THE SPANISH ROADMAP FOR THE EUROPEAN RESEARCH AREA DEVELOPMENT 2016-2020

1. INTRODUCTION

The European Research Area (hereinafter, ERA) was integrated to the Lisbon Treaty in 2007 (Article 179[1]) as key to strengthen research and innovation capacities in Europe and its Member States. Its development needs commitment from all stakeholders, i.e.: the European Commission, the Member States, all the responsible agents for the implementation of Research, Development and Innovation (RDI) activities, including institutions and the scientific community itself.

ERA, conceived as a common area where there no barriers to the movement of researchers and knowledge, is closely linked to RDI policies. It aims to foster the alignment of European and national policies towards joint goals for summing up capacities and resources, as well as to adopt common principles and standards that make possible its achievement. ERA also seeks to promote knowledge and talent circulation, which will capitalise on the opportunities and advantages from the institutional, scientific and technological diversity and heterogeneity of Europe.

The operationalization of ERA was established in 2014 under the Europe 2020 Strategy Flagship Initiative Innovation Union. The European Commission made specific comments on the identification of the necessary measures for removing researchers' mobility barriers as well as for ensuring (1) quality of doctoral training, attractive employment conditions and a balance between women and men in the research careers; (2) mobility of researchers across countries and sectors, particularly through open recruitment in public research institutions and comparable research careers, as well as facilitating the creation of European supplementary pension funds; (3) cross-border operation of research performing entities, funding agencies and foundations, in particular by ensuring simplicity and coherence in the rules of participation and funding procedures; (4) dissemination, transfer and use of research results, especially through ensuring open access to publications and data from publicly funded research; (5) open use of research infrastructures managed by Member States to any European user; and (6) coherence of the EU and national strategies and actions for international cooperation in science and technology.

In the same line, the Communication "A Reinforced European Research Area Partnership for Excellence and Growth"[2] from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions identified five priorities:

1. More effective national research systems including increased competition within national borders and sustained or greater investment in research.
2. Optimal transnational co-operation and competition defining and implementing common research agendas on grand-challenges, raising quality through Europe-wide open competition, and constructing and running effectively key research infrastructures on a pan-European basis.
3. An open labour market for researchers - to ensure the removal of barriers to researcher mobility, training and attractive careers.
4. Gender equality and gender mainstreaming in research – to end the waste of talent which we cannot afford and to diversify views and approaches in research and to foster excellence.
5. Optimal circulation, access to and transfer of scientific knowledge including via digital ERA - to guarantee access to and uptake of knowledge by all.[3]

[1] The Union shall have the objective of strengthening its scientific and technological bases by achieving a European research area in which researchers, scientific knowledge and technology circulate freely, and encouraging it to become more competitive, including in its industry, while promoting all the research activities deemed necessary by virtue of other Chapters of the Treaties.

[2] http://ec.europa.eu/euraxess/pdf/research_policies/era-communication_en.pdf

In the “Enhancing and focusing EU international cooperation in research and innovation: A strategic approach"[4] Communication, the Commission expressed the need to strengthen international cooperation in the Union in research and innovation, incorporating the five priorities outlined above.

Figure 1. ERA Priorities

Since 2012 the initial development of ERA was set out in close collaboration between the European Commission and the Member States as well as the active participation of main stakeholders.

The 2013 and 2014 ERA Progress Reports[5] reflected what had been achieved and confirmed the differences among countries, which limit the effective functioning of the ERA. The main barriers to the optimal movement of researchers and knowledge are mainly linked to regulatory frameworks, regulations, organizational and administrative procedures. Some of the most significant differences, stated in the second ERA Progress Report in 2014[6] are:

1. The allocation of project-based and institutional performance based competitive funding.
2. The application of international standards in peer reviewing.
3. The degree of commitment to joint programming.
4. The level of linkage between national scientific infrastructure and the European ones.
5. The measures that foster employability of doctoral students and the skills acquisition for innovation (Innovative Doctoral Training) being that only 10% of doctoral students report having received training on intellectual property and entrepreneurship.
6. The degree of legislation that encourages recruitment of researchers at European level.
7. The establishment of open and competitive recruiting procedures for researchers.
8. The uneven impact of measures to correct gender imbalances in research institutions.

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[3] COM(2012) 401 final https://ec.europa.eu/research/science-society/document_library/pdf_06/era-communication-towards-better-access-to-scientific-information_en.pdf

[4] https://ec.europa.eu/research/iscp/pdf/policy/com_2012_497_communication_from_commission_to_inst_en.pdf

[5] https://ec.europa.eu/research/era/pdf/era_progress_report2013/era_progress_report2013.pdf and http://ec.europa.eu/research/era/pdf/era_progress_report2014/era_progress-report_150521.pdf

[6] http://ec.europa.eu/research/era/pdf/era_progress_report2014/era_progress_report_2014_communication.pdf

9. The development and implementation of open access policies to scientific publications and support for creating infrastructures that facilitate the implementation of these policies.
10. The limited effectiveness of initiatives to promote knowledge transfer despite the generalization of models and common goals (i.e. Transfer Offices, recognition of activities, etc.)

In this context, the Council of the European Union, in its Conclusions on the 2014 Report on the European Research Area adopted by the Council of Competitiveness, during its meeting on 5 December 2014[7], highlighted the need to develop a roadmap at European level – the so-called ERA Roadmap. This recognised that ERA cannot be built outside the national innovation systems themselves.

It corresponds therefore to the Member States and their main research and innovation institutions to drive the implementation of the necessary measures for strengthening the ERA and for making it fully operational.

Reaching the goals that would facilitate the optimal movement of researchers and knowledge in Europe is a gradual process that requires Member States' commitment and effort in close partnership with the European Commission, and other key players including research performers.

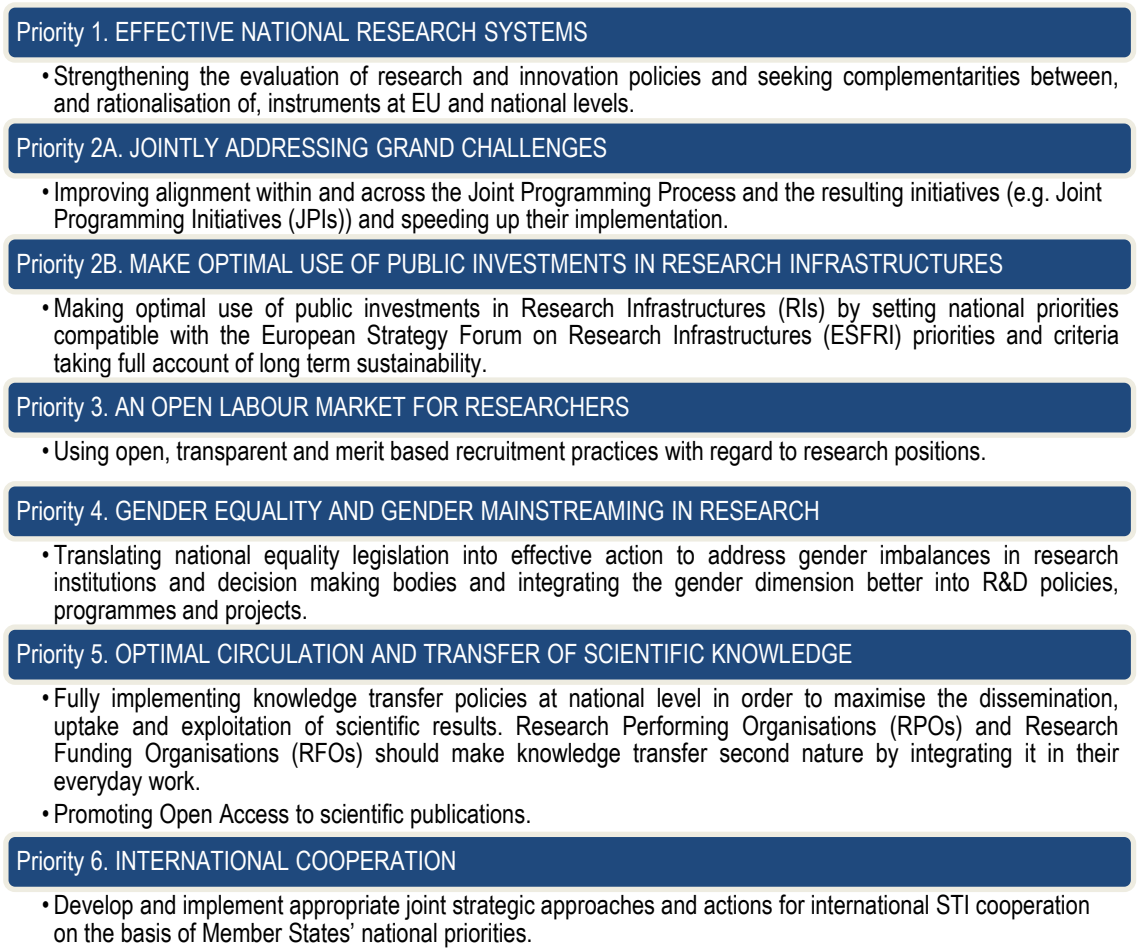
2. THE NEW EUROPEAN 2015-2020 ROADMAP

The 2015-2020 Roadmap[8] was endorsed by the Council in mid-2015[9] following its adoption by the European Research Area Committee (ERAC). It is a living document, subject to revisions for periodic updating and adoption of effective measures. Its purpose is to provide guidance to Member States, the Commission and the main users of the ERA Stakeholders Platform[10]. It also recognizes the need for Member States to promote the adoption of appropriate measures in the context of their own innovation strategies or specific action plans, and its inclusion, whenever deemed necessary, in the National Reform Programs.

The identified measures in the 2015-2020 Roadmap included a small number of top action priorities that are considered to be of greater impact (Figure 2), as well as a set of actions whose implementation corresponds to different members of the ERA Association: the Member States, the European Commission, and users.

[7] http://data.consilium.europa.eu/doc/document/ST-16599-2014-INIT/en/pdf
[8] http://data.consilium.europa.eu/doc/document/ST-9351-2015-INIT/en/pdf
[9] http://data.consilium.europa.eu/doc/document/ST-9351-2015-INIT/en/pdf
[10] The European Commission established the so-called ERA Stakeholder's Platform in 2012 after the Communication "A Reinforced European Research Area Partnership for Excellence and Growth", which was joined by the European Association of Research and Technological Organisations (EARTO); the European University Association (EUA); the League of European Research Universities (LERU); NordForsk and Science Europe. The Conference of European Schools for Advanced Engineering Education and Research (CESAER) joined in 2013 and EU-Life in 2015 EU-Life. NordForsk has not renewed its participation. http://ec.europa.eu/research/era/partnership_en.htm

Figure 2. **2015-2020 Top action priorities European Roadmap**



3. STRATEGIC FRAMEWORK AND GUIDING PRINCIPLES FOR THE SPANISH ERA ROADMAP 2016-2020

Spain has supported ERA as a necessary condition for the creation of an open knowledge and talent environment, in order to be highly competitive at a global level. ERA will enable strengthening the existing scientific and technological capabilities and it will respond, in a collective and aligned way, to the present and future grand-challenges of our society.

The Spanish commitment to ERA is seen in the goals and measures incorporated under the Spanish Law of Science, Technology and Innovation (The Law, hereinafter), adopted in 2011 with a broad parliamentary consensus. The new legal framework includes:

1. Putting into place internationally comparable evaluation and recruiting practices (Article 16), improving access to research careers (Article 22), and promoting the openness of the Spanish research institutions (Article 23).
2. Promoting geographical, inter-sectoral and interdisciplinary mobility of researchers within the Spanish Science, Technology and Innovation System (Article 17).

3. Encouraging knowledge circulation between the public and private sector through collaborative research projects, development of structures for knowledge valorisation, or generating RDI capacities in companies by incorporating researchers and technical staff (Article 33).
4. Promoting open access of scientific publications (Article 37).
5. Introducing international dimension in research, development and innovation as an intrinsic element of the Spanish Strategy for Science and Technology and Innovation (Article 39) and ensuring an active, coordinated participation with the Ministry of Foreign Affairs and Cooperation in international development initiatives (Article 40).
6. Adopting measures that aim to the foster the gender perspective in institutions and committees (including the evaluation ones) and promoting the adoption of Equality Plans by the Public Research Organisations (Provision 13).

The **Spanish Strategy of Science, Technology and Innovation 2013-2020**[11] (The Strategy, hereinafter) provides the framework for elaborating the Spanish ERA Roadmap. Approved by the Council of Ministers on 1 February 2013, the Strategy has a shared vision with Europe2020 Strategy, the Innovation Union Flagship and the Horizon 2020 Framework Programme enabling funding instruments for achieving strategic objectives.

The Strategy is the context for the mid-to-long term planning of RDI policies for the State Administration and the Regions. It contains specific measures to promote the development of ERA in its core principles and in its cross-cutting priorities.

The **gender perspective** in public RDI policies is one of the Strategy's five core principles. Its goal is to correct the human capital loss linked to the uneven incorporation of women and their professional development in RDI fields, both in the public and private sector. It also recognises gender perspective mainstreaming in RDI research as relevant to the creative process and innovative results.

The remaining the ERA principles in Spain also contribute to the ERA consolidation, as they aim to promote an effective functioning of the Spanish Science Technology and Innovation System[12].

Among its cross-cutting priorities the Strategy includes: (1) encouraging knowledge transfer and management in open and flexible collaboration environments; and (2) supporting the internationalization of Spanish STI System.

Finally, the Strategy provides the instruments for coordination measures for public administrations relevant to the Spanish STI System with the European Research Area, such as:

1. **Shared responsibility of the public administrations for joint programming and co-funding instruments** among the institutions and co-funding of the national Singular Scientific Technical Infrastructures, which, following a thorough assessment, will be integrated under a new national map that will be designed on the scientific and technical capacities and financial sustainability.
2. Promoting **Open Access** to the publications and public funded research results, and adopting measures and shared standards at all levels of administrations and research institutions.
3. Implementation of an **Integrated Information System** and improvement of monitoring and impact indicators for the results of public RDI funding.

[11] The measures proposed for the Spanish ERA Roadmap will be included in the mid-term revision of the Strategy during 2016, such as decided by the Executive Commission of the Council for Science, Technology and Innovation Policy on 25 November 2015.

[12] The remaining core principles are: (1) coordination of the public RDI policies with the European Union, which means adopting the shared criteria in terms of management, evaluation and establishment of co-funding models; (2) applying quality criteria, with relevance and social impact, and internationally recognised for allocating competitive public funding to foster RDI, including the evaluation of the scientific-technical merits by independent international experts. (3) raising the efficiency and accountability of the public administrations to guarantee the dissemination of the results to the broad society; and (4) enabling a stable framework for planning, which will allow: (i) structuring the investments and measures in RDI for the public and private sector, and (ii) improving the planning of the activities promoted by the public administration and raising their efficiency.

4. **Administrative simplification and streamlining** of the public activities, and adoption of simple procedures and funding schemes which may progressively reduce transaction costs incurred by users.
5. **Harmonization of criteria and evaluation practices** following international best practices including incorporation of independent experts from abroad.

In summary, both the Law and the Strategy contain principles and measures that contribute towards the consolidation of ERA. The ERA Roadmap objective is to identify and prioritise the activities to be promoted during 2016-2020.

Finally, the Spanish ERA Roadmap takes in consideration the recommendations of a panel of independent international experts that, in the framework of ERAC, evaluated the efficiency and effectiveness of our RDI policy, i.e.: Spanish ERAC Peer Review[13] in 2014. The main recommendations are:

1. Spain's R&I system needs increased resources but these must go hand in hand with structural reform for a more efficient and effective use of public investment.
2. Human resources are the most pressing problem and rapid action is needed, through: (a) improving access and recruitment; (b) introducing reforms research career structure; (c) introducing changes in the management of scientific careers by allowing accelerated promotion to positions of research leadership and autonomy for the most talented, and establish mobility as the norm, both between research institutions and between research and the private sector.
3. Reform the public research institutions and provide them with a greater autonomy, which should be matched by a strategic approach and by greater managerial accountability, including regular independent evaluation and assessment.
4. Research institutes and universities need to be subject to an assessment system that influences resource allocation both directly and indirectly. There is also a need to increase the proportion of competitive funding.
5. Create an effective innovation model and a new level of coordination between actors through the establishment of national consortia, termed Strategic Innovation Arenas.
6. Bringing more business actors into the innovation system is essential.
7. Develop a market and a culture for innovation.
8. There is a need for an autonomous funding research agency.
9. Incentivising regional synergies in support of business and business creation.
10. Effective monitoring and evaluation to support evidence-based policy.

In the framework of the Strategy, the Plan, the recommendations of ERAC Peer Review and the European Semester recommendations on ERA, the Spanish ERA Roadmap aims to define and promote activities linked to each of the identified pillars, and that contribute to the effectiveness of the Spanish System of Science, Technology and Innovation. At the same time, the Spanish ERA Roadmap activities are part of the regular follow up, as reflected annually in the corresponding National Reform Programmes.

The Spanish ERA Roadmap was elaborated taking into account the following guiding principles:

- **Coherence** with the Spanish Law of Science, Technology and Innovation, the Strategy of Science, Technology and Innovation and the ERAC Peer Review recommendations.
- The **regulatory framework** set out in the Law, which is necessary to complete, especially on aspects related to mobility of researchers between sectors (academia and industry), and its recognition for designing an attractive scientific career open at internationally.
- The **feasibility of the proposed measures** needs to take into account the RDI regional systems specificities, the distribution of the competences in the State Administration itself, and the autonomy of universities. The proposed measures in this roadmap fall under the competence of the State Secretariat of Research, Development and Innovation in collaboration with the State Administration. Furthermore,

[13] http://www.mineco.gob.es/stfls/MICINN/Prensa/FICHEROS/2014/140801_final_report_public_version.pdf

the measures under this Roadmap are subject to the available budget if additional funding is required, therefore they follow the principles of fiscal consolidation and the budgetary stability in force.

- The **consideration that the European dimension** is intrinsic to national level RDI promotion by rationalisation and simplification of the activities, and the interoperability and application of common principles; as well as **seeking greater involvement** from all funding agents and research entities to ensure the effective implementation of the proposed measures and a follow up of their impact.

The elaboration and implementation of the ERA Roadmap measures represent an opportunity to promote a research and innovation area without frontiers, to create an attractive environment at global level, to reduce the gap between countries, regions and institutions, as well as the gap between research and innovation. In addition, it conceives ERA as an open environment, as a result of the activities and opportunities promoted by every national system of science, technology and innovation.

4. THE SPANISH ERA ROADMAP 2016-2020

In the development and adoption of measures to promote the consolidation of the European Research Area, the State Secretariat of Research, Development and Innovation assumes leadership and coordination as specified in the Law 14/2011 of Science , Technology and Innovation in relation to state plans for scientific and technical research and Innovation (Articles 42 and 43).

The proposed activities are distributed along the six ERA priorities. They are the outcome of a throughout diagnosis and analysis of the national situation, and many of them may be incorporated in the new State Plan of Scientific and Technical Research 2017-2020, currently under development.

4.1. IMPROVING THE EFFICIENCY OF THE SPANISH SYSTEM OF SCIENCE, TECHNOLOGY AND INNOVATION (PRIORITY 1)

Six **areas of action** are identified:

4.1.1. MONITORING AND EVALUATION OF PUBLIC RDI POLICIES AND IMPACT ASSESSMENT OF THE RESULTS FROM THE PUBLIC SECTOR FUNDED ACTIVITIES

Despite referenced under the Strategy, monitoring and measurement of scientific, economic and social impact of RDI policies and programs has seen limited progress in recent years[14]. The growing need for systematic information for processing and analysis of public RDI based on the evidence is a priority measure included in the ERAC Peer Review recommendations and under Article 11 of the Law, which aims to develop the Science, Technology and Innovation Information System. The measures proposed are:

[14] Efforts in recent years have been primarily focused on the ex post evaluation of specific programmes (i.e. CENIT, Ramon y Cajal); in monitoring of CDTI projects; in conducting feasibility studies that allow to have a tool for prospective analysis and impact measurement based on advanced technologies (TDM and PLN) and massive data processing and texts.

Creation and consolidation of an hig level RDI policy unit at the State Secretariat, dedicated to: (a) implement and coordinate ex post evaluation and impact assessment of RDI public policy and its main instruments; and (b) the ex-ante evaluation and foresight on capacities and priorities for the Spanish System and its potential contribution to the definition of the European common agenda.

Definition of a **consistent, robust and internationally standards-based methodology** that facilitates ex post monitoring of RDI publicly funded activities embedded in the State Plan 2017-2020.

Development and implementation of an **Action Plan for the Evaluation of RDI Policies and Programmes** 2017-2020.

4.1.2. Efficient and Flexible National Management Model of Public Funding

The creation of the State Research Agency in November 2015 has been the first step to establish a more efficient and flexible management model that will allow the implementation of the measures needed to better integrate our system in ERA. Nevertheless, the advances on the new model would require:

Effective **implementation of the State Research Agency** through: (a) the constitution of its Governing Board, appointment of Director and other managerial posts; (b) the preparation and further approval of the Contract Program/ Multiannual Action Plan that will endow stability to its performance; (c) the consolidation of an administrative unit within the Agency that will standardise the rules of participation and procedure for different calls for proposals; and (d) improvement of IT facilities for application and management of the public RDI calls.

The creation of a unit dedicated to the simplification and **adoption of common rules of procedure** refers to: (a) the design of application models, and whenever possible, aligned to H2020 models; (b) the CV models should follow the CVN and CVA, and, whenever neccessary, in English; (c) project reporting needs to follow set procedures provided by the Agency; (d) the scientific-technical part of the project application needs to be filled in English; (e) the provision to every applicant researcher with a unique identifier to facilitate management and monitoring.

4.1.3. International Peer Review for Publicly Funded Activities

In spite of the fact that the procedures normally followed for the scientific technical evaluation of the competitive based funding on projects run by the Deputy Directorate General –Evaluation and Foresight National Agency at the State Secretariat follow international principles and criteria, a greater involvement of international peers in the evaluation of public funded activities is necessary to increase the openness, internationalisation and competition of the STI System.

To raise by 25% the number of international evaluators that participate regularly in remote evaluation process of public calls of the State Plan 2017-2020. This will require a revision and modification of the current administrative procedures that hinder foreign evaluators participation .

4.1.4. Promotion of Spanish Research Groups and Companies in Horizon 2020

Participation in H2020 ensures collaboration between researchers and companies, execution of projects with a European added value and strengthening linkages that contribute to ERA consolidation.

To promote participation in H2020 calls in order to foster integration of Spanish research groups and companies in European high impact projects and foster the continuous improvement of the Spanish System capacities.

To consolidate schemes similar to the "**Seal of Excellence**" and that are associated to the H2020 calls, that recognise and fund researchers, groups and companies that have passed the international evaluation threshold, but have not been supported due to the lack of availability of funds.

4.1.5. Planning and Stability of Public RDI Funds

Public investments are the main source of RDI in Spain. Private investment has historically been lower than in the countries similar to ours. The economic crisis and the fiscal consolidation measures necessary to adopt in the framework of the European Semester, have produced a gradual reduction of the public budget, mainly in competitive RDI funds managed by the State Administration managed through calls for proposals. The main action, in line with the recommendations of the ERAC Peer Review and the European Semester, includes:

To **consolidate RDI public national budget through a gradual and sustained increase** which will allow adequate planning and embed stability included in the State Plan 2017-2020. All of the above should not prejudice the application of budgetary stability measures.

4.1.6. Impact of RDI Public Investment and Policy Coordination Between the Central Government and the Regional Governments

The new model of governance referred in the Law and the establishment of the Council of Science, Technology and Innovation Policy, and the functioning of the Executive Committee of the Council, have been an important step in the definition of a shared vision and joint objectives in RDI. This is reflected in the Strategy, the new Association Agreement with the European Union, the RIS3s, and the new national map of Singular Scientific and Technological Infrastructures. However, improving public investment impact and efficiency requires a framework that facilitates collaboration and joint programming between the state government and the regions, and the development of specific instruments that optimise the use of available funds, including Structural and Finance Funds from Europe. The specific priority in this section is:

To foster the «**Seal of Excellence**» between the regions for all those calls from the State Administration that allow it, such as in RDI projects. To foster the recognition of the scientific and technical evaluation carried out through the same scheme.

4.2. JOINTLY ADDRESSING GRAND CHALLENGES (PRIORITY 2A)

The Strategy represents the political commitment of the Spanish public administrations (State and Autonomous Regions) in RDI and includes two key aspects for the ERA consolidation related to this priority: (1) The Strategy orientation towards the grand challenges of our society; and (2) the need to cooperate in transnational projects that allow adding resources and capacities to face successfully these challenges. This commitment is a reflection of the trend started by the first European initiatives of transnational collaboration[15]. This commitment and interest are maintained despite the evolution and progression seen in various schemes of transnational collaboration or joint programming which have evolved towards a: (1) a remarkable complexity and (2) an increasing demand for Member States funding.

Spain has followed the debates that, at European level, try to correct the dispersion of the instruments and the inefficiency of the mechanisms currently used to determine the priority thematic areas. For the above, the need to simplify and rationalise the incentives that come out at European Level is linked to the specific activities that allows to respond efficiently to the identified needs in two areas: (1) a better strategic identification of the themes of interest, as well as the management of international joint programming activities; and (2) an adequate definition of features, requirements and selection criteria for funded projects through national calls and in joint programming calls aimed at optimisation of available resources.

4.2.1. GOVERNANCE, STRATEGIC PLANNING AND MANAGEMENT COORDINATION

Coordination between the State Administration management and funding units happens through minimal standardised procedures and mechanisms for institutionalised strategic decision making is lacking. Therefore the following:

To improve governance and creation of the "High Level Group for Joint Programming" responsible for planning and making strategic decision that facilitates **priority alignment** in Spain (regional policies, institutions and research groups) with those promoted at European level.

To strengthen national priorities in the area of **PRIMA - Partnership in Research and Innovation in the Mediterranean Area** (Article 185).

To adopt **a manual of procedures** supported by good practices and simplified processes and procedures, including, eligibility[1] and selection criteria, time-to-grant, etc., which will allow a new established management model, specialised according to the needs of transnational collaboration and it will raise the Spanish leadership in the management of joint programming initiatives.

• [1] The revision of the eligibility criteria will be subject to the rules set by the national legislation.

[15] Spain has participated in 151 projects/initiatives during 7FP, and currently, through the State Administration we participate in 72 of 89 transnational schemes (ERAnets, Cofund, JPIs, Article 185) with the following distribution: (1) we participate in the 10 existing JPIs and it has been a founding leader of Water JPI; (2) the four Article 185 initiatives; (3) 52 out of 61 ERA Net Schemes; and (4) 6 out of 13 P2P initiatives.

4.2.2. Optimization of Funding Mechanisms Between National Calls And Actions for Joint Programming

RDI strategy alignment at national and European level is key to consolidate ERA and to create scientific-technical capacities to tackle grand challenges. However, the design of national instruments (i.e. State Plan) needs to better respond to the principles of opportunity, flexibility and variable geometry. Therefore the bottom up initiatives that may arise and involve Spanish research groups should not be seen as a legal commitment for national level funding.

Therefore, and in order to (1) improve synergies between calls for national projects and transnational collaboration, and (2) promote the participation and expertise of research groups in these initiatives, the following is proposed:

To design a **web based information and communication system for the joint programming thematic priorities** for a greater openness and involvement of the research community.

To prepare **a prospective map with the research capacities and thematic areas** funded by the State Plan in order to facilitate coordination at European level.

To review the **funding allocation criteria and procedures** for transnational projects.

4.3. Optimizing Investments in Research Infrastructure (Priority 2B)

Spain has had an outstanding participation in the development of the ESFRI roadmap since its start in 2006, and updated in 2008, 2010 and 201616. Currently, Spain participates in 14 out of 21 ESFRI projects, in 21 out of 29 landmarks, and also two out of four emerging projects.

Large research infrastructures are relevant and necessary for the national and European scientific and technological development. They require an important commitment for their development and exploitation, hence continuous monitoring for viability and adequate budgetary planning are necessary. In addition to the above, and considering that the Strategy (1) recognises the large infrastructures' role to both frontier research and to accelerate technology development and innovation; (2) introduces the economic and financial viability as key for prioritisation of the Spanish participation; and (3) includes the need to enhance coordination, and look for synergies and complementarities between the pan-European research infrastructures supported by Spain and the national infrastructures contained in the "Map of Scientific-Technical Infrastructures (ICTSs)" updated in 2014[17].

Also, in this roadmap attention is paid to or scientific facilities "core facilities" that are part of universities and public research centres, which are relevant to the new technological developments in partnership between the public sector and the business for its proximity to users and open character. Thus, the priority actions include:

4.3.1. Strengthening Strategic Planning and Coordination of Infrastructures Included in the ESFRI Roadmap Supported by Spain And the National Scientific and Technical Infrastructures (ICTS)

[16] http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=esfri
[17] http://www.idi.mineco.gob.es/stfls/MICINN/Innovacion/FICHEROS/4_Acuerdo_Mapa_ICTS.pdf

To create a **High-level Committee for Large Research Infrastructures** that is responsible for identifying, planning and making strategic decisions to facilitate priority alignment at national and regional level and at European level.

To prioritise and **support ESFRI infrastructures hosted or with nodes located in Spain**.

To develop **a roadmap that integrates ESFRI projects supported by Spain and the ICTS**, which will include all the necessary updates done under ESFRI and ICTS.

To complete research infrastructures impact assessment studies. To adopt the principles, criteria and methodologies that contribute to robust decision making process to the research infrastructures – identification, selection and prioritisation of research infrastructures projects, - with particular attention to measuring the economic impact of these and to define budgetary planning scenarios.

4.3.2. SUPPORTING E-INFRASTRUCTURES AND INTEROPERABILITY OF RESEARCH INFRASTRUCTURES (RIS)

To support participation in **e-infrastructures** and exploitation from the **interoperability** of RIs and nodes **located in Spain** in order to promote open data and open circulation of information. The Spanish support and the contributions from national RIs or research centres to **the European Open Science Cloud** are considered a priority.

4.3.3. SUPPORT FOR LEADING SCIENTIFIC «CORE FACILITIES» MEDIUM-SIZED

The construction of Research Infrastructures and their advanced equipment requires key technological and innovation capacities from the industry, which must be able to respond to the progress and challenges that the infrastructures may demand.

The development of a map of scientific «core facilities» to facilitate the identification and access to research institutions and companies to existing installations in Spain

Optimizing investments in facilities and advanced research technologies by promoting access and creating shared resources and expertise of the nodes in light of scientific and technological use .

The strengthening of such facilities by supporting the incorporation of highly qualified personnel

Recognition of advanced facilities and management procedures facilitating the identification of them as a reference at European level

4.3.4. The strengthening and consolidation of Spanish science industry linked to major infrastructure projects of national and international research

The construction of the infrastructures as well as advanced equipment that they have to incorporate into their operating phase requires significant technological capabilities and innovation by companies must be able to respond to the challenges that these infrastructures represent.

Supporting innovative firms linked to science industry as part of an innovation process that optimizes economic and technological returns associated with significant investments in major research infrastructures.

4.3.5. Optimising National and EU Sources in Large Research Infrastructures Funding

With the objective of optimisation of the RI investment by different sources, mainly through European Regional Development Funds (ERDF), the Spanish commitment during 2014-2020 includes the ESFRI nodes located in Spain.

To review and adopt **specific, responsive and flexible instruments** that facilitate co-funding and ERDF use to be allocated at Spanish based ESFRI project nodes. These instruments will optimise and execute investments in accordance with a schedule adapted to the project needs.

Improving coordination between the Central Government and the Autonomous Communities, through the exchange of experiences and best practices within the «Network of Public R&D Policy».

Promoting the opening of infrastructure to the productive environment and business collaboration.

4.4. CONSOLIDATING AN OPEN LABOUR MARKET FOR RESEARCHERS (PRIORITY 3)

An effective labour market without barriers is essential to ERA. The open market determines mid-to- long term capacities in order to generate knowledge and boost institutional competitiveness, thus institutional improvement. The development and consolidation of the European open labour market for researchers is associated with the removal of mobility barriers, which aggravate countries and regions differences, as well as it is associated with the adoption of more flexible and responsive management and human resources practices that promote competitiveness between European research institutions.

Training in innovation capacities and public and private sector recruitment are fundamental to developing and strengthening scientific, technological and innovation capacities in our country. These aspects are included in the Law, the Strategy, and the Plan. However, the legal framework rigidity and cultural as well as organisational practices make it often difficult to effectively establish an open environment for selection and recruitment of researchers. This results in low levels of foreign researchers and absence of inter-institutional and inter-sectorial mobility incentives.

The growing global competition for top scientists is generating tensions within the Spanish system, in the short term. This is recognised by ERAC Peer Review, as it points out: "Human resources are the most pressing problem of the system continued need for action with immediate effect." This has been a result of: (a) the researchers aging workforce in the public sector aggravated by the zero replacement rate for public recruitment, such as limited in the Annual Budget Law; (b) need to establish a public sector research career, other than the civil servant model, that includes the tenure track career based on excellence; and (c) need to make the research career more flexible to allow mobility both among the public research institutions and between them and the private sector[18].

Given the Spanish labour market major challenges and the opportunities available to the research institutions, the envisaged measures are grouped into four main priorities.

4.4.1. PROMOTING MOBILITY OF RESEARCHERS

Fostering international, inter-sectorial and inter-institutional mobility on a short-to-mid-term is key to foster knowledge circulation, internationalisation and international cooperation, and therefore to build open innovation environments. The specific measures to promote the mobility of researchers are:

[18] Since 2014, the State Secretariat, of which depend the Public Research Organisations and the public support instruments of the State Plan, has adopted measures to: (1) improving public funding schemes for hiring researchers in the private sector; (2) procuring social security subsidies for hiring researchers in private companies; (3) the implementation of the Industrial Doctorates; the approval of a replacement rate for researchers in public research institutions to 100% resulting in more than 300 new hires in 2016; (4) creating a total of 50 new posts for permanent (non -civil servant) recruiting of researchers in Public Research Organisations, with the objective to explore alternative models other than the civil service model; and (5) designing public calls which target specifically Ramon y Cajal researchers and aim to facilitate their incorporation by reducing costs for the recipient institutions.

To define the tools and **criteria for recognition of non-academic research activity** that boosts inter-sectorial mobility and circulation of knowledge, as set out in the Law. .

To review the **procedures and compatibility criteria for civil servant researchers** in order to encourage inter-sectorial mobility between public research organisations, universities and other public system, including the centers of the National Health System

To clarify and simplify the **portability criteria for public aids on recruiting researchers** in the public research system.

To review the criteria in order to allow **longer stays** (6 to 12 months) in foreign research centres for the beneficiaries of public aid dedicated to recruitment of researchers.

4.4.2. OPENING UP THE PUBLIC RESEARCH SECTOR AND THE INCORPORATION OF RESEARCHERS

Commitment from administrations, universities, PROs and trade unions to promote institutional opening through: (1) **creation of a tenure track non-civil servant research career**[1], and (2) the **review** of **internal norms and practices** for accrediting the researchers selection either for temporal hiring, for a determined research contract, for permanent or civil servant post that guarantees open, transparent and competitive criteria, and promote retention of researchers who have relevant international funding (i.e. ERC).

To **consolidate the replacement rate in universities and public research organisations at least 100%** and to recruit in accordance with open, transparent and merit based selection criteria.

To promote the adhesion of public research organizations and universities to **HRS4R strategy and the application «HR Excellence in Research»** seal.

Promoting the use of EURAXESS for advertising vacancies, including those associated with managerial functions, by research institutions by arranging specific dissemination events and training.

To **establish the use of English in all State Plan funding applications for training, recruitment and mobility of researchers**, whenever these aspects are a variable which help to contribute to international openness and competitiveness[2].

- [1] Facilitating the use of all contractual mechanisms established by the Law, i.e.: Contract of Access and Contract of Distinguished Researcher, as well as developing contractual figures LOMLOU under the figure of Associate Professor that would allow similar labour conditions to the civil servant PT and CU ones; as well as eliminating internal barriers and organisational practices that limit the effectiveness of these mechanisms.
- [2] The recruitment aids where the selection criteria include the implementation of research projects in collaboration with other researchers linked to a specific center are excluded.

4.4.3. Improving Institutional Coordination and Good Practices between the Administrations and Research Institutions

The Spanish system of higher education and research is highly heterogeneous, especially at university level. The differences consist on the autonomy of universities and in the competences that correspond to the regional governments in funding universities and promoting research. This brings an increased diversity in the application of criteria and definition of instruments linked to selection, promotion and researchers recruitment conditions.

To improve **institutional coordination**, information exchange and mutual learning on HR management practices among RDI regulators, funding and implementing institutions.

4.5. Gender Equality and the Gender Mainstreaming Research (Priority 4)

The Law, the Strategy and the ERA Roadmap contemplate gender equality in research through two aspects: (a) by achieving gender balance measured through the women and men participation in all levels and areas; and (b) by improving gender dimension integration in RDI policies, programmes and projects. They are both relevant and they both require specific actions[19].

Spain has an advanced legal, normative and strategic framework for gender equality that has enabled progress in the right direction. Recently two inter-ministerial groups have been created in the framework of the "Strategic Plan of Equal Opportunities 2014-2016" dedicated to (a) integration of gender analysis in research; and (b) promotion of gender equality policies in universities.

In spite of the framework conditions, only 21% of professorship are female nowadays in Spain, which demonstrates that the gender gap is still a key issue to address and which requires direct intervention to: (a) foster the women's role to more responsibility jobs in leading institutions and research centres[20]; (b) promote the scientific and technical vocations among young girls[21]; (c) improve and extend the application of criteria in the public calls for research funding, to ensure gender balance in the evaluation and selection committees[22]; (d) strengthen the monitoring, impact assessment and effectiveness of structures created for the promotion of gender equality in the public administrations, research institutions and, especially, in the universities[23]; (e) strengthen

[19] Following the analysis recently undertaken by GENDER-NET "Promoting gender equality in research institutions and in the content of the investigation"

[20] In 2014, the percentage of women as rectors of the Spanish universities was only 8% and none of the PROs was led by female researchers.

[21] Both FECYT as MUNCYT are promoting the gender perspective in scientific culture activities, bon in the composition of speakers, juries and committees, and in the images of women/girls and men/boys appearing in the promotion materials. The PROs and universities organise Girls' Days to increase the visibility of female researchers in different scientific fields in order to promote in a more general way the recognition of scientists and technologists.

[22] The main State Plan calls for funding require a gender balance in the composition of evaluation committees, but in 2014 only 31% of the call for funding in RDI projects and around 50-60% of the call for HR funding, fulfilled the requirement. Very recently new additional practices position women evaluators as a tiebreaker in the Industrial PhDs and Torres Quevedo calls for HR funding; and the awarded Severo Ochoa Centres of Excellence and María de Maeztu Units of Excellence are required to have a Gender Equality Action Plan.

[23] The Women and Science Unit at the State Secretariat of Research, Development and Innovation and the Gender Equality Unit in the Ministry of Education, Culture and Sport are the two main units in the State Administration. Most universities have a gender equality unit. The PROs have committees or specific groups. These structures have limited resources to promote, coordinate, monitor and evaluate respective internal plans, as well as to participate to national wide plans.

measures for promoting the Integrated Gender Analysis in Research (IAGI)[24]; and (f) ease the follow-up and evaluation of gender policies in research.

The **monitoring and accountability of these policies** requires common adoption of guidelines and indicators to measure progress and facilitate comparison between structures, as well as to measure the implemented activities impact. In spite of the fact that there are several publications[25] that give data on the researchers, the students and the RDI funds, it is important to improve the production of sex-disaggregated data in order to facilitate the analysis and application of standardised criteria to be used by universities and PROs in their reports.

And finally, conciliation from the co-responsibility is included in the Equality Plans of the universities and PROs, State Administration Equality Plans and the "Strategic Plan of Equality for Opportunities 2014-2016". It is remarkable the introduction conciliation in the selection procedures and public grants through the relaxation of deadlines and eligibility criteria or terms of grants usage and research contracts. However, it is necessary to introduce additional criteria in critical areas like the evaluation of the research activity – posts and number of publications – or in the provision of mobility grants for those with dependent family members, etc. [26] Two broad objectives group the specific measures under this Priority:

4.5.1. Reviewing and Adapting Procedures and Criteria in Public Calls

The revision and adaptation of procedures and criteria used in public calls for RDI to avoid gender bias and achieve greater gender balance, as well as to improve integration of the gender dimension in the to-be-funded proposals. Specific measures include:

To **review and incorporate gender sensitive criteria** in the field of scientific evaluation of performance, calls for training grants, and mobility and recruitment grants.

To **update and include the new criteria** on IAGI in RDI grants for projects, according to the Handbook on Gender Equality in H2020, and GENDER-NET recommendations, that allow identification of themes in which it is essential to apply IAGI (gender flagged topics) as well as those proposals where it is necessary to follow up on the matter.

To improve criteria and requirement for RDI evaluation committee composition with the objective to avoid gender bias and promote the IAGI assessment, through information materials aimed at evaluation committee members, coordinators and managers of the evaluation process.

To **update national and international databases** that: (a) facilitate the location of researchers, especially in scientific fields that show under-representation; and (b) include expert research staff in gender studies and gender research impact studies.

To **promote the presence and visibility of female scientific and technologists** in order to create an image of reference for science and technology vocation among young girls. To be done through funding conferences, meetings and other science dissemination activities.

To **include criteria of selection for RDI aids** (e.g.: ratio of priority in cases of a tie, etc.) that **promote gender equality** in teams, institutions and in the content of proposals, if relevant to the nature and content of the grant.

[24] Since 2009, there exists a specific RDI Project line in Gender Studies (FEM Programme), and since 2013 all proposals for research projects must indicate the impact of gender on the expected results. To the later, in 2014, only 9% of the applications considered that their expected results might have had an impact in this area.

[25] Statistics on RDI Activities (INE), Basic Data on Spanish University System (MECD) y Women Scientists in Figures 2013 (UMyC)

[26] At the universities there have been significant barriers to the implementation of conciliation measures, therefore the start of a new specific plan "Conciliate Plan"

4.5.2. Developing Guidelines, Promoting Best Practices and Training

Developing guidelines, promoting best practices and training to improve the implementation of gender equality policies, in its two aspects, in public research centres and RDI funding agencies, and monitoring and evaluation, includes the following measures:

To **design and implement a training plan in the two aspects of gender equality in RDI**, aimed at senior and middle managers of public research centres, their governing bodies, their committees of control and assessment, and considering all the research staff.

To develop gender equality structures at PROs and State Research Agency, and to improve institutional organisation at national level, including: the State Secretariat and its dependent entities, the Ministry of Education, Culture and Sports, and the Ministry of Health, Social Affairs and Equality.

Through the inter-ministerial MECD-MINECO-MSSSI working group**, to foster a joint area of knowledge and an accreditation system** for gender studies and guidelines, criteria, incentives and mechanisms to develop the gender related system of knowledge production.

To develop guidelines and manuals, to disseminate good practices for services development and work-life balance resources in the research centres. This is to ease the implementation of activities and resources from the institutional co-responsibility with the objective to avoid biases and gender-related barriers to mobility of the research staff and the promotion of greater stability and professional prestige (according to the recommendations of GENDER-NET).

To **develop guidelines for procedures and criteria update** in the calls for proposals, regulations and specific public research organisation rules aimed at ensuring gender equality in the evaluation of candidatures – selection, recruitment and promotion – like in the composition of the evaluation committees.

To **develop guidelines, good practices guides and dissemination materials in the public research centres, funding RDI agencies and other entities** that facilitate the development of specific and transversal actions for the promotion of scientific-technological vocations and raise the interest for science and technology to little and young girls.

To improve **monitoring, measurement and indicators, and accountability systems for activities and results in gender equality** in the research centres and funding agencies, and any other RDI system stakeholders. This will mean to include in the annual activities reports the inclusion disaggregated data on sex for all of the variables of the analysis.

4.6. Open Science and Open Innovation to Encourage Knowledge Circulation (Priority 5)

Knowledge and technology circulation is, together with the free movement of researchers, one of the principles around ERA (Article 179 of the Lisbon Treaty). The barriers that prevent or limit the free movement of knowledge and technology are the result of several factors, including: (a) the inadequacy of regulatory frameworks to research and innovation processes, which require greater flexibility and adaptation to dynamic and constantly expanding environments and technologies; (b) the separation between research activities and innovation ones, due to the linear model RDI policy; (c) access restrictions imposed by conventional channels of dissemination, and (d) the resistance to change, current norms and behaviour patterns that restrict access to scientific knowledge.

In recent decades, in our country and many countries of the European Research Area, new initiatives of different nature and scope to promote the "transfer" of knowledge have been taken place. The results of these initiatives have had mixed results because of the persistence of the so-called the "European Paradox".

In Spain, the legal framework for knowledge and technology circulation, open access and public private collaboration is provided by the Law. Open Access is an essential component of RDI policies in the latest years and through the promotion of the green open access Spain has put in place a comprehensive network of institutional repositories under RECOLECTA search engine. Since 2013, the State Plan, similar to H2020 promotes the gold open access recognising the eligibility of costs associated to it.

In addition, the Strategy introduced an important change in the traditional policy design for technology transfer, which focused mainly on two key instruments for the efficient knowledge and technology circulation: (1) the public-private collaboration to challenges-focused projects (*Retos Colaboration* grants) and large strategic project led by private companies (*CIEN* grants); and (2) the absorption capacity building in the business fabric through the incorporation of human resources – Torres Quevedo Programme, Industrial Doctorates – and inter-sectorial mobility, closely related to Priority 3. However, and regardless of the measures taken until now, the Spanish System still needs to increase investment in intangible assets (intellectual property - IP) and knowledge, as well as to promote a framework for adequate dissemination and subsequent exploitation targeted to the innovation chain process. In addition, recent advances and the rapid transformation linked to information technology are the source of a much deeper transformation of the way in which research and knowledge are produced and distributed in a digital context.

In this context, there are two aspects that deserve special attention and that integrate the Spanish Roadmap and its contribution to ERA: (1) adequate management of intellectual property rights associated with the results of scientific research and its operating plan; and (2) promotion and implementation of open access for publicly funded scientific research results, and data access provided that it does not limit or discourage private cooperation or erodes the competitive advantages of business partners.

Similarly, the definition of specific actions listed below, have a starting point in efforts currently underway as well as the most recent recommendations of both IPR management and Open Access aspects. There is a need to articulate these actions in a more general context that requires deep structural and behavioural changes.

Thus, the objectives to be achieved in this roadmap and the specific measures proposed include:

4.6.1. Improving IPR Management in Public Research Institutions

To consolidate **a permanent working group with representation of PROs**, universities and different public funding entities for improving IPR management o and exploitation of knowledge so that it: (a) **develops a manual of good practices** and (b) **participates in the design and delivery of training courses on IPR aimed at managers and researchers**.

To monitor the implementation of EC recommendations (2008/1329[1]) on the management of property rights and codes of good practice in universities and public centres.

To develop procedures and standard contracts for RDI management agreed between the public and private sector. To provide users with these models in different languages.

To promote the collaboration between knowledge transfer units of public research centers to increase critical mass and promote specialization

- [1] http://ec.europa.eu/invest-in-research/pdf/ip_recommendation_en.pdf

4.6.2. Strengthening collaboration between public research and industry

Improving the conditions of eligibility, management and funding of R&D to **strengthen RDI projects that favour academic research results exploitation** by innovative companies and especially technology-based and innovative ones.

To promote RDI Human Resources incorporation in private companies by fostering attention to Industrial Doctorate Programmes and the inter-sectorial mobility of researchers. (See Priority 3)

4.6.3. Developing Statistical Indicators and Measuring the impact of Knowledge Transfer Activities

To review, include and **exploit specific variables in innovation surveys of the National Institute of Statistics**.

4.6.4. Implementing Effective Open Science (and Innovation) Policies linked to Public Grants

To **review and adapt existing policies for the promotion of open science** (publication of results and data) covered by – national and international - experiences and recommendations. To define an open access policy between public and private to ensure the necessary balance between the protection associated with the commercial exploitation and open dissemination of scientific results .

To **set targets** [100%] for 2025 for availability of open research results (publications) based in a realistic and sustainable project that includes different models of open access.

To **participate in the re-organisation and coordination of subscription and open access models** with the key resource and scientific information suppliers – publishers – at national level. To define a financially sustainable model in the mid-term in close relationship with the Conference of Rectors of the Spanish Universities.

The **establishment of a permanent network of experts** for the promotion and implementation of open science and who responsible for: a) developing recommendations; b) coordinating specific working groups; c) coordinating information on publication costs, and tracking the degree of implementation of measures and regulations in the field.

To review and adopt measures for the effective promotion of open science and to monitor the calls for proposals of the State Plan, including **manuals, best practices and management forms and open access to research results and data (DMP**).

4.6.5. Strengthening Scientific Culture and Innovation in Open Environments

To hold **outreach sessions and to deliver training courses** to researchers, information managers, academics and public research institutions (e.g.: The Open Science Week).

To create **an award that gives visibility and recognition to institutions that stand out** for their leadership in implementing and monitoring open science promotion models.

4.6.6. Development of Advanced Tools for Analysis and Monitoring Research Activities and Support the Development of Open Science and Research E-Infrastructures

To elaborate recommendations and best practices and to adopt of standards that optimise information management in i**nstitutional repositories and their maintenance, especially in the field of research data**.

To promote Spanish participation in infrastructure projects and open e-infrastructures, including the **European Open Science Cloud (Priority 2B)**.

To design and develop an analysis and foresight platform for results of scientific and technical **natural language processing research based on advanced technologies (NLP) and text mining and data (TDM) for linking RDI public support with the main results disseminated and outputs.**

4.7. International Cooperation (Priority 6)

The dynamics with which new knowledge and innovations are generated, as well as the global and open science and innovation character, makes international cooperation a critical dimension, which is in turn necessary to support and institutionalise as part of RDI policies, and has a direct impact on the ability to attract talent and investment worldwide while providing access to new markets. For the above, it is necessary to add the international cooperation importance in the framework of research and innovation for social challenges, that by definition, scope and nature are not approachable from a purely national optimal and often they even go beyond the European dimension itself.

The internationalization of Spanish Science, Technology and Innovation has made in recent years significant progress in indicators such as: (a) international scientific collaborations; (b) participation in programs, agencies and international infrastructures; and (c) the greater business involvement in technological bilateral and multilateral cooperation programs.

In Spain international scientific cooperation, both in bilateral and multilateral projects, has been channelled traditionally mainly through the research institutions, which creates now a complex web of commitments, projects and activities that depend on those institutions and the researchers themselves.

The Ibero-American Science and Technology for Development Programme (CYTED) created in 1984 has been one of the main vehicles for scientific cooperation[27]. The Centre for Industrial Technological Development (CDTI) has led business technological cooperation for decades and it has its own programs of bilateral cooperation with third countries (Canada, Japan, China, South Korea, India and South Africa). CDTI has an important network of contact points abroad, a network which has recently been reinforced through collaboration with Institute of External Trade (ICEX).

The Spanish Strategy sees international cooperation as key to scientific leadership of institutions and competitiveness of business innovation capacities. It includes the following objectives:

1) To strengthen the bonds of scientific and technological cooperation with third countries, especially Latin America and the Caribbean, and the Mediterranean countries with which there is a long history of cooperation both bilaterally and multilaterally.

2) To improve the visibility of Spanish science abroad, mainly through the creation and consolidation of communities of Spanish researchers abroad.

3) To consolidate excellent scientific and technical research environments for attracting talent, investment, infrastructure and partnerships worldwide.

4) To strengthen innovative enterprises international presence and their participation in international innovation projects.

Therefore, recognising the interest and opportunity that ERA development represents for strengthening international cooperation, and with the aim of contributing to the implementation of the objective set out in the European roadmap, the following objective are identified as priority actions for Spain:

4.7.1. CONSOLIDATING AND PROMOTING BILATERAL AND MULTILATERAL RELATIONS WITH THIRD COUNTRIES

There is a long tradition of scientific and technological cooperation In Spain, especially through intergovernmental cooperation instruments based on flexible participation schemes which are essential in creating collaborative networks of agents in different countries. Thus the specific measures proposed include:

[27] CYTED está integrado por 21 países de habla hispana y portuguesa y desde su creación ha financiado *504 Redes Temáticas y 700 Proyectos de Innovación, con la participación de más de 8.500 grupos de investigación 301, y la implicación de más de 28.700 científicos y tecnólogos iberoamericanos.*

To strengthen relations with **Latin America, the Caribbean and the Mediterranean countries** by aligning research and innovation programs, and training programs for high level researchers and technologists.

To strengthen transnational cooperation through intergovernmental initiatives such as **EUREKA**and **CYTED**, including technology cooperation through **IBEROEKA** Programme.

To strengthen support actions and coupled support for technological collaboration abroad and to promote the presence of companies and Spanish institutions through technology missions in the countries where there is already **a coordinated action at European level (SFIC) and particularly in China, India and the United States**.

To promote and support international cooperation activities led by scientific-technical infrastructures, and centres and units of scientific and technical excellence through available instruments and especially aimed at Latin America and the Caribbean, the Mediterranean, China, India, United States, South Korea and Japan in strategic RDI areas for Spain (astronomy, supercomputing, energy, health and bio-economy).

4.7.2. Coordination and Prospective Analysis of Collaborative Activities in Science and Innovation

To **coordinate cooperation initiatives from PROs** with third countries and to develop a strategy/ catalogue 2025 that gathers the geostrategic priorities and themes to optimise international relations at European level.

To develop an **international collaboration prospective map** supported in the scientific and technical interests and capacities of the PROs and business initiatives (CDTI)

4.7.3. Raising the Visibility of Spanish Science and Innovation in the International Context

To implement **scientific and technological diplomacy** initiative promoted jointly with the Ministry of Foreign Affairs and Cooperation.

To collaborate with the network of Spanish scientists abroad as agents for creating links of scientific and technical cooperation with institutions in third countries.

To collaborate with the *Marca España* to promote science and technology abroad.

5. MONITORING AND INDICATORS

The monitoring of the actions included in the Spanish ERA roadmap will be held annually, corresponding to the State Secretariat of Research, Development and Innovation, supported by the Spanish Platform of Stakeholders of the European Research Area, which has participated in the development and validation of this document.

The monitoring will include measurement and indicators of behaviour such as identified in the Roadmap. Thus every ERA priority will include output and impact indicators linked to the specific measures included in this document.

In this context and taking into account the overall strategic framework of the Roadmap, which includes both the Strategy and the State Plans, indicators of both of them are included hereinafter.

ERA Priority	**1. IMPROVING THE EFFICIENCY OF THE SPANISH SYSTEM OF SCIENCE, TECHNOLOGY AND INNOVATION**	**SNAPSHOT INDICATOR (EUROPEAN ROADMAP)**	***Research Excellence Indicator***		
Objectives	**1.1. MONITORING AND EVALUATION OF PUBLIC RDI POLICIES AND IMPACT OF PUBLIC SECTOR FUNDED ACTIVITIES**	**NATIONAL INDICATORS**	Economic return of Spanish participation in H2020 calls (target: 9,5% in 2020)	Number of projects granted by European Research Council	Share of international experts in evaluation (target: increase 25%)
	1.2. AN EFFICIENT AND FLEXIBLE NATIONAL MANAGEMENT MODEL OF PUBLIC FUNDING				
	1.3. INTERNATIONAL PEERS IN THE EVALUATION OF PUBLICLY FUNDED ACTIVITIES				
	1.4. PROMOTION OF SPANISH RESEARCH GROUPS AND COMPANIES IN HORIZON 2020				
	1.5. PLANNING AND STABILITY OF PUBLIC RDI FUNDS				
	1.6. IMPACT OF RDI PUBLIC INVESTMENT AND THE POLICY COORDINATION BETWEEN THE CENTRAL GOVERNMENT AND THE AUTONOMOUS COMMUNITIES				
ERA Priority	**PRIORITY 2.A. FACING TOGETHER GRAND CHALLENGES OF THE SOCIETY**	**SNAPSHOT INDICATOR (EUROPEAN ROADMAP)**	***GBARD allocated to EU transnational cooperation***		
Objectives	**2.A.1. IMPROVING GOVERNANCE, STRATEGIC PLANNING AND MANAGEMENT COORDINATION**	**NATIONAL INDICATORS**	Budget allocated to transnational cooperation as % of total competitive National Plan Funds	Number of activities related to transnational cooperation as % of total	
	2.A.2. OPTIMIZATION OF COORDINATION AND FUNDING MECHANISMS BETWEEN NATIONAL CALLS AND ACTIONS FOR JOINT PROGRAMMING				
ERA Priority	**PRIORITY 2.B. OPTIMIZING INVESTMENTS IN RESEARCH INFRAESTRUCTURE**	**SNAPSHOT INDICATOR (EUROPEAN ROADMAP)**	***Availability of national roadmaps with identified ESFRI projects and corresponding investment needs***		
Objectives	**2.B.1. STRENGTHENING STRATEGIC PLANNING AND COORDINATION OF INFRASTRUCTURES INCLUDED IN THE ESFRI ROADMAP SUPPORTED BY SPAIN AND THE NATIONAL SCIENTIFIC AND TECHNICAL INFRASTRUCTURES (ICTS)**	**NATIONAL INDICATORS**	% Increase in number of projects in collaboration ICTS	% Increase in number of ICTS recognized and in use following targets set in Mapping ICTS	Economic returns from Industry of Science
	2.B.2. SUPPORTING E-INFRASTRUCTURES AND PROMOTING THE INTEROPERABILITY OF RESEARCH INFRASTRUCTURES (RIS)				

	2.B.3. STRENGTHENING AND CONSOLIDATING THE SPANISH SCIENCE INDUSTRY LINKED TO MAJOR RESEARCH INFRASTRUCTURE NATIONAL AND INTERNATIONAL PROJECTS **2.B.4. OPTIMISING NATIONAL AND EU SOURCES IN LARGE RESEARCH INFRASTRUCTURES FUNDING**				
ERA Priority	**3. CONSOLIDATING AN OPEN LABOUR MARKET FOR RESEARCHERS**	**SNAPSHOT INDICATOR (EUROPEAN ROADMAP)**	***Researchers' posts advertised through the EURAXESS job portal per thousand researchers in the public sector per year.***		
Objectives	**3.1. PROMOTING MOBILITY OF RESEARCHERS** **3.2. OPENING UP THE PUBLIC RESEARCH SECTOR AND THE INCORPORATION OF RESEARCHERS** **3.3. IMPROVING INSTITUTIONAL COORDINATION AND GOOD PRACTICES BETWEEN THE ADMINISTRATIONS AND RESEARCH INSTITUTIONS**	**NATIONAL INDICATORS**	Share of HRST employed in the public sector whose qualifying degree has been obtained abroad	Percentage of Universities and Public Research Organisations awarded the "HRS4R" logo	Percentage of doctoral programmes consistent with Innovative Doctoral Training Principles
ERA Priority	**4. PROMOTE GENDER EQUALITY AND THE GENDER DIMENSION IN RESEARCH**	**SNAPSHOT INDICATOR (EUROPEAN ROADMAP)**	***Percentage of women in A grade in academic positions***		
Objectives	**4.1. REVIEWING AND ADAPTING PROCEDURES AND CRITERIA USED IN PUBLIC CALLS** **4.2. DEVELOPING GUIDELINES, PROMOTING BEST PRACTICES AND TRAINING**	**NATIONAL INDICATORS**	Share of women participating in R&D evaluation panels (target: at least 40%)	Share of universities and Public Research Organizations which have adopted Gender Equality Plans	Percentage of funds in R&I projects that include gender dimension as a cross cutting issue
ERA Priority	**5. ENCOURAGE OPTIMUM CIRCULATION OF KNOWLEDGE AND OPEN SCIENCE AND INNOVATION MODELS**	**SNAPSHOT INDICATOR (EUROPEAN ROADMAP)**	***Percentage of product or process Innovative firms cooperating with higher education institutions or public research institutions for their innovation activities***		
Objectives	**5.1. IMPROVING IPR MANAGEMENT IN PUBLIC RESEARCH CENTERS AND UNIVERSITIES**	**NATIONAL INDICATORS**	Revenue percentage of	Private investment	Number of exchanges of

	5.2. STRENGTHENING COLLABORATION BETWEEN PUBLIC RESEARCH AND INDUSTRY **5.3. DEVELOPING STATISTICAL INDICATORS AND MEASURING THE IMPACT OF KNOWLEDGE TRANSFER ACTIVITIES**		Public Research Organisations and universities by patents and licenses granted	mobilized for the joint implementation of R&D actions/Public Investment	researchers between public research centres and the private sector
ERA Priority	**5. ENCOURAGE OPTIMUM CIRCULATION OF KNOWLEDGE AND OPEN SCIENCE AND INNOVATION MODELS**	**SNAPSHOT INDICATOR (EUROPEAN ROADMAP)**	***Percentage of Open Access papers (gold and green only)/Total number of academic papers***		
Objectives	**5.4. IMPLEMENTING EFFECTIVE OPEN SCIENCE (AND INNOVATION) POLICIES LINKED TO PUBLIC GRANTS** **5.5. STRENGTHENING SCIENTIFIC CULTURE AND INNOVATION IN OPEN ENVIRONMENTS** **5.6. IMPROVEMENT OF OPEN SCIENTIFIC RESOURCES – RESULTS AND DATA - DEVELOPMENT OF ADVANCED TOOLS FOR ANALYSIS AND MONITORING AND SUPPORT OF OPEN RESEARCH E-INFRASTRUCTURES**	**NATIONAL INDICATORS**	Development and full implementation of the open access policy of Law 14/2011	Share of repositories that have adopted standards and best practices for management of research data	Share of universities and Public Research Organizations which have adopted open Science models/plans
ERA Priority	**6. INTERNATIONAL COOPERATION**	**SNAPSHOT INDICATOR (EUROPEAN ROADMAP)**	***International scientific co-publications with non-ERA countries per 1000 of researchers in the public sector***		
Objectives	**6.1. CONSOLIDATING AND PROMOTING BILATERAL AND MULTILATERAL RELATIONS WITH THIRD COUNTRIES** **6.2. COORDINATION AND PROSPECTIVE ANALYSIS OF COLLABORATIVE ACTIVITIES IN SCIENCE AND TECHNOLOGY** **6.3. RAISING THE VISIBILITY OF SCIENCE AND INNOVATION IN THE SPANISH INTERNATIONAL CONTEXT**	**NATIONAL INDICATORS**	Nº activities, researchers and firms participants from LAC and Mediterranean countries	Development of an international collaboration prospective map on S&T capacities with third countries	