculties of the University of Tuzla, with the prior consent of the Dean of the Faculty. Students can use the equipment according to the schedule of laboratory exercises.

Researchers from business entities or other research institutions may access the equipment in the presence of researchers from the Faculty of Mechanical Engineering, with whom they jointly implement project activities, with the prior consent of the competent person of the Faculty.

Faculty of Natural Sciences and Mathematics

The research activities of the Faculty of Natural Sciences and Mathematics are carried out at: the Laboratory for applied chemistry; the Laboratory for detection, dosimetry and radiation protection and Chemistry department laboratories.

- **The Laboratory for applied chemistry**

The Laboratory for applied chemistry offers equipment for food analysis, cultivation, and identification of different microorganisms such as: incubators, water bath, sterile bench, different centrifuges, autoclave, microscope, freezers and sterilisers. The Laboratory equipment such as UV/VIS spectrophotometer, microplate plate reader, and UV cabinet is used on the daily basis for qualitative and quantitative analysis of proteins, measurement of enzyme kinetics and colorimetric methods for differentiation between bacteria and fungi.

Services provided: The Laboratory implements activities related to the implementation of research projects, preparation of graduate, master's and doctoral theses and implementation of laboratory exercises for students.

Research equipment: The Laboratory does not have capital research equipment worth over 50,000 euros. A total estimated value of research equipment is 8,120 euro (the purchase value was 56,700 euro).

- **The Laboratory for detection, dosimetry and radiation protection**

The Laboratory for detection, dosimetry and radiation protection performs radioactivity monitoring, assessment and analysis of ionising radiation doses, preparation of samples for radioactivity analysis, gamma-ray spectrometric analysis of samples, radon measurements in ambient environments (active and passive method), gamma dose rate measurements, etc.

Services provided: Low-level gamma-ray spectrometry system is used for identification and quantitative determination of natural and artificial radionuclides content in different samples. AlphaGUARD PQ2000PRO monitoring system, in combination with AquaKIT, AlphaPUMP, Radon Box and Soil gas probe, is used for determination and continuous measurement of radon activity concentration in air, water, soil gas and measurements of the radon exhalation rate from building materials and soil samples. Radosys system is used for determination of radon activity concentration in outdoor and indoor environment, by passive method with solid state nuclear track detectors. AlphaE radon meter enables continuous measurement of radon concentration indoors and outdoors.

The Laboratory provides preparation of master's and doctoral thesis in the field of radiation physics and conduct activities within scientific research projects.

Research equipment: The Laboratory does not have single capital research equipment worth over 50,000 euros. A total purchase value of research equipment is 120,000 euro.

- **Chemistry Department laboratories**

Chemistry Department of the Faculty of Natural Sciences and Mathematics is equipped with several spectrophotometric instruments (UV/VIS spectrophotometers, Atomic Absorption Spectrophotometer (Flame atomisation technique), ICP emission spectrometer), instruments for electrochemical analysis (voltammetry, conductometry, potentiometry) and other accompanying devices for sample preparation and analysis (pHmeter, rotavapor, digital scale, etc). The instruments are located in 3 laboratories (General and inorganic chemistry, Analytical chemistry and Organic chemistry) and are frequently used by the faculty employees and students.

Services provided: Equipment can be used for qualitative and quantitative determination of analyses in different samples, such as determination of heavy metal ions in environmental samples, food samples, etc.

Research equipment: The Faculty does not have single capital research equipment worth over 50,000 euros. A total purchase value of research equipment is 50,000 euro.

Access Policy: The formal access policy does not exist. RI is mainly accessed by teaching staff, researchers and students.

Faculty of Technology

The research infrastructure of the Faculty of Technology consists of five laboratories:

- Laboratory for knowledge and control of raw materials and food products;
- Laboratory for Chemical Technology, Engineering and Environmental Protection;
- Laboratory for physio-chemical, analytical and corrosion tests;
- Laboratory for Organic and Polymer Chemistry and Technology;
- Laboratory for Chemical Engineering and Sustainable Development.

Research activities conducted within these laboratories include technical testing, analysis and research of various chemical process parameters in the laboratory ratio. Laboratory equipment is used to obtain the experimental data needed for basic research and applications in analytical, environmental, organic, inorganic, and advanced material chemistry, while computer-aided equipment is used to study heat transfer, pressure measurement and calibration, and steam generation.

The Laboratory for Knowledge and Control of Food Raw Materials and Products covers research in the fields of: food technology and food production processes, development of new products and functional food additives, and food quality control and safety.

The Laboratory for Chemical Technology, Engineering and Environmental Protection explores the possibility of using by-products from the chemical and food industry, as secondary raw materials, or for certain purposes in industry.

The Laboratory for Physico-chemical, Analytical and Corrosion Tests performs the following activities: monitoring of reaction kinetics in aqueous systems, electrochemical deposition on oxide anodes, corrosion and material protection tests, monitoring of thermophysical properties and their changes in food, tests of photocatalytic activity of ferro porphyry, as well as photo synthesis and characterisation of photocatalysts based on tungsten oxides, research of eco-friendly inhibitors for corrosion protection, as well as research in the field of synthesis and analysis of biosorbents for the removal of heavy metals from water.

The Laboratory for Organic and Polymer Chemistry and Technology conducts research related to: production and analysis of biofuels (biodiesel, biogas) from various raw materials, new processes of application of bio glycerol by-products of biodiesel production processes, production and processing of polymeric materials, and recycling processes for polymer materials (PUR, PET, etc.).

The Laboratory for Chemical Engineering and Sustainable Development performs the application of numerical software packages and simulation software in research in the areas of: reaction engineering, process analysis and simulation, process design, process integration, energy efficiency of chemical processes, automation and process control, etc. The Laboratory uses computer-aided equipment for studying heat transfer, pressure measurement and calibration, and steam generation.

Services provided to research infrastructure users include: physicochemical characteristics of food, analysis of water and wastewater quality parameters, analysis of oil and derivatives, physico-chemical analysis of soil, monitoring the kinetics of chemical reactions, electrochemical and

corrosion tests, analysis of antioxidant activity of plant extracts, characterisation and antimicrobial screening of metal complexes and computer analysis and simulation of chemical processes.

Research equipment: The Faculty does not have single capital research equipment worth over 50,000 euros.

Access Policy: The formal access policy does not exist. RI is mainly accessed by teaching staff, researchers and students.

I-3.1.3. University of Bihać

The University of Bihać was founded in 1997. It consists of 7 higher-education institutions: Biotechnical Faculty, Faculty of Economics, Islamic-Pedagogical Faculty, Pedagogical Faculty, Faculty of Law, Technical Faculty and Faculty of Health Studies.

The University of Bihać is well equipped with research equipment. Through the Modernisation of the University of Bihać project financed by the Government of Una Sana canton, research equipment worth 5 million euros was procured. This included the procurement of capital research equipment worth over 500,000 euros and research instruments used for education, research, and transfer of knowledge to industry.

The Law on Scientific Research adopted by the Assembly of Una Sana Canton foresees establishment of an Institute of the University of Bihać which would integrate all research infrastructures of organisational units of the University of Bihać.

Biotechnical Faculty

In addition to teaching activities, the Biotechnical Faculty is conducting research activities in the fields of biotechnology, agriculture, food-processing technology and environmental protection. The Biotechnical Faculty has laboratories for performing exercises in subjects in which, in addition to the teaching process, experimental research is performed for bachelor and master's studies.

Services provided: The research equipment is used for training of students and teachers, preparation of the practical part of master's theses and for external services.

Research equipment: The research laboratories of the Faculty have been equipped in 2016 within the Modernisation of the University of Bihać project. More than 100 different research instruments and capital equipment were procured. The total value of the purchased equipment was more than 700,000 euros. Some of the most important research equipment owned by the Biotechnical Faculty includes:

- Mass Spectrometry System LC/MS/MS-an analytical chemistry technique that combines the physical separation capabilities of liquid chromatography (or HPLC) with the mass analysis capabilities of mass spectrometry.
- Oil Press Machine – Ölpresse KK100 F / 140 F Universal-KERN&KRAFT – used for all types of oil extraction processes.
- Farinograph-E Brabender-provides a reliable, reproducible picture of the water absorption and kneading properties of flours, in consideration of international standards.

- Extensograph–E Brabender-enables to recognise and determine the effect of flour additives to the plasticity and elasticity of dough.
- Microwave Reactin System, Anton Par-delivers the sample preparation solutions to obtain excellent trace analysis results. It masters high temperatures and provides comprehensive reaction control features. Its wide range of accessories allows digestion, leaching, oxygen combustion, solvent extraction, drying, evaporation, and UV digestion with one single system.

Access policy: In January 2021, the Senate of the University of Bihać adopted an Open Access Policy to Research Infrastructures, which provides detailed information on types of users and access to research infrastructures. This Policy applies to all organisational units of University of Bihać, including the Biotechnical Faculty.

Technical Faculty

The Technical Faculty has several laboratories in which scientific research activities are performed covering various scientific fields.

The Laboratory for testing building constructions and materials examines the quality of stone aggregates, asphalt masses, concrete cubes, reinforcing steels, etc. The Zwick / Roell z600 (material testing machine) press and ripper to test the mechanical properties is used for testing. The research equipment is mainly used for research activities, student's exercises, but also to provide services to third parties.

The Laboratory for automation and robotics is equipped with a robotic welding system KUKA, FESTO MPS 500 mechatronic system, etc. The research equipment is in good condition and is mainly used for teaching activities.

The Wood Testing Laboratory owns the SHIMADZU 50kN Kidalica and the EMCO TEST DuraVision G5 material hardness testing machine, used for wood quality testing. The machines are in well-preserved condition and are used to train students for preparation of scientific papers for master's and doctoral studies.

The Laboratory for turning technology and machining systems is equipped with a system of CNC machines with the possibility of complete machining on a five-axis CNC milling machine EMCO LINEARMILL 600 and on a lathe EMCO HYPERTURN 45 and EMCO LM 1200.

Services provided: All laboratories are established primarily for the purpose of educating students and scientific research of teachers. Research equipment is used for training of students and teachers, preparation of practical part of graduate and master's theses and for external services. The Laboratory for testing building materials and the Laboratory for testing wood provide services to business partners through commercial and scientific cooperation.

Research equipment: The research laboratories of the Faculty have been equipped in 2015 within the Modernization of the University of Bihać project. The total value of the purchased equipment was more than 2.3 mil. euros. More information on capital research equipment is provided in Appendix I.

Access policy: In January 2021, the Senate of the University of Bihać adopted an Open Access Policy to Research Infrastructures, which provides detailed information on types of users and access to research infrastructures. This Policy applies to all organisational units of University of Bihać, including the Technical Faculty.

Pedagogical Faculty

The research equipment within the Pedagogical Faculty is used for: diagnostics of athletes, recreationists, students and all other interested parties, i.e. for commercial purposes.

Services provided: The following tests are performed: isokinetic diagnostics; electromyographic analysis of muscle activity; balance measurement; assessment of body composition; scanning the position of the human body; functional abilities; measurement of lower limb force tests to assess human movement.

Research services are provided to primary and secondary school students, sports clubs and individuals, sports schools, adolescents recovering from sports injuries or illness and persons with diagnosed health problems or those who suspect that they have potential limitations when it comes to the scope and intensity of physical activity (control of functional, postural and motor status).

Research equipment: The Faculty does not have capital research equipment worth over 50,000 euro. In their research activities, they use small value equipment.

Access policy: In January 2021, the Senate of the University of Bihać adopted an Open Access Policy to Research Infrastructures, which provides detailed information on types of users and access to research infrastructures. This Policy applies to all organisational units of University of Bihać, including Pedagogical Faculty.

I-3.1.4. International University of Sarajevo

- **Research and Development Centre**

Research and Development Centre of the International University of Sarajevo (IUS) is a modern research centre covering the area of 1,300 square meters. The Centre is conducting research activities in the following scientific fields: bioengineering, genetics, chemistry, physics, mechanical and electrical engineering.

The aim of the Centre is to provide good working conditions for research staff and students in their projects, to establish communication and information sharing as well as developing new projects with other research centres, institutions and companies in Bosnia and Herzegovina and beyond.

Services provided: Research (integral part of education), primarily serving the academic needs at the Faculty of Engineering and Natural Sciences programmes, at the International University of Sarajevo; regional and international collaborations with other RIs; scientific workshops.

Research equipment: The University owns single capital research equipment worth over 50,000 euros. A total estimated value of research equipment is 230,000 euro (purchase value was 980,000 euro).

Access Policy: There is no formal access policy. The access to research infrastructure is open and available for everyone.

I-3.1.5. University Sarajevo School of Science and Technology

Sarajevo Medical School

Sarajevo Medical School is conducting research activities within its 5 laboratories:

Laboratory for Medicinal Chemistry and Biochemistry: The Laboratory for Medicinal Chemistry and Biochemistry is equipped with a PCR thermoblock, ELISA test, UV-VIS spectrophotometer and photodetector with UV lamp. In addition to these instruments, the Laboratory has two technical and one analytical scale as well as a microbiological incubator/dryer. The chemicals used for medicinal chemistry, biochemistry, molecular biology and genetics are also stored in this Laboratory together with all adequate glass and plastic containers frequently used in these fields. Along with the chemicals, the Laboratory has MSDS sheets, which serve as instructions for safely storing, handling and disposing of chemicals. The Laboratory contains two separate digestors, a board, refrigerator for storing chemicals, and other equipment necessary for teaching.

Laboratory for Medical Physics and Biophysics: The Laboratory for Medical Physics and Biophysics is used for practical classes in the first and second years of study at the Sarajevo Medical School. The equipment is appropriate for the curriculum of the courses taken by students. Students have the opportunity to conduct experiments which can be directly applied in medicine, dentistry, pharmacy, etc. The Laboratory has some essential equipment sets, such as an optical bench with accessories (lamp, converging and diverging lens, lens holder, etc.), oscilloscope, electric generators, multimeters, callipers, ultrasonic echoscope, test cylinders and blocks for ultrasonic measurements, heart, breast, eye models, etc.

Laboratory for Human Physiology and Immunology: In the Laboratory for Human Physiology and Immunology students learn about the function of the human body, homeostasis, and the integration of different organ systems which make up a whole and contribute to maintaining homeostasis**.**

Practical classes in the Laboratory are organised so that students are given the opportunity to demonstrate and see in practice what they learn in their lectures, and to transform theoretical knowledge into practical clinical skills. Students are taught to handle equipment which is used on a daily basis in clinics and in scientific and medical research, and includes:

a. A standard 12-lead electrocardiograph, used for representing the heart's electrical activity;

b. A dynamometer, used for measuring the force of skeletal muscle contraction;

c. An EKF hemo analyser, useful for providing quantitative hemoglobin results, and other important blood parameters;

d. A spirometer, used for measuring the air capacity of the lungs;

e. Mercury and aneroid sphygmomanometers, used for demonstrating how to measure blood pressure and a pulse meter PM 18 for monitoring the heart rate;

f. Standard stethoscopes, necessary for clinical examinations of the cardiovascular and respiratory systems – auscultation of heart sounds, lung sounds and pathological phenomena;

g. Optical microscopes, for viewing blood cells, behaviour of cells in various solutions etc.;

h. Organ dissection kits, used for demonstrating anatomy relevant for the physiological function;

i. An ELISA reader for immunological analysis;

j. A medical exam bed, and reanimation doll with an interactive ECG simulator;

k. Equipment necessary for neurological examinations: reflex hammer, vibration forks, discriminator, ophtalmoscope, Ishihara tests, medical pen torches, etc.;

l. Equipment necessary for anthropometric measurements: digital scale, measuring tape for measuring waist size and length of extremities, body fat calipers;

m. A glucometer for determining the approximate concentration of glucose in the blood and performing an Oral Glucose Tolerance Test (OGTT).

The Laboratory offers an excellent opportunity for better understanding of physiological mechanisms necessary for the normal functioning of the human body, and is used in the study of medicine, dentistry and pharmacy at the University SSST.

Laboratory for Anatomy: The Laboratory for Anatomy is used for teaching students of medicine, dentistry and pharmacy. The Laboratory contains Van Hagen anatomic models which students use to learn about the fundamentals of anatomy. The plastinates are classified according to anatomic groups and students learn about the anatomic and topographic structure and relations between organs and organ systems through practical and theoretical classes. The Laboratory is also equipped with software for 3D representation of anatomic structures so that students can learn about human anatomy in great detail.

Laboratory for Histology and Embryology: The Laboratory for Histology and Embryology consists of a central microscope used by the lecturer to introduce the students to the shape and arrangement of cells in human tissue, and microscopes for students to independently use, and with the help of the lecturer, learn about histological techniques.

Services provided: The students, academic staff/researchers can conduct their hands-on courses, as well as all experiments and scientific research related to their scientific work (for academia and research), or learning and adapting knowledge guided by their professors or through group or individual work.

Research equipment: The Faculty does not have single capital research equipment worth over 50,000 euros. A total estimated value of research equipment is 240,000 euro (purchase value was 300,000 euro).

Access Policy: The Medical School does not have an official document on Access Policy. The users of this research infrastructure are: researchers, students for their thesis research and practical part for every course they have, collaborators from other institutions. Access is allowed to every student enrolled at the University, precisely at the Sarajevo Medical School, as well as all the professors and assistants included in the teaching process and practical work according to the department's programme.

I-3.1.6. Centre for Development Evaluation and Social Science Research

Following the development of open science and initiatives in the ESFRI, CREDI has developed the Data Archive for Social Sciences in Bosnia and Herzegovina, and established a network of universities and other research institutions with which it cooperates to strengthen research infrastructure in Bosnia and Herzegovina and open access to data and science. The aim of these activities is to promote the principles of open science in Bosnia and Herzegovina, and to contribute to meeting one of the conditions for inclusion in EOSC flows and growing requirements for long-term data storage and reuse (e.g. within Horizon Europe).

CREDI is also involved in two more initiatives. The first is the use of the GDN methodology for Doing Research Assessment (http://gdn.int/doingresearch/methodology) by economy, and the second is the initiative to establish an observatory for COVID-19 and Research Systems (https:// www.inasp.info/ project / covid-19-and-research-systems-observatory).

Data Archive for Social Sciences in Bosnia and Herzegovina

Data Archive for Social Sciences in Bosnia and Herzegovina (DASS-BiH) is the economy-level service whose role is to ensure long-term preservation and dissemination of social science research data. The CREDI has launched the archive with its own funds and with the support of the FairsFair project for obtaining CoreTrustSeal certification, and the support of the MarketMakers project for the purchase of servers and accessories.

The purpose of the data archive is to provide a vital research data resource for researchers, teachers, students, and all other interested users. Data that are collected are those from social science research in following disciplines: economy, education, employment and labour, political science, psychology, sociology, society and culture, social welfare policy and systems.

Services provided: DASS-BiH is authorised to provide the following services to its depositors and users: collection, validation, data conversion, distribution of data collections; administration of network/system specialised in collecting, storing, and distributing data; assuring quality and safety of data collections within data management activities; permanent monitoring of international standards in data management systems and improving infrastructure when needed; mediation between the demand of data users and supply of data providers (contracts for deposit and distribution of data, admission requirements, testing, etc.); customer support; activities related to web portal development and maintenance; providing services to third parties and user training.

Research equipment: The research equipment procured for the implementation of DASS-BiH includes: server, computers and lab furniture, licenses for Stata software, Zoom, Zoiper, Miro, etc. The total value is approximately 20,000 euros.

Access Policy: Procedures to access Data Lab are defined under Data Lab Access Policy. Access to datasets is allowed only to users that fill in the Users' Declaration Form or Users' Request Form. For unrestricted category of datasets, users are only asked to fill in the Users' Declaration Form and are directed towards the download of the dataset. For the restricted access category, users are asked to fill in the Users' Request Form in which they state the reasons that they are seeking the dataset. The request is processed to the data archivist, and every request is assessed separately. Access to the dataset is then allowed through a safe connection environment. If the database cannot be sent directly to the user, he/she can visit the archive premises and access the dataset. In this situation, a user can take only the results produced using the dataset.

I-3.2. Access Policy

The Access Policy refers to the creation of an internal policy document by the owner (host institution) of the RI which clearly defines the rules for authorised physical, remote or virtual access to research equipment for research purposes. The Access Policy should include directions for accessing the research infrastructure for both internal and external users. Through the creation of this policy document, the research infrastructure at the same time defines the services offered to the broad research community, which is an important step towards internationalisation and strengthening of scientific excellence, both within the institution itself and in the economy. It is an important factor in creating greater synergies between researchers in a particular field of science and connecting business and research sectors.

Regarding the current status of this area in the Federation of Bosnia and Herzegovina, it is worth noting that the University of Sarajevo, the University of Bihać, the University of Zenica and the Centre for Development Evaluation and Social Science Research adopted an Open Access Policy to Research Infrastructures, providing detailed information on types of users and access to research infrastructures. The adopted documents on open access policies are the results of the Open Access Research Infrastructure in the Western Balkans Support Programme, supported and implemented by RCC Secretariat in the period from May to December 2020. In addition to the abovementioned institutions, the University of Banja Luka and the University of East Sarajevo also participated in this programme and have adopted an Open Access Policy to Research Infrastructures. However, except the faculties and laboratories within the University of Bihać, it is evident that research institutions/laboratories within the University of Sarajevo still do not have an official access policy.

Research equipment is open for research and teaching staff while access to research infrastructure by external users can be established upon signing an agreement on research cooperation, involvement in joint projects and cooperation contract.

I-3.3. Participation in Large Pan-European RIs and RI projects

Bosnia and Herzegovina is an associate member of the ESFRI. Research institutions from Bosnia and Herzegovina have not participated in large pan-European RIs and have not been included in the ESFRI Roadmap. However, it is important to note that the Council of Ministers of Bosnia and Herzegovina supported the initiative of the Ministry of Civil Affairs for the accession of Bosnia and Herzegovina to the Digital Research Infrastructure for the Arts and Humanities (DARIAH). Bosnia and Herzegovina has officially become a member of DARIAH. The membership will be recorded as of 1st July 2021. University of Sarajevo will be coordinating institutions for the first programme period. In addition to DARIAH, an initiative has been launched to join two more infrastructures: Consortium of European Social Science Data Archives (CESSDA) and European Social Survey (ESS).

Full accession of researchers from Bosnia and Herzegovina to DARIAH-ERIC infrastructure will enable researchers to find and use digital research data from across Europe, to exchange knowledge and research practice in various fields, and to follow the best applicable research standards. DARIAH aims to enhance and support digitally-enabled research and teaching across

the arts and humanities. It is a network of people, expertise, information, knowledge, content, methods, tools and technologies from its participating economies. It develops, maintains and operates an infrastructure in support of ICT-based research practices and sustains researchers in using them to build, analyse and interpret digital resources. By working with communities of practice, DARIAH brings together individual state-of-art digital arts and humanities activities and scales their results to a European level. It preserves, provides access to and disseminates research that stems from these collaborations and ensures that best practices, methodological and technical standards are followed. DARIAH was established as a European Research Infrastructure Consortium (ERIC) in August 2014.

With regards to RIs projects, organisations from the Federation are participating in 2 ongoing H2020 projects aimed at developing research infrastructures. Detailed information on each project is provided below.

Population Health Information Research Infrastructure (PHIRI)

- **Funding Programmes:** H2020
- **Project partners from Bosnia and Herzegovina:** Institute of Public Health of the Federation of Bosnia and Herzegovina (€ 25,000)
- **Total number of partner organisations:** 32
- **Project implementation period:** 1/11/2020 – 31/10/2023
- **Topic:** Mobilisation of Research Infrastructures for the COVID-19 Public Health Emergency

A structured European mechanism for COVID-19 exchange to organise and share information between economies is urgently needed, especially in the area of population health. Information on the broader impacts of COVID-19 on the health of populations is needed to facilitate multidisciplinary European research and underpin decision-making. PHIRI aims to facilitate and support open, interconnected, and data-driven research through the sharing of cross-economy COVID-19 population health information and exchange of best practices related to data collection, curation, processing, use and reuse following ELSI and FAIR principles. It has the objective: to provide a Health Information portal for COVID-19 with FAIR catalogues on health and health care data, to provide structured exchange between economies on COVID-19 best practices and expertise, and to promote interoperability and tackle health information inequalities. To this end, it builds with domestic nodes a Health Information portal on data sources, population health studies, training material and courses, considering ethical and legal aspects.

Religious Studies Infrastructure: tooLs, Experts, conNections and Centres (RESILIENCE)

- **Funding Programmes:** H2020
- **Project partners from Bosnia and Herzegovina: University of Sarajevo** (€ 80,757.50)
- **Total number of partner organisations:** 12
- **Project implementation period:** 1/09/2019 – 31/12/2021
- **Topic:** Preparatory Phase of new ESFRI projects and early phase support to ESFRI high strategic potential areas

RESILIENCE addresses the need of a larger involvement of excellent scholars, producing fertile competencies, new knowledge, fresh approach and visible impact in terms of innovation within the scientific domain of religious studies. Such an involvement has been marked by several steps: a) ReIReS, an emerging community funded by the programme INFRAIA-02-2017-Integrating Activities for Starting Communities; b) the H2020 call Religious diversity in Europe-past, present and future; c) the vast platform of the European Academy of Religion; and d) a first proposal submitted to the ESFRI Forum for a research infrastructure in religious studies, RESILIENCE/0. All these activities created a critical and gravitational mass capable to give effectiveness to the scientific community of religious studies: such an effort was acknowledged in the ESFRI Roadmap 2018 with the definition of religious studies as a high potential strategic area. However, RESILIENCE/0 was accompanied by some remarks concerning its actual weaknesses and potential ambiguities concerning the way the consortium presented itself and some of its partners. The present renewed, improved, enhanced RESILIENCE proposal wants to respond to those remarks and better demonstrate the excellence of a partnership which can prove to be effective; it describes how to achieve an implementation which is feasible and stable; it aims to express the capacity of the infrastructure to attract resources and competences. It will enrich the open science cloud with a series of challenges and opportunities which will preserve and improve the European leadership in the area of religious studies. RESILIENCE creates, selects and tests digital and physical infrastructures capable of generating, preserving and transmitting knowledge between academics, members of religious communities, and the many groups on whom religious studies have a consequential impact.

I-3.4. Research e-Infrastructures

E-infrastructures refer to distributed networks, computers, storage devices, software and other support operations which facilitate the collaboration among research communities by sharing resources, analysis tools and data. The functioning of modern research systems is inconceivable without a strong support of e-infrastructures. The importance of e-infrastructure is also emphasised by the European Commission. As stated by the European Commission, e-Infrastructures are key in future development of research infrastructures, as activities go increasingly online and produce vast amounts of data. E-Infrastructures enable and support the circulation of knowledge in Europe online and therefore constitute an essential building block for the ERA. Core European e-Infrastructure for large-scale e-Science research consists of the backbone GÉANT network; distributed storage & computing infrastructure-European Grid Initiative (EGI); and the PRACE initiative providing tier-0 High Performance Computing (HPC) infrastructure.

The current level of e-infrastructure development in Bosnia and Herzegovina is not at a satisfactory level. Unlike other Western Balkan economies, Bosnia and Herzegovina has not been involved in South-East European e-Infrastructure initiatives aimed at equal participation of the less-resourced economies of the region in the development of the public e-infrastructures. These initiatives aim to ensure equal participation of the region in European networking and Grid computing trends. Close collaboration of National Research & Education Networks and National Grid Initiatives in the region was crucial in materialising this vision. Since the Academic and Research Network of Bosnia and Herzegovina has not been operational in the last 20 years, this opportunity has been missed.

I-3.4.1. The Academic and Research Network of Bosnia and Herzegovina

The Academic and Research Network of Bosnia and Herzegovina (BIHARNET) was established in 1998. The founders were: the University of Sarajevo, the University of Banja Luka, the University of Tuzla and the University of Mostar. The project of establishing BIHARNET was implemented by IZUM (Institute of Information Science) from Maribor, Slovenia. However, when the project was finished, the Council of Ministers of Bosnia and Herzegovina did not provide financial resources for continuation of operations. As a result, BIHARNET was shut down at the end of 2000 due to the lack of financial resources.

I-3.4.2. University Tele-Informatics Centre (UTIC)

The University Tele-Informatics Centre (UTIC) is a sub-organisational unit of the University of Sarajevo whose activities combine the needs for the applicative IT support to the University organizational units, integrating educational and business functions of organisational units and linking their computer resources into a unique academic network and service. The academic computer network of the University of Sarajevo was created with the intention of setting up an information communication infrastructure linking Faculties and institutions into the University Unified Computer Network managed by a central node established at the University Telecommunication Centre. Network services are established on servers located in UTIC and used by students and academics of all Faculties.

UTIC carries out non-cyclical training of the UNSA staff on Information Technologies and performs other activities that contribute to fulfilment of its core activity goals, which contribute to better exploitation of human and spatial capacities and the equipment, as well as professional tasks for the needs of the University.

I-3.4.3. COBISS.BA network

The library automatization in Bosnia and Herzegovina started in the early eighties of the last century, and in the 1988, 5 libraries have entered the COBISS system. In the period from 1992 to 1998, the system was not active. In 1998, all public university libraries and other numerous libraries of Bosnia and Herzegovina accepted COBISS. The COBISS.BH system includes 61 libraries (public, faculty and special libraries). It aims to automate all work processes in the library and to follow the requirements of modern library science. The main role of COBISS.BA system is to:

- enable establishment of a unified library and information system of Bosnia and Herzegovina;
- enable establishment of mutual cataloguing, so that they can be accessible to a wide range of users with their own databases and exchange data with libraries from all over the world;
- include public, faculty, and school libraries in the system, thus enriching the mutual database;
- educating library staff;
- continued automation of library processes;
- enable all library users to have online access, both to domestic and foreign libraries;

- create a single database for the purpose of coordinated procurement of publications and development of collections;
- create databases (database of scientists, as well as normative data file);
- harmonise cataloguing rules, etc.

COBISS.net is a network of economies' COBISS systems (Bosnia and Herzegovina, Montenegro, North Macedonia, Slovenia, Serbia, Bulgaria, and Albania). A protocol on the free flow of bibliographic records that are created in autonomous library information systems has been signed. Each national library information system, built on the COBISS platform, is co-created by the economy's COBISS centre and the libraries as members of the system.

There are two systems in Bosnia and Herzegovina, because Republika Srpska decided to establish an autonomous system COBISS.RS in 2013.

E-CRIS System

E-CRIS.BH is the information system on research activities in Bosnia and Herzegovina which is an integral part of the COBISS.BH information system. ECRIS.BH allows users a direct insight into the bibliographies of researchers, research organisations, departments and projects in Bosnia and Herzegovina.

In compliance with the CERIF (Common European Research Information Format) recommendations, the web application E-CRIS was developed at the Institute of Information Science in Maribor (IZUM), which offered it to all users of COBISS applications within the COBISS.Net network free of charge in order to establish as comprehensive as possible register of research and development providers in individual economies. The register is essential for research monitoring and evaluation. Economy's CRIS systems are linked to the COBISS library information systems, thus allowing direct access to the bibliographies of researchers and institutions. economies' E-CRIS systems include interconnected databases comprising data on research organisations, researchers and research projects. Most of the data is in English.

Researchers and institutions have shown great interest in E-CRIS.BH. Unfortunately, the system does not have a regular source of funding, and updating the data is mostly reduced to the work of employees of the National and University Library of Bosnia and Herzegovina and librarians of faculty libraries that are members of the COBISS.BH system.

Currently, the information system on research activity in Bosnia and Herzegovina E-CRIS.BH contains data on 86 research organisations and 2,183 researchers.

I-4. POLICY RECOMMENDATIONS FOR RESEARCH INFRASTRUCTURES IN THE FEDERATION OF BOSNIA AND HERZEGOVINA

As a result of the analysis of current situation of research infrastructures in Federation of Bosnia and Herzegovina, the following policy recommendations are provided with the aim to improve the quality of the existing research infrastructure:

Increase investments in R&D

The gross expenditure on R&D as a percent of GDP is extremely low in Bosnia and Herzegovina. If Bosnia and Herzegovina wishes to catch up with developed economies, the total investments in R&D need to be increased. This could be achieved through reallocations of public budget to R&D and through introducing measures aimed at encouraging private business investments in R&D. Lack of capital research equipment limits more intensive growth of research sector reflected in a low level of excellence in science.

Regarding the financing of research infrastructures, the Federation of Bosnia and Herzegovina should follow a good example of the implemented Modernisation of the University of Bihać project aimed at equipping the higher education institutions at the University of Bihać with modern research and teaching equipment. This project raised the standards of the teaching process and laboratory exercises to a higher level by supporting research laboratories operating within the University with the state-of-art research instruments and equipment.

Make distinction between teaching and research activities-enable higher engagement of teaching staff in research activities

The university teachers are mainly engaged in education activities, often in several higher-education institutions. As a consequence, most of them are not engaged in R&D projects. The Ministries in charge of education and science should encourage the higher level of engagement of teaching staff in research activities. This can be achieved by revising the rulebook on the evaluation of scientific research activities.

Establish conditions for re-launching of BIHARNET

The Council of Ministers of Bosnia and Herzegovina in cooperation with entity ministries in charge of science should provide financial resources for the re-establishment and normal operation of the public academic and research network BIHARNET. By re-establishing BIHARNET, Bosnia and Herzegovina would move closer to EU standards in the integration process. The BIHARNET is important for several reasons: it provides services on the internal and international connectivity of academic research network and educational community and supports their research and educational activities; its role is important in: promoting and disseminating the use of information and communication technologies particularly in the academic and research sector, maintenance and management of the economy's domain system, international representation and membership, etc.

Create a Smart Specialisation Strategy taking into account the research potential identified in RI Roadmap

The Smart Specialisation (S3) process in Bosnia and Herzegovina is currently in preparation, following a decision by the Council of Ministers. In the process of mapping research potential to identify potential priority domains, the RI Roadmap should be considered as an important input. The process of mapping research infrastructures provides the basis for the analysis of research potential and selection of research areas in which Bosnia and Herzegovina has the strongest potential. Therefore, the final selection of S3 priority domains should take into account the research infrastructure potential identified in the RI Roadmap, as an important indicator for deciding on final priorities.

Intensify activities for the participation in DARIAH infrastructure and consider the possibility of participating in other large pan-European infrastructures.

The Council of Ministers of Bosnia and Herzegovina should consider the participation in large pan-European RIs. By enabling researchers to participate in major European RIs, Bosnia and Herzegovina would take an important step towards retaining researchers in the economy. The RI Roadmap is important step towards this initiative. However, further research is needed to identify research infrastructures that are currently a priority.

Having in mind that the Council of Ministers of Bosnia and Herzegovina has already supported the initiative of the Ministry of Civil Affairs for the accession of Bosnia and Herzegovina to the DARIAH-ERIC infrastructure, it is important to continue with this initiative-take the concrete steps necessary to make this initiative a reality.

Improve the legal and policy framework

Analysis of the current legal and policy framework has shown insufficient regulation in the area of R&D in the Federation of Bosnia and Herzegovina. Only a few Cantons have regulated this area, while others do not have legal and policy documents that regulate R&D. In the context of the development of RIs, it is important to clearly define which organisations are considered as scientific research organisations. Additionally, the terms Research Infrastructures and Research Infrastructure Roadmap should be defined within legal and policy documents on the Cantonal and Federation level, or at least in those cantons where key research organisations operate.

Encouraging Open Access to RI

As a result of the Open Access Research Infrastructure in the Western Balkans Support Programme implemented by RCC Secretariat in 2020, the University of Sarajevo, the University of Zenica and the University of Bihać adopted an Open Access Policy to Research Infrastructures. Building on the experience gained in this programme, the Federal Ministry of Education and Science should encourage other research institutions to adopt their own Open Access Policy documents. In order to make RIs transparent and available for a wide range of users, we recommend that the access offered to external users and the rules and mechanisms of access should be included in the selection criteria for the next funding calls to research institutions.

CHAPTER II:
RESEARH INFRASTRUCTURE ROADMAP IN REPUBLIKA SRPSKA

EXECUTIVE SUMMARY II: RI ROADMAP IN REPUBLIKA SRPSKA

The Ministry of Scientific and Technological Development, Higher Education and Information Society is responsible for preparation and implementation of the Research Infrastructure Roadmap in Republika Srpska(RS RI Roadmap).

International cooperation and integration of research and innovation community in Republika Srpska into European Research Area and wider S&T community is legally predefined by the Science Law. The Action Plan for implementation of Scientific and Technological Development Strategy of Republika Srpska 2017-2021:-Knowledge for Development clearly defines that the Research Infrastructures Roadmap needs to be developed in line with the guidelines of the European Strategy Forum on Research Infrastructures (ESFRI) and the relevant investment needs in the economy.

Based on the overview of research infrastructure in Republika Srpska, it can be concluded that there is a potential that needs to be thoroughly investigated in the process of mapping of research infrastructures. The Ministry of Scientific and Technological Development, Higher Education and Information Society invests in research equipment through the Programme for ensuring and maintaining research equipment and space for scientific research. Participation in consortia for research projects financed from the EU sources (FP7, H2020, etc.) is considered as potential RI, particularly if such projects focus on investments in establishment of wider EU platform for integration of research resources in specific fields of science and technology. Republika Srpska has 4 projects implemented under FP7 and H2020 that have been important in the context of the development of research infrastructures in Republika Srpska.

Research Infrastructures Roadmap has to be related to the implementation of other strategic documents in Republika Srpska, primarily the Scientific and Technological Development Strategy of Republika Srpska 2017-2021: Knowledge for Development.

Research Infrastructures Roadmap should be treated as a key strategic document for improvement of scientific and research system in the Republika Srpska and as a tool for identification of research potential in order to direct further development of research infrastructures. The importance of Research Infrastructures Roadmap has multiple benefits:

- Recognition of research infrastructures is one of the basic conditions for enriching the knowledge base, strengthening research capacities, improving the development of all scientific disciplines and accelerating the dynamics of technological progress.
- It encourages institutions to cooperate in planning and implementation of major infrastructure projects of special significance to the entity in order to avoid overlapping and to increase investment efficiency.

- Supported competitive research infrastructures gather excellent researchers and research teams, strengthen their mutual cooperation, improve development of certain research areas, address the economic and social challenges, stimulate innovation, and attract foreign researchers and other users, which significantly contribute to strengthening the internation competitiveness of entity's economy.
- The Research Infrastructures Roadmap provides a framework for improving the model of cooperation that involves the joint use of infrastructure capacities (research space and equipment, knowledge and resources) in order to optimally and efficiently use the existing infrastructure and investments in new research equipment in Republika Srpska.
- Through the adoption of the Research Infrastructures Roadmap, the Ministry of Scientific and Technological Development, Higher Education and Information Society will significantly increase the visibility of entity's infrastructures in order to be visible and transparent to potential users who should be able to draw benefits from such an access to infrastructure.
- Open access to research infrastructures opens up numerous opportunities for cooperation; it becomes apparent to the wider community and reveals the space to assess competitive advantages and complementarities with other infrastructures. This approach also opens up a better chance of fostering interdisciplinarity, international and intersectoral mobility, as well as better use of the EU and other available funds.
- In the context of the preparation of Smart Specialisation Strategy, the mapping of research infrastructures takes an important role, as it provides the framework for analysis of research potential and indicates how key entity infrastructures can influence the strengthening of research and innovation as key elements of regional development. Therefore, the process of mapping Research Infrastructure and presenting the current state of research infrastructure is an important element of the process of preparing a Smart Specialisation Strategy and is the basis for the preparation of future activities of the instruments in this field.
- The Research Infrastructure Roadmap should serve as major instrument for integration of research and innovation community with economy and society of Republika Srpska.

In the process of developing RS RI Roadmap, first step was comprehensive mapping of research infrastructure. The methodology of mapping research infrastructures involves comprehensive questionnaires/interviews to collect a whole range of information. The analysis of data obtained in this way enables optimisation of existing infrastructure, more rational use and future development of planned research infrastructures, and it is also a significant source of information for decision makers, who in this way have an overview and state of the research infrastructures on the basis of which they can plan future investments and strategic directions towards international research infrastructures. The survey questionnaire as well as detailed instructions for launching and conducting survey was developed in summer 2019. Survey was conducted in autumn 2019, and Roadmap was drafted in early winter 2019.

Republika Srpska should work to progress in the process of opening up to the international scientific research community as well as in activities undertaken on the path to integration into the European Research Area (ERA). In order to successfully integrate into the ERA, it is necessary to recognise research infrastructures of strategic importance for the development of Republika Srpska, which have the potential to enable excellent research, encourage interdisciplinarity and foster a service oriented approach to "access to users".

Republika Srpska should ensure transparency of information on the possibilities of cooperation between different research infrastructures. Strengthening macro-regional cooperation in this regard can significantly contribute to saving resources and facilitating implementation of individual tasks during research process. Finally, access to large international infrastructures and cooperation with international research teams contributes to strengthening research capacities and encourages the transfer of knowledge and technology.

The Ministry of Scientific and Technological Development, Higher Education and Information Society should continue the process of establishing the E-CRIS system in Republika Srpska. The establishment of the E-CRIS system will greatly benefit both the Ministry in charge and scientific community and organisations in order to enhance cooperation and promotion at both the entity and international levels.

Republika Srpska should consider options for accessing large European research infrastructures. Supporting international engagement is a smart investment that provides Republika Srpska with access to a much greater range of high quality research infrastructures. This is infrastructure that Republika Srpska alone cannot build but is essential to the research needs of society. Benefits of access to large research infrastructures for researchers and research institutions from Republika Srpska are multiple:

- Capacity building through training and work with experienced researchers and research groups in international infrastructures would enable researchers to be able to transfer acquired knowledge to home economy and other members of the research groups;
- Realisation of a certain stage of the research process that is not possible in the economy due to the lack of appropriate equipment;
- Strengthening of scientific excellence through cooperation with renowned research teams (participation in joint projects, integration of current initiatives, etc.);
- Important for young researchers-scholarships for doctors and postdoctoral students, participation in conferences, workshops.

Republika Srpska should provide stronger support to organisations providing infrastructure support to innovation and research activities. It is particularly important to support opening up new business incubators, innovation centres, as well as to consider establishing Science and Technology Park.

Potential changes of the Scientific and Technological Development Strategy of Republika Srpska or the text of new Strategy should include explicate positioning of the policy and decision-makers towards priorities of Republika Srpska in the area of research and innovation. The precisely defined future priorities should pay particular attention to the position of the Research Infrastructures in Republika Srpska.

Potential future amendments to the Science Law should include separate article(s):

- directly related to the establishment and use of Research Infrastructures Roadmap in Republika Srpska;
- directly related to collection of necessary data, creation of data bases, data and information security and exchange, analysis and statistical treatment – all these in relation to establishment and use of the Research Infrastructures Roadmap in Republika Srpska;

- directly related to integration of the Research Infrastructures Roadmap in Republika Srpska into The European Strategy Forum on Research Infrastructures (ESFRI) Roadmap.

Further public source investments in entity/regional level RIs in Republika Srpska should be clearly planned within and derive from the RS RI Roadmap. These investments should be prioritised as capital investments with adequate support with human, institutional and financial resources. In addition, future investments should be based on results of regular monitoring and evaluation of research and academic sector in Republika Srpska, with identified level of use of RIs and cost-benefit analysis of investments and use of RIs.

II-1. INTRODUCTION

The main aim of this chapter is to present to domestic and international research and innovation community the very first attempt of integrating data and information constituting the RS RI Roadmap.

The next section provides methodological instructions for developing RS RI Roadmap within the framework and conditions of existing research and innovation system in Republika Srpska, followed by the presentation of survey findings and discussion on open access policy as mode of integration of research infrastructures in Republika Srpska into regional and international infrastructure. Finally, the recommendations for adoption and further use of RS RI Roadmap are provided. The survey questionnaire together with detailed instructions for launching and conducting survey and further integration of RIs data are provided in Appendix 2 and 3. Appendix II-1 is a list of capital equipment at purchase price higher than 40,000 BAM as it is provided in collected survey questionnaires.

II-1.1. Implementation of the RS RI Roadmap

Implementation of the RS RI Roadmap must be considered with potential gaps and fits in mind between entity's research and innovation (R&I) priorities and existing RIs:

1. **Identified existing RIs in Republika Srpska, together with centres and laboratories which are to be included in entity's RIs list, belong to entity and/or regional level RIs.**

Recommendation 1: Further public sector investments in entity/regional level should be defined within Smart Specialisation Strategy (S3) of Republika Srpska, following priorities identified within S3, in order to integrate Republika Srpska research and academic sector into the economy of Bosnia and Herzegovina;

2. **Public sector investments in RIs- from budgets of the ministries in charge for research and innovation in Republika Srpska, in general-are in line with entity R&I priorities.**

Recommendation 2: Further public sector investments in entity/regional level RIs in Republikaf Srpska should be clearly planned in accordance with Research Infrastructures Roadmap in Republika Srpska (this document);

3. **Academic Network SARNET could be considered as major RI in Republika Srpska. This is entity RI but at the same time, this network has provided integration of Republika Srpska research and academic sector with the EU and wider research and academic society. Further updates of Research Infrastructures Roadmap in Republika Srpska will provide more information about the support needed through future RIs investments to develop conditions for SARNET to become an integral part of EU research and academic network.**

Recommendation 3: Further public sector investments in major RIs in Republika Srpska should be prioritised as capital investments with adequate support with human, institutional and financial resources;

4. **Identification of the use of and benefits from identified RIs in Republika Srpska, together with centres and laboratories which are to be included in the entity RIs list, must be part of regular monitoring and evaluation of research and academic sector in Republika Srpska.**

Recommendation 4: Further public sector investments in entity/regional level RIs in Republika Srpska should be based on results of regular monitoring and evaluation of research and academic sector in Republika Srpska, with identified level of use of RIs and cost-benefit analysis.

II-2. GUIDELINES FOR THE DEVELOPMENT OF RS RI ROADMAP

II-2.1. Organisation of Overall Research Infrastructures and Legal Framework

Legal framework for research and innovation activities in Republika Srpska

Legal framework for research and innovation activities in Republika Srpska is defined by the Law on Scientific Activities and Technological Development, the so-called Science Law. Using EC definition of Research Infrastructures (RI), the following are findings and conclusions of the analysis of relations between Science Law and Research Infrastructures Roadmap in Republika Srpska, including the relevance and possible influence of Science Law on and legal bases for the development of Research Infrastructures Roadmap in Republika Srpska:

1. **Legal basis for establishment of the RS RI Roadmap is not directly (in word) defined by the Science Law. Nevertheless, all necessary legal elements are already in place and could be used without amendments to the existing Science Law.**

   Recommendation 1: Potential future amendments to the Science Law should include separate article(s) directly related to establishment and use of the RS RI Roadmap.

2. **All institutions, individuals, as well infrastructures, equipment and facilities within S&TD community or for use in research and innovation activities could be subject to the information treatment and retrieval: collection of necessary data, creation of databases, data and information security and exchange, analysis and statistical treatment. Science Law provisions are sufficient for obligatory provision of data and information from S&TD**

community to the Ministry in charge of research and innovation, as well as for data handling and dissemination of information.

Recommendation 2: Potential future amendments to the Science Law should include article(s) directly related to collection of necessary data, creation of data bases, data and information security and exchange, analysis and statistical treatment – all these in relation tn establishment and use of the RS RI Roadmap.

3. **International cooperation and integration of research and innovation community in Republika Srpska into European Research Area and wider S&TD community is legally predefined by the Science Law. Therefore, integration of the RS RI Roadmap into ESFRI Roadmap, although not directly (in word) predefined by the Science Law, is possible and welcome.**

   Recommendation 3: Potential future amendments to the Science Law should include article(s) directly related to integration of the RS RI Roadmap into ESFRI Roadmap.

Findings and Recommendations extracted from the STD Strategy and its Action Plan

The Scientific and Technological Development Strategy of Republika Srpska (hereinafter: Strategy) is the major instrument for planning of research and innovation activities in Republika Srpska. It is defined by the Science Law. The findings and conclusions of the analysis of relations between the Strategy with Action Plan and RS RI Roadmap, including relevance and possible influence of Strategy and its Action Plan on the development and implementation of the RS RI Roadmap are:

1. *Obligation for establishment of the RS RI Roadmap is directly (in word) defined. Objective 5.4: Strengthening administrative capacities in the field of science and technology through the development of human resources and digitisation, includes Measure 5.4.2.: By mid-2018, develop the Research Infrastructures Roadmap in line with the guidelines of the European Strategy Forum on Research Infrastructures (ESFRI) and the relevant investment needs in the economy. Although deadline for implementation of Measure 5.4.2. has already expired, activities on preparation of the RS RI Roadmap were launched in first six months of 2019 and the Research Infrastructures Roadmap in Republika Srpska was adopted by the end of 2019.*

   Recommendation 1: Obligation for establishment of the RS RI Roadmap should be clearly defined in documents such as the Scientific and Technological Development Strategy of Republika Srpska or in the Law on Scientific Activities and Technological Development.

2. *Internationalisation, as well as integration of research and innovation community of Republika Srpska into regional (Western Balkans; Danube region), and European Research Area, is well positioned within the Strategy.*

   Recommendation 2: Finalisation of the RS RI Roadmap could strongly support integration of research and innovation community of Republika Srpska into WBC and ERA.

3. *Incentives for more efficient research and innovation system in Republika Srpska, particularly integration with economy, together with identification of weak links between researchers and industry, are well explored in the Strategy.*

   Recommendation 3: The RS RI Roadmap should serve as a major instrument for integration of research and innovation community with economy and society of Republika Srpska.

R&D institutions in Republika Srpska

According to the Register of R&D institutions in Republika Srpska, there are total of 162 institutions in this sector belonging to 4 types of institutions:

- Public Institutes: 33
- Private Institutes: 60
- Public Universities and Faculties: 38
- Private Universities and Faculties: 31

There are 23 R&D institutions participating in EU projects, i.e. 14.2% out of all R&D organisations in Republika Srpska.

There are several universities in Republika Srpska that are mostly located in three regional centres: Banja Luka, Istočno Sarajevo and Bijeljina. Two public and most important universities in Republika Srpska are:

- University of East Sarajevo
- University of Banja Luka

University of East Sarajevo

University of East Sarajevo, under the name of the University of Sarajevo, Republika Srpska, was established on 14 September 1992 by the decision of the National Assembly of Republika Srpska.

Considerable resources have been invested in modernisation of laboratories and IT equipment, especially in the 7 research centres at the University of East Sarajevo, thus enabling practical application of knowledge and giving impetus to the development of science. The University of East Sarajevo, as a partner or coordinator, has been actively involved in major projects and programmes such as IPA, Erasmus + (including former Tempus programme), Horizon 2020, providing improvement of academic community, exchange of teaching staff and students, volunteering or work abroad, cooperation with industry in order to commercialise innovative products or services, improvement of infrastructure, etc.

The University of East Sarajevo is a member of the European University Association-EUA, Danube Rectors' Conference, Alpe-Adria Rectors' Conference, and the Rectors' Conferences of Bosnia and Herzegovina and Republika Srpska. Mobility is achieved through CEEPUS programme, Erasmus + programme, strategic programmes of the Ministry of Education and Culture of Republika Srpska,

as well as through bilateral cooperation of certain organisational units with related higher education institutions from abroad.

In the field of international and inter-university cooperation, the University has 55 general cooperation agreements with higher education institutions in the economy, region, Europe and the world, as well as 119 special agreements defining the cooperation of organisational units with related universities, commercial enterprises, institutes and agencies.

It consists of 17 faculties: Academy of Fine Arts, Faculty of Orthodox Theology, Faculty of Economics-Pale, Faculty of Economics – Brčko, Faculty of Electrical Engineering, Faculty of Philosophy, Faculty of Physical Education and Sport, Faculty of Business and Economics, Production and Management Faculty, Faculty of Mechanical Engineering, Academy of Music, Faculty of Medicine, Faculty of Pedagogy, Faculty of Agriculture, Faculty of Law, Faculty of Transport and Traffic Engineering, Faculty of Technology.

University of Banja Luka

University of Banja Luka was established in 1975. It consists of seventeen faculties and one Institute: Academy of Arts, Faculty of Architecture and Civil Engineering, Faculty of Economics, Faculty of Electrical Engineering, Faculty of Mechanical Engineering, Faculty of Philology, Faculty of Political Sciences, Faculty of Mine Engineering, Faculty of Agriculture, Faculty of Law, Faculty of Natural Sciences and Mathematics, Faculty of Technology, Faculty of Physical Education and Sport, Faculty of Philosophy and Faculty of Forestry, Faculty of Security Sciences, and Institute for Genetic Resources.

The University of Banja Luka has 52 licensed study programmes. There are around 600 professors, 400 assistants and 450 administrative staff members currently employed at the University. At present there are around 17000 students at the University. As of 1st January 2008 the University of Banja Luka is integrated with faculties as organisational units. The Steering Board, Senate and Rector govern the University. The Rector legally represents the University. There are four Vice-Rectors (in charge of: research and scientific work, international relations, teaching and student issues and human resources). It is a public university, and therefore the main source of funding is provided by the Government of Republika Srpska.

The equipment and facilities are situated at the respective faculties. Some units have well equipped laboratories; however there is a need for further development. The University has development plans; however these cannot be implemented using only own resources. That is the reason the University has been active in many different projects.

Supporting research infrastructures in Republika Srpska

The only institution whose aim is to support research and innovation initiatives in Republika Srpska is the Innovation Centre Banja Luka. There are no other supporting institutions like incubators, science and technology parks, etc.

The Innovation Centre Banja Luka (ICBL) focuses on support to and development of entrepreneurship in Republika Srpska, with the purpose of developing knowledge-based

enterprises and applying innovative and advanced technologies. ICBL is the first modern equipped centre for entrepreneurship support and development in Republika Srpska.

ICBL, in cooperation with accredited companies, educational institutions and experienced specialists, provides professional development services through the delivery of commercial, internationally certified and domestically recognised training courses in the fields of business, information technology, project management, e-education, etc. ICBL uses incubation to provide its users all the necessary elements for successful professional development through a wide range of services.

As one of the founders of the Innovation Centre in Banja Luka, the Ministry of Scientific and Technological Development, Higher Education and Information Society participates in the financing of operational costs and continuously works on identifying and providing key resources and support to the Centre. Its financial support to ICBL has increased by 25% in the period from 2012 to 2018.

II-2.2. Research e-Infrastructure

The e-Infrastructure provides the framework for all research priorities and is therefore highlighted as a separate unit that precedes the description of the very priorities. It allows researchers access to devices and other resources, regardless of their geographic location. Furthermore, it supports new working methods based on cooperation and partnership of different research units around Republika Srpska.

The e-infrastructures in Republika Srpska are:

- Academic and research network SARNET
- National and University Library of Republika Srpska
- E-CRIS system

1. Academic and research network SARNET

SARNET-Academic and Research Network of Republika Srpska was founded by the Government of Republika Srpska in 2006. SARNET is responsible for the construction, development, maintenance and use of information and communication infrastructure for the needs of higher education and scientific research institutions of Republika Srpska, which will connect them to each other, with related institutions and neighbouring networks and with European and Global Networks. By the Decision of the Government of Republika Srpska of 24 January 2019 the Public Institution SARNET was taken over by the Ministry of Scientific and Technological Development, Higher Education and Information Society.

The Science Law of Republika Srpska has determined that SARNET belongs to the scientific-research infrastructure of general relevance for Republika Srpska.

SARNET should enable improvement and acceleration of the development of higher education and scientific research institutions in Republika Srpska. The main tasks of SARNET include the following:

- construction and development of information and communication infrastructure for science, research and education in Republika Srpska;
- implementation and support to the experimental work of state-of-art equipment and solutions in the field of information and communication technologies (ICT);
- experimental application of ICT in different fields;
- creating conditions for the wider use of ICT in Republika Srpska and Bosnia and Herzegovina;
- creation of appropriate conditions for education, development and employment of domestic staff in the field of ICT;
- overall improvement of domestic information potentials.

2. National and University Library of Republika Srpska

The National and University Library of Republika Srpska (NUB) in Banja Luka is a public institution that unifies three basic functions of its activities: "national", university and city. The unification of the "national", university and city function within the activities of NUB has stipulated that this library is the parent organisation for all libraries in Republika Srpska through its "national" function; is in charge of all public higher education libraries in this entity through its university function; and it is also the parent library for all libraries in the Banja Luka region through its city or public function. NUB performs the library activities through:

- connecting all libraries to the unique information system in Republika Srpska and their inclusion in the global information systems,
- organising and supervising the professional work of parent libraries,
- encouraging and organising cooperation of libraries in Republika Srpska in coordination of procurement, collection, processing, information flows and interlibrary loans,
- co-ordinating the work of libraries performing the roles of library activities and taking care of the purchase of technical equipment for libraries,
- preparation of methodical instructions and norms for the professional operation of libraries.

NUB is also engaged in the following activities:

- keeping a register of libraries,
- keeping a catalogue of library materials,
- providing professional help to libraries,
- supervision of the professional work of libraries,
- care for staff training for performing library activities,
- monitoring and studying the condition, needs and work conditions in libraries,
- proposing measures for improving library activities and their implementation.

3. E-CRIS system

The E-CRIS.RS system includes databases of research organisations, researchers and research projects in Republika Srpska. All databases are interconnected and include English language data. The complete system was implemented with the support of the Institute of Information Science from Maribor, which developed the web application E-CRIS. In order to coordinate all activities related to the implementation of E-CRIS system, E-CRIS Centre is located in the Ministry in charge of science and technology in Republika Srpska.

There are 94 R&D institutions and 1210 researchers registered in E-CRIS.RS system in Republika Srpska.

The CRIS (Current Research Information System) system in Europe is being built and applied for several decades. Due to incompatible methodologies in the past, the integration and widespread use of CRIS systems was prevented in many economies. For this reason, it has been lately working on standardisation on the basis of recommendations related to the CERIF-Common European Research Information Format, which is maintained and developed by EuroCRIS. In accordance with the recommendations of CERIF, the E-CRIS web application developed by the Institute of Information Science in Maribor (IZUM) was provided free of charge to users of COBISS (COBISS-cooperative online bibliographic systems and services) applications in the COBISS.Net network, in order to establish as complete a record of researchers, research organisations and projects as necessary to monitor and evaluate results. Entity CRIS systems are linked to the entity library-information systems COBISS, which allows immediate access to bibliographies of scientific workers and institutions.

II-2.3. Research Infrastructure and Smart Specialisation

In the context of the preparation of Smart Specialisation Strategy, the mapping of research infrastructures takes an important role, as it provides the framework for analysis of research potential and indicates how key entity infrastructures can influence the strengthening of research and innovation as key elements of regional development. Therefore, the process of mapping Research Infrastructures and presenting the current state of research infrastructures is an important element of the process of preparing a Smart Specialisation Strategy and is the basis for preparation of future activities of the instruments in this field.

II-2.4. Cooperation within European Research Area

Republika Srpska should work to progress in the process of opening up to the international scientific research community as well as in activities undertaken on the path to integration into the European Research Area (ERA). In order to successfully integrate into the ERA, it is necessary to recognise research infrastructures of strategic importance for the development of Republika Srpska, which have the potential to enable excellent research, encourage interdisciplinarity and foster a service oriented approach to "access to users".

Republika Srpska should ensure transparency of information on the possibilities of cooperation between different research infrastructures. Strengthening macro-regional cooperation in

this regard can significantly contribute to saving resources and facilitating implementation of individual tasks during research process. Finally, access to large international infrastructures and cooperation with international research teams contributes to strengthening research capacities and encourages the transfer of knowledge and technology.

II-2.5. Financing Research Infrastructure

Investments in research equipment

The Ministry of Scientific and Technological Development, Higher Education and Information Society is supporting research institutions through the Programme for ensuring and maintaining research equipment and space for scientific research. In total, 45 different research institutions received financial support for research equipment in the period from 2010 to 2018. Table 1 shows the first 16 research institutions that have received at least 40,000 BAM in the period 2010-2018

Research Institution	Total received Amount (BAM) in period 2010-2018
Faculty of Agriculture, University of Banja Luka	129,500
Faculty of Electrical Engineering, University of Banja Luka	123,600
Academy of Sciences and Arts of Republika Srpska	92,000
Faculty of Electrical Engineering, University of East Sarajevo	91,300
Faculty of Natural Sciences and Mathematics, University of Banja Luka	88,500
Institute of Genetic Resources, University of Banja Luka	85,500
Faculty of Technology, University of Banja Luka	77,500
Faculty of Mechanical Engineering, University of East Sarajevo	72,500
Faculty of Medicine, University of Banja Luka	68,000
Agricultural Institute of Republika Srpska	68,000
Faculty of Mechanical Engineering, University of Banja Luka	60,500
Faculty of Technology Zvornik, University of East Sarajevo	57,800
Faculty of Architecture and Construction and Geodesy, University of Banja Luka	52,000
Institute for the Protection of Ecology and Informatics of Republika Srpska	51,900
Faculty of Mining Prijedor, University of Banja Luka	49,000
Faculty of Economics, University of Banja Luka	45,000

Table 1: Research institutions in Republika Srpska that have received financial support for research equipment by the Ministry of Scientific and Technological Development, Higher Education and Information Society in the period 2010-2018

Further public sector investments in entity/regional level RIs in Republika Srpska should be clearly planned within RS RI Roadmap. These investments should be prioritised as capital investments with adequate support with human, institutional and financial resources. In addition, future investments should be based on results of regular monitoring and evaluation of research and academic sector in Republika Srpska, with identified level of use of RIs and cost- benefit analysis of investments and use of RIs.

II-3. OVERVIEW, SITUATION AND PRIORITIES OF RESEARCH INFRASTRUCTURES IN REPUBLIKA SRPSKA

II-3.1. The process of mapping research infrastructures in RS–ethodological instructions and implementation

The process of lunching the survey and integration of infrastructure data consisted of two steps:

1. Survey launching

Methodological instructions

The entire process of launching and conducting survey was carried out in broad cooperation with the scientific and research community. Ministry of Scientific and Technological Development, Higher Education and Information Society was responsible for lunching and gathering the information from the survey. The process of surveying was complemented with the integration of infrastructure data from other sources – memberships in international research infrastructures organisations, research infrastructures on entity level developed from domestic and EU funds, etc.

The Survey questionnaire contained several sets of questions that served as input for the identification and evaluation of research infrastructures potential. The aim of this questionnaire was to map the research infrastructures in Republika Srpska as the first and indispensable step in the process of designing the Research Infrastructures Roadmap.

The survey questionnaire consisted of 5 sections:

1. **General information**
2. **Data on human resources**
3. **Data on expenditures and funding**
4. **Data on infrastructure and equipment**
5. **Information on access, collaboration and networks**

The questionnaire was filled in for one Research Infrastructure and all data and descriptions were given for the specific infrastructure that was the subject of the questionnaire. The Survey questionnaire is provided in the Appendix 2 of this document.

In addition to the survey questionnaire, detailed instructions for launching and conducting survey, and further integration of infrastructure data is provided in Appendix 3. This guide comprises detailed instructions for web-based or mail-based launching of questionnaire to the research community as well as gathering and necessary data processing and integration of all responses that served as the main input for the selection and mapping of research infrastructures in Republika Srpska.

Implementation

The Ministry of Scientific and Technological Development, Higher Education and Information Society launched mail-based questionnaire to the research community in September 2019, and collection of the replies was completed in mid-November 2019. The following text will present the main findings of the analysis of collected data and information.

2. Selection of infrastructures to be included in the Roadmap

Methodological instructions

After collecting the questionnaires, it was necessary to continue the process through the selection of infrastructures that were to be included in the final Roadmap. Ministry of Scientific and Technological Development, Higher Education and Information Society was responsible for this process as well as for mapping the domestic research infrastructures, planning cooperation with foreign research infrastructures, and monitoring scientific performance resulting from such cooperation. Where it was necessary, external stakeholders were involved in the process of selection of research infrastructures and planning of the Roadmap. In order to select research infrastructures to be included in the Roadmap, evaluation criteria were developed. An evaluation criterion was defined depending on the current state of the Register so as to cover the most important research infrastructures in Republika Srpska.

In order to create the roadmap, a set of criteria are necessary for the classification of RIs operating in Republika Srpska. The list of RIs to be included in the Roadmap might be too heterogeneous. So, their classification were based on and justified according to the following selection criteria:

- **Open access and capacity – provides access to any domestic and international research community subject to the availability of capacities; open to industrial cooperation (for a fee); able to provide and operate the services necessary for open use (number of cooperation agreements).**
- **International connection – maintains and is actively involved in actual international research cooperation; able to host foreign researchers; and able to participate in international research projects (number of international research infrastructure cooperation agreements generated by the research infrastructure).**

- **Uniqueness, scientific excellence – outstanding technology level and associated expertise makes it comparable with the relevant European RIs (number of publications and patents authored together with external researchers, broken down by research institution).**
- **Strategic importance – has scientific importance for at least the domestic research community (number of researchers served, including PhD students).**
- **Room for further development – keeps abreast of new development trends; has the potential of adapting and developing further technologies.**
- **Purchase price of capital equipment – select only capital equipment valued more than specific value (only capital equipment with purchase prices higher than 20,000.00 eur).**

Implementation

The key criterion for the selection of equipment included in this document was the price of the equipment at its acquisition. It was decided to include only equipment that cost at least 40,000 KM in the Research Infrastructures Roadmap of Republika Srpska.

II-3.2. Analysis of the existing research infrastructures in RS

The questionnaire for providing data and information about existing research infrastructures was sent to all institutions of the SR (scientific research) and RD (research and development) sector in Republika Srpska. The responses are illustrated in Table 2. It is indicative that only about 16% of registered scientific research organisations (institutes and faculties) stated that they had equipment relevant to the roadmap. This is a key fact that limits the scope of this document-Research Infrastructures Roadmap, and indicates the need to introduce a legal obligation for all registered SROs (scientific research organisations) to provide the information necessary to update the comprehensive document Research Infrastructures Roadmap.

SRO (scientific research organisations)	Registered	Completed the questionnaire	SRO with equipment relevant to the roadmap	% SRO with equipment relevant to the roadmap	Equipment worth more than 40,000 KM
Public institutes	33	5	4	80%	29
Private institutes	60	4	3	75%	15
Public faculties	38	28	17	60.71%	126
UBL-University of Banja Luka		18	11		60
UIS- University of Ist Sarajevo		10	6		58
Private faculties	31	4	1	25%	1
Specific infrastructures (e-infrastructure: SARNET)	1	1	1	100%	1
Total	**163**	**42**	**26**	**61.90% (15.92% registered SRO)**	**172**

Table 2: Statistics on completing the Research Infrastructure Questionnaire in Republika Srpska

Table 3 illustrates the thematic purpose and type of the Research Infrastructures in Republika Srpska. The highest number of SROs that reported equipment relevant to the Research Infrastructures Roadmap were in the fields of "Physical Sciences and Engineering", followed by "Health and Food Sciences" and "Environment". Consequently, the distribution of equipment worth KM 40,000 is the same. Most SROs are "single-site facilities" type, with relatively few "mobile facilities" and "distributed facilities", and only two are "virtual facilities".

Thematic categorisation of research infrastructures	Number of SRO			Total number of SRO	Equipment worth more than 40,000 KM			Total Equipment
	Institutes	Faculties	Spec. Inf.		Institutes	Faculties	Spec. Inf.	
1. Energy	1	3		**4**	15	7		**22**
2. Environment	4	6		**10**	23	12		**35**
3. Health and Food Sciences	2	11			19	48		**67**
4. Physical Sciences and Engineering	1	16		**17**	10	108		**128**
5. Social and Cultural innovation	2	3		**5**	2	7		**9**
6. e-infrastructures	1	2		**3**	1	6	1	**8**
Type of research infrastructures								
1. single-site facilities	6	28		**34**	34	126		**160**
2. distributed facilities	2	2	1	**5**	15	6	1	**22**
3. mobile facilities	2	5		**7**	14	11		**25**
4. virtual facilities	1	1		**2**	1	1		**2**

Table 3: Research infrastructures in Republika Srpska by thematic categorisation and type

Table 4 lists data on staff employed at the SROs, who reported to the Ministry on the equipment relevant to the roadmap of the research infrastructures in Republika Srpska. A total of 1458 employees are employed in these SROs, of which 766 are researchers, 250 are associates and 185 are technical staff.

SRO employees	Institutes	Faculties	Spec.Inf.	Total
Researchers	73	693		**766**
Professional associates	52	198		**250**
Technical staff	67	116	2	**185**
Management staff	7	47	1	**55**
Other staff (support staff)	61	141		**202**
Total number of employees	**260**	**1195**	**3**	**1458**

Table 4: Employees of the SRO that has research infrastructure in Republika Srpska

Table 5 illustrates the value of equipment in the SROs reported by the Ministry regarding equipment relevant to the RS RI Roadmap. Data on the percentage of depreciation of this equipment (54.19%) is indicative of planning new procurement and providing the necessary funds for investments in planned procurement, which were reported by almost all SROs analysed

Value of equipment (KM	Purchase value of equipment (KM)	Current value (KM)	Depreciation (%)
Institutes	10.879.971	6.217.066	42.86%
Faculties	24.502.911	10.070.476	58.90%
Specific infrastructures	1.020.082	390.095	61.76%
Total	**36.402.964**	**16.677.637**	**54.19%**

Table 5: Value of equipment in research infrastructures in Republika Srpska

The LIST OF CAPITAL EQUIPMENT AT PURCHASE PRICE HIGHER THAN 40,000 BAM is provided in Appendix II-1 of this document. The following data and information are extracted from the established database of existing research infrastructures in Republika Srpska:

- Name of SRO
- Place
- Address
- Website
- Thematic categorisation of research infrastructures: ON1, ON2, ON3, ON4, ON5, ON6
- Type of research infrastructures: T1, T2, T3, T4
- Name of individual equipment
- Purchase value of equipment (KM) (related individual equipment)
- Year of purchase (related individual equipment)
- Estimated duration of equipment (in years) (related individual equipment)
- Estimated number of users annually (related individual equipment)
- Access policies and procedures for users of research infrastructure

II-3.3. Priorities in Developing Research Infrastructures in Republika Srpska

The Scientific and Technological Development Strategy of Republika Srpska (hereinafter: Strategy) is the major instrument for planning of research and innovation activities in Republika Srpska. The National Assembly of Republika Srpska, at its 18th Session of 27 April 2017, adopted the Science and Technology Development Strategy of Republika Srpska 2017–2021: Knowledge for Development (hereinafter: Strategy).

After adoption of the Strategy, the Government has adopted an Action Plan, developed by the Ministry in charge of Strategy implementation in accordance with the Science Law (Article 15, paragraph 2). This Action Plan includes:

- 6 strategic objectives,
- 28 sub-targets,
- 75 measures,
- performance indicators,
- deadlines for the attainment of goals, and
- competent institutions / organisations obliged for Strategy implementation.

Analysis of the Strategy in search for priorities of Republika Srpska in the area of Research and Innovation lead the team of experts to the conclusion that there are NO precisely/directly (in word) defined R&I priorities. Instead, this document has defined:

- Six key challenges in research and innovation in Republika Srpska;
- Six goals-objectives in Republika Srpska which should be attained in research and innovation;
- Compliance with six ERA priorities; and

Analysis of attainment of the five objectives of the former Strategy is provided at the beginning of document.

Six key challenges in research and innovation in Republika Srpska are:

- Human resources;
- Participation in international cooperation programmes;
- Scientific productivity;
- Investments in research and development;
- Innovation;
- Smart specialisation – priority areas defined for smart specialisation are those already selected for sectoral policies:
  - ICT,
  - Energy,

- Food production,
- Creative economy.

The main goal of Republika Srpska in the field of science and innovation for the period 2017-2021 is: significant improving of the efficiency and effectiveness of scientific and innovation system. Six particular objectives in Republika Srpska which should be attained in research and innovation in this period, defined by the Strategy, are:

- Objective 1: Stimulating the scientific and research quality and excellence;
- Objective 2: Stimulating internationalisation of science and innovation;
- Objective 3: Stimulating cooperation between the research and innovation community with the economy;
- Objective 4: Creating conditions for increasing the budgetary allocation for science and innovation;
- Objective 5: Developing human resources in science and innovation;
- Objective 6: Promoting smart specialisation.

The Strategy is in line with the main strategic documents in Republika Srpska, as well as with six ERA priorities:

- Main strategic documents in Republika Srpska:
  - Education Strategy of Republika Srpska for the period 2016-2021,
  - Industrial Strategy of Republika Srpska for the period 2016-2020,
  - Strategy for Development of Small and Medium Enterprises of Republika Srpska 2016-2020,
  - Strategy for encouraging foreign investments in Republika Srpska 2016-2020,
  - Strategic plan for development of agriculture and rural areas of Republika Srpska 2016-2020,
  - Strategy for Forestry Development of Republika Srpska 2011-2021,
  - Regional strategy for research, development and innovation of Western Balkan economies,
  - Danube Region Strategy,
  - Energy Development Strategy of Republika Srpska until 2030,
- Six ERA (European Research Area) priorities:
  - More efficient entity research systems,
  - Optimal transnational cooperation and competition,
  - An open labour market for researchers,
  - Gender equality in research,
  - Optimal circulation, access and transfer of scientific knowledge, including digitisation of the ERA,
  - Open access to research results financed from public funds.

The Strategy has provided very brief analysis of the attainment of the following five objectives of the former Strategy:

- Strengthening social awareness about importance and role of science and technology;
- Developing a favourable environment for research and development;
- Development of human resources;
- Strengthening cooperation and transfer of research results from the scientific research to the economic sector;
- Increasing financial investment in research and development.

Having in mind that, after adoption of the Strategy, the Government adopted an Action Plan, which is elaborated as a plan for attainment of the six particular objectives, it is reasonable to conclude that these six particular objectives are, in fact, **the six priorities of Republika Srpska in the area of research and innovation,** together with **four priority sectors** for involvement of available resources for science and innovation in Republika Srpska, deriving from specific approach to defining new innovation policy using smart specialisation concept and all actions in the area of science and innovation that will be organised in compliance with six ERA priorities.

As conclusion, the six priorities of Republika Srpska in the area of research and innovation are:

- **OBJECTIVE 1: Stimulating the scientific and research quality and excellence;**
- **OBJECTIVE 2: Stimulating internationalisation of science and innovation;**
- **OBJECTIVE 3: Stimulating cooperation between the research and innovation community with the economy;**
- **OBJECTIVE 4: Creating conditions for increasing the budgetary allocation for science and innovation;**
- **OBJECTIVE 5: Developing human resources in science and innovation;**
- **OBJECTIVE 6: Promoting smart specialisation.**

Four priority sectors for involvement of available resources for science and innovation in Republika Srpska are:

- **ICT,**
- **Energy,**
- **Food production,**
- **Creative economy.**

II-4. ACCESS TO RESEARCH INFRASTRUCTURE IN REPUBLIKA SRPSKA

II-4.1. Open access to research infrastructure in RS

According to the European Commission, access refers to the legitimate and authorised physical, remote and virtual admission to, interactions with and use of Research Infrastructures and to services offered by Research Infrastructures to Users. Such access can be granted, amongst others, to machine time, computing resources, software, data, data-communication services, trust and authentication services, sample preparation, archives, collections, the set-up, execution and dismantling of experiments, education and training, expert support and analytical services[3]. Access to research infrastructure is an important factor in creating greater synergies between researchers in a particular field of science and connecting business and research sectors in order to promote the development of research and innovation.

Research infrastructure in Republika Srpska is mostly used for in-house research and educational purposes. The research equipment is available to the users with the prior approval of the Institute's or Faculty management. The access policy is mostly based on the acts regulating the working procedures as well as additional acts, arising from the process of accreditation of certain laboratories.

Access to research equipment at higher education institutions is performed as part of regular teaching, student's research projects and research papers with the presence of a professor or assistant. In most cases it is used for the purposes of domestic and international research projects as well as for doctoral theses. In addition, research equipment and infrastructure is available to other researchers from Republika Srpska. Research equipment is used according to the agreed timing and financial terms. Procedures for users of research infrastructure services are described in internal documents. Research groups intending to use the infrastructure need to provide a description of the activities they wish to undertake, time dynamics, means of providing funds and other information that will enable them to comply with regular activities in the research infrastructure and thus ensure smooth implementation of desired activities.

According to the information gathered through the questionnaire, the following groups of researchers have access to research equipment in Republika Srpska:

- Professors, associates, researchers, junior researchers, students employed in research institution
- Researchers from other institutions, faculties and institutes with the obligation to apply for access to research infrastructure
- Access through scientific research projects, bilateral cooperation projects and exchange programmes. If there is a signed cooperation agreement through the project or staff exchange programmes, users are permitted to use the infrastructure for the duration of the project or exchange programme.
- Through cooperation in the field of education and training

3 https://ec.europa.eu/research/infrastructures/pdf/2016_charterforaccessto-ris.pdf

Institute directors and heads of laboratories approve the ways and use of research equipment in accordance with the internal rules of the institutes and faculties. Access procedures are defined and strictly adhered to, because of the security aspects that must be met.

The users of research infrastructures are mainly researchers from Republika Srpska: research groups within the same research or educational institution; research groups from other institutions in Republika Srpska – faculties, institutes, schools and public institutions and to a lesser extent the business sector. To a much lesser extent, the research infrastructure is used by institutions of Bosnia and Herzegovina: partner research institutes and researchers from business entities.

Access to research equipment for Western Balkans was mainly provided to educational institutions and partner research institutions from Serbia, Croatia and Slovenia. The access is also provided for visiting researchers and within regional education programmes.

II-4.2. Access to regional research infrastructures

Research infrastructures in Republika Srpska are not integrated into pan-European research infrastructures. The only link that the most of research institutions have with regional or European RIs are through collaborative research projects founded within Horizon 2020, Eureka and other programmes. According to the responses gathered through the questionnaire, respondents highlighted the following international associations, projects and infrastructures: International society of soil and geotechnical engineering, International society of rock mechanic, International consortium of landslides, National Initiatives for Open Science in Europe, Global Seed Vault, International Union Forest Research Organisation, and COBISS, etc. One of the most important research infrastructures, Academic and Research Network of Republika Srpska – SARNET, was founded by the Government of Republika Srpska. It is responsible for the construction, development, maintenance and use of information and communication infrastructure for the needs of higher education and scientific research institutions of Republika Srpska. The external connection to the Pan-European Research Network (GÉANT) has been established in cooperation with the Academic Network of Serbia-AMRES.

Access to regional research infrastructures is important for research institutions in Republika Srpska, and more efforts need to be put in place by the Ministry of Scientific and Technological Development, Higher Education and Information Society in order to provide necessary conditions to connect them with regional and European research infrastructures.

II-4.3. Internationalisation and potential for access to EU research infrastructure

Participation of research institutions from Republika Srpska in international projects related to RI development

Participation in consortia for research projects financed from EU sources (FP7, H2020, etc.) could be considered as potential RI, particularly if such projects focus on investments in establishment of wider EU platform for integration of research resources in specific fields of science and

technology. In the process of identifying research institutions from Republika Srpska that have participated in international projects in the field of research infrastructure, several sources have been used. In addition to internal evidence from the Ministry of Scientific and Technological Development, Higher Education and Information Society, the most comprehensive source of information was *RIs Observatory*[4] portal that presents the single entry point for information on H2020 and FP7 projects related to RI development.

According to RIs Observatory, several projects implemented under FP7 and H2020 and important in the context of development of research infrastructures in Republika Srpska in the last 10 years are the following:

1. VRE for regional interdisciplinary communities in Southeast Europe and the Eastern Mediterranean

- **Funding Programmes:** H2020, Dates: 01/10/2015-30/09/2018
- **Research institution from Republika Srpska:** University of Banja Luka
- **Description of the project:** VI-SEEM proposal brings together e-Infrastructures to build capacity and better utilise synergies for an improved service provision within a unified Virtual Research Environment (VRE) for the inter-disciplinary scientific user communities in the combined SEE and EM regions (SEEM). The overall objective is to provide user-friendly integrated e-Infrastructure platform for regional cross-border Scientific Communities in Climatology, Life Sciences, and Cultural Heritage for the SEEM region by linking compute, data, and visualisation resources, as well as services, models, software and tools. This VRE provides the scientists and researchers with the support in full lifecycle of collaborative research: accessing and sharing relevant research data, using it with provided codes and tools to carry out new experiments and simulations on large-scale e-Infrastructures, and producing new knowledge and data-which can be stored and shared in the same VRE. Climatology and Life Science communities are directly relevant for Societal Challenges.

2. SEE-GRID e-Infrastructure for Regional e-Science

- **Funding Programmes:** FP7, Dates: 30/04/2008-30/04/2010
- **Research institution from Republika Srpska:** Faculty of Electrical Engineering in Banja Luka
- **Description of the project:** SEE-GRID-SCI leverages the SEE e-Infrastructure to enable new scientific collaborations among SEE user communities. SEE-GRID-SCI will stimulate widespread integrated e-Infrastructure uptake by new cross-border user groups extending over the region, fostering collaboration and providing advanced capabilities to more researchers, with an emphasis on strategic groups in seismology, meteorology and environmental protection. The initiative thus aims to have a catalytic and structuring effect on a variety of user communities that currently do not directly benefit from the available e-Infrastructures.

4 RIs Observatory (http://observatory.rich2020.eu/rich/) is a single access point to all information on H2020 and FP7 projects related to RI development. The National Contact Points for H2020-RI programme gather, organise and provide access to information on RI projects, their transnational access opportunities, policy issues, stakeholders, national and regional initiatives on RIs, etc. The information covers all participating economies and all thematic fields.

3. EGI-INSPIRE-European Grid Initiative: Integrated Sustainable Pan-European Infrastructure for Researchers in Europe

- **Funding Programmes:** H2020, Dates: 30/04/2010-30/04/2014
- **Research institution from Republika Srpska:** Faculty of Electrical Engineering, University of Banja Luka
- **Description of the project:** The EGI-InSPIRE project continued the transition to a sustainable pan-European e-Infrastructure started in EGEE-III. It sustained support for grids of high-performance and high-throughput computing resources, while seeking to integrate new Distributed Computing Infrastructures (DCIs), i.e. Clouds, SuperComputing, Desktop Grids, etc. as they are required by the European user community. It established a central coordinating organisation, EGI.eu, and supported the staff throughout Europe necessary to integrate and interoperate individual entity-level grid infrastructures. EGI.eu provides a coordinating hub for European DCIs, working to bring existing technologies into a single integrated persistent production infrastructure for researchers within the European Research Area.

4. High-Performance Computing Infrastructure for South East Europe's Research Communities

- **Funding Programmes:** H2020, Dates: 31/08/2010-31/05/2013
- **Research institution from Republika Srpska:** Faculty of Electrical Engineering, University of Banja Luka
- **Description of the project:** HP-SEE focused on a number of strategic actions. First, it linked the existing and upcoming HPC facilities in the region in a common infrastructure, and provided operational solutions for it. As a complementary action, the project established and maintained the GÉANT link for Caucasus. Second, it opened this HPC infrastructure to a wide range of new user communities, including those of less-resourced economies, fostering collaboration and providing advanced capabilities to researchers, with an emphasis on strategic groups in computational physics, chemistry and life sciences. Finally, it ensured establishment of entity-level HPC initiatives, and acted as a SEE bridge for PRACE. In this context, HP-SEE aimed to attract the local political & financial support for long-term sustainable e-Infrastructure. HP-SEE aspires to contribute to the stabilisation and development of South East Europe by overcoming fragmentation in Europe and stimulating e-Infrastructure development and adoption by new virtual research communities, thus enabling collaborative high-quality research across a spectrum of scientific fields.

II-5. POLICY RECOMMENDATION FOR RESEARCH INFRASTRUCTURES IN REPUBLIKA SRPSKA

Important part of the RS RI Roadmap is policy recommendations for decision / policy makers with activities, instruments and procedures necessary for adoption and successful implementation of RS RI Roadmap:

Policy Recommendation 1:

The Ministry of Scientific and Technological Development, Higher Education and Information Society is responsible for preparation and implementation of the RS RI Roadmap.

RS RI Roadmap should be treated as a key strategic document for improvement of scientific and research system in Republika Srpska and as a tool for the identification of research potential in order to direct further development of research infrastructures. The importance of RS RI Roadmap has multiple benefits:

- Recognition of importance of research infrastructures is one of the basic conditions for enriching the knowledge base, strengthening research capacities, improving the development of all scientific disciplines and accelerating the dynamics of technological progress;
- It encourages institutions to cooperate in planning and implementation of major infrastructural projects of strategic relevance in order to avoid overlapping and to increase investment efficiency;
- Supported competitive research infrastructures gather excellent researchers and research teams, strengthen their mutual cooperation, improve development of certain research areas, address the economic and social challenges, stimulate innovation, attract foreign researchers and others users, which significantly contributes to strengthening the international competitiveness of the entity's economy;
- It provides a framework for improving the model of cooperation that involves the joint use of infrastructural capacities (research space and equipment, knowledge and resources) in order to optimally and efficiently use the existing infrastructures and investments in new research equipment in Republika Srpska;
- Through the adoption of the RS RI Roadmap, the Ministry of Scientific and Technological Development, Higher Education and Information Society will significantly increase the visibility of entity's infrastructures in order to be visible and transparent to potential users who should be able to draw benefits from such an access to infrastructures;
- Open access to research infrastructures opens up numerous opportunities for cooperation; it becomes apparent to the wider community and reveals the space to assess competitive advantages and complementarities with other infrastructures. This approach also opens up a better chance of fostering interdisciplinarity, international and intersectoral mobility, as well as better use of the EU and other available funds;
- In the context of the preparation of Smart Specialisation Strategy, the mapping of research infrastructures takes on an important role, as it provides the framework for analysis of research potential and indicates how key entity-level infrastructures can influence the strengthening of

research and innovation as key elements of regional development. Therefore, the process of mapping Research Infrastructures and presenting the current state of research infrastructures is an important element of the process of preparing a Smart Specialisation Strategy and is the basis for the preparation of future activities of the instruments in this field;

- It should serve as a major instrument for integration of research and innovation community with economy and society of Republika Srpska.

Policy Recommendation 2:

Republika Srpska should work to progress in the process of opening up to the international scientific research community as well as in activities undertaken on the path to integration into the European Research Area (ERA). In order to successfully integrate into the ERA, it is necessary to recognise research infrastructures of strategic importance for development of Republika Srpska, which have the potential to enable excellent research, encourage interdisciplinarity and foster a service oriented approach to "access to users".

Republika Srpska should ensure transparency of information on the possibilities of cooperation between different regional research infrastructures. Strengthening macro-regional cooperation in this regard can significantly contribute to saving resources and facilitating implementation of individual tasks during research process. Finally, access to large international infrastructures and cooperation with international research teams contributes to strengthening research capacities and encourages the transfer of knowledge and technology.

Policy Recommendation 3:

The Ministry of Scientific and Technological Development, Higher Education and Information Society should continue the process of establishing the E-CRIS system in Republika Srpska. The establishment of E-CRIS system will greatly benefit both the Ministry in charge and scientific community and organisations in order to enhance cooperation and promotion at both the entity and international levels.

Policy Recommendation 4:

Republika Srpska should consider options for accessing large European research infrastructures. Supporting international engagement is a smart investment that provides Republika Srpska with access to a much greater range of high quality research infrastructures. These are infrastructures that Republika Srpska alone cannot build but are essential to the research needs of the society. Benefits of access to large research infrastructures for researchers and research institutions from Republika Srpska are multiple:

- Capacity building through training and work with experienced researchers and research groups in international infrastructures would enable researchers to be able to transfer acquired knowledge to home economy and other members of the research groups;

- Realisation of a certain stage of the research process that is not possible in the economy due to the lack of appropriate equipment;
- Strengthening of scientific excellence through cooperation with renowned research teams (participation in joint projects, integration of current initiatives, etc.);
- Perspective for young researchers-scholarships for doctors and postdoctoral students, participation in conferences, workshops.

Policy Recommendation 5:

Republika Srpska should provide stronger support to organisations providing infrastructures support to innovation and research activities. It is particularly important to support opening up new business incubators, innovation centres, as well as to consider establishing Science and Technology Park.

Policy Recommendation 6:

Potenial changes of the Scientific and Technological Development Strategy of Republika Srpska or the text of new Strategy should include explicate positioning of the policy and decision makers toward priorities of Republika Srpska in the area of research and innovation. The precisely defined future priorities should pay particular attention to the position of the Research Infrastructures in Republika Srpska.

Policy Recommendation 7:

Potential future amendments to the Science Law should include separate article(s):

- Directly related to establishment and use of the RS RI Roadmap;
- Directly related to collection of necessary data, creation of databases, data and information security and exchange, analysis and statistical treatment – all these in relation to establishment and use of the RS RI Roadmap;
- Directly related to integration of the RS RI Roadmap into ESFRI Roadmap.

Policy Recommendation 8:

Further public sector investments in entity level RIs in Republika Srpska should be clearly planned according to RS RI Roadmap. These investments should be prioritised as capital investments with adequate support with human, institutional and financial resources. Future investments should be based on the results of regular monitoring and evaluation of research and academic sector in Republika Srpska, with identified level of use of RIs and cost-benefit analysis of investments and use of RIs.

POLICY RECOMMENDATION FOR RESEARCH INFRASTRUCTURES IN BOSNIA AND HERZEGOVINA

Most of previously defined recommendations for RIs in the Federation of BiH and Republika Srpska largely apply to Bosnia and Herzegovina as well. Given the decentralised system and the level of competence for R&D, the text below provides recommendations for RIs related to Bosnia and Herzegovina:

- Consider ways to establish a new research and education network for the entire Bosnia and Herzegovina or re-establish National Research and Education Network (BIHARNET) by leveraging, inter alia, on the existing resources at the entity levels (ex. SARNET). By providing financial resources for normal operations of such a network, Bosnia and Herzegovina would support research and education institutions and provide connectivity and services to universities, research institutes, schools, libraries, museums and other public institutions, including connectivity with GEANT (Bosnia and Herzegovina is the only economy in Europe that is not a member of GEANT).
- Finalisation of the Smart Specialisation Strategy (S3) development process. The S3 in Bosnia and Herzegovina is currently in preparation, following a decision by the Council of Ministers. Given the complexity of the S3 process, it is important that all political actors in charge of research and innovation in Bosnia and Herzegovina are committed to the common goal of finalising the S3 Strategy document. The final selection of S3 priority domains should take into account the research infrastructure potential identified in this document, as an important input for deciding on final priorities.
- Consider the possibility of participating in pan-European RIs. Certain progress in increasing participation in large RIs has already been made. Bosnia and Herzegovina has officially become a member of DARIAH and launched an initiative to join two more RIs: Consortium of European Social Science Data Archives (CESSDA) and European Social Survey (ESS). As an associate member of the ESFRI, Bosnia and Herzegovina should stay on this path and accelerate this process that should enable researchers to participate in large European RIs.
- Support Open Access to RIs. Building on the experience gained in Open Access Research Infrastructure in the Western Balkans Support Programme implemented by RCC Secretariat in 2020, the Council of Ministers in close cooperation with the Federal Ministry of Education and Science and the Ministry of Scientific and Technological Development, Higher Education and Information Society of Republika Srpska should encourage remaining research institutions in Bosnia and Herzegovina to adopt their own Open Access Policy documents.

APPENDIX I-1: LIST OF RESEARCH EQUIPMENT AT THE UNIVERSITIES OF THE FEDERATION OF BOSNIA AND HERZEGOVINA

Institution	No.	Name of research equipment.	Purchase Price (EUR)	Year of Purchase	The source of funds for the purchase of equipment	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Faculty of Electrical Engineering, University of Sarajevo	1	Laboratory model of wind turbine FESTO	53.684,65	2020	**a)** Ministry of Youth, Science and Education of Canton Sarajevo (80%) **b)** Federal Ministry of Science and Education (15%) **c)** Own funds (5%)	20	30
	2	Spitzenberger Spies PD 2190 GV/GSM	75.000,00	2001	Own funds	25	20
	3	Omicron CMC 356: Universal Relay Test Set *76 items, purchase price lower than EUR 50.000, from EUR 138 to EUR 17220*	52.000,00	2001	Own funds	25	30
Faculty of Sports and Physical Education, Sports institute University of Sarajevo	4	Biodex System 3 *4 items, purchase price lower than EUR 50.000, from EUR 3583.13 to EUR 12200*	70.915,03	2006	Own funds	7,7	1500

Institution	No.	Name of research equipment.	Purchase Price (EUR)	Year of Purchase	The source of funds for the purchase of equipment	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Institute for Genetic Engineering and Biotechnology System for experimental research in biotechnology, University of Sarajevo	5	Next generation sequencer (MiniSeq - Illumina)	68.944,00	2020	Resources of other ministries, Own funds	10	50
	6	Genetic analyzer 3500 Series (Applied Biosystems)	111.926,46	2015	Own funds, Resources of the Federal Ministry of Education and Science	10	50
	7	ABI PRISM 310 Genetic Analyzer	55.000,00	2007	Own funds	10	50
	8	Real Time PCR (AB 7300. Applied Biosystems)	50.000,00	2005	Funds from international projects	10	50
Veterinary Faculty, University of Sarajevo	9	Mass spectrometer UPLC MS/MS	300.000,00	2012	International donations	20	10
	10	Liquid Chromatograph HPLC-FLC/ DAD	52.000,00	2011	Funds from international projects	20	10
	11	Liquid proporcional alpha/beta counting system ORTEC	57.000,00	2017	Donations	20	4
	12	HPGe Gamma Spectrometer System with Ultra Low Background Shield *71 item, purchase price lower than EUR 50.000*	71.500,00	2021	IAEA TC Programme	20	4
Laboratory for physical measurements in mechanical engineering, Faculty of Mechanical Engineering, University of Sarajevo	13	SMPS - nanoparticle spectrometer in the air with accompanying equipment	75.000,00	2019	Donations	3	5
	14	Black carbon concentration meter AE33	45.000,00	2019	Donations	5	5
	15	Air sampler with two independent channels	40.000,00	2019	Donations	5	5

Institution	No.	Name of research equipment.	Purchase Price (EUR)	Year of Purchase	The source of funds for the purchase of equipment	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Faculty of Mechanical Engineering, University of Tuzla	16	Energy Systems Laboratory	60.000,00	2008	Public funds	20	150
	17	Common equipment: Laboratory for mechanical structures, Laboratories for reversible engineering and rapid prototyping	75.000,00	2020	Donations	10	200
Faculty of Natural Sciences and Mathematics, University of Tuzla	18	Low-level gamma-ray spectrometry system	74.500,00	2010	Resources of FederalMinistry of Education and Science		15
	19	RadoSys system for radon measurement, AlphaGUARD PQ2000PRO radon monitor system (with AquaKit, AlphaPump, Radon Box i Soil gas set), AlphaE radon monitor	45.500,00	2008	Funds from international projects (IAEA)		15
	20	Laboratory for applied chemistry	56.685,37	2014-2019	Funds from international projects (FP7)		15
	21	Chemistry Department laboratories	50.000,00	2008-today	Funds from international projects (NEWEN) Public resources and Federal Ministry of Education and Science		15
Biotechnical Faculty of the University of Bihać	22	Mass Spectrometry System (Spectomegtry of the core mass) LC/MS/MS – BRUKER	202.307,14	2016	Government of Una-Sana Canton, Project: UNIVERSITY MODERNISATION		4-5
	23	Oil Press Machine – Ölpresse KK100 F/140 F Universal-KERN&KRAFT	162.462,04	2016	Government of Una-Sana Canton, Project: UNIVERSITY MODERNISATION		
	24	Farinograph-E Brabender	67.051,85	2016	Government of Una-Sana Canton, Project: UNIVERSITY MODERNISATION		2-3

Institution	No.	Name of research equipment.	Purchase Price (EUR)	Year of Purchase	The source of funds for the purchase of equipment	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Biotechnical Faculty of the University of Bihać	25	Extensograph-E Brabender	65.651,05	2016	Government of Una-Sana Canton, Project: UNIVERSITY MODERNISATION		2-3
	26	Microwave Reactin System, Anton Par	58.896,07	2016	Government of Una-Sana Canton, Project: UNIVERSITY MODERNISATION		5-6
	27	FT-R Spectrometer, BRUKER, Tensor 27	58.522,52	2016	Government of Una-Sana Canton, Project: UNIVERSITY MODERNISATION		4-5
	28	SoxtecTM 8000-FOSS (Soxlet Instrument-SoxtecTM 8000-FOSS)	49.689,69	2016	Government of Una-Sana Canton, Project: UNIVERSITY MODERNISATION		6-7
	29	DNA Analyser-Agilent 2200 Tape Station System	46.366,66	2016	Government of Una-Sana Canton, Project: UNIVERSITY MODERNISATION		3-4
Technical Faculty of the University of Bihać	30	ZWICK/ROELL Z600	387.476,00	2015	Public resources		
	31	SPEEDCAM MACROVIS	54.986,00	2015	Public resources		
	32	FESTO MPS 500	315.315,00	2015	Public resources		
	33	KUKA	340.691,00	2015	Public resources		
	34	EMCO TEST DuraVision G5	83.198,00	2015	Public resources		
	35	EMCO LINEARMILL 600	593.029,00	2015	Public resources		
	36	EMCO HYPERTURN 45	507.796,00	2015	Public resources		
	37	EMCO LM 1200	69.904,00	2015	Public resources		
Research and Development Centre, International University of Sarajevo	38	Milling and prototyping machine LPFK S104	50.000,00	2020	own funds	10	100

Institution	No.	Name of research equipment.	Purchase Price (EUR)	Year of Purchase	The source of funds for the purchase of equipment	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Faculty of Pharmacy University of Sarajevo	39	Liquid chromatograph (HPLC) with DAD and electrochemical detection	38.644,28	2020	Resources of the Ministry of Education, Science and Youth of Sarajevo Canton	/	12
	40	Gas chromatograph (GC) with thermal conductivity detector and electron capture detector	36.219,89	2008	Funds (from the project: Persistent Pollutants in Rivers in Bosnia and Herzegovina)	/	12
Sarajevo Academy of Performing Arts, University of Sarajevo	41	Camera-AMIRA with additional equipment	41.195,00	2018	Bank loan		100
	42	Camera-ARRI Alexa	37.200,00	2018	University fund		100
	43	Set of objectives Angenieux EZ *39 items, purchase price lower than EUR 50,000, from EUR 240.50 to EUR 41195*	26.584,51		Resources of Federatl Ministry of Education and Science		100
Labs of Department of Energy, Faculty of Mechanical Engineering, University of Sarajevo	44	Laboratory scale counter-flow, direct contact cooling tower	28.205,13	2006	Resources of other ministries	~15	15
	45	Test line for determination of thermal characteristics of flat plate water cooled solar collectors	34.925,00	2003	Resources of the FederalMinistry of Education and Science Funds / International donations	~30	30
	46	Test line for determination of characteristics of hybrid domestic hot water systems	31.000,00	2003	Funds / International donations	~30	30
	47	Equipment for the provision of training services for refrigeration and air conditioning service technicians *21 item, purchase price lower than EUR 50.000*	25.000,00	2015	Funds from international projects	~15	30

Institution	No.	Name of research equipment.	Purchase Price (EUR)	Year of Purchase	The source of funds for the purchase of equipment	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Laboratories of the Department of Process Engineering, Faculty of Mechanical Engineering, University of Sarajevo							
3D scanner Atos Core 200 Faculty of Mechanical Engineering, University of Sarajevo	48	Atos Core 200	35.000,00	2020	own funds	10	15
3D scanner Artec Eva Faculty of Mechanical Engineering, University of Sarajevo	49	3D scenner Artec Eva	13.537,49	2020	Resources of other ministries (Canton Sarajevo)	20	20
Laboratory for testing automotive turbo-compresores (turbochargers) Faculty of Mechanical Engineering, University of Sarajevo	50	Laboratory space infrastructure equipment (air conditioning, ventilation, fire protection, video surveillance, computer equipment, control panel control equipment)	45.000,00	2010	Donation	40	25
	51	Compressor station (Atlas Copco GA 1108 compressor, Atlas Copco compressed air dryer, FD 380, 3 m3 air tank, Festo air pressure regulator, MS12-LR-AGI-PE6.	40.000,00	2010	Donation	20	25
	52	Combustion chamber 1000 ° C with equipment for ignition and control of the combustion process of a mixture of air and diesel fuel, pipelines, solenoid valves, silencers	15.000,00	2010	Donation	20	25

Institution	No.	Name of research equipment.	Purchase Price (EUR)	Year of Purchase	The source of funds for the purchase of equipment	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Laboratory for testing automotive turbo-compresores (turbochargers) Faculty of Mechanical Engineering, University of Sarajevo	53	Equipment for ensuring optimal lubrication conditions of turbochargers (oil tank, lubrication pump, equipment for regulating the operating temperature of lubricant, etc.)	15.000,00	2010	Donation	20	25
	54	Equipment for storage and preparation of fuel necessary for the operation of the combustion chamber (fuel tank, high pressure pump, fuel purification equipment, equipment for measuring the amount of fuel consumed, etc.).	7.000,00	2010	Donation	20	25
	55	Measuring and data acquisition equipment: - temperature measurement (thermocouples for total and static temperature up to 1200 ° C) - pressure measurement (U-pipes, manometers, digital manometers, differential manometers) - flow measurement (measuring apertures, measuring nozzles) - speed measurement (without contact method using inductive encoder) - measurement of oscillations of a rotating turbocharger assembly based on a piezo sensor	22.000,00	2010	Donation	20	25

Institution	No.	Name of research equipment.	Purchase Price (EUR)	Year of Purchase	The source of funds for the purchase of equipment	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Laboratory for wood technologies, Faculty of Mechanical Engineering, University of Sarajevo	56	Universal measuring system (acquisition system)HBM QuantumX MX840B	9.500,00	2020	Funds from international projects	20	20
	57	CNC woodworking centre 4-axis	40.000,00	2020	Funds from international projects	10	10
Laboratory for Mechatronics, Robotics and Automation - LAMRA Faculty of Mechanical Engineering, University of Sarajevo	58	Industrial robots ABB IRB 1600	20.000,00	2009			100 (teaching staff and students)
	59	Flexible manufacturing cell (EMCO F1 milling machine, EMCO Compac 5 Lathe and Industrial robot RV-M1 Mitsubishi)		1991	DC projects-100%		100 (teaching staff and students)
	60	Experimental line for closed-loop pneumatics	14.500,00	2008	**a.** Federal Ministry of Education and Science-100%		100 (teaching staff and students)
	61	Electrohydraulics experimental line	13.750,00	2019. 2020.	**a.** Own funds-93% **b.** Federal Ministry of Education and Science-7%		50 (teaching staff and students)
	62	Mechatronic products (several mobile robots: one with omnidirectional wheels, selfbalansing robot, crawler robot; robot and assembly line, electronic components etc.)	15.500,00	2018. 2019.	**a.** Own funds, **b.** Federal Ministry of Education and Science, **c.** Ministry of Education, Science and Youth of Sarajevo Canton		80 (teaching staff and students)
	63	Mobile robot Robotino	10.000,00	2007. 2012. 2014	**a.** Federal Ministry of Education and Science, **b.** Ministry of Education, Science and Youth of Sarajevo Canton		50 (teaching staff and students)

Institution	No.	Name of research equipment.	Purchase Price (EUR)	Year of Purchase	The source of funds for the purchase of equipment	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Laboratory for Material Removal Machining Processes - LaTOOS Faculty of Mechanical Engineering, University of Sarajevo	64	Experimental line for metallographic testing. It consists of: Abrasive cut-off machines for metallographic samples METACUT 251; Automatic mounting press ECOPRESS 102; Grinding and Polishing Machine FORCIPOL 202; AE2000MET Inverted Trinocular Metallurgical Microscope	29.200,00	2018	**(1)** Faculty of Mechanical Engeneering Sarajevo-50% **(2)** Federal Ministry of Education and Science-35 % **(3)** Ministry of Education, Science and Youth of Sarajevo Canto-15 %		500 (teaching staff and students)
	65	Experimental line for laser beam machining. It consists of two lasers: mini CNC laser STORM 6040 and CNC CO2 140 W laser.	17.100,00	2017. 2019.	**(1)** Faculty of Mechanical Engeneering Sarajevo-80% **(2)** Federal Ministry of Education and Science-20 %		500 (teaching staff and students)
	66	Electro-discharging machine of 25A		1990	DC projects-100%		50 (teaching staff and students)
	67	Measuring equipment: Tool Microscope Mitutoyo TM-505; The Mitutoyo Surftest SJ-210; Infrared Thermometer LS-PLUS)	10.000,00	2013.2014. 2017.	Federal Ministry of Education and Science-100%		500 (teaching staff and students)
Laboratory for additive technologies, Faculty of Mechanical Engineering, University of Sarajevo	68	3D printer: Ultimaker S5 Pro	13.900,00	2020	Donations	10	10
	69	3D printer: Markforged Mark 2	20.000,00	2020	Donations	10	10
	70	3D skener: RangeVision Pro	30.000,00	2020	Donations	10	10

Institution	No.	Name of research equipment.	Purchase Price (EUR)	Year of Purchase	The source of funds for the purchase of equipment	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
Labaratory for testing polymeric materials, Faculty of Mechanical Engineering, University of Sarajevo	71	Shimadzu AGS-X 10kN	19.700,00	2020	Donations		
	72	Ultimaker S5 pro	9.555,00	2020	Donations		
	73	ezAFM+Atomic Force Microscope	15.000,00	2020	Donations	Unlimited	15/yr

APPENDIX II-1: LIST OF RESEARCH EQUIPMENT AT PURCHASE PRICE HIGHER THAN 40,000 BAM IN REPUBLIKA SRPSKA

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
1	Agricultural Institute of Republika Srpska	Banja Luka	http://www.poljinstrs.org/sr-YU/		1	1				1	1			Microchip-based electrophoresis system					
														Genetic analyzer-sequencer with computer	216,119.22	2014.	10	100	
														Real Time PCR with laptop	75,000.00	2014	10	600	
														Freeze-dried lyophilizer	73,683.94	2014.	10	100	
														Gas fat chromatograph with equipment	91,291.55	2008	20	700	
2	Civil Engineering Institute "IG"	Banja Luka	www.institutig.com	1	1		1				1	1		Semi-mobile air quality monitoring laboratory	160,000.00	2009	15	10	The researcher submits a request for access to the research infrastructure. Scientific Council grants access to the research infrastructure in accordance with the available time limits.
														Mobile laboratory for air quality monitoring	143,600.00	2018	15	10	
														Portable gas analyzers for measuring emissions from stationary sources	72,000.00	2019	15	10	
														Steel breaker	143,500.00	2019	10	50	
														Fraste drilling rig	295,406.07	2014	10	10	
														Asphalt analyzer	56,992.00	2019	10	50	

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
2	Civil Engineering Institute "IG"	Banja Luka	www.institutig.com	1	1		1				1	1		Roller compactor	82,669.00	2019	10	50	The researcher submits a request for access to the research infrastructure. Scientific Council grants access to the research infrastructure in accordance with the available time limits
														Wheel tracking apparatus	74,536.00	2019	10	50	
														Gyratory compactor	63,687.00	2019	10	50	
3	Public scientific-research institution Institute for Protection and Ecology of Republika Srpska	Banja Luka	www.institutzei.net		1					1		1		Pollutant emission monitoring equipment	65,963.78	2015	15	50	As a self-financing institution, the use of research infrastructure is approved for a fee based on a written request.
														Portable equipment for testing air quality of the environment and working environment, for basic and specific parameters in the air (Gasmet Dx 4030)	129,519.00	2009	15	200	
														Air quality measuring station	116,923.53	2013	15	300	
														Electromagnetic radiation measuring equipment	68,475.24	2015	10	15 korisnika, preko 500 ispitivanja	
4	IPIN Ltd. Institute	Bijeljina	www.ipininstitut.com		1					1				Geomechanical laboratory	160,000.00	2012			As a self-financing institution, the use of research infrastructure is approved for a fee based on a written request.
														Geophysical laboratory	345,000.00	2012			
														Laboratory for hydrogeology and groundwater remediation	235,000.00	2007			
														Mechanization and field equipment	1,200,000.00	2011			

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
5	**Oikos institute Research centre**	Bijeljina	*www.oikosinstitut.org*					1		1				OJS OPEN JOURNAL SYSTEMS PKP I PUBLIC KNOWLEDGE PROJECT	50,000.00	2019	15	100	The research infrastructure is completely transparent and available on the Institute's website www. oikosinstitut.org Everything that is done is visible on the site. Most of the texts are published in English so that it is available to the wider academic community.
6	**The Andrić Institute**	Višegrad	*http://www.andricevinstitut.org/*					1	1	1			1	Institute Library					Access to the Library of the Andrić Institute is provided to all scientific researchers, students and other interested users whose area of interest coincides with the areas that the Institute itself deals with. Users can directly access the library in the premises of the Institute or to get acquainted with its fund through an electronic catalog within the COBISS. RS database.
7	**Veterinary Institute of Republika Srpska "Dr Vaso Butozan"**	Banja Luka	*www.virs-vb.com*			1				1				Autoklav-MMM medical technology group; I.B.2711	234,000.00	2014	15		The Veterinary Institute is available to anyone who needs the services provided by this institution. The users of the services are producers, farmers, food business entities, inspections, public and private institutions, citizens ... All services are listed in the catalog of services that interested parties can see, choose and request a service according to the valid price list or enter into a contract for a certain period according to which the specific requirements and obligations of the contracting parties are defined.
														Microbiological substrate spill machine-Biotool	49,995.00	2012	10		
														Laboratory dishwasher	90,000.00	2012	7		
														Bactoscan 150X (FOSS Denmark) IB 1156	528,496.21	2004	25		
														Bactoscan 100X (FOSS Denmark) IB 1004	321,412.18	2004	25		
														Combyfoss 200X (FOSS Denmark) IB 1157	490,948.76	2004	25		
														Combyfoss 200X (FOSS Denmark) IB 1005	490,527.64	2004	25		

APPENDIX II-1: LIST OF RESEARCH EQUIPMENTAT PURCHASE PRICE HIGHER THAN 40,000BAM IN REPUBLIKA SRPSKA

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
7	Veterinary Institute of Republika Srpska "Dr Vaso Butozan"	Banja Luka	www.virs-vb.com			1				1				UPLC / GC MS / MS with vacuum pump for LC / -MS / MS and Nitrogen Generator Manufacturer: HEVO TQ MS; 749-9365 R005; NM32LA Label: Waters, Agilent Technologies; Peak Scientific IB: IB 2513	958,298.00	2012	25		The Veterinary Institute is available to anyone who needs the services provided by this institution. The users of the services are producers, farmers, food business entities, inspections, public and private institutions, citizens ... All services are listed in the catalog of services that interested parties can see, choose and request a service according to the valid price list or enter into a contract for a certain period according to which the specific requirements and obligations of the contracting parties are defined.
														Gas Chromatograph (GC) Manufacturer: SCION 456-GC Label: Bruker IB: SB-GC1404F233	55,000.00	2014	10		
														AAS- Graphite technique ,Agilent Technologies IB: IB2544	51,047.20	2012	10		
														FOODSCAN: FOSS, 78800 IB: IB2694	136,139.47	2013	20		
														Liquid chromatograph with UV / VIS detector Manufacturer: InfinityLab LCSeries 1260 Infenty II Quaternery System Tag: Agilent Technologies IB: IB2983	60,216.84	2018	15		
														Invert microscope, Axio Obesrver. A 1, IB. 2790, Carl Zeiss	62,860.38	2014	20		
														Stratagen Mx 3005P, Agilent Technologies, 2133	64,005.77	2009	20		
														Olimpys Bx 40- IB 1292	44,925.96	1996			
														Autoklav oko 205 l 161379	59,275.20	2002	20		
														Autoklav 205 l 161444	54,037.70	2002	20		
														Automatic extractor IB 2321	51,908.49	2010	20		
														Preparation system - IB 2541	43,000.00	2012	10		

APPENDIX II-1: LIST OF RESEARCH EQUIPMENTAT PURCHASE PRICE HIGHER THAN 40,000BAM IN REPUBLIKA SRPSKA

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
8	Faculty of Architecture, Civil Engineering and Geodesy, University of Banja Luka	Banja Luka	http://www.aggf.unibl.org				1			1	1	1		There is no single research equipment worth over 40,000 BAM					The right to access and apply the procedures have all employees of the Faculty of Architecture, Civil Engineering and Geodesy, but also other public universities, as well as individuals and legal entities that have concluded agreements on business-technical and scientific-research cooperation.
9	Faculty of Electrical Engineering, University of Banja Luka	Banja Luka	http://etf.unibl.org				1			1				MULTI FMS learning system	619221.65	2013.	5	10	Access to the research infrastructure is free for teachers, associates and students of the Faculty. Access to the infrastructure can be granted to teachers, associates and students of other organizational units of the University of Banja Luka. Users from this group submit a request to the Dean of the Faculty, who approves the use of the infrastructure on an ad hoc basis. Through scientific research projects, bilateral cooperation projects and exchange programs of scientific research staff and students, access to the infrastructure can be provided to both staff and students from partner institutions. Beneficiaries in this group are allowed to use the infrastructure for the duration of the project or exchange, provided that there is a signed cooperation agreement through the project or staff exchange program. Through lifelong learning programs, the use of infrastructure can be provided to participants in trainings, presentations and seminars. The use of the infrastructure is enabled during the training, presentation or seminar under the conditions defined by a specific training program, presentation or seminar.
														Instrument and control system	46339.48	2013.	5	10	
														Spectrum analyzer	52032.9	2013.	5	10	
														Network analyzer	56588.03	2013.	5	10	
														Spectrum analyzer	77685.57	2013.	5	10	
														Spectrum analyzer	41674.83	2013.	5	10	
														3D scanner Steinbichler Comet L3D 5M	172914.93	2013.	5	10	
														Signal analyzer	196529.62	2013.	5	10	
														Vector signal generator	109784.65	2013.	5	10	
														Digital broadcasting equipment	49920	2018.	5	10	
														General Purpose Graphics Workstations (GPGPU)	89592.93	2018.	5	10	
														Aibotix X6 drone	93378.17	2015.	5	10	

APPENDIX II-1: LIST OF RESEARCH EQUIPMENTAT PURCHASE PRICE HIGHER THAN 40,000BAM IN REPUBLIKA SRPSKA

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
10	Institute of genetic resources, University of Banja Luka	Banja Luka	http://igr.unibl.org/		1	1				1		1		There is no single research equipment worth over 40,000 BAM					Access to research equipment is in accordance with the Rules of Procedure of the Laboratories.
11	Mechanical Faculty, University of Banja Luka													Equipment classified by laboratories					
	B0-07 Laboratory for hydraulics and pneumatics	Banja Luka	http://mf.unibl.org/				1			1				Set of experimental hydraulic components (2 sets)	45 000	2013	15	20	Users of research infrastructure make contact through the Center for Economic Support of the Faculty, the Center for Accredited Laboratories and the Departments of the Faculty.
														Hydraulic unit with pump	41 000	2013	15	30	
														Mobile work station		2013	15	40	
														Elements of proportional pneumatics (2 sets)	42 000	2013	15	10	
														Hydraulic unit	51 000	2018	15	10	
	B0-09 Laboratory for Mechatronics and Robotics													Robot Motoman HP6	70.000,00	2007	15	10	
														Positioner	40.000,00	2008	15	15	
														Flexible system	1.100.000,00	2013	1	30	

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
11	**Mechanical Faculty, University of Banja Luka**													**Equipment classified by laboratories**					
	B0-09 Laboratory for Mechatronics and Robotics	Banja Luka	http://mf.unibl.org/				1			1				Measuring equipment (multimeter digital VC130, hand-held endoscope BS-150XSD, digital oscilloscope VDO 2052, digital force meter 5000N FH 5K, metal beam detector I700, multimeter digital VC840, 4-channel signal recorder, frequency-meter function 8116A, 1956A flux meter) RLC meter 4274A, Quartz Thermometer 2804A, RSA30 vibrator module, spectrum analyzer, 1703A oscilloscope, etc.)	41 000	2010	15	40	Users of research infrastructure make contact through the Center for Economic Support of the Faculty, the Center for Accredited Laboratories and the Departments of the Faculty.
	B0-12 Laboratory for Engines and Vehicles													engine testing device	40000	1990	15	30	
														dynamometer ec 240 kw (power test brake)	140000	2013	15	40	
														8-channel indication equipment	80000	2013	5	10	
	A0-03 Laboratory for Cad and Plm Systems													nc glodalica wf-800	240 000	2010	15	40	
														3d scanner with joint arm	180 000	2013	15	10	
														robot motoman dx-100	70000	2015	15	10	

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
11	Mechanical Faculty, University of Banja Luka													Equipment classified by laboratories					
	B0-11 Laboratory for Plasticity Technology	Banja Luka	http://mf.unibl.org/											old 3d printer	45 000	2005	10	10	Users of research infrastructure make contact through the Center for Economic Support of the Faculty, the Center for Accredited Laboratories and the Departments of the Faculty.
														new 3d printer	62 000	2013	15	10	
														vacuum casting system mk-mini	68 000	2013	5	10	
	A0-10 Cutting Laboratory						1			1				emco pc turn machine	55000	2005	15	150	
														grinder ga4530 720w-115mm	50 000	1990	5	10	
														universal milling machine tos olo mouc	70 000	1990	5	10	
														universal lathe pressure	60000	1990	5	10	
														universal milling machine alg 100	48 000	1990	5	10	
														emco vertical machining center	180 000	2013	15	100	
	B0-10 Welding Laboratory													plasma cutting device	42000	2013	15	10	
														automatic gutter cutter on the tube	32237.62	2018	20	10	
	B0-03 Materials Laboratory													universal roller	20000	2013	15	10	
														device for impact testing	165 000	2013	15	10	

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
12	**Institute for Reproduction of Domestic Animals, Faculty of Agriculture**	Banja Luka	*www.agro.unibl.org*			1				1									Research infrastructure is used for research and educational purposes. The equipment is available to a wider range of users with the prior approval of the Institute's management. Disposal of the equipment implies the full responsibility of each user in terms of proper storage and use of materials and devices.
13	**Institut za ekonomiku poljoprivrede i ruralni razvoj, Faculty of Agriculture**	Banja Luka	*www.agro.unibl.org*			1				1				They do not have single capital equipment worth more than 40,000 BAM					The available research infrastructure is used for research and educational purposes. A certain part of the research infrastructure is available to a wider range of users with prior authorization. Each user is responsible for the correct use of the equipment. The management of the organizational unit approves and is responsible for the maintenance, upgrade and configuration of IT equipment.
14	**Institute of Agroecology and Soil, Faculty of Agriculture**	Banja Luka	*www.agro.unibl.org*		1	1				1				HPLC Agilent with accessories	300000	2015	10	15	The director of the institute and the heads of the laboratories approve the use of the equipment in accordance with the regulations of good laboratory practice and the internal regulations of the institute. Disposal of the equipment implies the full responsibility of each user in terms of proper storage and use of materials and devices.

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
15	Institute of Horticulture, Faculty of Agriculture	Banja Luka	www.agro.unibl.org			1				1				Greenhouse	150.061,15	2005	20	40	Access policy to research infrastructure is based on acts that regulate the work (Rulebook on the work of the institute, Rulebook on the work of the laboratory) as well as additional acts resulting from the accreditation process of certain laboratory. Research groups that want to use the infrastructure need to provide a description of the activities they want to implement, time dynamics, how to provide funds and other information, which will enable compliance with regular activities in the research infrastructure and thus ensure the smooth implementation of activities.
														Nikon Eclipse Ni-E microscope	165,948.26	2013	20	30	
														Nikon Eclipse Ti-U invert microscope with Norman optics	134,132.78	2013	20	30	
16	Institute of Field Crops, Faculty of Agriculture		www.agro.unibl.org			1				1									
17	Institute for Animal Husbandry, Faculty of Agriculture		www.agro.unibl.org			1				1									The existing infrastructure is intended for research work. The laboratories that exist at the Institute of Animal Husbandry have a procedure according to which the equipment is used. The infrastructure is available for scientific-research work with the aim of improving the scientific base in the field of animal husbandry in Republika Srpska.

APPENDIX II-1: LIST OF RESEARCH EQUIPMENTAT PURCHASE PRICE HIGHER THAN 40,000BAM IN REPUBLIKA SRPSKA

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
18	Faculty of Law, University of Banja Luka	Banja Luka	www.pf.unibl.org					1			1								The Faculty of Law provides access to users of research infrastructures in accordance with the European Charter for Access to Research Infrastructures (based on excellence, market-oriented and broad access), depending on the type of users and services provided. Steps are being taken to improve the visibility and wide access to scientific data and services of the Faculty.
19	Faculty of Sciences, University of Banja Luka	Banja Luka	www.pmf.unibl.org	1	1	1	1	1	1	1	1	1	1	Planetarium	70 000	2019	5	10 000	All equipment and the entire research infrastructure is available to staff and students in accordance with internal rules. Competent managers approve specific experiments and supervise the
														GIS software	40 000	2014	10	100	
														GIS laboratory equipment	50 000	2016	10	100	
														Modern microscopes	200 000	2015	10	100	
														Gas-mass chromatograph (GCM)	70 000	2014	10	100	
20	Faculty of Mining, Prijedor	Prijedor	www.rf.unibl.org		1		1			1		1		Laboratory flotation machine "Laarman"	47 894,37	2013	12	45	The equipment is used according to the agreed conditions - time and financial.
														Jaw crusher "Metso morse"	78 980,33	2013	15	45	
														Laboratory mill with balls, micronizing, "Matest"	54 735,86	2013	15	45	

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
21	Faculty of Forestry, University of Banja Luka	Banja Luka	www.sf.unibl.org		1		1			1		1							Users of the research infrastructure of the Faculty of Forestry are representatives of the business sector, ie Public institution Forests of Republika Srpska with their organizational units (forest farms, center for seed and nursery production Doboj, Center for Karst Trebinje). In addition, the beneficiaries are companies, private nurseries, and local governments whose access to equipment, resources and services is defined by contracts signed between the Faculty and the other party. These contracts prescribe the possibility and conditions of access to research infrastructure, depending on the scope of the contracted work, the requirements for the use of research infrastructure, and the duration of activities within the contracted cooperation.
22	Faculty of Technology, University of Banja Luka	Banja Luka	www.tf.unibl.org				1			1				ICP OES spectrophotometer OPTIMA 8000	160 000	2014	15	50	Users of the research infrastructure can find all information about services and activities on the website of the Faculty of Technology. Procedures for users of research structure services are described in internal documents.
														Lambda UV and VIS spectrophotometer 25	60 000	2014	20	80	
														Air quality control station	55 000	2014	15	5	
														Clarus gas chromatograph	65 000	2014	15	10	
														FTIR spectrophotometer	60 000	2014	15	50	
														Calorimeter	70 000	2014	15	40	

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
23	Medical Faculty, University of East Sarajevo	Foča	mef.ues.rs.ba			1				1				Freezer	42302.98	2012	5	50	Research center is managed by Academician Miodrag Colic, who approves the use and access to the infrastructure. The research infrastructure is available to both teachers and students. Research infrastructure is mainly used for the purpose of preparing doctoral dissertations and research projects.
														Olympus binocular microscope	57544.49	2012	5	50	
														Spectrophotometer	131248.96	2012	5	50	
														Rider	44401.5	2018	5	30	
														Fluocitometer	80000	2017	5	30	
24	Faculty of Technology Zvornik, University of East Sarajevo	Zvornik	www.tfzv.ues.rs.ba			1	1			1				ICP-EOS multipurpose emission spectrometer	179470.87	2015	8		Based on the cooperation agreement, the employees of the faculty manage the procedures and access to the research infrastructure
														Gas chromatograph with ECD and FID detector	89735.44	2015	8		
														HPLC system with UV-VIS and FLD detectors	149558.41	2015	8		
														Gas chromatograph with mass detector	149558.41	2015	8		
														Capillary electrophoresis with mass detector	259118.77	2015	8		
														FTIR spectrometry	44868.7	2015	8		
														Farinograf	107682.13	2015	8		
														Extenzograph	100549.22	2015	8		
														Mammography	62815.39	2015	8		
														Food texture analysis device	80531.3	2015	8		
														Stationary spectrophotometer CM-5	62123.03	2015	8		
														Transmission light microscope	276793.11	2012	8		

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
24	Faculty of Technology Zvornik, University of East Sarajevo	Zvornik	www.tfzv.ues.rs.ba			1	1			1				injector	42022.96	2015	8		Based on the cooperation agreement, the employees of the faculty manage the procedures and access to the research infrastructure
														Filler	70421.61	2015	8		
														Frozen meat cutter	48267.93	2015	8		
														System for massage table-tiles	46670.02	2015	8		
														Boiling and smoking chamber	126769.08	2015	8		
														Maturation chamber	42552.99	2015	8		
														Laminator	102697.02	2012	8		
														Modular furnace	80251.24	2012	8		
														Depository for the production of biscuits	84294.9	2012	8		
														Automatic laboratory reactor	230091.66	2015	8		
														Liquid-liquid extraction unit	147258.35	2015	8		
														Absorption column for gas-liquid system	87435.38	2015	8		
														Sprej drajer	79381.27	2015	8		
														Laser particle size distribution analyzer	96637.56	2015	8		
														Heat exchanger	123559.56	2015	8		
														Stationary chamber for cyclic testing	57522.92	2015	8		

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
25	**Photovoltaic power plant, Faculty of Electrical Engineering, University of East Sarajevo**	Istočno Sarajevo	*www.etf.ues.rs.ba*	1						1									Access to the photovoltaic power plant is possible for all teachers and researchers of the University of East Sarajevo, in the presence of a laboratory assistant who is in charge of the proper functioning of the power plant.
26	**Electromagnetics Laboratory, Faculty of Electrical Engineering, University of East Sarajevo**	Istočno Sarajevo	*www.etf.ues.rs.ba*				1			1									Access to Electromagnetics Laboratory is possible for all teachers and researchers of the University of East Sarajevo, in the presence of a laboratory assistant who is in charge of the proper functioning of laboratory equipment.
27	**Laboratory for embedded systems, Faculty of Electrical Engineering, University of East Sarajevo**	Istočno Sarajevo	*www.etf.ues.rs.ba*				1			1				ProtoMat S63 - PCB milling machine with vacuum table and additional materials	72356.71	2012	20	20	The equipment is available to students of the Faculty of Electrical Engineering. Students have the ability to make printed circuit boards, semi-automatic placement of components on printed circuit boards, soldered and assembled printed circuit boards.

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
28	Laboratory for electric machines and electric motor drives, Faculty of Electrical Engineering, University of East Sarajevo	Istočno Sarajevo	www.etf.ues.rs.ba				1			1				Laboratory table for testing electrical machines, with sources of alternating and direct voltage	59999	2012	5	20	Access to the equipment is provided during regular classes, student projects and final papers in the first and second cycle of studies. Within other scientific research activities, access is provided in the presence of experienced researchers. Other researchers also have access to the equipment with the regular approval of the Faculty of Electrical Engineering.
29	Laboratory for Mechatronics and Automation, Faculty of Electrical Engineering, University of East Sarajevo	Istočno Sarajevo	www.etf.ues.rs.ba				1			1				Robotic station	400.000,00	2012	20	15	
														AS-RS station	80,000.00	2012	20	10	
														Conveyor belt	80,000.00	2012	20	20	
														Mill 105, a rodent control computer	400,000.00	2012	20	5	
														TURN 105, computer controlled lathe	400,000.00	2012	20	5	
														Robotic system with MITSUBISHI RV-3SDB robot	460,000.00	2012	20	5	
														MPS PA compact station	108,000.00	2012	20	5	
30	Laboratory for programmable logic controllers, Faculty of Electrical Engineering, University of East Sarajevo	Istočno Sarajevo	www.etf.ues.rs.ba				1			1				Experimental simulator SIMATIC	42000	2012	20	20	The laboratory is open to all students in the I and II cycle of studies and for course participants.
														Pneumatic bending device	75000	2012	20	20	
														Technology station	56000	2012	20	20	

APPENDIX II-1: LIST OF RESEARCH EQUIPMENTAT PURCHASE PRICE HIGHER THAN 40,000BAM IN REPUBLIKA SRPSKA

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
31	**Telecommunications Laboratory, Faculty of Electrical Engineering, University of East Sarajevo**	Istočno Sarajevo	www.etf.ues.rs.ba				1			1				Radio equipment	44886,28	2012	10	50	The users of the research infrastructure are teaching staff and students.
														Other communication equipment	330221.64	2012	10	50	
32	**High Voltage Laboratory, Faculty of Electrical Engineering, University of East Sarajevo**	Istočno Sarajevo	www.etf.ues.rs.ba	1						1				Udarni naponski generator maksimalnog izlaznog napona 500 kV, energije 4,4 kWs	237 790	1975	55	10	All users can have access to the research infrastructure, under commercial conditions. Exceptionally, access to infrastructure can be achieved within research projects, or on the basis of cooperation in the field of education. Access procedures are defined and strictly followed, due to the safety aspects that must be met.
33	**Laboratory for CNC machine tools and CIM systems, Faculty of Mechanical Engineering, University of East Sarajevo**	Istočno Sarajevo	www.maf.ues.rs.ba											EMCO Concept Mill 450 machining center	322.100,09	2012	10		Laboratory open to all students in the I and II cycle of studies and for course participants, teachers and assistants. It is also open to users from other organizational units of the University of East Sarajevo, as well as to users from other universities.
														CNC lathe EMCO Concept Turn 450	267,965.43	2012	10		
														EMCO Concept Mill 250 machining center	217,703.32	2012	10		

APPENDIX II-1: LIST OF RESEARCH EQUIPMENTAT PURCHASE PRICE HIGHER THAN 40,000BAM IN REPUBLIKA SRPSKA

No.	Research institution	Address	Website	ON1	ON2	ON3	ON4	ON5	ON6	T1	T2	T3	T4	Research equipment	Purchase price (BAM)	Year of purchase	Estimated Duration of Equipment (yrs.)	Estimated number of users	Access Policy
34	**Welding and Testing Laboratory, Faculty of Mechanical Engineering, University of East Sarajevo**	Istočno Sarajevo	*www.maf.ues.rs.ba*				1			1				Industrial AC / AD machine for TIG and REL welding process-type MagicWave Comfort 3000	**Total:** 144.563,22	2016	10		Laboratory open to all students in the I and II cycle of studies and for course participants, teachers and assistants. It is also open to users from other organizational units of the University of East Sarajevo, as well as to users from other universities.
														Industrial machine for MIG and MAG welding process-type TransPuls 3200 Synergic		2016	10		
														Portable MMA & TIG welding machine-type TransPocket 1500 TIG		2016	10		
														Plasma cutting device-type PowerMax 45		2016	10		
														Schimatzu universal test machine (ripper)	5. 65.800,00	2015	10		
35	**Independent University of Banja Luka**	Banja Luka	*www.nubl.org*		1			1	1	1			1						
36	**Academic and Research Network-SARNET**	Banja Luka	*jusarnet.net*						1		1								The main users of the Academic and Research Network of Republika Srpska are higher education institutions registered in the Register of managed by the Ministry. The rights and obligations are regulated by the Regulations on the use of services.

APPENDIX 2: SURVEY QUESTIONNAIRE

This survey questionnaire contains several sets of questions that serve as an input for the identification and evaluation of research infrastructures potential in Bosnia and Herzegovina. The aim of the questionnaire is to map the research infrastructure as the first and indispensable step in the process of designing the Research Infrastructure (RI) Roadmap.

According to the definition of European Commission, Research Infrastructures (RI) are facilities that provide resources and services for research communities to conduct research and foster innovation. They include:

- major scientific equipment or sets of instruments;
- collections, archives or scientific data;
- computing systems and communication networks;
- any other research and innovation infrastructure of a unique nature which is open to external users.

Research infrastructures can be centralised, that is, based in a single location. They can also be distributed or virtual, and can form mutually complementary wholes and networks.

Please note that the questionnaire is designed for research centres, laboratories and departments operating within public and private organisations (universities and faculties, public and private research institutes) accredited for research and innovation.

1. General information

1.1. Data about respondent

Full name	
Name of your institution	
Institution's address	
Your position in the institution	
Your email address	
Institution's website address	

1.2. General information about research infrastructure or important research equipment and facilities

1. Name of research infrastructure
2. Host institution
3. Research Infrastructure's address
4. Research infrastructure's website
5. Thematic categorisation of RI by field of science*
6. Type of RI**
7. Main scientific domain
8. Other scientific and technological domains served by RI
9. Total number of RI users
10. Name and position of a person responsible on behalf of research infrastructure:
11. Year of establishment of RI:
12. Founder

Institution(s)	Ownership Share (%)

*Thematic categorisation of RI types by field of science.
The ESFRI sets the following 6 thematic areas:
1. energy;
2. environment;
3. health and food sciences;
4. physical sciences and engineering
5. social and cultural innovation;
6. e-infrastructures

E-Infrastructure for scientific research–provides computing services for the scientific community.

**Four types of RI are commonly distinguished:
1. single-site facilities;
2. distributed facilities;
3. mobile facilities;
4. virtual facilities

1.3. Description of Research Infrastructure. Please provide basic information and objectives of the research infrastructure

1.4. Please list the services provided to research infrastructure users

2. Data on research equipment

2.1. Estimated value of research equipment

Total estimated value of research capital equipment (in EUR):

purchase value: EUR

current value (amortisation): EUR

2.2. List of capital equipment at purchase price higher than EUR 50.000

	Name of research equipment	Purchase Price (EUR)	Year of Purchase	The source of funds for the purchase of equipment	Estimated Duration of Equipment (yrs.)	Estimated Number of Users
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
...						
n						

Please enter only the equipment the purchase value of which is above EUR 50,000.
In the column "The source of funds for the purchase of equipment" please enter the funding source. If there are two or more sources, please indicate each one with the participation share:
a. Own funds
b. Resources of the Federal Ministry of Education and Science
c. Resources of other ministries
d. Public funds
e. Donations
f. Funds from international projects
g. Funds / international donations
h. Other sources - specify which!

3. Information on access, collaboration and impact

3.1. Information on access

Please provide short description of access policy and procedures for users of this research infrastructure.

3.1.1. Information on external users

Users of RI	Please specify the name of Institution, department
Research groups from your economy	
Research groups from Western Balkan economies	
Research groups from EU and other countries	

3.2. Information on cooperation

Please list the international co-operation agreements and partnerships in which this RI has been involved.

3.2.1. Integration into larger RIs

Is RI connected or integrated into larger RIs (international) or is it a member of any European RI?

Yes

No

If yes, please specify the details:

The name of larger RI:

Membership conditions:		
Membership fee, who finances it:	Active	Joined
Additional information:		

3.3. Engagement in projects related to research infrastructure development

Have you been engaged in a project aiming at the development of research infrastructure?

Yes

No

If yes, please specify the details:

Title of the project:	
Time duration:	
Link to web address:	

Please add new rows if necessary.

3.4. Plan for the Future

Please describe in detail the plan for the next period, at least for 2-5 years:

Future investments in research equipment:	
Is integration into larger research infrastructures considered:	
Other relevant information:	

APPENDIX 3: DETAILED INSTRUCTIONS FOR COMPLETING THE SURVEY

The entire process of launching and conducting survey needs to be carried out in broad cooperation with the scientific and research community. The process of surveying need to be complemented with the integration of infrastructure data from other sources i.e. memberships in international research infrastructure organisations, research infrastructures on economy level developed from domestic and EU funds etc.

The text below provides detailed instructions for completing survey questionnaire.

The survey questionnaire consists of 3 sections:

1. General information
2. Data on infrastructure and equipment
3. Information on Access, Collaboration and Networks

The questionnaire should be filled in for one research infrastructure and all data and descriptions should be given for the specific infrastructure that is subject of the questionnaire. Detailed instructions for completing the questionnaire are provided in the text below.

Instructions for completing Part 1: General information: Tables 1.1., 1.2., 1.3., 1.4.

Table 1.1. should include the main information about respondent. The second Table 1.2 refers to the general information about research infrastructure which is the main focus of the questionnaire.

In the field "Thematic categorisation of RI types by field of science", research infrastructure should be grouped thematically. The ESFRI Roadmap 2016 sets the following 6 thematic areas:

1. energy;
2. environment;
3. health and food sciences;
4. physical sciences and engineering
5. social and cultural innovation;
6. e-infrastructures.

Research infrastructures should be linked to one of these defined categories.

In the next field "Type of RI", there are four types of RI that are commonly distinguished:

1. Single-site facilities;
2. distributed facilities;
3. mobile facilities;
4. virtual facilities.

Each research infrastructure should belong to one of these 4 types.

Table 1.3. should provide a detailed description of research infrastructure (general information on research infrastructure) and it's main purpose and objectives.

Table 1.4. should specify and explain specific research services provided to users and external researchers. It is necessary to list the services available to researchers that the research infrastructure offers.

Instructions for completing Table 2.1:

Total value of research equipment used within the research infrastructure should be entered in Table 2.1. It is important to enter two types of values: the purchase value and the current value which takes into account the depreciation of equipment.

Instructions for completing Table 2.2:

Table 2.2 should lit only capital research equipment at purchase price higher than EUR 50,000.

Funding sources should be entered in the column "The source of funds for the purchase of equipment" funding source should be entered. If there are two or more funding sources, each one should be indicated with the participation share. One of the following funding sources should be inserted:

- Own funds
- Resources ofFederal Ministry of Education and Science
- Resources of other ministries
- Public funds from Bosnia and Herzegovina
- Donations
- Funds from international projects
- Funds / international donations
- Other sources - specify which!

Instructions for section 3: Information on Access, Collaboration and Impact

Section 3 consists of 4 open questions and sub-questions and it requires information on access, collaboration and impact of research infrastructure.

Instructions for completing section 3.1.

Short description of access policy and procedures for users of research infrastructure should be provided in section 3.1. If there is no official access policy, please describe internal procedures that are being used. In addition, the estimated number of users of research infrastructure should be also inserted since that it is very important information for determining the importance of the selected research infrastructure for the research community at the economy and international level. All external organisations and institutions that used research equipment provided by research infrastructure so far should be listed in section 3.1.1.

Instructions for completing section 3.2.

Recognition of research infrastructure and scientific impact on the international level should be emphasised in the sections 3.2 and 3.3 of this questionnaire. This information is of particular interest for determining the relevance of research infrastructure on an international level.

Information on cooperation with other research institutions is important for determining the relevance of research infrastructure as well as the level of interaction with other actors in the research community. In section 3.2, all international research projects, partnerships or agreements that the research infrastructure has been involved in the last 10 years should be listed. Please note that only research projects that included the use of research equipment should be inserted. Information on the potential integration into international or pan-European research infrastructures should be provided, if there is any, in 3.2.1.

Instructions for completing section 3.3.

The section 3.3 refers to the engagement in research projects (H2020, FP7, other programmes) which aimed at establishing research infrastructures on economy or international level.

Instructions for completing section 3.4.

The last section (3.4.) refers to future plan of RI management. The respondent needs to briefly specify the future investment, integration into wider RI and other relevant information as considered important.

good.
better.
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