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COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT

Accompanying the document

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF REGIONS

A Reinforced European Research Area Partnership for Excellence and Growth

(Text with EEA relevance)

{COM(2012) 392 final}
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1. PROCEDURAL ISSUES AND CONSULTATION OF INTERESTED PARTIES

1.1. Policy context

The European Research Area (ERA) is a unified research area open to the world based on the Internal Market, in which researchers, scientific knowledge and technology circulate freely and through which the Union and its Member States shall strengthen their scientific and technological bases as well as their competitiveness and their capacity to collectively address grand challenges.

ERA was launched with the European Commission's **Communication 'Towards a European Research Area**' in January 2000[1] and was subsequently endorsed by the EU at the March 2000 Lisbon European Council. The **Lisbon Treaty** gives a new impetus and status to ERA, as it is now one of the key objectives of the Union[2]. Achieving ERA is thus a legal obligation for the EU and the Treaty provides a new basis for ERA policy.

The contribution of research to innovation and growth is precisely the aim of the 2010 **Innovation Union (IU) flagship** initiative launched as part of the **Europe 2020 Strategy**[3]. The IU Flagship announced for 2012 an **ERA framework and supporting measures** to remove obstacles to mobility and cross-border co-operation, to be in force by the end of 2014. This was endorsed by the European Council of 4 February 2011 (Council of the European Union, 2011 and reiterated by the European Council of 2012: *"Innovation and research are at the heart of the Europe 2020 strategy. Europe has a strong science base but the ability to transform research into new innovations targeted to market demands needs to be improved. (...) efforts must be stepped up with a view to: – completing the European Research Area by 2014; in this connection the European Council welcomed the Commission's intention to propose an ERA framework in June 2012; – improving the mobility and career prospects of*

1 COM(2000) 6 final
2 Article 179 (1) TFEU.
3 http://ec.europa.eu/europe2020/index_en.htm

researchers; – rapidly establishing and implementing the inventory of EU-funded R&D and the single innovation indicator; (...)".

In a context of economic crisis, the completion of the European Research Area focusing on research and research-based solutions is even more urgent to support economic growth, scientific excellence and cohesion amongst regions and countries. Action is needed to overcome the negative effects of national fragmentation in the design and implementation of research policies and activities on Europe's research effectiveness. Measures should aim at increasing competition and exploiting cross-border synergies between national research systems, facilitate researcher careers as well as mobility, and the free circulation of knowledge, addressing thus the research component of the broader Innovation agenda of the Commission[4].

This Impact Assessment report accompanies the Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee on 'A Reinforced European Research Area Partnership for Excellence and Growth', which presents actions responding to the need to complete ERA by 2014. This Communication was announced in the Commission's 2012 Legislative and Work programme (European Commission, 2010a).

1.2. Organisation and timing

The Commission's Directorate-General for Research and Innovation is the lead DG for this initiative.

Consultation with other Directorate-Generals (DGs) was carried out through the ERA inter-service group (ISG) and additional bilateral meetings. The ERA ISG, chaired by the RTD Deputy Director-General in charge of Innovation and ERA, included representatives from the following DGs: SG, SJ, AGRI, BEPA, COMP, DEVCO, EAC, ENV, ELARG, EMPL, ENER, ENTR, ESTAT, HOME, INFSO, JRC, MARE, MARKT, MOVE, REGIO, SANCO and TRADE. Most DG RTD Directorates were also represented[5]. The ERA ISG acted as the Steering Group for the ex-ante Impact Assessment and was convened for the identification of the problems (June 2011), the identification of policy options (October 2011) and the completion of the ex-ante Impact Assessment and Communication (February and March 2012 and consulted on the revised version of the Impact Assessment report in April 2012). The Legal Service was also consulted on several occasions.

In addition, bilateral meetings were organised with representative stakeholders: European Research Council (ERC), European Free Trade Association (EFTA), European Association of Research and Technology Organisations (EARTO), European University Association (EUA), Science Europe and League of European Research Universities (LERU). These meetings focused on the identification of problems in specific research sectors, policies and possible ways forward. The European Parliament, the Committee of the Regions and the European Economic and Social Committee were also informed of the public consultation and Impact Assessment work.

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4 COM(2010) 546 final

5 The Directorates present included Dir A, Dir B, Dir C, Dir D, Dir E, Dir F, Dir G, Dir H, Dir I, Dir K, Dir M.

1.3. Consultation of interested parties and expertise

Several activities were carried out to consult stakeholders to gather the necessary evidence. Relevant activities included stakeholder consultations via a broad web-based public consultation (public consultation on the ERA Framework), conferences, numerous meetings with Member State representatives, experts and academics, high-level panels with leading experts/academics as well as studies and research projects. A summary of these activities is presented in Annex 1.

The various stakeholder consultations were crucial for identifying key issues hampering the development of ERA. The public consultation on the ERA Framework (from 13 September 2011 to 30 November 2011) provided an opportunity for a wide range of stakeholders to express their views on priorities for ERA. It gathered a total of 691 responses (590 responses to the online questionnaire and 101 ad-hoc contributions/position papers) from researchers (51% of respondents), research performing/funding organisations[6] (17%), citizens (12%) and the private sector (7%)[7]. The summary of the outcomes is provided in Annex 1.

The various stakeholder consultations revealed common concerns and issues within each group of actors. The key messages emerging were as follows:

For researchers, the key concerns are the low attractiveness of careers, the limited freedom of career movement and the lack of opportunities for cross-fertilisation of ideas. Key EU-level stakeholders[8] emphasised that researchers face insufficiently transparent procedures for appointment, hampered access to research results and insufficient interoperability of data repositories whilst grants are not easily portable or accessible to non-residents.

For research performing/funding organisations, more should be done to achieve excellence in research and better coordinate efforts for tackling grand challenges in Europe and internationally. Several stakeholder organisations[9] indicated that cross-border cooperation, increased pan-European competition and further support to suitable infrastructures and mechanisms for open access publishing and data repositories were desirable features for ERA. This group of stakeholders indicated the urgency to better involve them better in ERA policy.

For the private sector, there is general concern about the lack of highly-skilled and well-trained researchers in Europe. Industry also called for enhanced cooperation between education providers and the business sector. According to the ERA Framework consultation, businesses believe that the private sector academia and the business sector do not cooperate sufficiently. Small and medium-sized enterprises (SMEs) call in particular for enhanced cooperation/dialogue mechanisms and platforms between research stakeholders.

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6 This category includes universities and higher education institutions, public research organisations and research funding organisations.

7 International organisations, national governments and other stakeholders also replied to the online questionnaire (4% of respondents, 2% of respondents and 7% respectively).

8 These include: European Council of Doctoral Candidates and Junior Researchers, European University Association, League of European Research Universities and Science Europe.

9 These include: Association of European Research Libraries, European Research Council, European Intergovernmental Research Organisations, European University Association, German Research Foundation, International Federation of Library Associations and Institutions, Institut National de la Recherche Agronomique, League of European Research Universities, Science Europe, SPARC Europe.

For Member States and Associate countries, action is needed at EU level to complete ERA to improve attractiveness of research careers and remove obstacles to mobility, enhance cross-border operations and support open access. Several Member States have underlined the need to promote excellence in research and to focus on global challenges. They have also called for strengthened cooperation between academia, research institutes and industry, whilst favouring a soft/voluntary approach based on best practices rather than hard legislative measures. Member States also pointed out the need to offer better career prospects through enhanced social security rights and easier grant portability.

In addition, the "Opinion on the development of an ERA Framework"[10] issued by the **European Research Area Committee** contributed to the identification of possible actions.

An informal meeting with **Directors General of the 27 EU Member States Ministries** took place in April, 2012. The DGs supported the overall approach and the ERA priorities envisaged, notably the choice to consider first the use of voluntary actions to complete ERA. Regarding measures to reinforce the partnership, they requested to take account the important relationship between national governments and national research actors, notably funding organisations.

1.4 Opinion of the Impact Assessment Board

Following the opinion of the Impact Assessment Board on the resubmitted report, this document includes a revised version of the problem definition, notably the gender aspects, it presents, when evidence is available, the efforts taken since 2000 on the specific barriers considered in this Communication. The presentation of the impacts and comparison of the policy options has been strengthened and includes the feedback of stakeholders. The proposed monitoring system is now presented in detail.

2. PROBLEM DEFINITION

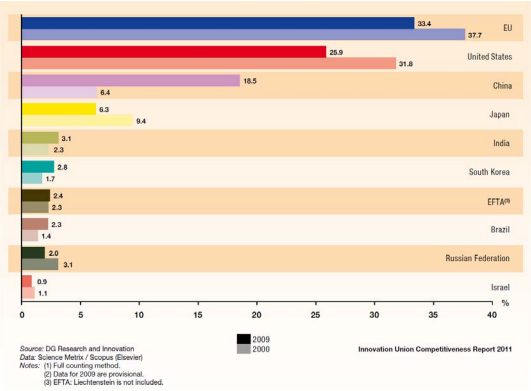
2.1. The urgent need to improve research effectiveness in the EU

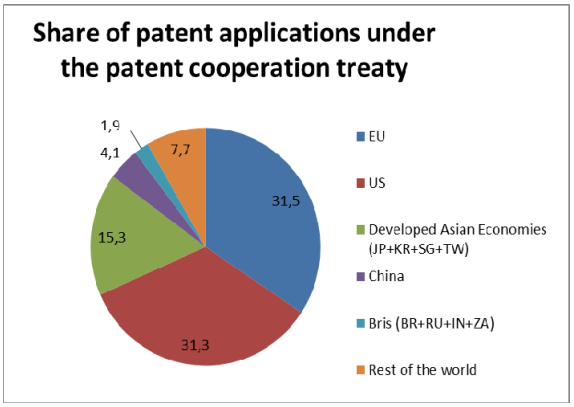
European research is still among the best in the world. In many areas, research has enabled European companies to be leaders or first movers in technology development and be ahead of the game in many areas, setting the standards and performance levels for others to follow. For example, Europe has introduced "fly-by-wire" in the commercial aircraft industry and GSM in mobile telecommunications, promoted the growth of capabilities in satellite development and launch, invented the compact disc, and more recently fostered the emergence of the wind energy industry. Moreover, Europe is still the best producer of scientific publications worldwide and facing competition from emerging actors, it had lost less of its world share than the United States. Europe also generates more than 30% of world patent applications. (see Figure 1 below). Also, EU inward Foreign Direct Investment (FDI) in R&D is holding up, bucking the trend of a decline in overall inward FDI[11].

[10] ERAC 1215/11

[11] "Internationalisation of business investments in R&D and analysis of their economic impact", study commissioned by DG Research and Innovation, forthcoming

Figure 1: World share of scientific publications (2000 and 2009) (left) and EPO patent applications by inventor's country of residence (2007) (right)





However, Europe suffers from an innovation gap with the US, Japan and other competitor economies. The 'Innovation Union Scoreboard 2011' (European Commission, 2012a) shows that the US, Japan and South Korea have a performance lead over the EU27[12]. New economic powers such as Brazil, China and India have emerged and their R&D weight is already growing. This implies that, on the one hand, Europe is losing ground, in relative terms, in producing knowledge. Europe's share of publication is declining, not because Europe is publishing less, but because others are publishing more. Besides, the world share of the EU in excellent research is lower than that of the US: in 2007, Europe and the US produced respectively 32.4 % and 34.2% of the top-10% most cited scientific publications worldwide (European Commission, 2011c). On the other hand, global innovation leaders such as the US and Japan are particularly ahead of the EU27 on indicators of business activity. This reflects a lower presence of EU industry in sectors based on new technological paradigms (such as ICT and biotechnologies), as Europe has been less able, compared to the US, to develop competitive new technology-based business[13].

Europe also faces a series of crucial internal challenges: economic and financial crisis, low growth, ageing population, and a diverse set of environmental and grand challenges. To tackle these, Europe 2020 and the Innovation Union flagship initiative has put innovation at the centre of the EU's economic strategy. To respond to the many factors of Europe's weak innovation performance[14], the IU flagship sets up a comprehensive agenda to improve conditions and access to finance for research and innovation in Europe, to ensure that innovative ideas can be turned into products and services that create growth and jobs. One major component in the Innovation Union Flagship which requires action is research.

12 For instance, the US is performing better than the EU27 in 10 indicators, in particular in tertiary education, international co-publications, most cited publications, R&D expenditure in the business sector and public-private co-publications.

13 Three symptoms of this are the deficits of the EU vs. the US in terms of volume of private sector R&D investments (EU: 1.27% of GDP, US: 2.12% of GDP in 2009), of patenting (25% of triadic patent families originated from the EU in 2007 vs. 35% originating from the US) and of medium and high-tech product exports (representing 47% of total EU products export in 2008 vs 59% of total US products exports) in 2008 (European Commission, 2011c, and Pro Inno Europe, 2009) .

14 An overview of the most important explanations for the European innovation underperformance has been developed in section 2.3 of the Commission Staff Working Document "A rationale for action" accompanying the Commission's Communication Innovation Union

First, Europe invests too little in research compared to major competitors. In relative terms, the investment is lower than in the US (1.92% of GDP in Europe - or 201 billion Euros PPP in 2008- vs. 2.79% of GDP in the US (or 283 billion Euros PPP in the same year) (Eurostat). Recognizing that Europe's future growth relies to a large extent on research and innovation, the European Council reaffirmed in March 2010 that the overall R&D investment level should be increased to 3% of EU GDP as part of improving the conditions for research and development.

Second, knowledge production is concentrated in a relatively small number of Member States as indicated by the distribution of 10% of the most cited scientific publications and the share of patents applications by inventor's country application (Annex 2). This partly reflects the volume of public R&D expenditure in these Member States when compared with the rest of Europe (the GBAORD of DE, FR, IT, UK represented 64% of the total EU GBAORD in 2010) as well as the number of researchers in Member State.

Last but not least, Europe is short in the cutting-edge research that can deliver the breakthroughs required to fuel science and technology (S&T)-based business development. The EU deficit with respect to the US in scientific excellence is particularly important in some fast-moving fields which are precisely those where the US has generated most S&T-based growth (e.g. Information and Communication Technologies, Nanotechnology, Biotechnology, Molecular biology, Genetics). The EU deficit with regard to the US in the field of nanotechnologies is presented in Box 1 below.

Box 1: Research investment and research outputs: comparison between the EU and key third countries in the area of nanotechnologies

The case of nanotechnology is a good illustration of the underperformance of the European research system. In this key enabling technology, which is critical for future international competitiveness, the EU spends more public money annually than other countries. According to several recent estimates (NMP Scoreboard, 2011, Roco et al., 2010, OECD 2009), the European Union spends around 1.5 billion Euros annually (including the 27 Member States' national funding and EC funding), which is considerably more than the USA (1 billion Euros), Japan (0.47 billion Euros) and China (0.1 billion Euros).

However, if one looks at highly cited scientific publications in this field, 10% of EU publications are in the top 10% most cited publications, compared to 16.1% for the USA, 5.4% for Japan and 8.1% for China. Another indication of Europe lagging behind is the market introduction of nanotechnology-based products and applications. According to a recent nanotechnology product inventory compiled by the Project on Emerging Nanotechnologies at the Woodrow Wilson International Centre, a total of 53% of identified nanotechnology-based products come from the US, followed by companies in East Asia (24%), Europe (15%), and other world regions (8%). Fragmented public funding in Europe leads to lower scientific and technological outputs per euro invested: the efficiency of EU countries can be seen lagging behind the US and the OECD average.

Overall European underperformance and differences in scientific output and quality amongst Member States entail missed opportunities notably in terms of growth and jobs. This is due to a variety of national, local-specific and international factors. Although it is difficult to disentangle research-specific factors from those outside the research field (i.e. factors linked to the overall economic structure and performance of a country, its labour market, the quality of its infrastructure and education and training systems, etc.) 'structural' factors such as different national approaches to competition for funding and cross-border cooperation, as well as to the fragmented labour markets for researchers; "delocalised" working methods; and policies promoting access to scientific knowledge and high speed interconnection of research centres with the availability of shared high performance computing services and unique collections of research information and data are specific to research policy. These underlying problems act as 'structural' breaks, as they do not permit the development of adequate

framework conditions for research and innovation at national and European level – i.e. they constitute barriers or obstacles to the completion of ERA. In addition, the current highly variable and fragmented way of structuring research in Europe is not fostering open innovation, essential to enhance competitiveness and attractiveness of the European economy. A more co-ordinated approach to reduce this fragmentation between Member State research systems and removing barriers to competition and cooperation could act as drivers to improve the effectiveness of research in Member States and on the European level (and notably in less-advanced Member States). Reducing fragmentation and increasing effectiveness is even more important in times of budgetary austerity and when there is a need to optimise the innovation, economic, social and environmental returns on research investments.

2.2. Main problems hampering research performance in ERA

Since 2000, the European Union and Member States together have progressed towards a European Research Area. Commission initiatives supported by the Framework Programme include the European Research Council for basic research, ERA-NETs for the coordination of European, national and regional research programmes (e.g. E-Rare which co-ordinates almost half of rare disease research in Europe) and 'Article 185s' which integrate EU, national and regional efforts into a single European programme (e.g. the EMRP metrology or science of measurement initiative pools 44% of EU-wide resources into a single programme). Significant progress has also been made under Member States led ERA Partnership initiatives - Joint Programming[15] continues to gain momentum and political commitment, with the 2010 guidelines on framework conditions for joint programming in research[16] produced by the Member States providing an excellent basis on which to move to joint implementation; the 'European Partnership for Researchers[17] has led to improved management of research careers in a growing number of institutions by, *inter alia*, promoting take-up of the Commission-proposed Charter & Code[18] - furthermore, national efforts and the Framework Programmes have facilitated mobility for 30% of EU researchers[19]; The Knowledge Sharing[20] initiative has helped to ensure that all Member States have policies paying attention to the dissemination of knowledge. In the area of research infrastructures, a major step towards a coordinated policy approach was the establishment of the European Strategy Forum on Research Infrastructures, the e-Infrastructure Reflection Group and the first ever European Roadmap for Research Infrastructures in 2006 - subsequently up-dated in 2008 and 2010. Furthermore, since the entry into force of the Community legal framework for a European Research Infrastructure Consortium (ERIC[21]) in 2009, 12 European research infrastructures have been launched[22]. European Commission has also played a major role in supporting and coordinating the European level e-infrastructure development, especially in the areas of connectivity, high-performance computing and grid computing resources development. As a result, 8800 research and education institutions in 40 countries are benefiting from high-speed connectivity through GEANT with global connections, 24 countries have joined the

15 COM(2008) 468

16 http://ec.europa.eu/research/era/docs/en/voluntary_guidelines.pdf

17 COM(2008) 317 and Conclusions of the Competitiveness Council on 25 and 26 September 2008

18 COM(2005) 576

19 In the last three years, 30% of researchers have worked abroad for a period of at least three months.

20 COM(2008)1329

21 Designed to facilitate the joint establishment and operation of research infrastructures of European interest http://ec.europa.eu/research/infrastructures/index_en.cfm?pg=eric

22 10 out of the 48 projects of the 2010 ESFRI Roadmap are now in the implementation phase and another 16 are proceeding so well that the start of their implementation could be envisaged before the end of 2012

Partnership for advance Computing in Europe (PRACE), the European Grid Infrastructure (EGI) supports 221 different scientific communities to share resources by means of a reliable and sustainable system.

However, Member States should take more ownership of the ERA and translate it into national policies which could contribute to constructing ERA, building policy coherence across borders and across policy levels. Several barriers at national level[23] continue to act as major breaks to the development of adequate R&D framework conditions. These barriers negatively impact on the effectiveness of Europe's research and hamper the free movement of researchers, scientific knowledge and technology. Some are specific to the research field and should be addressed through policy intervention. These barriers are analysed in the sections below. The problem tree is presented in annex 6.

2.2.1. Insufficient competition in national research systems

The level of competition amongst researchers, research teams and institutions is determined in a large part by the way public funding mechanisms are organised at national level (i.e. how public resources are allocated to researchers, research teams and institutions). Competitive funding implies that several research teams compete for project funding. In the EU, the share of public funding (i.e. government budget appropriations or outlays on research and development – GBAORD) allocated competitively varies a lot, between 20% and 80% with an average of 40% allocated through open calls for research proposals (See Annex 2). The remaining share is allocated via 'institutional funding' (i.e. funding allocated as block funding to institutions), but the share of it linked to their performance varies greatly. The majority of universities in the EU still heavily rely on public 'institutional' funding not related to performance (OECD, 2011).

As a consequence, researchers, universities and research institutions throughout the EU do not face the same level of competition for accessing public funding. This is particularly problematic as there is clear evidence in the academic literature that excellence in science is linked to competition between researchers (Franzoni, Sclelatto and Stephan, 2011). Scientists evaluated through comparable international benchmarks (e.g. analysing their international publication patterns) achieve higher research quality[24]. The literature also demonstrates a clear link between a more competitive funding environment for universities and the productivity of the whole research system in terms of the number of publications per euro invested (Auranen and Nieminen, 2010). Competition for funding acts as a strong incentive for research institutions a) to improve their financial capacities, b) to increase the visibility of individual research institutions, c) to attract and retain the best brains and d) to attract more students, access additional funding etc. (Harris, 2005, p.36). Conversely, limited competition leads to insufficient specialisation: many European universities spread their research activity too thinly across many subject areas (Mitsos et al., 2012). Without international competition, it is difficult for each university or research organisations to identify those areas in which their teams are (or could be) competitive. Last but not least, competition ultimately pays off.

[23] They were identified using the following criteria: 1. Compelling political logic; 2. Potential for radical improvement; 3. Short-term feasibility; 4. Fundamental for sustained long-term reform; and 5. No additional public resources required.

[24] The launch of the Excellence Initiative in Germany, the adoption of a similar program in France for the selective funding of laboratories and universities, the creation of professional agencies for ex ante selection of research in France and Poland, and for ex post evaluation of research in Italy, all bear witness to a keen recognition for the need to inject more transparency, openness and competition into research funding across Europe.

Innovation leader countries in Europe[25] with open and competitive systems tend to exhibit stronger records of scientific quality, as measured by average citations (Mitsos, et al, 2012).

Furthermore, researchers, research teams and research programmes and proposals are not evaluated with comparable standards. Member States' evaluation systems are national-specific and do not use - in most case - comparable standards. This results in the fact that Member States with similar shares of competitive funding do not necessarily generate comparable levels of research quality. In some countries peer-review processes are very conservative, inward-looking or complacent (Harris, 2005, p.36). Progress is observed in a limited number of national funding agencies which have introduced evaluation by international peer-reviewers, by using the European Research Council evaluation for national funding decisions and by jointly organising trans-national competition between trans-national teams in some specific fields (e.g. 'Open Research Area', Nordforsk initiatives and the Lead Agency Cooperation scheme). Increasing compatibility (even calibration) between the European Research Council and national research councils is also observed, as the latter progressively 'accept' the ERC evaluation results as a basis for awarding national grants to highly-rated researchers who fail to obtain ERC funding (European Commission, 2010f). However, these initiatives represent a limited share of total research public funding, therefore their impact on removing sheltered funding and increasing competition amongst researchers and research teams is bound to remain limited.

2.2.2. Barriers to pan-European cooperation and competition remain

Pan-European research cooperation has been concentrated around some major initiatives: the Framework Programmes, and the European Space Agency (ESA), the European Molecular Biology Laboratory (EMBL), European Organisation for Nuclear Research. According to estimates by the European Commission, trans-nationally coordinated public funding in Europe represented around 12% of national GBAORDs in 2010, of which 7.6% for FP7 activities, 2.5% for the activities carried out by ESA, and 1% for other transnational performers. This implies that only 0.8% of national GBAORDs is used for joint programmes identified by Member States, including those supported or co-funded by the European Commission, such as ERA-Nets, Article 185 activities, etc. Only a minor portion of the budget is allocated to trans-nationally coordinated bi- or multi-lateral programmes[26] such as DEUFRAKO (French-German cooperation in transport research) and the number of initiatives, even if rising steadily, remains too low. Evidence from cross-border cooperation through the Framework Programmes shows though that it is possible to improve R&D performance by increasing spill-overs between sectors and nations, and leverage additional public and private research investment by coordinating activities amongst Member States. The evidence shows also that "imposed" contractual requirements of the Framework Programmes have brought down the average number of steps for connecting two random entities, from 6 to 2.1-2.5 steps (Di Pietrantonio, 2009). This means a strong degree of networking and of dissemination and knowledge across Europe. The evaluation of schemes such as ERA-NET and Articles 185 and 187 initiatives, facilitated since FP6, shows their strong structuring and economic impacts[27]. The launch of the Joint Programming process has

[25] E.g. Scandinavian countries, NL and CH.

[26] This does not include EU and EU-funded initiatives such as the ERA-Nets, Art. 185, etc.

[27] The leverage effect of FP funding is close to 5 Euros for the ERA-NETs and 2.5 Euros for the ERA-NET Plus. Participating researchers indicate the strong structuring impact and confirm that these schemes enable transnational R&D activities (85.5% of respondents), reduce duplication between national programmes (37.5%), increase the thematic focus in existing (38%) or new programmes

enabled Member States to start coordinating their research agendas in areas linked to grand challenges[28]. This mechanism entails the definition, development and implementation of a common strategic research agenda. Despite the existence of these initiatives, there are still significant barriers preventing Member States from cooperating in a more systematic manner.

The most important barriers are linked to the low compatibility and interoperability of national research programmes. Current features, organising and functioning principles of national research programmes do not provide sufficient flexibility for national programmes to cooperate[29]. As a result, it is difficult for researchers to establish cross-border research projects using national project funding, only some national programme cycles are synchronised, proposal and project evaluation systems and notably the use of fair and transparent international peer review selection differ. This problem is particularly important in the field of grand challenges where research efforts need to reach a critical mass, and where national research programmes designed and implemented within national borders do not reach the required scale and scope for generating the necessary breakthroughs. Moreover, national programmes are not inclined to align their mainstream research agendas, meaning that Member States tend to fund the same type of research. This leads to unnecessary duplication and insufficient scale and scope at EU level. This also implies insufficient funding left to supporting innovative scientific approaches (i.e. which are outside the mainstream agenda). Evidence of these problems has been documented for instance in the field of Cancer Clinical Practice Guidelines and organic food security (Delanghe, Muldur, Soete, 2009).

The low level of cross-border co-operation in research programmes implies that Europe is not using opportunities for enhancing the quality and impact of its research. Quantitative evidence of bibliometric and patent-based patterns show that the average impact (as measured by citations) of internationally co-authored work in most countries is significantly higher than purely domestic papers (see Annex 2)[30]. Similarly, inventions resulting from international cooperation have on average a higher impact than purely national ones (Guellec and Dernis, 2008). It is therefore not surprising that the EU has one of its highest scientific impacts in 'space' where research activities are highly coordinated and integrated across European countries[31]. Two other fields where cross-border collaboration rates are higher in the EU are 'physics' and 'earth and environmental sciences' in which respectively 85% and 50% of EU

(34%), stimulate good practices and innovations in programme designs (over 50%) and positively influence national programme budgets (46%). The interim evaluation of two Art.185 initiatives (AAL and EUROSTARS) shows that they have created substantial leverage effect, integrated national programmes and pooled. A recent study on FP6 behavioural additionality (IDEA Consult, 2009) indicates that national projects would have led to a smaller range of potential applications and a smaller number of marketable products without FP6 funding.

28 For instance, 23 Member States and Associated Countries have committed on a voluntary and variable geometry basis to the Joint Programming Initiative 'Neurodegenerative diseases/Alzheimer's'. The first two calls were launched in 2011 with a budget of 14 million Euros. For more details, see http://www.neurodegenerationresearch.eu/

29 A survey of 127 national programmes (Optimat, VDI/VDE-Innovation and Technik, 2005) identified among the internal barriers the 'traditional' approach to national programme design, the lack of explicit criteria encouraging transnational activities (the transnational proposals will be *de facto* disadvantaged in the selection process) and existing legal frameworks explicitly forbidding the transfer of funds to non-residents researchers. In 2007 the Commission (COM(2007) 161) indicated that national and regional programme 'owners' are reluctant to restructure their programmes in a way which would enable the development of genuine joint programmes.

30 Exceptions are the US, China and India which have a large pool of domestic researchers.

31 Over the period 2000-2009, the Average of Relative Citations of EU publications in Space (1.25) was higher than that of US publications (1.11).

publications involve authors based in several Member States. In Germany, France and the UK, these two fields are among those with the highest scientific impact[32].

Barriers remain also in terms of access to large national research facilities of European interest for non-nationals as well as to pan-European research infrastructures for scientists working in non-participating Member States, as this is determined on a variable geometry basis. In both cases, access is determined on a national basis, linked with national preference. Difficulties in accessing research infrastructures are frequently cited as an obstacle to the development of ERA by stakeholders[33].

Member States activities on research infrastructures are not yet well incorporated into national research strategies. Large research infrastructures can increase the efficiency of research efforts, as they offer scale and scope and thus allow results to be delivered faster and at a lower cost compared to fragmented efforts. Evidence shows that the ratio between publications of pan-European RIs and budget/staff is much higher than the ratio achieved by national research facilities (see Annex 2 for further evidence). The European Strategy Forum on Research Infrastructures (ESFRI) has been the key driver for the establishment a coordinated mechanism for assessing the needs and priorities for new European RIs. The ESFRI process and Roadmap have triggered similar policy development at Member States level, with a majority of Member States having adopted or preparing such national roadmaps. EU initiatives have also addressed the issue of legal forms for European research infrastructure consortia (ERIC) adapted to the needs of new European infrastructures, responding to requests from EU countries and the scientific community. So far, two initiatives have been awarded the ERIC status by the Commission[34] and 10 more are in the process of being established as ERIC. Despite the remarkable progress made by ESFRI, the efficient development and maintenance of research infrastructures of pan-European interest is currently hampered by the fact that evaluation, monitoring and impact assessment mechanisms are not sufficiently harmonised across the EU. Political willingness and means to implement the reforms required are insufficient.

2.2.3. Persisting distortions among national labour markets for researchers

Barriers remain to the implementation of open, transparent and merit based recruitment. Research shows that countries without sufficiently open, transparent, merit-based recruitment procedures coupled with relatively closed and unattractive research systems, high levels of endogamy and low levels of staffing autonomy are more likely to underperform in terms of research outcomes. Recruitment practices are not always transparent, for example, criteria for selection are not always advertised with the position or the rules for the identification of the members of the evaluation panel are not always known nor are they comparable across Member States. In seven Member States researchers' positions openings are not (or rarely) advertised through the common portal Euraxess Jobs Portal while in other countries the use of Euraxess varies significantly, creating information asymmetries for potential candidates. In several Member States, the institutions lack autonomy to select and hire staff. For example, in nine Member States, universities and research performing organisations face tight restrictions over hiring staff (European University Association, 2011). In four Member States the

[32] ASSIST project – Regular collection of bibliometric indicator, CWTS-Leiden university using Web of Science data.

[33] Stakeholders' contribution to Horizon 2020 (European Commission, 2010)

[34] These are Survey for Health Ageing and Retirement in Europe (SHARE-ERIC) and the Common Language Resources and Technology Infrastructure (CLARIN-ERIC).

appointment of some or all senior positions needs to be confirmed by an external authority (European University Association, 2011). Inbreeding practices seem to prevail in Mediterranean countries and in the Eastern Member States (Technopolis, 2010). Hiring their own graduates as faculty induces lower performance (in terms of publications and prizes) (Aghion et al., 2008). It can be hypothesised that a certain number of researchers' positions are not filled in based on merit, although their exact number remains unknown (i.e. there are around 40,000 researchers vacancies per year, amongst which 9,600 are professorship positions) (Technopolis, 2010). Up to 70% of previously mobile researchers cited "finding a suitable position", as a 'major' obstacle to possible future mobility, explained partly by a lack of open and transparent recruitment procedures. A similar finding came out of the public consultation on the ERA framework (78% of respondents considering the lack of open recruitment as one of the main factors hindering internationally mobile researchers).As a consequence Europe is not fully taking advantage of the human capital available, preventing "brain circulation" and cross-fertilisation of ideas.

Working conditions of researchers in Member States differ and in some cases they are not sufficiently attractive to draw young people in the research profession, retain leading talent and attract foreign researchers. Career promotion practices and perspectives vary between countries: the UK career structure is primarily based on performance while a mix of seniority and performance predominates in most other countries. This implies that a researcher in the UK can obtain a full time, autonomous position in their mid-to-late twenties, whereas in many other Member States researchers do not obtain the same conditions until their late thirties or forties[35]. In many European countries, early career researchers have to spend many years on short-term contracts while most people from the same age group enjoy stable employment conditions in other sectors. While employment conditions and career patterns for young academics vary substantially by country, short-term employment up to the age of about 40 and high selectivity is common in a large number of countries (Teichler, 2011). Also, career structures do not always recognise mobility as a factor of productivity. The UK evidence shows that researchers who worked abroad are significantly more productive in terms of articles published than those who never left the UK. Support to inter-sectoral mobility is often lacking, with only one in six researchers in academia having experience in the business sector, and there are significant disparities between Member States (MORE Study, 2010). This is particularly important during doctoral training which is a problem for knowledge transfer according to European firms[36], as the supply of people who are qualified and trained in fields relevant to industry needs is insufficient. In the ERA public consultation only 22% of respondents find that researchers are well trained for the business labour market. This results in what is the 'European exception': the EU has only 46% of its research labour force in business compared to 69% in China, 73% in Japan and 80% in the US (Eurostat R&D statistics). Applying the Principles for Innovative Doctoral Training will ensure that the new generation of researchers has a set of skills which allows them to tackle societal challenges and contribute to innovation. Other EU funding schemes such as the Marie Curie actions have contributed to increased internationalisation of European research and 'brain circulation' (The Evaluation Partnership, 2010), but the number of researchers concerned remains limited when compared with the needs[37].

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35 ERC, 2011

36 http://ec.europa.eu/invest-in-research/monitoring/analyses01_en.htm

37 Around 50,000 researchers have benefited from the Marie Curie Actions between 1996 and 2010. Source: European Commission

Conditions for portability of and access to grants also hamper researcher's mobility and careers vary between Member States. Researchers usually cannot take with them their national grants (this is the case in 13 Member States) and research teams cannot always involve partners from other countries in their research projects using national funding since in many countries (11 Member States) beneficiaries must be domestic institutions. Grants are limited to nationals in four Member States.

EU initiatives such as the Commission Recommendation on the 'European Charter for Researchers', the 'Code of Conduct for the Recruitment of Researchers' (hereunder referred to as the Charter and Code) and the 'European Partnership for Researchers'(EPR) (European Commission, 2008a) have triggered several initiatives at national and institutional level. To support the concrete uptake of the Charter and Code principles, in 2008 the Commission launched the "Human Resources Strategy for Researchers incorporating the Charter and Code" and in 2009 established an "Institutional Human Resources Strategy Group" to provide a platform for the exchange of best practice among stakeholders from across Europe. However the implementation of the Charter and Code principles at institutional level remains slow. As to the EPR, while the Commission and Member States have delivered results in a number of priority areas and laid the ground for future action in other areas, progress at national level remains relatively slow and piecemeal. The lack of a baseline and clearly quantifiable targets in relation to some areas has resulted in Member States having different approaches[38]. Moreover, the level of involvement in the above initiatives varies between Member States and between priority areas.

2.2.4. Limited progress on gender equality and gender content in research

Not all Member States have national policies to encourage the use of the potential talent of female scientists and the integration of a gender dimension in research content. This implies that skilled female scientist's potential is under-utilised; that women are under-represented and gender balance is lacking in research and innovation decision-making; and that the lack of gender dimension in research content possibly undermines quality and relevance of research activities. This under-utilisation of the available skilled female researchers is a waste of talent as well as a waste of return on investment, which is particularly unacceptable when Europe's future prosperity depends on its human capital. 45% of PhD graduates are women, but we have only 30% female researchers in Europe and just 19% in the top grade in academic careers. The number is even smaller at leadership level: only 13% of heads of institutions in the higher education sector. There is evidence that mixed research teams contribute to increased research performance as they benefit from a wider expertise, knowledge sharing, diverse points of view and a higher level of social intelligence. Given that a more equal participation of women in science would increase the diversity of the talent pool, a more diverse workforce and decision making process would have positive effects on scientific productivity and excellence. Furthermore, the lack of gender dimension in research content undermines the quality and relevance of knowledge. Not only would research quality benefit from this, but moreover, there are high enormous costs and even dangers associated to not taking into account the gender perspective in the research process would be avoided.

Positive developments can be observed in a few European countries, where research organisations are encouraged explicitly through legal provisions to adopt gender action plans.

[38] While several Member States now publish a large share of their research positions on the EURAXESS Jobs Portal, a number of other countries make little or no use of this facility.

In several other countries there is a legal basis for the creation of gender action plans and positive action - although gender action plans are not explicitly an obligatory instrument to establish gender equality in science (this is the case in five Member States). Female scientists also tend to be less represented in the highest grade of research careers (European Commission, 2009b) and this varies significantly among Member States. For example in two Member States 25% of the heads of higher education institutions are female, whilst in four of them their share is below 10% (European Commission, 2009b). The female gender perspective in research agendas is seldom encouraged by Member States even if a small number of Member States fund programmes for gender equality and/ or gender in research content. Explicit gender requirements or evaluation criteria for funding in research programmes, projects or studies exist in, again, very few Member States. Without enhancing women's participation and the integration of the gender dimension in research content, ERA's aims to deliver high levels of employment, productivity and social cohesion are not fully achievable. A majority of respondents to the public consultation stated that a higher involvement of women in science would contribute to European socio-economic growth as well as impact research performance and research excellence.

2.2.5. Restricted circulation of and uneven access to scientific knowledge

Scientists, especially in less endowed institutions, have increasing problems to access scientific knowledge. Journals constitute over 90% of scholars' information sources (Tenopir et al., 2009, King et al., 2009). Journal subscription prices as well as the number of peer-reviewed journals are increasing rapidly. Between 1986 and 2008, journal subscription expenditures increased by 374% (Giglia, 2010b). A single institution cannot afford to subscribe to all the relevant ones, negatively affecting access[39], use and impact of knowledge (Gargouri et al., 2010). For more than a half of the respondents, one of the reasons for the absence of access was that their organisation's library had not purchased a licence for the content because of budgetary constraints. According to a 2009 UK survey (Publishing Research Consortium, 2009) a significant share of SMEs (55%) said that they had recently experienced difficulty accessing a research article (against 34% in the case of large companies), with cost reported as the key barrier. This prevents incorporating recent developments in research or innovation agenda, affecting their scientific quality and the economic outcome.

In April 2008, the Commission issued a Recommendation[40] on the management of intellectual property in knowledge transfer activities together with a Code of Practice for universities and other public research organisations. This Recommendation provides Member States and stakeholders with a set of best practices and policies to stimulate knowledge transfer. However, knowledge transfer between public research institutions and the private sector to foster innovation remains insufficient. Europe is lagging behind when compared with the US in terms of performance. Even if the share of public research funding coming from the private sector was higher in the EU (0.05% of GDP) than in the US (0.02%) or Japan (0.015%), on average the EU lagged behind in terms of scientific cooperation measured by co-publications (36.2 publications per million researchers, while in the USA they were 70.2). The number of staff (e.g. in university knowledge transfer offices) with experience in industry is significantly lower in Europe. In addition, only 5-6% of the researchers in the EU have moved back-and-forth between the public and private sector.

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[39] For example, over 40% of UK-based researchers said that they were unable to access licensed content at least weekly and two-thirds at least monthly (Research Information Network, 2009).

[40] C(2008)1329

Several EU initiatives have addressed the issue of open access to scientific knowledge and of knowledge transfer. The Council Conclusions (14865/07) invited the Commission to experiment with open access in the Framework Programme and Member States to reinforce national strategies on access to scientific information, thus building on the Commission Communication on scientific information in the digital age[41]. Since then, funding and soft measures have been adopted at EU level to support the development of open access. As a result of FP7, scientific publications resulting from a set of EU-funded projects are now increasingly available in open access. Despite their relevance, FP-funded measures concern only a very limited share of EU's overall R&D expenditure and their impact remains thus limited. Member States[42] are not equally advanced in how they support and address the issue of open access (European Commission, 2011d).

In addition to open access, effective implementation of ERA for research excellence requires a strategic approach to promoting the development and take up of digital research services and the transformation of traditional ways of doing research into new data-intensive and collaborative research paradigms. Member States have different usage policies for publicly funded research e-infrastructures. In some cases high-speed connection networks or supercomputers are offered only for universities, in others to schools and hospitals, and in others allow linkages with commercial services providers and industrial research. Different national policies create obstacles for multi-national research collaborations, if research consortia have partners of different types. This is against the principles of Innovation Union. Also, the new millennium has seen an accelerating deployment of information and communication technologies, and a rising tide of information sweeping across all scientific areas. Although in a digital age the majority of knowledge transfer and creation takes place through digital means, there are several barriers preventing researchers from having seamless access to research on-line services. This creates major obstacles for collaboration and resource sharing between organisations across borders. For instance, researchers wishing to access research related services online, e.g. publications, research data, or computing services, have to apply and manage different user accounts depending on the service provider or the administrative location of the researcher. Europe lacks a common Authentication (identification) and Authorisation (rights to access services) Infrastructure (AAI) which provides researchers with seamless access to research services in digital ERA. In the last years, there has been progress in this area, through eduGAIN European inter-federation service. Currently, eduGAIN has 11 members, 4 candidates and 2 pilot countries[43]. However, several countries have not yet joined service, and there is no clear data on the number of research institutions in different MS providing the necessary identification services needed to implement the cross-border access to digital research services. Development of new modes for research through different digital research services has been supported through framework programme funding. In the last years, some Member States have set up national level strategies or joint collaboration to deal with the issues relating to digital research services provision and take-up (UK, NL, Nordic countries)[44]. However, this is not enough to ensure efficient research and innovation through the potential of digital services for all European

41 COM(2007)56

42 See Annex 3 for more details.

43 http://edugain.org/federation_status.php

44 http://www.epsrc.ac.uk/ourportfolio/themes/researchinfrastructure/subthemes/einfrastructure/escience/Pages/default.aspx, http://www.nordforsk.org/en/programs/programmer/escience/evitenskap-og-einfrastruktur-en and http://esciencecenter.com/about-the-center/background/

researchers in all Member States. Effective implementation of Digital ERA requires strategic action in all Member States, with active involvement of all research related stakeholders.

2.3. The EU's right to act, subsidiarity and EU added-value

Article 179[45] of the Treaty on the Functioning of the European Union (TFEU) lays down the right for the Union to create the necessary conditions for realising the European Research Area. Article 182.5 of the TFEU allows the use of the legislative procedure to establish the measures necessary for the implementation of the European Research Area.

The completion of ERA does not put into question the sovereignty of Member States. The Treaty clearly states that research is a policy area of shared competence between Member States and the Union. All the measures proposed in the ERA framework are compliant with the Treaty provision (TFEU, Art. 4.3) stating that the exercise of EU competence shall not result in Member States being prevented from exercising theirs. The options selected illustrate how European integration and internal reform of research systems must go hand in hand, respecting the subsidiarity principle. The objectives of the proposed actions cannot be achieved sufficiently by Member States in the framework of their national constitutional system (necessity test). Three options are proposed to tackle the identified problems: (1) Reinforced partnership for ERA; (2) Sectoral legal measures for ERA; and (3) Development of an overall legal framework at Community level. Given the persistent barriers and the limited progress observed 12 years after the launching of ERA, the Union is best placed to provide directions for Member States and the Union, on the basis of Article 179 for the first one, and through Article 182.5 for the two others.

European added-value is demonstrated by several reasons. First, optimised allocation of activities – where necessary - will be attained through a coordinated approach, improving effectiveness of research systems and reducing unnecessary duplication of efforts. Second, level playing field and critical mass are expected to be achieved from the implementation of ERA, thus allowing creating the conditions for the most productive research teams to work together and to be competitive internationally. Third, European impetus maximises the possibility of completing ERA in the short term, given the persistence of national barriers mentioned above. Fourth, the European Union level is the best one to assess objectively whether progress has been attained, whether it is proportionate; and whether there is a need for further action to improve the situation.

In particular, European action will warrant the implementation of common approaches so that researchers, knowledge and technologies circulate freely across Europe, thus promoting the opportunities for effective research systems. It will ensure transnational 'connectivity' of the European research system for every region and country in Europe, thus helping solving the innovation divide. For example, the development of open access to scientific publications and research data is very important for researchers who are based in less endowed universities/research organisations. EU intervention will help ensuring similar conditions for competition in an EU-wide space, both in relation to research projects selection and researchers recruitment. Moreover, EU intervention can facilitate the removal of barriers to launch large-scale and complex research efforts between Member States to tackle grand challenges. Setting up common research priorities and agendas requires a strong interface with i) policy-makers in charge of the policies addressing those challenges and framing the

[45] According to Art.179,'its scientific and technological bases by achieving a European research area in which researchers, scientific knowledge and technology circulate freely (…)'.

markets where the innovations need to take place; and ii) the industry active on these markets. In the context of the Single Market, such interfaces can be best organised at EU level. Common solutions developed through cross-border collaboration may lead to common standards, thus contributing to shaping new markets and providing more certainty to R&D investment.

Alternative solutions exist through the setting up of inter-governmental agreements; however the administrative and legal processes which typically have to be followed under such intergovernmental schemes are sometimes considered as too lengthy, difficult and cumbersome and may not lead to completion of ERA by 2014.

2.4. Baseline scenario

The baseline scenario reflects how the current situation would evolve without intervention. Solving the problems presented above require both strong political willingness and the means to implement the reforms required. However, efficiency in the use of public funds can be a major driver in times of budgetary constraints. But if some reforms are undertaken in each Member State, they would probably be insufficient and carried out in an uncoordinated way, reinforcing fragmentation within Europe. FP7 will continue to foster cross-border and excellent research, but no additional funding would accompany reforms at Member State level.

2.4.1. Different levels of competition and low co-operation between research funding systems remain

In the short term, the current activities will probably not induce progress in terms of promoting competition and co-operation in national research funding systems nor at cross-border level, as most of the observed barriers and fragmentation between national systems will remain. Barriers to competition in national research systems would remain as there is no indication that structural changes may take place in national funding systems. However, some progress can be expected in terms of compatible evaluation systems through an extended use of ERC evaluation mechanisms by some national funding agencies. Limited and uneven progress is expected in continuing the implementation of joint programming between Member States. The recently adopted framework conditions for joint programming will foster Member States common, voluntary policy actions on public research, but probably at a slow pace. Besides, the degree of concrete commitment to joint actions will be a function of the budgetary situation in participating Member States. Under the current circumstances, it is probable that major research actors will continue driving the process, with little cooperation with lagging Member States. This may reinforce the innovation divide. Existing cooperation initiatives between some of Member States research programmes are expected to continue.

Reinforced attention to grand challenges, increased technological leadership and funding the innovation capability of firms can be expected through the adoption of the Commission proposal for Horizon 2020 programme. This programme will run from 2014 to 2020. It has been developed to increase the contribution of research and innovation to tackle grand challenges and promote innovation. However, even if the proposal includes an increased budget (approximately 80 billion Euros) when compared to previous FPs, this budget will still represent only a small share of the total funding for research in Europe and insufficient to raise substantially overall performance and only after 2014.

In the field of research infrastructures, the sustainability of Member State financial commitments for developing and maintaining research infrastructures may be challenged in

the short or medium term. With a majority of Member States facing budgetary squeezes and postponing long-term and major investments, the financing of the European Strategy Forum on Research Infrastructures (ESFRI) Roadmap may be jeopardised. As part of the ESFRI Roadmap, 48 priority pan-European research infrastructures have been identified in a number of scientific fields and 10 projects have already started, whilst additional 17 projects are due to be launched before the end of 2013[46]. Considering that the commitment at the Innovation Union is to implement 60% of the ESFRI Roadmap projects by 2015, it is expected that the current pace and efforts will be sufficient to meet the goal if no deviations take place.

The baseline situation will hardly respond to stakeholder's expectations. 82% of the on-line respondents to the consultation on ERA see developing more synergies between European and national actions as important, while 79% believe that EU support for transnational access to research infrastructures of pan-European relevance should be increased. Strengthening the inter-operability of instruments and of scientific data at EU level and increasing awareness at EU level of access opportunities to national research infrastructures are also considered as 'important' and 'very important' by more than 70% of respondents.

2.4.2. Limited action on researcher labour market towards mobility and careers

Distortions in the labour market for researchers will continue to exist or worsen, notably in a context of budgetary cuts and economic austerity. In-breeding practices are likely to persist and may even be exacerbated in Mediterranean countries and East European Member States as shrinking public R&D expenditure may lead to fewer senior and permanent research positions. There is little evidence suggesting that Member States lagging behind will undertake the necessary reforms to ensure that open, transparent and merit-based recruitment procedures are in place in all universities and public research institutes. Most likely the share of positions advertised on Euraxess (currently about 30% of all researchers' positions in Europe) will increase slowly in the short to medium-term. Researcher mobility will not be substantially enhanced as restrictions to grant portability and accessibility are likely to continue in a majority of Member States. Uneven and patchy implementation of the Charter and Code and the EPR by Member States and research organisations in the area of recruitment and portability of grants is expected to continue in the short and medium-term. The number of research employers and funders in Europe participating in the "Human Resources Strategy" process is expected to rise at a relatively slow pace[47].

The status quo is not acceptable for stakeholders. 81% of the respondents to the public consultation on the ERA Framework consider that working conditions and career prospects of public sector researchers are less attractive than those of other professionals with similar qualifications. Up to 75% of respondents believe that the lack of attractiveness stems from universities and research institutions being underfunded, limited availability of research positions, low wages and insufficient cooperation between academia and the private sector.

2.4.3. Unequal opportunities for female researchers and insufficient attention to gender content in research

No significant improvements are expected with regard to gender equality and the gender dimension in research even if a broad majority of respondents to the ERA consultation

[46] Annex 3 provides the list of ESFRI projects.

[47] Currently approximately 150 institutions of which 82 have been awarded the "HR Excellence in Research" logo.

consider that a higher involvement of women in science will contribute to European socio-economic growth. Although some slow progress may be achieved in some Member States (and mostly on an ad-hoc manner), the percentage of female researchers in senior and management research positions in the EU27 is likely to stagnate or increase in a marginal and irregular manner. There is no ground for expecting radical changes in terms of gender dimension in research in the majority of Member States where no such measures exist. Gender equality will continue to be promoted through EU programmes (i.e. mainstreaming of gender within the Science in Society FP7 Programme, Horizon 2020 and the research part of the Structural Funds) and various activities (i.e. the development of indicators, analyses and guidelines), however the overall impact on improving gender equality will remain limited to the beneficiaries of the EU programmes and to the small number of beneficiary institutions and will therefore be insufficient to correct the under-representation of women in science. The two-year public information campaign to be launched in 2012 will aim tackle stereotypes on gender and attracting and retain more women in scientific careers[48]. However, existing and planned initiatives will not be sufficient to support long-term structural change at Member States and institutional level in gender management and research design and implementation. A multiplier effect is required in order to reach a critical mass of research institutions by strengthening the collaboration among Member States on the basis of a common approach or guidelines.

2.4.4. Uneven access and circulation of scientific knowledge remain

Access to publications and data will remain limited and uneven and researchers in less-advanced Member States or less-endowed institutions will continue to experience barriers in accessing knowledge. Policies on open access will continue being implemented unevenly by research funding organisations in 17 Member States and by universities or research centres with open access mandates in 22 Member States.

Identity federation services will continue being provided through EduGAIN by 11 member countries, and current candidate (4) and pilot (2) countries will develop into becoming members. . European level expansion of the identity federation services and their deployment for online access to publications and research data as well as computing and virtual collaboration services is uneven, as it depends on strategies of national authorities and individual research institutions. Without joint coordination it is unlikely by 2014 these services will be made widely available to all researchers across Europe.

National support to the implementation of e-services will remain limited and uneven. Absence of co-operation among the Member States in the roll-out of new services (building on the available e-infrastructures, pooling of resources) will hinder their effective use. This may result in a limited use of the current facilities during off-peak periods and ultimately an inefficient use of resources. Industrial research partners will keep facing problems if trying to participate in multinational research collaboration because of lacking shared acceptable usage policies for common collaborative research infrastructures.

Actions to promote knowledge transfer will continue to be implemented on a case by case basis, with some Member States taking the lead and some other lagging behind. The Commission is supporting the development of knowledge transfer capacity in higher

[48] The key targets are young people, as well as women researchers at an early stage in their career.

education institutions and public research organisations, in particular through its 2008 Intellectual Property Recommendation[49].

3. POLICY OBJECTIVES

The European Research Area policy overarching goal is to increase the performance, excellence and impact of Europe's Research and Development system. It will help the EU back to the path of economic growth by fostering scientific excellence and research underpinning innovation and increasing the attractiveness of the EU as a research location.

The objective of the Communication is to identify and promote actions which ensure that by 2014 the adequate conditions are in place for improving the effectiveness of European research systems.

Specific objective	**Operational objective for 2014**
More effective national research systems	Barriers to competition and the use of international peer review evaluation in national research systems are removed
Optimal transnational co-operation and competition	Barriers to compatibility and interoperability between national research programmes and to access to pan-European research infrastructures are removed
	One pilot cross-border synchronised research call, notably on grand challenges, launched using international peer review evaluation and a single pan-European score
	Harmonised monitoring, evaluation and impact assessment principles and procedures for pan-European research infrastructures are adopted and implemented
An open labour market for researchers	Barriers to open, transparent and merit based recruitment in public research systems, cross-border portability of and accessibility to national grants are removed
	Frameworks supporting the career development of researchers and innovative doctoral training are adopted and implemented
Gender equality and gender mainstreaming in research	Barriers to gender equality and the gender dimension in research are removed
Optimal circulation, access to and transfer of scientific knowledge	Policies and means for facilitating online access to publicly-funded scientific publications and data are defined and coordinated Policies to foster knowledge transfer, cross-border sharing of e-infrastructure and take up of digital services for research are defined Electronic identity services for researchers enabling transnational access to digital services (collaboration, computing, scientific information) are implemented or planned

[49] C(2008)1329

4. POLICY OPTIONS

To complete ERA by 2014 many barriers at national level have to be removed quickly. This report analyses four policy options. The first one is Policy Option 1 (Business as usual). The three other policy options would follow alternative paths to achieve the overall objective and they all require action from Member States, Research funding and performing organisations and the Commission. Their implementation would neither entail increased public R&D spending at Member State level nor increased cross border funding (only reallocation based on commonly agreed agendas). Policy Option 2 (Reinforced Partnership for ERA) is based on voluntary action at Member State level whose progress would be partly linked with the European Semester. This option also entails reinforced partnership between research funding and performing organisations (hereunder referred to as research stakeholders) and the Commission. Policy Option 3 (Sectoral legal measures for ERA) combines legally-binding measures for ERA with voluntary actions by Member States, linked as appropriate with the European Semester. It also entails reinforced partnership between research funding and performing organisations (hereunder referred to as research stakeholders) and the Commission. Policy Option 4 (ERA Framework Directive) explores the adoption of a coherent legal framework of principles and mechanisms.

The potential measures included in the options were identified and screened on the basis of their advantages and disadvantages. The intervention logic and the full spectrum of measures envisaged to address each specific objective is presented in Annex 5.

Policy option 1: Business as usual (BAU)

This option would entail the continuation of current policies, presented in the Baseline. The major development would be based on the adoption and implementation in 2014 of Horizon 2020, with its increased budget supporting research and innovation cross-border activities.

Policy option 2: Reinforced partnership for ERA

To deliver ERA by 2014, reforms of the national research and innovation systems and reinforced partnership - deeper, wider and more efficient than to date - between Member States, the Commission and research stakeholder organisations would be at the core of this policy option. It fully develops the ERA partnership via the implementation of the '*Ljubljana Process*'[50].

This policy option would entail that Member States undertake reforms for ERA as called for by the Innovation Union. A Commission Communication would invite Member States to remove specific barriers for competition and co-operation as well as for fostering a research friendly environment. Member State would be invited to include in the National Reform Programmes[51] an annex in which they specify the reforms planned by field of action. The Commission would assess the reforms and publish ERA-Progress reports in September every year, possibly with ERA recommendations for Member States. In case of persisting barriers,

[50] The Ljubljana Process is an enhanced partnership between the Member States, associated countries, stakeholders and the Commission to make European research more effective. The Ljubljana Process was launched in May 2008 with two clear goals: 'Europe now needs to develop a common vision and effective governance of the European Research Area'.

[51] The national reform programmes are monitored within the framework of the 'European semester' of enhanced economic policy coordination.

different options will be considered, including the legislative options, based on the new provisions in the TFEU. This mechanism is expected to motivate Member States to undertake the necessary reforms.

At the same time, this option foresees the research stakeholder organisations[52] would take responsibility for the ERA actions addressed to them within the limits of their respective autonomies and jurisdictions as set by national authorities. Relevant research stakeholder organisations would be invited to sign with the Commissioner a Joint Statement in general terms of their willingness to work towards completing ERA. They would also set out the specific ERA actions they would take in terms of timing, deliverables, public reporting on progress, etc. in a Memorandum of Understanding co-signed with the Commission or a unilateral declaration, informing their respective national authorities and the other Partners.

The Commission would also propose measures in different forms (such as Recommendations) to complete ERA. The Commission would support Member States and stakeholder organisations. It would ensure that Horizon 2020 helps to consolidate the completion and functioning of ERA from 2014, supporting ERA-compliant actions relating to researcher careers and mobility, gender action, cross-border cooperation, open access, knowledge transfer and infrastructures. It would ensure inclusive ERA policy development by supporting structured dialogue with research stakeholder organisations and relevant civil society bodies - e.g. in the form of a dedicated stakeholder platform.

The set of measures which will be included in the Communication are presented below, by specific objective:

More effective national research systems:

- *Member States* are invited to introduce or enhance competitive funding through calls for proposals and institutional assessments as the main modes of allocating public funds to research and innovation, introducing legislative reforms if necessary; and to ensure that all public bodies responsible for allocating research funds apply the core principles of international peer review

- *The Commission* will support through the Smart Specialisation Platform Member States and regions in using Structural Funds to develop research capacity and smart specialisation strategies, including support to joint research programmes, in line with Cohesion Policy objectives; support mutual learning and the exchange of good practice between Member States on the removal of national legal and other barriers to ERA for the priorities set out in this Communication; and support ERA Chairs aimed at fostering structural change in institutions to raise their research quality to international levels of excellence

Optimal transnational co-operation and competition

- *Member States* are invited to step up efforts to implement joint research agendas addressing grand challenges, sharing information about activities in agreed priority areas, ensuring that adequate national funding is committed and strategically aligned at European level in these areas and that common *ex post* evaluation is conducted;

[52] Federative and representative bodies of public and private research actors including researchers, universities, funding and performing organisations.

ensure mutual recognition of evaluations that conform to international peer-review standards as a basis for national funding decisions; remove legal and other barriers to the cross-border interoperability of national programmes to permit joint financing of actions including cooperation with non-EU countries where relevant; confirm financial commitments for the construction and operation of ESFRI, global, national and regional RIs of pan-European interest, particularly when developing national roadmaps and the next Structural Fund programmes; and remove legal and other barriers to cross-border access to RIs

- *Research stakeholder organisations* are invited to agree on common funding principles - eligible costs, reporting requirements, etc. to make national research programmes compatible, interoperable (cross-border) and simpler for researchers; pilot the use of synchronised calls with, where possible, single joint international peer review evaluation of proposals as a basis for funding decisions; and further develop and deploy the Lead-Agency, Money-Follows-Cooperation Line, Money-Follows-Researcher and other models for cross-border cooperation

- The *Commission* will pursue, stimulate and participate in Public-Public Partnerships to address grand challenges as set out in the Communication on Partnering in Research and Innovation to co-ordinate and leverage Member States' contributions and ensure close coordination with relevant activities under Horizon 2020; on the basis of the information supplied by Member States, map activities in agreed priority areas, with a view to identifying strengths, weaknesses, gaps and duplications; support Member States and research funding organisations in implementing joint international peer review evaluations and setting common funding standards - e.g. through an ERA Mark label recognising best practice in cross-border research operations; support through Horizon 2020 access to RIs as well as the on-going overall integration of EU RIs particularly those awarded ERIC status; encourage Member States to link RI roadmaps to the ESFRI roadmap and smart specialisation strategies in Structural Funds co-financed research and innovation programmes, reinforcing the capacity of less favoured regions to host and participate in RIs of pan-European and international interest; support training programmes for the management of such RIs; develop in cooperation with ESFRI, e-IRG and other stakeholders a Charter of Access setting out common standards and harmonized access rules and conditions for the use of RIs; work with ESFRI to set priorities for implementing the Roadmap and to provide advice and guidance to Member States on overcoming legal, financial or technical obstacles to implementation; define with ESFRI, e-IRG and other stakeholders common evaluation principles, impact-assessment criteria and monitoring tools which can be applied in regional, national and European programmes to help combine funds from different sources; and work with e-IRG to promote the alignment of EU and national approaches to eRI development and use

An open labour market for researchers

- *Member States* are invited to remove legal and other barriers to the application of open, transparent and merit based recruitment of researchers and which hamper cross-border access to and portability of national grants; support a national body to implement the Declaration of Commitment to provide coordinated personalised information and services to researchers through the pan-European EURAXESS network and the setting up and running of structured innovative doctoral training

programmes applying the Principles for Innovative Doctoral Training; and create an enabling framework for implementing the HR Strategy for Researchers incorporating the Charter & Code.

- *Research stakeholder organisations* are invited to advertise all vacancies on the EURAXESS Jobs portal using the common profiles established in the European Framework for Research Careers; fill research positions according to open, transparent and merit based recruitment procedures proportionate to the level of the position in line with the basic principles of the Charter & Code and including non-EU nationals; develop strategies to support the career development of researchers in line with the HR Strategy for Researchers; define and implement principles for accessibility to and portability of national grants, provide structured doctoral training based on the Principles for Innovative Doctoral Training; and develop and implement structured programmes to increase mobility between industry and academia

- The *Commission* will bridge information gaps to foster mobility and research career development by assessing and strengthening collaboration and coordination in the EURAXESS network for researchers to have direct access to personalised assistance, making it the means of accessing tailor-made assistance; support the setting up of a European Accreditation Mechanism for Charter & Code-based human resources management in universities and publicly-funded research institutions and the work of a 'pathfinder group' of countries for the achievement of automatic recognition of comparable degrees; as well as take initiatives to address social security barriers for researchers in the EU and further facilitate the entry and stay of third country national researchers by clarifying in a Communication EU rules on coordination of social security schemes for groups of workers with a high level of intra-EU mobility, including researchers, resuming work on a pension portability Directive setting minimum standards for the acquisition and preservation of supplementary pension rights, supporting stakeholders in setting up pan-European supplementary pension fund(s) for researchers and reviewing Directive 2005/71/EC on a specific procedure for admitting third country nationals for the purposes of scientific research

Gender equality and gender mainstreaming in research

- *Member States* are invited to create a legal and policy environment and provide incentives to remove legal and other barriers to the recruitment, retention and career progression of female researchers while fully complying with EU law on gender equality, address gender imbalances in decision making processes and strengthen the gender dimension in research programmes; engage in partnerships with funding agencies, research organisations and universities to foster cultural and institutional change on gender - charters, performance agreements, awards and ensure that at least 40% of the under-represented sex participate in committees involved in recruitment/career progression and in establishing and evaluating research programmes

- *Research stakeholder organisations* are invited to implement institutional change relating to HR management, funding, decision-making and research programmes through Gender Equality Plans which aim to conduct impact assessment / audits of procedures and practices to identify gender bias, implement innovative strategies to correct any bias and set targets and monitor progress via indicators

- The *Commission* will foster gender equality and the integration of a gender dimension in Horizon 2020 programmes and projects from inception, through implementation to evaluation, including through the use of incentives; and propose in 2013 a Recommendation to Member States with common guidelines on institutional change to promote gender equality in universities and research institutions and dedicate specific funds to reinforce collaboration between Member States

Optimal circulation, access to and transfer of scientific knowledge

- *Member States* are invited to define and coordinate their policies on access to and preservation of scientific information; ensure that public research contributes to Open Innovation and foster knowledge transfer between public and private sectors through national knowledge transfer strategies; harmonise access and usage policies for research and education-related public e-infrastructures and for associated digital research services enabling consortia of different types of public and private partners; and adopt and implement national strategies for electronic identity for researchers giving them transnational access to digital research services

- *Research stakeholder organisations* are invited to adopt and implement open access measures for publications and data resulting from publicly funded research; implement and promote the uptake of electronic identity and digital research services; ensure optimal interaction and linkages and strategic partnering between academia and industry and define joint collaborative research agendas to maximize the use of research results; and improve recognition and professionalization of knowledge transfer activities and strengthen the role of knowledge transfer offices

- The *Commission* will establish open access to scientific publications as a general principle for all EU funded projects in Horizon 2020. For research data, develop a flexible approach that takes into account different scientific areas and business-related interests; continue to fund infrastructure projects related to open access; adopt a Communication and Recommendation to Member States on access to and preservation of scientific information in the digital age; propose a roadmap for e-infrastructure development to support e-Science through open access to research tools and resources; support activities to raise stakeholder awareness of open access and e-Science; promote knowledge transfer activities in Europe through networking of innovative university-business platforms, including bottom up, practitioner-led initiatives, and sectoral knowledge transfer offices; work with stakeholders to develop a set of model consortium agreements to enhance knowledge transfer; and facilitate a Member State forum for regular exchange and reporting on national developments on the provision, take-up and use of digital research services.

Annex 6 presents the details of the measure and the main actors responsible for their delivery.

Policy option 3: Sectoral legal measures for ERA

This policy option responds to the request of the Impact Assessment Board and includes a number of binding legal measures proposed by the Commission in several sectors (i.e. topic-specific fields) as required. The rationale for proposing such binding measures is that legislation more surely guarantees that common principles and governance mechanisms would be put in place and that barriers indeed would be removed, and that adequate framework conditions would be in place in all Member States. Legal measures would ensure

uniform implementation of key ERA elements, which may entail reforms at Member State level. Legal measures would be possible given the new legal competencies of the Union to achieve ERA introduced by the Lisbon Treaty (Article 179.1 TFEU in conjunction with Art. 182.5 TFEU), bearing in mind the shared competence.

This set of legislative measures would be completed by voluntary actions by Member States and stakeholders. They would cover areas where Member States and stakeholders are best placed to identify and address key barriers. In these areas, the Commission Communication would identify as in the previous option both the barriers to be removed as well as the operational strategies to be adopted.

The measures will address the following objectives and will include the following actions:

More effective national research systems:

- Member States to undertake national reforms to remove legal, administrative and other types of barriers to competitive funding allocation

- The Commission to propose legislative measure on international peer review evaluation for national funding decisions

Optimal transnational co-operation and competition:

- Member States to remove legal, administrative and other types of barriers to cross-border access to national research infrastructures of European interest; set up jointly with stakeholder organisations joint calls using common international peer review evaluation (notably within the Joint Programming process) and a 'Charter for Access' for research infrastructures

- The Commission to launch the 'ERA Mark' label for cross-border research programmes and to propose legislative measures on common principles for cross-border operations, on common principles for the monitoring, evaluation and impact assessment of research infrastructures and funding decisions and on common principles and procedures for the setting up and management of pan-European research infrastructures

An open labour market for researchers:

- Member States and stakeholder organisations to set up frameworks and strategies for the career development of researchers, innovative doctoral training, to advertise vacancies and provide tailored information to mobile researchers on national single access points/Euraxess

- The Commission to set up an accreditation mechanisms for the Charter and Code, to propose legislative measures on common principles on open, transparent and merit-based recruitment of researchers and on common principles for portability of grants and for access to national grants and to adopt relevant support measures (e.g. Communication on social security) and amendments to key EU legislation (Directive 2005/71/EC)

Gender equality and gender mainstreaming in research:

- Member States and stakeholder organisations to integrate the gender dimension into publicly funded research programmes and implement gender strategies and action plans

- The Commission to propose a Commission Recommendation on guidelines for institutional change in universities and other research organisations (foreseen on 2013)

Optimal circulation, access to and transfer of scientific knowledge:

- The Commission to propose a Commission Communication and Recommendation on access to and preservation of scientific information in the digital age and to provide support measures on digital ERA; legislative measures on open access to all publicly-funded scientific publications as well as for research data, when relevant; on specific identity provision and federation approach for researchers and scholars to be implemented by all MS and all research organisations and using publicly funded research infrastructures for research consortia with private and industrial research organisation partners.

As in the previous option, research stakeholder organisations would be responsible to implement flanking actions within the context of their specific commitments. Their actions would be reinforced by the adoption of the principles and mechanisms included in the legal measures.

Annex 6 provides an overview of the legislative and voluntary measures included in policy option 3.

Policy Option 4: ERA Framework Directive

This policy option would consist of a comprehensive legal package in the form of a Directive which would contain legally binding measures in conjunction with the freedom for Member States to choose the appropriate means to achieve the results required by the Directive. To express that the Directive intends to be of an overarching nature, covering the whole research system, it will be referred to as a Framework Directive. Whilst policy option 3 contains a set of separate legal and non-legal measures, this policy option would bundle the different legal measures into a single framework. Legal measures are based on the legal competencies of the Union to achieve ERA introduced by the Lisbon Treaty (Article 179.1 TFEU in conjunction with Art. 182.5 TFEU).

The objective of the Framework Directive would be to introduce binding principles as well as specific provisions facilitating competition and cross-border research, the opening up of the labour market for researchers and the free circulation of knowledge. This approach would lead to a situation where common standards and principles are applied across the EU. Given the diversity of the rules underpinning national R&D systems, the framework directive approach allows Member States to choose the most adequate means to obtain the results made obligatory by the Framework Directive.

The Directive would contain principles, (governance) procedures, and provisions that are binding on Member States as to the barriers to remove. Technical or operational details would be included in annexes and could be subject to review by an implementing committee.

The provisions would contain the definition, objective and scope of ERA, identify the main actors, as well as their rights and obligations. The policy coordination role of the Commission under Article 181 TFEU would be set in an appropriate governance framework aiming as consistency between Member States' and EU's policy and action in this area.

By introducing ERA as an instrument for sectoral integration in the field of R&D, distinct from the Internal Market, the Treaty legislator has expressed that measures to complete ERA go over and above those of the Internal Market. In other words, measures to achieve free circulation of researchers, knowledge and technology are not confined to those that establish free movement of persons, goods, services and capital. They can for instance also encompass research policy coordination, promotion and assistance measures.

The framework directive would include the following provisions:

- General principles for ERA (legally binding provisions applying to all Member States)

- The establishment of ERA as a 'unified research area based on the internal market which is open to the world, in which researchers, scientific knowledge and technology circulate freely and though which the Union and its Member States shall strengthen their scientific and technological bases as well as their competitiveness';

- Policy coordination and reporting: a governance mechanism to ensure consistency between national R&D policies, and between those policies and European R&D policy. The monitoring and subsequent evaluation would be performed by the Commission.

Specific provisions regulating ERA:

- *More effective national research systems*: the framework directive would require Member States to ensure that funding, as defined in the Directive, takes place on a competitive basis and also to use an international peer review evaluation processes (binding provision) for the allocation of funds to projects;

- *Optimal transnational co-operation and competition*: the framework directive would require Member States to enhance research co-operation through a) adoption of minimum standards for the interoperability of research systems, b) carrying out synchronised calls for research proposals in conjunction with a common international peer review system; and c) adoption of principles to reinforce access to pan-European research infrastructures;

- *An open labour market for researchers*: the framework directive would require Member States to adopt strategies and action plans on a) career development of researchers, b) principles for open recruitment in public research systems, c) principles for cross-border portability and accessibility of national grants and d) the setting up of doctoral training linking private and public sector;

- *Gender equality and gender mainstreaming in research*: the framework directive would require Member States to adopt strategies and action plans on gender.

- *Optimal circulation, access to and transfer of scientific knowledge*: the framework directive would require Member States to adopt relevant policies and measures for ensuring open access to scientific publications and scientific data and online research and identification services and shared usage policies for digital ERA.

The Commission would propose the Framework Directive at the earliest in 2013.

5. ANALYSING THE IMPACTS AND COMPARING THE POLICY OPTIONS

The policy options consist of different mechanisms to remove barriers and promote effectiveness of research systems. Once and if all ERA related measures are put in place, they are expected to attain similar indirect impacts (as, for example, on excellence and performance). Therefore, the main differences in terms of impacts reside in the timing for delivering the expectations, in the implementation costs associated and in acceptance by Member States and Stakeholders of each option. But before presenting the specific assessment of each option, the overall added value of ERA in terms of indirect economic, social and environmental impacts as well as the main caveats which may arise will be discussed.

Expected economic impact of ERA

Public and private sectors in all Member States would benefit from the efficiency gains of the increased cooperation as well as competition for funding in national systems. It is expected that more funding would be allocated to the best performing researchers, that through more cooperation between Member States better solutions to grand challenges would be found and that public and private sectors everywhere and notably in less endowed regions have access to and the advantage of scientific knowledge and of conditions promoting open innovation.

A decreasing share of non-performance based institutional funding would imply greater focus on financial sustainability of scientifically strong fields in these institutions. This would entail trying to recover the full economic costs of research activities. Full economic costing would require that capital and infrastructure costs associated with each piece of research commissioned from public research establishments are included in the final price. This would be a major change and represents a step towards establishing internal and external market pricing[53]. It could be expected though that in Member States where institutional funding is not linked to performance, or where evaluation systems do not follow international standards, universities and other research performing organisations may resist the removal of barriers. However, the need for more efficient use of scarce public funding may convince Member States to pursue the necessary reforms. Besides, the improved context for the research systems and a reinforced cross border focus on grand challenges could leverage private investment in research.

A reallocation of national funds to transnationally coordinated funding could benefit the EU's economy and job market. For example, in the case that the removal of barriers which would improve the conditions for cross border cooperation and interaction would lead Member

[53] Full economic costing is an approach being picked up in several countries, including Canada, Finland and Sweden (OECD 2010c, p. 96).

States to gradually reallocate funding to increase the attention given to transnational activities (i.e. to reach 4% research funding by 2020, from the current 0.8% share), this would induce a possible extra gain of GDP of 16 billion Euros in 2030 (0.25% additional GDP growth on top of the 0.92% additional growth expected from Horizon 2020). Higher transnational coordinated funding would create 323,000 additional jobs. The impact would be much stronger if the Barcelona target (3% of GDP dedicated to research) were reached by 2020. The combined effect of the Barcelona target, Horizon 2020 and an increased share of transnational funding would imply 445 billion Euros extra GDP and 7.2 million more jobs in 2030 (See Annex 4 for a detailed presentation of the simulations).

Measures linked to the development of the digital ERA would also lead to coordinated demand for the provisions of interoperable and effective digital research services, which will boost the ICT sector and ICT innovations in the EU. Study on the economic benefit to high tech industry involved in CERN's procurement contracts showed that procurement lead to increase of competence and direct economic benefits in terms of new products and markets. Furthermore, 75% of the increased sales were in sectors outside particle physics, thereby showing the value for innovation and knowledge transfer for other fields[54].

Open access would also generate significant benefits for most actors and potential savings for many institutions (i.e. libraries). It is estimated that policies and measures supporting open access could generate between 2 and 31 billion Euros of net economic benefits for the UK from increased returns to R&D over a period of 20 years[55]. In Denmark, the savings would amount to between 4 and 634 Million Euros[56], whilst for a country such as the Netherlands the savings would amount to between 13 million and 1 billion Euros be up to over a period of 20 years. Benefits can also be especially important for research institutions and firms in less-endowed countries, as they would be able to benefit from a more open access to knowledge.

However, there would be costs incurred by Member States' administrations and businesses. It is not possible to provide a reliable estimation of costs as it would depend on the specificities of the barriers to be removed by each Member State. But some examples could be useful. Estimates show that for the UK, the total costs at national level for implementing the Concordat (i.e. the UK version of the Charter and Code) amount to 882,000 Euros per annum[57] but they do not include one-off and running/maintenance costs incurred by research institutions and universities for reforming existing HR policies and rules, setting up and maintaining adequate human resources structures. As shown in Annex 4 and given that the cost for filling in a vacancy (research-related or professor position) varies from €5.000-20,000, it can be assumed that the cost for filling in a vacancy is equal to one or two month researcher salary. The adoption of gender strategies, national framework for the career development of researchers and innovative doctoral training may prove expensive for less-endowed institutions or institutions located in less-advanced Member States, but they could benefit from reciprocity. Member States which have experienced brain drain may oppose the removal of obstacles to grant portability. There will be costs associated with open access. Houghton, (2009 and 2009a) calculated that the costs for implementing open access would amount to between 21 and 406 million Euros for Denmark and between 124 and 636 million

54 http://www.hep.ucl.ac.uk/~markl/pp2020/CERN_ProcurementBenefits.pdf

55 This applies to the Green open access scenario. See Annex 4 for more details.

56 These figures were calculated based on Houghton (2009) using the exchange rate of 1DKK/0.1344 Euros.

57 Implementation costs at national level amount to 135,000 GBP per year and approx. 3 million GBP over a period of five years. Source: Vitae, UK.

Euros for the Netherlands over a period of 20 years (for more details see Annex 4). Regarding the impact of open access on the publishing market, research by RIN et al (2011) show that in the case of green open access (i.e. authors publish in any journal and then self-archive a version of the article for free public use in a repository or on an open access website) and assuming a 10% cut in subscription volumes of journals, the cost incurred by the publishing industry would amount to over 447 million Euros in global lost annual revenues (or approx. 134 million Euros per year in lost global operating profit[58]).

Expected social impacts of ERA

Institutions will benefit from better research staff functioning better. Recent research (Mitsos et al., 2012) has shown that R&D cooperation creates social benefits to non-participating organisations and the rest of society. These social benefits result from knowledge spill-overs to non-participants, increased industrial competitiveness and increased levels of competition, favourable changes in investment behaviour, more efficient establishment of technology standards, broad socioeconomic benefits as a result of structural adjustment and increased economic cohesion between European regions. Measures on the digital ERA would also support researchers in smaller and less-advanced Member States and regions, by facilitating access to research services through online sharing. This would improve cohesion across the ERA, as researchers would have the opportunity to work from any region or Member State in the EU and be involved in world-class research teams. Measures foreseen under the ERA will also have a positive impact on fundamental rights, in particular as regards the respect for gender equality, freedom of expression, freedom of arts and sciences etc. For example, effective online service provision should support gender equality by facilitating the development of flexible work arrangements (e.g. working remotely). Ensuring that open, transparent and merit-based recruitment procedures are in place in universities and public research institutes would also facilitate the mobility of researchers into and across Europe. However, resistance can be expected from "protected" researchers, used to in-breeding and less favourable to mobility.

Expected environmental impacts of the options

Several grand challenges have a strong environmental component which can essentially be tackled by cross-border cooperation. Removing barriers to compatibility and interoperability of national research systems as well as the promotion of common transnational synchronised research agendas and calls would facilitate that Member States reinforce the attention on environmental issues in a cooperative way avoiding unnecessary duplication and thus increasing efficiencies.

5.1. Assessing the options

Policy Option 1 (Business as usual)

Overall assessment: Existing barriers would remain, preventing higher effectiveness in national systems. The most important benefits would be mainly induced after 2014 when Horizon 2020 would start.

Timing for completing ERA: not possible to determine but certainly not by 2014.

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58 These figures were calculated based using the exchange rate of 1£/1.2 Euros.

Costs: This option would not entail additional costs.

Pros: Limited.

Cons: does neither respond to the Council requests nor to stakeholder expectations.

Stakeholder opinion: strongly advocate for further progress towards ERA, therefore this option would disappoint them. Moreover, it would not respond to the European Council call.

Policy Option 2 (Reinforced partnership for ERA)

Overall assessment: this option would allow quick progress in ERA (Table 1). It is expected that all Member States would concentrate on removing remaining barriers and taking action according to the self-assessment of the national situation and structure in the areas mentioned in the Communication. The monitoring mechanism would allow assessing progress regularly and possibly identify additional measures to ensure progress. Research funding and performing organisations would be able to contribute to completing ERA immediately. This option would not entail though even progress in all Member States, as each of them would undertake reform at their own pace, according to their own priorities and approaches. However, the qualitative assessment of the degree of achievement of the policy objectives confirms the positive impacts in the short and long term.

Timing for completing ERA: 2014 would see concrete actions implemented in terms of barriers removed and progress towards the specific objectives.

Costs: low additional burden for the implementation of the option. As Member States and stakeholder organisations would remove barriers at their own rhythm and according to the identified needs and priorities, the administrative costs should remain low. In some cases, national laws will have to be repealed or amended. For the Commission, this option would entail costs to identify the baseline situation and quickly assess progress by the end of 2013 or early 2014 as well as to create the ERA Policy Monitoring System and support financially the measures indicated.

Pros: quick removal of barriers without EU legislation. This policy option would also allow gathering further evidence on the state of ERA advancement both in 2012 and at the end of 2013 or early 2014.

Cons: the successful implementation of this policy option relies on Member States and stakeholders support and commitments to undertake the required reforms at national and institutional level. Progress may be uneven across Member States and/or amongst institutions, which may require specific recommendations in the ERA progress report or legal action if lack of progress is generalised.

Stakeholder opinion: the various consultation exercises have shown that stakeholders and Member States strongly support change in ERA and expect measures to be taken at EU level. As there is a consensus to employ voluntary measures to complete ERA, notably amongst Member States, this option would satisfy their expectations. It would also respond to the European Council call.

Policy Option 3: (Sectoral legal measures for ERA)

Overall assessment: this option would entail progress by 2014 only in those areas of ERA tackled by Member States on a voluntary basis, but possibly important impacts in the long term if the legislation to be proposed would be adopted and transposed (Table 1). Time would be needed to collect further evidence for legislative action, implying that action may be driven by existing data and not by urgency or importance of the problem in each Member State. Second, in those cases where data is available, adoption, transposition and negotiation of each legal action would imply that progress would be attained after 2014.

Timing for completing ERA: Legislative actions towards ERA could start to be proposed at the earliest by 2012 for cases where evidence is available. Implementation would be delayed at least until 2016[59]. Voluntary action would deliver results by 2014.

Costs: This policy option would entail significant additional administrative and compliance burden for national public administrations, universities, research funding organisations and public research institutions. The transposition and implementation of legal actions at Member State level would generate an administrative burden for public authorities, as a) the transposition of the Directives would require Member States to identify the standards for the proposed principle and b) in some cases, the national regulatory framework would have to be amended or repealed. Public research institutions, universities and research funding organisations would also incur compliance costs. These are expected to be significantly higher than in option 2, as stakeholders will have less flexibility in how they implement the regulatory requirements. No administrative or compliance costs would be incurred by businesses. For the Commission, this option would entail heavy burden and costs linked to data gathering as well as the design and adoption of the numerous legal actions to be proposed from 2013 on. Resources would be needed to identify the baseline situation and for monitoring compliance at a later stage. This option will also imply that Associated Countries would not contribute to progress in areas addressed by legislative measures. The possible use of the National Reform Programmes would provide an incentive to Member States to act in sectors not regulated.

Pros: this option would lead to a level playing field amongst Member States in those areas which are subject to EU Directives and Regulations.

Cons: under this policy option, the achievement of the policy objectives by 2014 is expected to be uneven, as progress would be mainly achieved by voluntary actions in a limited number of barriers. As this policy option includes a set of binding and non-binding measures, there is a risk that no action is taken for barriers tackled by binding measures before adoption. Furthermore, all legal measures may not be proposed within the same timeframe, thus reducing the coherence and overall impact of the package.

Stakeholder's opinion: some researchers, stakeholder organisations and Member States are in favour of EU policy intervention if it can yield results in the short term. Given the time required for adopting and implementing the proposed regulations, this policy option would not satisfy stakeholders and Member States. Moreover, a vast majority of Member States is

[59] It is estimated that for adopting a Directive, 2 years are necessary, and another 2 year for transposition by Member States.

strongly opposed to the use of legislation, which makes this option very difficult to take through the Council.

Policy Option 4 (ERA Framework Directive)

Overall assessment: this option would entail very important progress towards ERA in the long-term, only if the Framework Directive is adopted (Table 1). This option requires further gathering and assessing data for all ERA dimensions at the same time to thoroughly develop principles and mechanisms. The negotiation process linked with a full set of measures to be proposed at the same time would be burdensome and long, and may lead to the adoption of the lowest levels of ambition in some or all of the ERA dimensions in order to ensure acceptance by all Member States.

Timing for completing ERA: Considering the timeframe required for further gathering the sufficient information to ensure the right definition of principles and mechanisms and for the adoption, the Framework Directive can be proposed in 2012/13 at the very earliest. The binding provisions included in the Directive would not be implemented either before the completion of the entire legislative process. Implementation of concrete measures by Member States would be delayed until at least after 2016/17 and would be transposed unevenly.

Costs: this policy option leads to additional administrative and compliance costs which would be incurred by Member States' administrations and public institutions. The transposition and implementation of the Framework Directive would require Member States to identify the standards for the principles and possible measures. In many cases, national legislation would have to be amended or repealed. However, compared with policy option 3, the administrative burden of this option should be lower for Member States' administrations as they would have to transpose and implement one Directive only. Administrative and compliance costs would be incurred also by research performing and funding organisations. Compliance costs for institutions may be lower than in option 3, as Member States may tailor national measures to the local needs and priorities. For the Commission, this option would entail extremely heavy administrative burden and costs for identifying the baseline situation and for the design of a complete set of measures that would be included in the Framework Directive. Also, the monitoring system would be very heavy and costly. No administrative or compliance costs would be incurred by businesses.

Pros: this option would lead to a level playing field in all areas covered by the Framework Directive and transposed by Member States.

Cons: Most Member States actions would be delayed until after the adoption of the Framework Directive, making it little attractive given the urgency to complete ERA by 2014. This option would also imply that Associated Countries would not be formally requested to contribute to progress to complete ERA.

Stakeholder opinion: as in Option 3, this policy option would not be supported by stakeholder and Member States.

5.2. Choosing the preferred policy option

A qualitative assessment of the degree of completion of ERA by operational objective, based on the feasibility of implementing the changes as explained above, allows the comparison of expected short term (ST) impacts in 2014 (Table 1). The table also presents the assessment of impacts in the long term (LT), important for options 3 and 4. The assessment is linked with

the type of measures: voluntary (positive in the short term +, very positive in the long term ++) versus legislative (none in the short term, extremely positive in the long term +++).

Table 1: Degree of completion of the operational objectives by policy option.

Specific objective	Operational objective for 2014	PO2	PO3	PO4
More effective national research systems	Barriers to competition removed	ST + LT ++	ST + LT ++	ST None LT +++
	Barriers to use international peer review evaluation in national research systems are removed	ST + LT ++	ST None LT +++	ST None LT +++
Optimal transnational co-operation and competition	Barriers to compatibility and interoperability between national research programmes are removed	ST + LT ++	ST + LT ++	ST None LT +++
	Barriers to access to pan-European research infrastructures are removed	ST + LT ++	ST Partial LT ++	ST None LT +++
	One pilot cross-border synchronised research call, notably on grand challenges, launched using international peer review evaluation and a single pan-European score	ST + LT ++	ST + LT ++	ST None LT +++
	Harmonised monitoring, evaluation and impact assessment principles and procedures for pan-European research infrastructures adopted and implemented	ST + LT ++	ST None LT +++	ST None LT +++
An open labour market for researchers	Barriers to open, transparent and merit based recruitment in public research systems, cross-border portability and accessibility of national grants are removed	ST + LT ++	ST Partial LT ++	ST None LT +++
	Frameworks supporting the career development of researchers and innovative doctoral training are adopted and implemented	ST + LT ++	ST Partial LT ++	ST None LT +++
Gender equality and gender mainstreaming in research	Barriers to gender equality and the gender dimension in research are removed	ST + LT ++	ST + LT ++	ST None LT +++
Optimal circulation, access to and transfer of scientific knowledge	Policies and means for facilitating online access to publicly-funded scientific publications and data are defined and coordinated	ST + LT ++	ST Partial LT ++	ST None LT +++

	Policies to foster knowledge transfer, cross-border sharing of e-infrastructure and take up of digital services for research are defined	ST + LT ++	ST Partial LT ++	ST None LT +++
	Electronic identity services for researchers enabling transnational access to digital services (collaboration, computing, scientific information) are implemented or planned	ST + LT ++	ST Partial LT ++	ST None LT +++

Notes: ST: Short term; LT: Long Term.

Policy option 2 (Reinforced partnership for ERA) alone ensures a substantial level of progress towards compliance with the 2014 deadline imposed by the Council (i.e. "to complete ERA by 2014"). This option would also allow the development of an assessment system for possible future action. Moreover, this option entails (with the exception of the Business as usual) the lowest level of administrative and compliance costs for Member States, Commission and stakeholders.

Therefore, policy option 2 (Reinforced partnership for ERA) is the preferred option.

5.3. Risks and mitigating strategies

The main risk associated with policy option 2 resides in possible reluctance from Member States to implement reforms. However, the Communication sets two mechanisms to minimize the risk of inaction. First, the Communication would invite relevant research stakeholder organisations to sign with the Commissioner a Joint Statement in general terms of their willingness to work towards completing ERA. They should also set out the specific ERA actions they will take in terms of timing, deliverables, public reporting on progress, etc. in a Memorandum of Understanding co-signed with the Commission or a unilateral declaration, informing their respective national authorities and the other Partners. They would thus directly be involved in delivering ERA. As such, each organisation would become the main agent of change at national level, as in many cases the implementation of the actions would depend on the removal of barriers. Second, the monitoring mechanism - presented below - would implement annual assessments of progress on ERA. It would recommend, if needed, concrete actions in specific area(s) for each Member State. In case of insufficient and/or persisting progress, the Commission would propose legal or other action.

6. MONITORING AND EVALUATION

So far, insufficient efforts have been put on gathering evidence on the importance of the problems or on progress in achieving ERA. It is essential to put in place an appropriate and well-timed mechanism to monitor and assess progress towards the policy objectives in this Communication as well as to improve transparency towards the scientific community. However, there is a need to avoid unnecessary burden for Member States. Therefore, the mechanism needs to be aligned with the assessment of progress in the Innovation Union and fully synchronised with the European Semester. Additional efforts will be limited to

collecting specific data needed to strengthen monitoring of ERA progress[60] and to guide reforms to ensure maximum added-value.

Indeed, annual monitoring is foreseen for the Innovation Union Flagship Initiative, via the State of the Innovation Union. The achievement of the ERA is one of the commitments, in relation to some other relevant commitments. The current list of twelve **ERA-related indicators under the Innovation Union Scoreboard** (IUS) will continue to provide information on R&D system performance and impacts although this information is insufficient to monitor the ERA measures. A good synchronisation between ERA monitoring and political steering, with the overarching Innovation Union processes is necessary.

At the beginning of the European Semester the Commission adopts its Annual Growth Survey, which analyses progress achieved over the past year in implementing the Europe 2020 growth strategy and presents priorities at EU level for the following 12-18 months. It is the basis for the overall guidance provided by the Spring European Council to Member States for adapting the annual National Reform Programmes (NRF) (presented by MS in April). Based on their assessment, the Commission proposes Country-specific recommendations in good time for their adoption by the European Council in June.

The ERA monitoring mechanism will be developed to be seamlessly integrated in these mechanisms. It will be organised as follows:

- In 2012, the Commission will identify - on the basis of official statistics used to their maximum potential, existing data, ad hoc studies and surveys and voluntary inputs from Member States and stakeholders - the **baseline** in each Member State as well as the state-of-play at stakeholder/institutional level for each action. The baseline will be discussed during the first meeting of the **ERA-Stakeholder Forum** that will be launched by the Commission

- Member States (e.g. authorities in charge of R&I) will be asked to present a report on *ERA-reform measures* in **April 2013**, as an annex to their national reform programmes. This report should indicate in sufficient detail on-going activities and actions planned to fulfil their policy commitments in direct relation to the objectives in this Communication

- In **April-May 2013**, the Commission will analyse both the NRPs, the more detailed description of national *ERA-reforms measures* and compare them to the baseline established in 2012. It will discuss ERA related issues with Member States and will encourage discussions and mutual learning in the context of European Research Area Committee (ERAC) and its specific configurations (GPC, SFIC), possibly resulting in an *ERAC opinion to the Council and Commission*

- in **September 2013**, the Commission will issue the first ***ERA-progress report*** which will assess the proposed measures by MS in comparison with the Baseline situation. The report may include, when necessary, *ERA recommendations for the Member States*. This will also provide inputs to the overall monitoring of the Innovation Union Flagship Initiative. This ERA Progress report could be discussed in the December Competitiveness Council, possibly resulting in *Council Conclusions on ERA progress*

[60] See for instance the ERAC opinion presented in December 2011 addressing the issue of data gathering, evaluation and monitoring.

as input for the next Annual Growth Survey which guides national reforms by Member States in the context of the European Semester. The progress report may also be the basis for debate in, and guidance by an ERA minister conference, involving Associated Countries. It will also be discussed in the second meeting of the **ERA-Stakeholder Forum** which will take place in October-November 2013. The Commission will launch studies/surveys at the end of 2013 to assess progress

- Member States will be asked to continue including the *ERA-reform measures* in an annex to their NRPs delivered by **April 2014**

- In April-May **2014**, the Commission will analyse the NRPs, the more detailed description of national ERA-reforms and the assessment of impacts of the reforms issued from the studies and surveys. ERA related issues will be discussed with Member States during country visits and, as described, the Commission will continue encouraging discussions and mutual learning in the context of European Research Area Committee (ERAC) and its specific configurations (GPC, SFIC)

- in **September 2014**, the Commission will issue the second ***ERA-progress report*** which may include, when necessary *ERA recommendations for the Member States*. The report will be discussed within the Stakeholder Forum. It may also contribute to the following Annual Growth Survey

- Afterward, Member States will be asked to continue including the *ERA-reform measures* in an annex to their NRPs delivered by **April every year**

- In April-May **every year**, the Commission will analyse the NRPs, the more detailed description of national ERA-reforms and the assessment of impacts of the reforms. ERA related issues will be discussed with Member States during country visits, and as described, the Commission will encourage discussions and mutual learning in the context of European Research Area Committee (ERAC) and its specific configurations (GPC, SFIC), possibly resulting in an *advice by ERAC to the Council and Commission*.

- in **September every year**, as indicated previously, the Commission will issue an ***ERA-progress report*** which may include, when necessary *ERA recommendations for the Member States*. The report will be discussed within the Stakeholder Forum. It may also contribute to the following Annual Growth Survey.

The analysis and conclusions of the *ERA-Progress Report* will be presented through the ERA monitoring mechanism, based on a set of indicators of progress (See Annex 7 for a tentative list of indicators). It will be developed by the Commission as part of the overall Research and Innovation Observatory and will be consistent with the monitoring of the future Horizon 2020 programme and articulated with the Knowledge Triangle and the Innovation Union flagship initiative.

Annex 1: Consultation of interested parties and expertise used

Public Consultation on the ERA Framework: a public online consultation was organised with a view to gathering Member States and stakeholder views on ERA and areas of untapped potential for the development of ERA (see below for more details).

Consultation on ERA as part of the public consultation on the **Green Paper on a Common Strategic Framework for EU Research and Innovation Funding** (European Commission, 2011a): this questionnaire included a set of questions on ERA and stakeholders were invited to express their views on how European science can be stimulated towards a higher level of excellence.

Stakeholder meeting (**21 June 2011):** the meeting was organised with main research stakeholders (15 European level organisations) to discuss the preparation of the public consultation on the ERA framework. The meeting allowed optimising the public consultation so as to ensure that its objectives and content are fully understood and endorsed by ERA stakeholders.

ERAC stakeholder seminar (13 September 2011): this seminar marked the formal launch of the public consultation on the ERA Framework. The meeting convened 33 stakeholder organisations, 26 countries representatives as well as ERA Partnership Group chairs. The seminar aimed to achieve a better shared understanding and validation of the main barriers and areas of untapped potential to the development/completion of ERA, the costs of non-ERA as well as the benefits of ERA. A final report is available.

2012 ERA Conference (30 January 2012): the objective of the conference was to present a synthesis of the responses to the consultation questionnaire received. The conference provided an opportunity for the 400 participants, European-level stakeholders, ERAC members, chairs of ERA groups and the Commission to engage in a series of both plenary and theme-specific parallel discussions in view of achieving a consensual view and understanding on the main barriers and areas of untapped potential to the development and completion of ERA.

Opinion by the European Research Area Committee (ERAC)[61]: ERAC has examined in depth the key obstacles for the completion of ERA and adopted a written opinion on the ERA framework on 9 December 2011.

Expert Group - High-Level Economists Group: a subgroup of the High-Level Economists Group 'Innovation for Growth' has been set up with the mandate to identify the socio-economic benefits expected from a fully functioning ERA. The report will be delivered in March 2012.

Study on Member States' R&D regulatory systems: the Commission organised one ad-hoc expert group meeting on gathering different national perspectives on the regulation of research across EU member states. This served as a basis for the Commission to order a six month study on gathering an overview of the way research and research systems are regulated in the 27 Member States. The final report was delivered in December 2011

[61] ERAC is an advisory body to the Council and the Commission, composed of experts from national authorities.

Research projects and other studies: the report benefited from contributions of the FP7 SSH-funded DEMETER project and of the FP7 SSH-funded VERA project.

Summary of results from the ERA consultation

Research and innovation are at the heart of the Europe 2020 agenda which aims to get Europe out of its current economic difficulties and transform it into a smart, sustainable and inclusive society. For the first time, the Lisbon Treaty empowered the European Union to achieve the European research area (ERA). Completing ERA will require the support and effort of all Member States and associated countries and their stakeholders.

The public consultation on the ERA framework, 'Areas of untapped potential for the development of the European research area', aimed at gathering, from stakeholders, views and evidence on the key obstacles which have to be tackled to achieve a well-functioning ERA. It was open from 13 September 2011 to 30 November 2011. It generated a substantial response from those with a stake in European research, the highest numbers coming from individual researchers and the higher education sector, followed by public administrations and the business sector.

This report synthesises the responses to the consultation based on the 590 responses received to the online questionnaire as well as the 102 ad hoc contributions received by the end of December 2011 submitted mostly as position papers by national and European research organisations and in the form of official positions of Members States/associated countries from ministries or national governments, including a joint input by Member States/associated countries via the ERA Committee. All Member States are represented through at least one stakeholder contribution.

Most important gaps for the achievement of ERA

Overall, there is overwhelming support for pursuing the development of the European Research Area and for action on all its dimensions to complete ERA by 2014. Problems and deficiencies in relation to research careers and mobility emerge as a clear priority even when factoring out the dominant proportion of responses from individual researchers to the online questionnaire. Furthermore, the responses from national and European organisations which represent the interests and views of significant numbers of research stakeholders as well as the official responses from Member States also point to cross-border operations, open access and international cooperation as important priorities.

Research careers and mobility

Researchers are at the core of the European S & T system. Having a well-trained and competitive labour force is a prerequisite for the development of a well-balanced knowledge-based economy. There is a clear signal that further efforts are required to ensure that the European and national systems attract and retain a sufficient number of leading researchers. While 40 % of respondents agree that Europe produces enough leading researchers, less than 20 % believe that Europe attracts and retains sufficient numbers, and 14 % underline the low retention rate of the profession. Moreover, only 22 % believe that researchers are adequately trained for the business labour market. Therefore, there is a need to attract and retain more leading researchers and to provide all researchers with better skills, especially for the business sector as this remains an obstacle to economic growth.

Furthermore, 80 % of respondents believe that research careers in the public sector are comparatively unattractive because of the current uncompetitive working conditions and the lack of career prospects. The reasons for unattractiveness are the underfunding of universities and research institutions, the limited availability of research positions in academia, the relatively low wages in academia and the insufficient cooperation between academia and the private sector. Respondents also report a lack of recognition of the research profession.

The mobility of researchers is one of the ERA objectives. It contributes to improving research quality and provides more attractive careers. However, a range of factors hampers internationally mobile researchers who, in addition, face difficulties to move between sectors. The lack of portability of publicly funded grants is the most important impediment, while the lack of open and transparent recruitment procedures is regarded as one of the main barriers to international mobility. Protectionism/nepotism is considered to be the main reason followed by the lack of a human resources strategy in institutions and the lack of awareness of job portals such as EURAXESS Jobs.

Other obstacles relate to the lack of information on social security and pension rights as well as to the lack of recognition of diplomas in other countries. As regards moving between sectors, the move from the private to the public sector is considered to be harder than from the public to the private sector. Removing the remaining obstacles to the mobility of researchers seems to be a shared concern amongst all respondents, who demand EU action in this area.

Cross-border operation of research actors

Europe faces a series of major societal and global challenges where research can play a key role in providing solutions but which cannot be solved within national borders only. The level of funding explicitly coordinated between different countries and/or available for cross-border cooperation remains relatively modest in Europe, both in absolute terms and compared to funding allocated on a purely national basis.

It is necessary to coordinate research at transnational level to raise research quality, reduce costs and tackle major challenges. An overwhelming number of respondents feel that joint programming is one of the most interesting initiatives launched in recent years to enhance cross-border operations. Joint research programmes are highly valued when the countries involved engage in long-term commitments. Joint programming initiatives and alliances between research institutes are considered appropriate mechanisms for making progress in cross-border research, while a certain level of duplication is recognised as appropriate since competition contributes to raising research quality. However, the lack of political commitment is considered by 68 % of respondents to be the major difficulty for transnationally coordinated research. Another important issue is the consistency between priorities in national and joint research programmes. Much more political will is required for national funding agencies to support joint research programmes. A dedicated budget allocation for cross-border cooperation would also be necessary.

Furthermore, the complexity of too many cross-border schemes is counterproductive. Minimum rules for ensuring interoperability of funding schemes are required to facilitate cross-border research, such as common principles and standards, rules for grant/funding applications, evaluation and reporting, as well as synchronisation of calls for proposals. The openness and transparency of procedures are considered as essential conditions for implementing joint research programmes.

Moreover, many respondents see the individual researcher as being in the centre of cross-border operations and support the promotion of long-term mobility grants. In addition, the majority of respondents support better access to information on initiatives open for cross-border operation in order to facilitate the implementation of joint research programmes and to better show the benefits for research actors and stakeholders, which in turn would facilitate broader and stronger commitment.

Research infrastructures

Several EU measures have been adopted to ensure that Europe effectively develops and maintains pan-European research infrastructures of strategic interest. The setting-up of the European Strategy Forum on Research Infrastructures (ESFRI) in 2002, the ESFRI roadmaps and the financial support provided through the EU framework programmes have been crucial in this respect. Despite these achievements, some issues still need to be addressed for Europe to keep world-class research infrastructures and face future challenges.

While most respondents believe that public funding should be increased for the realisation of the next generation of research infrastructures of pan-European interest, developing more synergies between European and national actions is considered to be necessary for an optimal exploitation of existing research infrastructures. Increasing the role of the EU in helping Member States to reach agreements on the costs of construction and operation is considered to be one of the priorities to realise the next generation of infrastructures. The setting-up of regional partner facilities along with the development of more harmonised rules between public research funding and Structural Funds is also perceived as important.

Many stakeholders highlighted that the quality of research can be increased by the implementation of an open and excellence-based access to facilities for all actors of research. 79 % of respondents consider that EU support for transnational access to research infrastructures of pan-European relevance should be increased, while 64 % of respondents support remote access to research facilities through for instance the development of e-infrastructures. Strengthening the inter-operability of instruments and of scientific data at EU level is also regarded as important. Uniform evaluation criteria and practices for research infrastructures will contribute to raising the research quality within ERA.

Knowledge transfer

Improving knowledge transfer between universities, public research organisations and industry is essential for ensuring that publicly funded research results contribute to economic output and can effectively support innovation and the development of new services and products. Likewise, knowledge transfer has an increasing importance for research, especially in all fields of transdisciplinary and cross-border research. Strategic and comprehensive approaches and strategies for knowledge transfer in Europe are not yet common and in many instances there is insufficient awareness about this topic.

A majority of respondents considers that universities and public research organisations should be given incentives to develop and implement strong knowledge transfer strategies and structures. These should complement the development of strategic partnering with the private sector, including: researchers' mobility, better alignment of incentives and interests, and the development of effective collaboration channels in order to tighten the links between the public sector and the private sector. Furthermore, respondents consider that researchers should

be better informed about knowledge transfer and that knowledge transfer activities should be professionalised, thereby allowing knowledge transfer offices to play a stronger role.

Open access

All research builds on former work and depends on scientists' possibilities to access and share scientific information. The advent of the Internet and electronic publishing has resulted in unprecedented possibilities for the dissemination and exchange of information. However, most scientific information generated by public funding, in whole or in part, is not available for free. This limits the access, dissemination and use of research results.

'Open access', defined as free access over the Internet, aims to improve and promote the dissemination of knowledge, thereby improving the efficiency of scientific discovery and maximising the return on public investment in R & D. In the consultation, respondents favoured the idea that publications resulting from publicly funded research should be given open access and that it should become a principle for EU-funded activities. Some respondents also emphasised also the importance of guaranteeing not only access to, but also reuse of, scientific information.

In order to improve open access to scientific publications and data, as supported by 81 % of the respondents, actions suggested at EU level include increasing stakeholder awareness, facilitating the exchange of best practices and setting standards for the repositories and data-sharing practices.

Respondents also supported the view that national open access policies could be better coordinated and suggested a key role for the European Commission in coordinating national initiatives, and in monitoring and promoting open access policies to publications and data.

International dimension

S & T cooperation boosts the quality of European research and strengthens the economic, industrial and technological competitiveness of Europe. The EU and its Member States have not yet been able to combine their weight to address global challenges which lie beyond the scope and resources of individual Member States or Member States and the EU as such. It has been difficult for them to act together to contribute to the establishment of a level playing field vis-à-vis third countries. Europe should be in a position to engage in effective international cooperation, and in shaping or leading major international cooperation initiatives, in particular to tackle global societal challenges.

To achieve this, the global attractiveness of Europe as an S & T location (for researchers, companies and investment) could be increased by reducing the fragmentation of the European market and by improving employment and career prospects for researchers, including third-country researchers, in the EU. Furthermore, improved information-sharing and coordination between international R & D policies and programmes of the EU and of the Member States, as well as the development of a common EU–Member States strategy for international science and technology cooperation and of coordinated initiatives by the EU and the Member States vis-à-vis third countries, have been identified as the most important steps which should be taken by the EU and its Member States to maximise the benefits from international S & T cooperation. Policy planning, coordination and implementation should involve the main stakeholders.

Many comments from respondents underline the importance of openness towards third countries with regard to other ERA-related topics, such as the mobility of researchers, scientific excellence, global challenges, knowledge transfer and research infrastructures. International cooperation should be part of all relevant ERA measures and instruments. Reciprocity should be ensured: there should be similar access for European researchers to the R & D programmes of third countries as there is for third-country researchers to European programmes.

Gender

Although 45% of PhD graduates in the EU are women, only 31 % of researchers and 18 % of full professors are women. Progress has been slow towards achieving gender equality (i.e. gender-sensitive human resources management, gender balance in decision-making and the integration of the gender dimension in research content) in ERA.

A broad majority of respondents consider that a higher involvement of women in science will contribute to European socioeconomic growth. They mainly attribute slow progress in achieving gender equality to the persistence of gender stereotypes on the labour market, the lack of top-level support in research institutions and slow progress in the modernisation of research institutions. Therefore, respondents stress that research institutions need to implement adequate gender equality strategies at the level of their human resources management and in research programming.

Reflecting on how EU policies on gender in research could be made more effective, stakeholders are in favour of increased incentives, improved working environments and the inclusion of gender issues in research programmes, content and outcomes.

Ethics

Respondents agree on the need to create the necessary conditions for the main actors to discuss common principles and common practices that can facilitate the work of researchers and allow a closer cooperation between the ethics experts at the European level. Ethics review procedures should be simplified without compromising current standards.

Managing and monitoring the ERA partnerships

Following the launch of ERA in 2000, some notable results were achieved by the open method of coordination, steered by the EU Scientific and Technical Research Committee (CREST), and by instruments under successive framework programmes. The Ljubljana process, based on a partnership approach (launched by research ministers in 2008), has given new impetus to efforts to build ERA. The ERA vision 2020 (2008), the revamping of existing thematic ERA groups, the creation of the High Level Group for Joint Programming (GPC), the Strategic Forum for International S & T Cooperation (SFIC) and the transformation of CREST into ERAC (European Research Area Committee) in 2010 have changed the governance structure of ERA. However, as stated by the Council in its progress report of 2010 on the realisation of ERA: 'Much progress has been made, but the fact that the same issues as at the start of ERA in 2000 remain at the forefront of the policy debate shows that there is still a long time to go.' A new ERA framework is needed to bring ERA to a more ambitious level.

There is overall support from respondents for closer cooperation and coordination in policy development and implementation in order to reduce the research and innovation deficit and inefficiencies in the EU. The full use of intellectual capability in Europe will be feasible if all

regions and countries are able to engage fully in ERA. More synergies and increased coordination are necessary between European and national/regional research agendas and programmes. However, several respondents emphasised that there was no need to establish new structures, but to build further on existing structures to support the good functioning of ERA including for progress monitoring of ERA-related initiatives. Monitoring should nevertheless involve more stakeholders than Members States only and should not induce an increased administrative burden.

An important message resulting from the consultation is that almost 80 % of respondents support a greater involvement of stakeholders in all ERA processes. This would result in more balanced, efficient and better-accepted policy options agreed at EU level and allow a more bottom-up approach in the decision-making process. The establishment of a stakeholder platform is supported by a majority of respondents. A high number of respondents request more transparency and information about ERA's available instruments and initiatives.

Another important observation is that 73% of respondents believe that the completion of ERA requires a strengthened political commitment both at national and EU levels. 72 % agree on the inclusion of dedicated EU research policy content in national research policy programmes, whereas 64 % support the inclusion of ERA-related policy in national reform programmes.

The principles of simplicity, low administrative burden, scientific autonomy, freedom of research, scientific integrity and ethical principles are considered as the most important principles to be retained in an ERA framework.

The outcome of the consultation will help the Commission to decide on those issues which should be addressed as priorities when preparing in 2012 the ERA framework, which will set out the focused, proportionate and effective measures to be taken to realise ERA. The ERA framework will focus on non-funding measures.

Annex 2: Further evidence for the problem analysis

Differences in overall performance between the European and American research systems

This section presents the overall performance of the European research system, mostly in comparison with the performance of the US research system. Science and scientific excellence are crucial to develop the necessary knowledge and skills for technology-based innovation.

One key driver of the differences is the fact that the EU has not played a role comparable to the US in the IT revolution. In the US much more than in the EU, the IT revolution has given rise to the creation of many R&D intensive firms which have developed and grown into global leaders. But this "IT story" seems not to be an isolated case as we see again that the US biotech sector attains a size which is about the double that of the EU[62]. Also in nanotechnologies, in spite of a higher level of public research expenditures in the EU than in the US, EU/US comparisons on the volume of business activity generated (based on indicators such as private R&D investments, number of patents and market introduction of new products) are clearly not favourable for the EU[63].

While scientific excellence and quality cannot be measured as such, the best proxies are bibliometric indicators which measure the scientific impact of published research results. The number of citations that a scientific publication receives informs about the value which the scientific community ascribe to this publication for subsequent scientific developments: it is therefore an indication of the impact of this publication on science.

Citation data indicates that top-level science of the EU is less cited than in the US[64]:

- On average over the period 2000-2009, US scientific publications received 27% more citations than EU ones in most fields, with the exception of Energy and Space[65].
- In the EU, 11.6% of its researchers' publications are among the top 10% most cited worldwide[66], which is above the world average. In the US, 15.3% of its publications are among the top 10% most cited worldwide, showing a better performance than the EU[67]. Moreover, the share of 10% most cited scientific publications is unevenly distributed as are the patents (Figure 2below).
- In the Shanghai ranking of world's universities, 27 of Europe's universities features in the top 100 in 2011 whereas the corresponding figures for US universities is 55.

62 *Biotechnology in Europe, 2006 comparative study*, Critical 1, prepared for EuropaBio..

63 European Commission (2009), "STC Key Figures report 2008/2009", pages 69 , and "Europe in the global research landscape", pages 44 to 48

64 Dosi, Llerena, Labini (2006)

65 P. Albarran, J. Crespo, I. Ortuno, J. Ruiz-Castillo, (2009), "A comparison of the scientific performance of the US and the EU at the turn of the century",

66 A country which exhibits an average scientific performance is expected to have 10% of its publications among the top 10% most cited ones worldwide.

67 EC 20011, Innovation Union Competitiveness Report. The figures concern 2007 scientific publications, cited in 2007-2009.

The dominance of US universities is even more pronounced when looking at the top 50 (11 EU universities) and top 10 world's universities (2 EU universities).

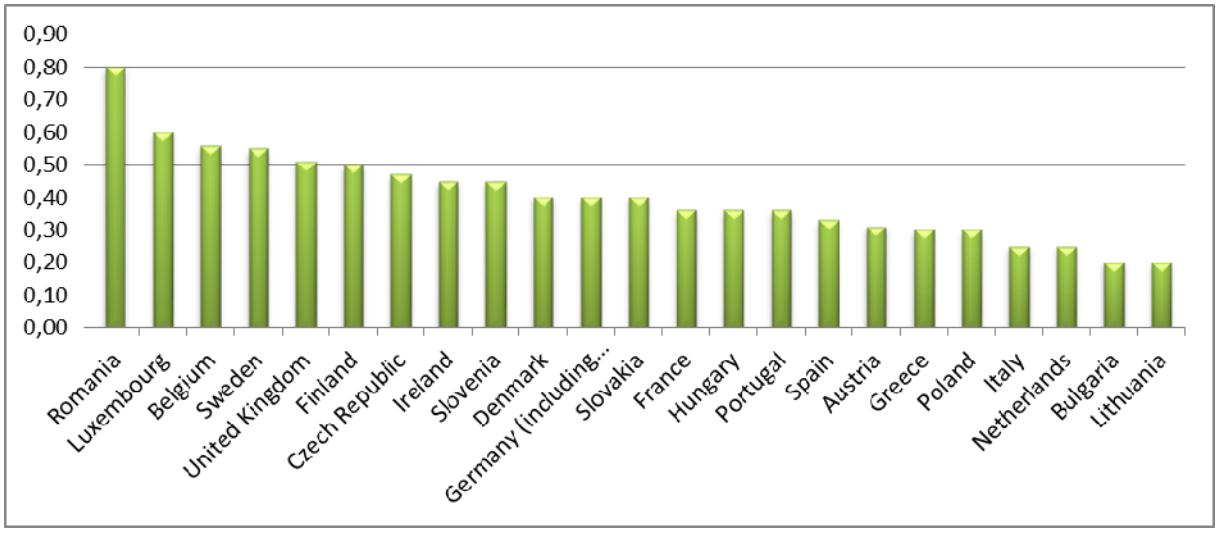
The EU scores well in 'traditional' scientific fields, such as Agricultural science, Chemistry, Physics and Engineering, while it lag the farthest behind the US in fast-developing fields such ICT, Nanotechnology, Biotechnology, Molecular biology and Genetics[68]. In his paper "*Explaining poor performance of European science: institutions versus policies*", A. Bonaccorsi (2007) developed the following diagnosis: "*European science is weak in the upper tail of quality, in fast moving new fields, and in fields characterised by divergent growth and new forms of complementarities, many of which are also responsible for breakthrough technological developments*"[69].

Figure 2: Distribution of the 10% most cited scientific publications as percentage of total national publications (left) and EPO patent applications by inventor's country of residence (2007)

Competitive funding in Europe

As shown in Figure 3 below, the share of competitive funding as a total of public R&D funding (GBAORD) varies from 20 to 80% between Member States.

Figure 3: Share of GBAORD allocated through calls for proposals



Source: OECD, based on preliminary data from the microdata project on public R&D funding of the Working Party of National Experts in Science and Technology (NESTI), 2009-2010 and Commission estimations for missing observations.

68 P. Albarran, J. Crespo, I. Ortuno, J. Ruiz-Castillo, (2009), "A comparison of the scientific performance of the US and the EU at the turn of the century"

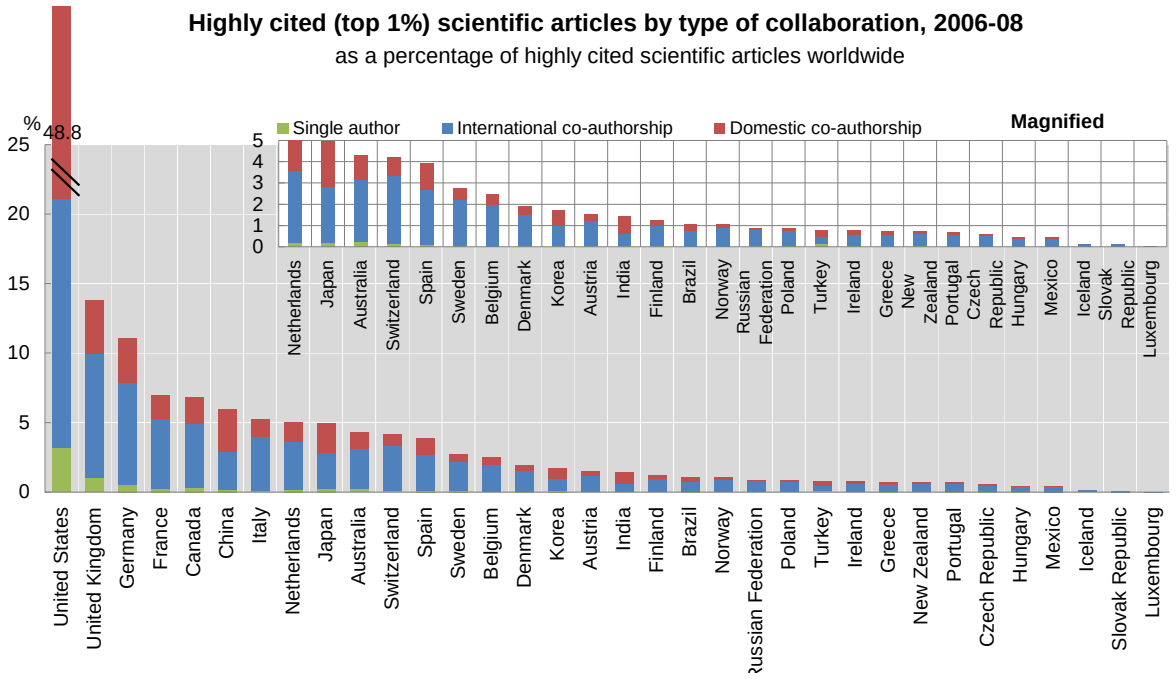
69 *Science and Public policy*, June 2007.

Well-coordinated research programmes and priorities

Estimations indicate that around 87% of public R&D in the EU is programmed, financed, monitored and evaluated at national level, with too little collaboration or coordination between countries. In 2011 an EC Communication on Partnering in Research and Innovation[70] was launched aiming to simplify the existing partnering landscape in research and innovation. The FP7 SSH VERA project indicates that "research programming of universities in Europe is currently not co-ordinated across borders in a systematic way. With regard to co-ordination between research institutes, two initiatives exist to date: the European Energy Research Alliance (EERA) and the European Climate Research Alliance (ECRA). According to NETWATCH data, there were 7 active networks in 2011 receiving no funding from FP7. They were all self-sustaining networks, which were actually former ERA-NETs, and which continued without EU support" (VERA, 2012).

Co-operation between research institutions leads to international co-authorship. As shown in Figure 4 below, international co-authorship is more cited than domestic co-authorship.

Figure 4: Highly cited scientific articles by type of collaboration, 2006-08



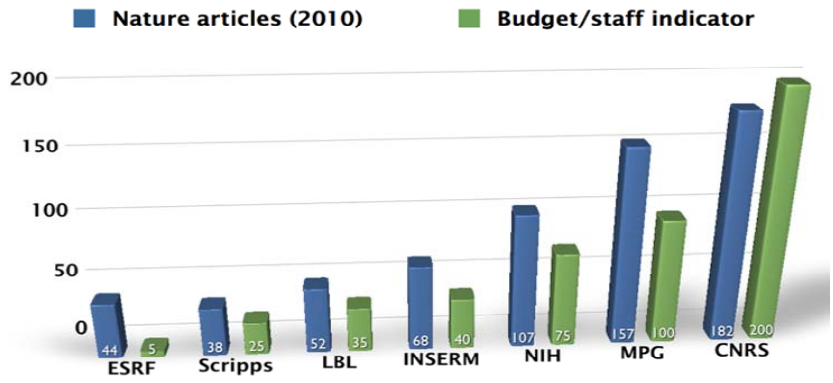
Source: DG Research and Innovation
Data: OECD, Measuring Innovation: A New Perspective (2010)

Research infrastructures

Pan-European research infrastructures allow research and scientific results to be delivered faster and at lower costs as shown below.

[70] COM(2011) 572 Final

Table 2: Ration of publications of pan-European RIs vs. national research entities: the case of ESRF



Source: Nature Publishing Index, Global Top 50 (BETA)

As stated by the FP SSH VERA project, "through FP7, the EU provides mainly catalytic support to an initial Preparatory Phase (~220 M€) to address legal, governance, financial and technical issues in order to launch the projects. The EU contracts provide a framework allowing all necessary stakeholders to cooperate. FP7 funds to support to the actual Construction Phase is much more limited (90 M€). Additional financial resources (200 M€) are devoted to the RSFF to make available loans from the European Investment Bank (EIB). In view of the overall financial needs (~ 20B€), the contribution of FP7 of ~ 500 M€ is rather limited.

The EU Structural Funds can provide a substantial support to some research infrastructures. Under the current Financial Perspectives from 2007 to 2013, 10 B€ are earmarked for "R&TD infrastructure and centres of competence". This support is particularly important for the 12 new MS. The projects need to meet requirements of scientific excellence and impact on the regional economy. For some ESFRI projects, industrial partners have already been identified and letters of interest from companies received, demonstrating the potential impact on the economy (partnership with innovative industries, large companies, SMEs and start-ups; links with innovative incubators for the creation of spin-offs). After 2013, as part of Horizon 2020, Research Infrastructures (including e-infrastructures) are expected to be funded under the priority 'Excellent Science'" (VERA, 2012).

Realising a single market for researchers

The ERA Green Paper (2008) identified several barriers to the European single market for researchers. These include the limited extent and lack of harmonised rules and conditions for open recruitment in public research institutions, the lack of recognition in the labour market law of the research profession and its specificities, its poor working conditions and the existence of barriers to easily transferable pension funds. The FP7 SSH VERA project has identified that "mobility across sectors or borders is often penalised in terms of career advancement and consolidation and, in general, the private sector is not sufficiently active in research. In this context, procedures for facilitating access to the EU for third country researchers are still cumbersome and lengthy. Doctoral education in EU is fragmented and lacks critical size at the expense of excellence and attractiveness These barriers are further reinforced by some demographic and social trends: on the one hand, women are under-represented in top scientific positions (see section below); young PhDs emigrate from Europe to the US; many of the old researchers close to retirement will not be replaced resulting in loss

of competences. These barriers have not been substantially overcome in the recent years and the Innovation Union flagship initiative has identified further obstacles. For instance, it has pointed out that the research profession suffers from a lack of a common understanding of researchers' competences, which hinders the match of demand and supply and thus the effective allocation of resources" (VERA, 2012).

Recruitment practices in the EU

In the large-scale MORE survey of university-based researchers[71], previously mobile researchers were asked about 'major' obstacles to possible future mobility. Up to 70% cited "finding a suitable position", which is explained partly by a lack of open and transparent recruitment procedures. This finding was supported by the recent public consultation on the ERA framework. The lack of open and transparent recruitment procedures was regarded by more than 59% of respondents (and up to 78% if those who rate it as of 'medium importance' are included) as one of the main factors hindering internationally mobile researchers.

Recruitment procedures at Member State level are complex and vary significantly across the EU. Recruitment policies and practices in public institutions are determined by a number of factors, such as universities' and research institutions' autonomy over hiring, career progression mechanisms and career paths for research-related positions.

Regarding staffing autonomy (the capacity to decide on recruitment procedures, on salaries, on dismissals and on promotions of senior academic/senior administrative staff), the recent EUA report[72] (European University Association 2011) shows that universities in nine EU Member States (DE, CZ, ES, FR, EL, HU, IE, PT, SK) face tight restrictions over hiring and cannot freely hire staff. In several Member States (CZ, HU, SK, EL) the appointment of some or all senior positions need to be confirmed by an external authority. Italy lies in 24th, Spain 26th and Greece 28th.

Recruitment practices in Italy are not sufficiently open and transparent. For example, selection criteria are published but often remain very generic. Moreover, recent research[73] into Italian universities points to a remarkable level of nepotism. This has led to a recent reform law (no. 240 of 2010) whereby Italian universities i) must advertise any position publicly, at national and European level; and ii) cannot employ a new researcher or professor even on a part time or temporary basis in the same University Institute/Department where his/her relatives (to the 4th degree of relationship) teach and work.

In Germany the openness of appointment procedures is guaranteed by the constitutional principle of the selection of the best and laws explicitly calling for international publication of many positions although a study by the German Federal Ministry of Education and Research (BMBF, 2010) indicates that the majority of staff in universities and research institutions feel that recruitment in Germany is neither fair nor transparent.

In Greece, institutions are constrained by (at times multiple) restrictions imposed on all areas of higher education staffing. The number of posts is limited; appointments are confirmed by

71 http://ec.europa.eu/euraxess/pdf/research_policies/MORE_HEI_report_final_version.pdf

72 European University Association (2011), *University Autonomy in Europe II, The Scorecard*, by Thomas Estermann, Terhi Nokkala & Monika Steinel, http://www.eua.be/eua-work-and-policy-area/governance-autonomy-and-funding/projects/university-autonomy-in-europe/

73 http://www.timeshighereducation.co.uk/story.asp?sectioncode=26&storycode=418337&c=1

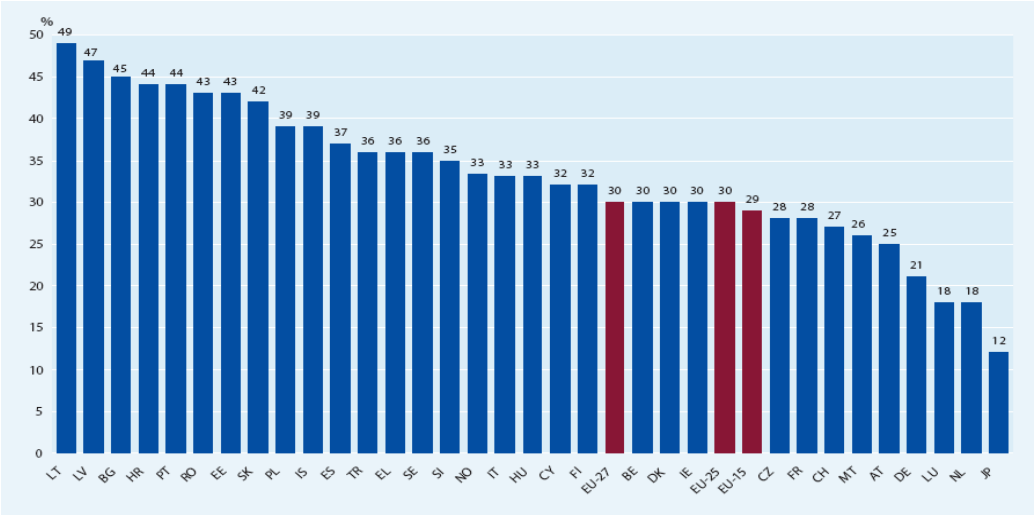
an external authority for academic and carried out through a centralised national system for administrative personnel. Salaries and dismissals are strictly regulated due to the civil servant status held by all staff, and the law states detailed requirements for the promotion process.

Under-representation of female researchers

Evidence shows that the potential represented by female scientists may not be used in an optimal manner. Research[74] shows that female researchers tend to be under-represented across the EU (average share of 31% of females amongst the research profession). Whilst the number of female researchers is almost on a par with the number of male researchers in Member States such as Lithuania, Latvia and Bulgaria (49%, 47% and 45% respectively), the proportion of female researchers drops to 21% in Germany and to 18% in Luxembourg and the Netherlands.

Table 3 below provides an overview of the proportion of female researchers in EU Member States and selected third countries.

Table 3: Proportion of female researchers, 2006



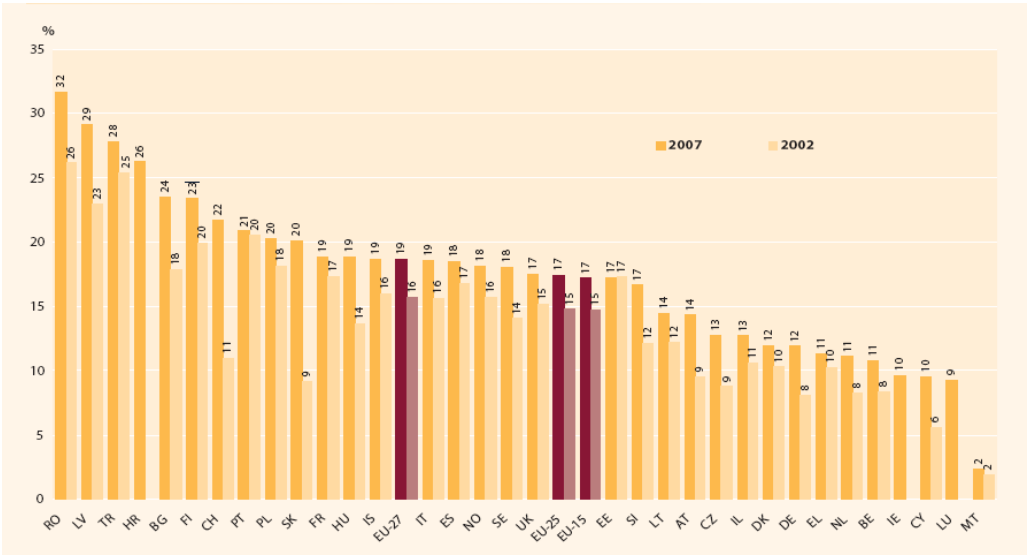
Source: S&T statistics (Eurostat), Norwegian Institute for Studies in Innovation, Research and Education
Exceptions to the reference year: CZ, EE, SK, NO: 2007; BE, DK, DE, IE, EL, LU, NL, PT, SE, IS, JP: 2005; CH: 2004
Data unavailable: UK, IL, Provisional data: NL
Data estimated: EU-27, EU-15 (by Eurostat), EU-25 (by DG Research), EE

Females also tend to be less represented in the highest grade of research careers[75] (EU average proportion of 19%) and amongst management positions (EU average proportion of 13%) as shown in **Table 4** and **Table 5** below).

74 European Commission (2009), She Figures 2009, Statistics and Indicators on Gender Equality in Science

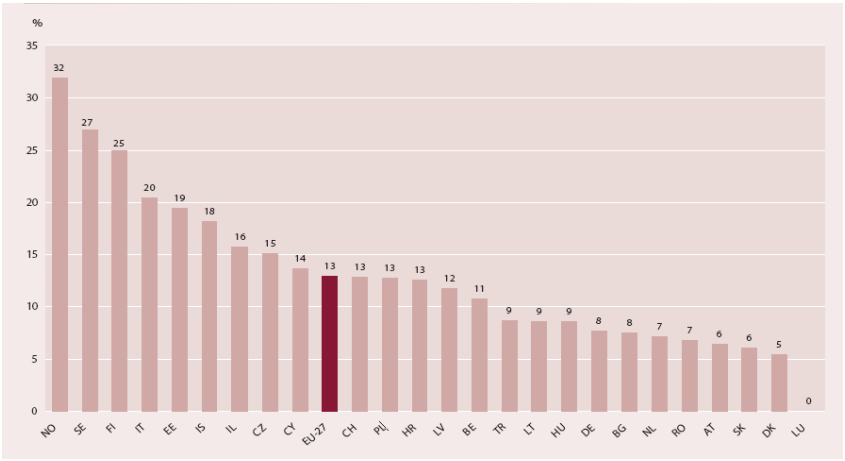
75 European Commission (2009), She Figures 2009, Statistics and Indicators on Gender Equality in Science

Table 4: Proportion of women in grade A academic positions, 2002/2007



Source: WiS database (DG Research); Higher Education Authority for Ireland
Exceptions to the reference year (s): 2007 HR: 2008; UK: 2007/2006; DK, FR, CY, LU, AT, IL: 2006; EE, MT: 2004; PT: 2003; IE: 2002-2003; EL: 2000; 2002 NO, UK, NL: 2003; IL: 2001; EL: 1999
Data unavailable: HR, LU, IE: 2002
Break in series: CZ (2005)
Provisional data: ES
Data estimated: EU-27, EU-25, EU-15 (by DG Research), SI
Head count
NO: before 2007 biannual data
Data for Ireland on Grade A professors does not include the Institutes of Technology

Table 5: Proportion of female heads of institutions in the Higher Education Sector (HES), 2007



Source: WiS database (DG Research)
Exceptions to the reference year: IT: 2009; BE (Dutch-speaking community), DE, EE, HU, AT, PL, SK, FI, SE, HR, CH, IL: 2008; DK, CY: 2008/2007; RO: 2007/2006
Data unavailable: BE (French-speaking community), IE, EL, ES, FR, MT, PT, SI, UK
Data estimated: EU-27 (by DG Research)
BE data refer to Dutch-speaking community

Openness of high level education systems to young researchers

According to recent data, the average share of doctoral candidates who are not EU-nationals amounts to 19% across the EU (PRO INNO Europe, 2011) and there exist significant differences between Member States with regard to the share of doctoral candidates who are

not nationals of that Member State. In the UK and France, the share amounts to 48% and 41% respectively, compared with 1% in Latvia and Lithuania, 3% in Romania and 8% in Italy.

Table 6 below shows the share of second stage of tertiary education students (doctoral candidates and other training course leading to advanced research qualification) in the EU who come from third countries and other European countries.

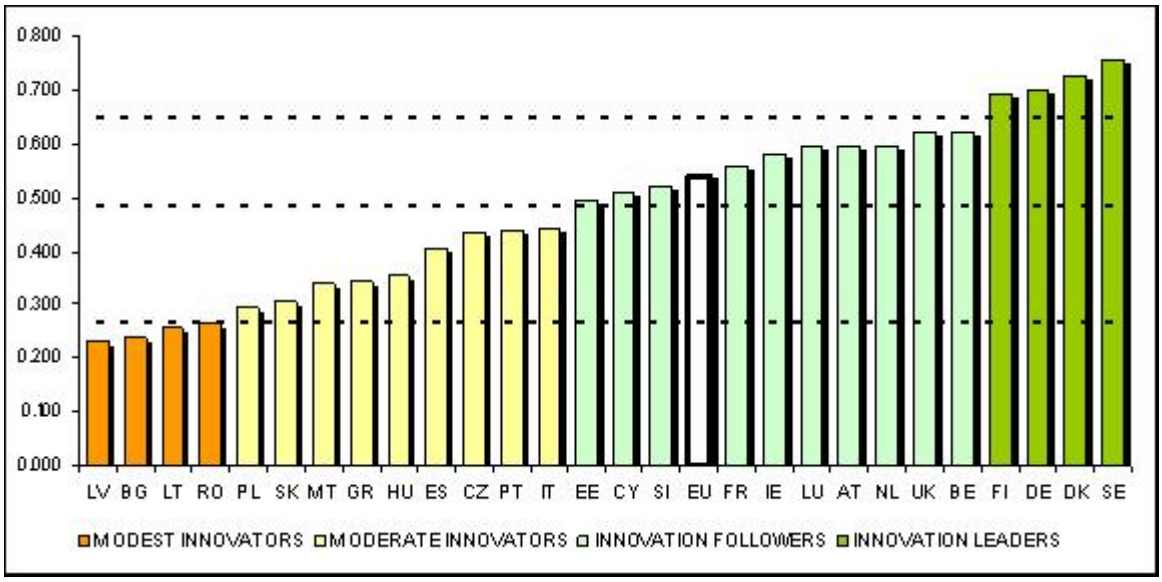
Table 6: Second stage of tertiary education students (ISCED6) in EU Member States and share of non-national doctoral students, 2009

	Total doctoral students (ISCED6)	Foreign doctoral students (ISCED6)		
		Total no.	of which:	
			Citizens of another EU MS	Other
Belgium	12,505	3,958	1,540	2,418
(in %)	*100%*	*32%*	*12%*	*19%*
Bulgaria	3,949	226	71	155
(in %)	*100%*	*6%*	*2%*	*4%*
Czech Republic	24,906	2,539	1,607	932
(in %)	*100%*	*10%*	*6%*	*4%*
Denmark	7,063	1,388	648	740
(in %)	*100%*	*20%*	*9%*	*10%*
Germany	**na**	**na**	**na**	**na**
Estonia	2,465	130	56	74
(in %)	*100%*	*5%*	*2%*	*3%*
Ireland	7,321	**na**	**na**	**na**
(in %)	*100%*	-	-	-
Greece	**na**	**na**	**na**	**na**
Spain	77,211	16,995	3,792	13,203
(in %)	*100%*	*22%*	*5%*	*17%*
France	71,718	29,355	4,721	24,634
(in %)	*100%*	*41%*	*7%*	*34%*
Italy	39,399	3,250	790	2,460
(in %)	*100%*	*8%*	*2%*	*6%*
Cyprus	443	42	34	8
(in %)	*100%*	*9%*	*8%*	*2%*
Latvia	2,025	15	5	10
(in %)	*100%*	*0.7%*	*0.2%*	*0.5%*
Lithuania	2,939	32	14	18
(in %)	*100%*	*1.1%*	*0.5%*	*0.6%*
Luxembourg	-	-	-	-
Hungary	6,911	487	296	191
(in %)	100%	7%	4%	3%
Malta	74	7	4	3
(in %)	100%	9%	5%	4%
Netherlands	7,749	**na**	**na**	**na**
(in %)	100%	-	-	-
Austria	18,471	5,087	3,027	2,060
(in %)	*100%*	*28%*	*16%*	*11%*
Poland	32,494	777	133	644
(in %)	*100%*	*2.4%*	*0.4%*	*2.0%*
Portugal	15,279	1,874	344	1,530
(in %)	*100%*	*12%*	*2%*	*10%*
Romania	27,892	859	285	574
(in %)	*100%*	*3%*	*1%*	*2%*
Slovenia	1,994	170	38	132
(in %)	*100%*	*9%*	*2%*	*7%*
Slovakia	10,417	754	604	150
(in %)	*100%*	*7%*	*6%*	*1%*
Finland	20,792	1,941	877	1,064
(in %)	*100%*	*9%*	*4%*	*5%*
Sweden	19,911	5,153	1,516	3,637
(in %)	*100%*	*26%*	*8%*	*18%*
UK	81,693	38,839	13,053	25,786
(in %)	*100%*	*48%*	*16%*	*32%*

Source: DG Research and Innovation
Data: Eurostat
Notes:
n/a: data not available

Countries which are more open (i.e. higher share of doctoral candidates coming from other European countries or third countries) also tend, on average, to perform better in terms of R&D. The 2011 Innovation Union Scoreboard shows that countries such as Sweden, Denmark, Germany and Finland are innovation leaders. Some of these innovation leaders are also amongst the most open research systems.

Table 7: EU Member States' innovation performance, 2011



Source: European Commission, Innovation Union Scoreboard 2010
Notes:
1) Average performance is measured using a composite indicator building on data for 24 indicators going from a lowest possible performance of 0 to a maximum possible performance of 1. Average performance in 2010 reflects performance in 2008/2009 due to a lag in data availability
2) The performance of Innovation leaders is 20% or more above that of the EU27; of Innovation followers it is less than 20% above but more than 10% below that of the EU27; of Moderate innovators it is less than 10% below but more than 50% below that of the EU27; and for Modest innovators it is below 50% that of the EU27.

Annex 3: Evaluation of previous and existing EU, regional and national initiatives

The European Research Area – Policy making and progress so far

The European research project "VERA"- Forward visions on the European research Area (FP7, Social Sciences and Humanities)" coordinated by Fraunhofer Institute, has recently produced the ERA Fabric Map, which gives a snapshot of the ERA today. The following section is inspired on this report.

The ERA making

The ERA concept was launched at the Lisbon European Council in March 2000 and was given new impetus in 2007 with the European Commission's Green Paper on ERA and with the launch by the Council of the Ljubljana Process to improve the political governance of ERA in 2008. A series of initiatives were proposed by the Commission in 2008 to further the ERA in five key areas, namely: (a) working conditions and mobility of researchers; (b) the joint design and operation of research programmes; (c) the creation of world-class European research infrastructures; (d) the transfer of knowledge and cooperation between public research and industry and (e) international cooperation in science and technology. Since the adoption of the Lisbon Treaty in 2009, ERA is an explicit objective of the European Union. Announced in the Europe 2020 strategy, the seven flagship initiatives launched since 2010 contribute to ERA. The European Council stated in February 2011, and reiterated in March 2012, that the ERA must be completed by 2014.

Several official advisory bodies and fora for discussion contribute to delineate ERA[76]:

- The **European Research Area Committee** (ERAC), so-called CREST before the renewal of its mandate, is the advisory body assisting the Council of the European Union and the European Commission in the field of research and technological development. A number of candidate and associated countries participate as observers in ERAC[77]. ERAC has several dedicated configurations: the High Level Group for Joint Programming; the Strategic Forum for International Cooperation (SFIC); and the Knowledge Transfer Group.

- The **Steering Group on Human Resources and Mobility** (SGHRM) recognised by the Council in 2008 to be the appropriate forum for promoting and monitoring the implementation of the European Partnership for Researchers.

- The **European Research Advisory Board** (ERAB).established by the Commission in 2007 is a consultative body responsible for advising the EU on the realisation of the ERA.

- The **European Strategy Forum on Research Infrastructures** (ESFRI) aims to support a coherent and strategy-led approach to policy-making on research infrastructures in Europe.

- The **Science and Technology Options Assessment** (STOA) unit advises the European Parliament on research related issues.

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[76] Source: ERAWATCH

[77] Albania, Bosnia & Herzegovina, Croatia, Faroe Islands, Former Yugoslav Republic of Macedonia, Iceland, Israel, Liechtenstein, Moldavia, Montenegro, Norway, Serbia, Switzerland and Turkey.

Moreover, there are numerous advisory councils and groups on specific thematic themes relating to research policy. These include advisory councils, advisory groups for the 7th Framework Programme (FP7) and standing committees on thematic issues. There are also permanent expert groups on women in science and ethics.

Progress so far

Member States play a crucial role in realising the ERA. In terms of progress so far, Chioncel and Cuntz (2012) have found that

- The ERA dimensions People and Infrastructures are more important than others from national perspective. This is possible due to financial incentives at EU levels, in particular the one on infrastructures, i.e. this likely leading into path-dependency and overweighting of specific ERA dimensions.

- ERA progress and integration takes place at different speed, particularly relevant in the areas of promoting excellent research institutions and well-coordinated research programmes and priorities.

- Knowledge circulation dimension is an area of potential policy failure for countries with lower innovation performance.

By tapping further into these policy fields as rent-seeking EU funds, Member States may face increased systemic failure due to limited absorptive capacities of their businesses and continue developing science base on national levels.

Initiatives aiming at coordinating national funding

The main initiatives taken at EU level and their results and impacts are analysed in the sections below.

ERA-NET scheme[78]

The ERA-NET scheme was launched, as a novelty, in 2002 under FP6 to support the coordination and collaboration of national research programmes. It aimed at facilitating the exchange of views and good practices, the strategic planning and the design of joint research programmes as well as the implementation of joint activities, in particular joint calls. Under FP7, the ERA-NET scheme was reinforced by introducing a new module, 'ERA-NET Plus', which allows the 'topping-up' of joint trans-national funding with European Union funding.

Between 2002 and 2010, the EU invested 341 million Euros in more than 100 ERA-NET actions: ERA-NET proved to be an immediate success, resulting in 101 different ERA-NET initiatives by the end of 2010. Nine ERA-NET Plus actions have been funded since 2007. The total funding ERA-NETs have received under FP6 is 185 million Euros. The ERA-NET

78 Relevant material and data for the ERA-NET section are as follows: Evaluation and impact assessment of the ERA-NET scheme and the related ERA-NET actions under the 6th Framework Programme, ERA-NET Plus Review 2010, Draft report Statistics on ERA-NET and ERA-NET plus actions and their joint calls and programmes (2004-2010), NETWATCH, including 'Mapping ERA-NETs across Europe: overview of the ERA-NET scheme and its results', published by the IPTS, Input received from Interservice Group on Coordination of National Programmes, Reports of the Annual ERA-NET events 2008-2010, ERA-NET continuation workshop November 2010

scheme under FP7 has been funded with 156 million Euros for the period 2007-2010 (ERA-NET Plus: 68 million Euros).

Until 2010, a total of 51 countries participate in ERA-NETs, including all EU Member States, Associated Countries to the EU Framework Programme for Research and Technological Development and Third Countries. France and Germany are the leading participants, but there is also significant involvement of a group of other countries: Austria, Finland, The Netherlands and Belgium. The most active associate countries are Turkey, Norway, Switzerland and Israel.

ERA-NETs have launched more than 190 calls, resulting in more than 2,000 transnational projects funded since 2004: a total of 194 joint calls have been implemented from 2004-2010 and more than 30 calls were done in 2011. The average funding per project is 725.000 Euros, with more than 2,000 projects funded in the period 2004-2010. The consortia size of projects funded by ERA-NETs is substantially smaller than in the FP (≈ 3-6) with a very high SME participation in many areas (some > 50%).

Annual volume of coordinated research close to 300 million Euros: the public funding of transnational research by ERA-NET and ERA-NET Plus actions has been growing steadily since the first calls in 2004 and currently adds up to 290 million Euros per year. The total public funding of research implemented by ERA-NETs and ERA-NET Plus since its beginning until 2010 amounts to more than 1.400 Million Euros. The biggest contributors are Industrial Technologies and SMEs (more than 500 million Euros) and Environment, Knowledge Based Bio-Economy and Health (around 200 million each Euros).

Substantial leverage effects on research coordination funding: The leverage effect of the Framework Programme funding is close to 5 Euros for ERA-NETs and 2.5 Euros for ERA-NET Plus. More than 15 Euros of the initial FP6 ERA-NETs have achieved a leverage effect of 10 Euros and more (1 Euro Framework-programme funding resulting in 10 Euros coordinated research funding).

Virtual common pot and mixed mode supporting transnational programme collaboration: virtual common pot and mixed mode have proven to be the preferred funding mode for transnational programme collaboration in the context of the ERA-NET scheme. The virtual common pot is applied in almost 80% of all call budgets. ERA-NET Plus actions rely mainly on the mixed mode (84% of all ERA-NET Plus call budgets). The real common pot is scarcely used (4%) and is limited to social sciences and humanities, fundamental research or public procurement actions.

ERA-NET Plus supporting critical mass, evaluation standards and financial integration: the ERA-NET Plus instrument results in substantially larger average call budgets of 25 million Euros compared to 7 million Euros for the ERA-NET calls and supports achieving critical mass. In addition, they establish international peer review as an evaluation standard, as well as successfully increasing financial integration to ensure proposal selection exclusively based on excellence.

Positive impact on structuring the ERA and national programmes and their collaboration, but limited success in creating multiannual joint programmes with critical mass: in addition to the calls and the transnational research opportunities they create, the ERA-NETs deliver a wealth of intangible results. Participants confirm the ERA-NET scheme results in new opportunities to enable transnational R&D activities (reported by 85.5% of all participants),

reduces duplication between national programmes (37.5%), increases the thematic focus in existing (38%) or new programmes (34%), stimulates good practices and innovations in programme designs (>50%) and positively influences national programme budgets in the selected theme of the ERA-NET (46%). It has proved to be a valuable mutual learning process that contributes to an overall improvement of the research system in Europe.

Article 185 initiatives[79]

Article 185 of the TFEU enables the EU to participate in joint research programmes undertaken by several Member States, as well as to participate in the dedicated implementation structures. The aim is to strongly support the integration of national research activities beyond coordination, and to achieve critical mass. The EU provides financial support out of the Framework Programme. The basic selection criteria are:

- Involvement of a sufficient number of Member States to obtain a significant structuring effect and critical mass;
- Topic of great interest to the EU and fitting in with the thematic priorities of the Framework Programme;
- The principle of co-funding by the Member States and the EU, and principle of additionality are respected; significant European added value;
- Article 185 is the only way the project could be implemented.

With Article 185 initiatives, the European Union goes beyond simply coordinating existing research programmes. It requires scientific integration through common definition and implementation of S&T activities; management integration in a single implementation structure; and financial integration through a clear multi-annual commitment of the participating Member States.

A first Article 185 initiative, the European and Developing Countries Clinical Trials Partnership (EDCTP), was launched in June 2003. Under FP7, four initiatives, Ambient Assisted Living (ALL), EUROSTARS (for SME research), the European Metrology Research and Development Programme EMRP have followed and a Joint Baltic Sea Research Programme (BONUS) are currently being implemented.

The FP6 EDCTP initiative has a total volume of 400 million Euros with 50% EU contribution. The focus is on clinical trials, capacity building, training and mobility and less on research. From 2004 to 2010 a total of 326 projects have been funded with 312 million Euros (EU contribution 132 million Euros, 42%).

The three FP7 initiatives have implemented from 2008 until 2010 calls with a total public funding of 530 million Euros, of which the EU contribution amounts to 191 million Euros (36%). For the total duration of these three initiatives a total public funding of 1.1 billion Euros is planned, of which the EU contribution would amount to 450 million Euros (not including Bonus, which will start its implementation in 2012 with an EU contribution of 50 million Euros). In total 441 projects have been funded with an average public funding for the Eurostars projects comparable to the average ERA-NET project (680.000 Euros) and

[79] Relevant material and data for the Art.185 section are: VAN VELZEN REPORT (EDCTP ACTIVITIES 2007-2008), Mid-term assessment AAL and Mid-term assessment EUROSTARS

substantially higher average amounts for ALL (2,3 million Euros) and EMRP (6,8 million Euros).

AAL and EUROSTARS have concluded their interim evaluation in 2011. Both evaluations have shown that the use of Art. 185 TFEU has created substantial leverage effect and real European added value for the respective area of research by integrating national programmes and pooling resources. Both initiatives as well as EMRP clearly demonstrate the functioning of a partly virtual common pot. All individual initiatives have specific arrangements to assure that Member States honour their financial commitments. Lessons learned show that operational arrangements are improving constantly and from the Commission point of view the instrument seems very cost efficient.

Joint Programming

The Joint Programming process launched in 2008, allows committed Member States to jointly address major societal challenges through national public funding, with the eventual support of EU instruments. Within the concept of Joint Programming, Member States shall coordinate national research activities, pool resources, benefit from complementarities and develop common research agendas, in order to face the grand societal challenges – all in variable geometry and therefore on a voluntary basis. Joint Programming intends to tackle challenges that cannot be solved solely on the national level and allows Member States to participate in joint initiatives that seem useful for them.

The Council of the European Union welcomed the concept and the objectives of Joint Programming in its respective Conclusions adopted on 2 December 2008, and called 'for the implementation of that process led by the Member States to step up their cooperation in the R&D area in order to better confront major societal challenges of European or worldwide scale, where public research plays a key role'. The council called furthermore for a Joint Programming pilot initiative in the area of neurodegenerative diseases with its respective conclusions 'Concerning a common commitment by the Member States to combat neurodegenerative diseases, particularly Alzheimer's disease'. A **pilot JPI** on Neurodegenerative Diseases (including Alzheimer's) was launched by Council Conclusions in December 2009. **A first wave of 3 JPIs** was launched in October 2010 on Agriculture, Food Security and Climate Change; Cultural Heritage and Global Change, a new challenge for Europe; and A Healthy Diet for a Healthy Life. A second wave of six JPIs was identified by the GPC in 2010 and launched by the Council in December 2011: More Years, Better Lives - Potential & Challenges of Demographic Change; The Microbial Challenge - An emerging threat to human health; Healthy and Productive Seas and Oceans; Water Challenges for a Changing World; Urban Europe - Global Urban Challenges, Joint European Solutions; and Connecting Climate Knowledge for Europe (CliK'EU).

The administrative, normative and regulatory factors considered essential for effective implementation of Joint Programming in Research are jointly referred to as 'Framework Conditions'. They include the development of common accepted approaches for: peer review procedures; forward looking (foresight) activities; evaluation of joint programmes; funding of cross-border research; dissemination of research findings; management of intellectual property. A first version of Guidelines on Framework Conditions for Joint Programming was endorsed (November 2010 Council Conclusions).

A number of issues remain critical in the current move from definition to implementation of JPIs:

- To date, Member States' commitments of human and financial resources remain weak due to difficulties in pooling resources; Joint Programming will fail if Member States do not make concrete, long-term commitments;
- Application of the Voluntary Guidelines on Framework Conditions is still at an early stage;
- Progress in completing the definition of Strategic Research Agendas has been slow;
- The process of building trust between the partners is still at an early stage;
- In many cases, the areas being addressed by JPIs are outside the direct remit of Research Ministries. Inadequate prioritisation of societal challenges by the Ministries directly responsible for addressing them at Member State level risks hindering the successful implementation of JPIs.

Impacts of some actions coordinating national funding in relation to policy-driven themes

Pooling resources on a European scale and catalysing new national initiatives: example of the Ambient Assisted Living (AAL) programme

The Ambient Assisted Living (AAL) programme

The Ambient Assisted Living (AAL) programme engages 20 Member States and three Associated Countries. The programme has been successful in addressing the pan-European challenge of ageing and in coordinating national policies in the area. It has minimised the duplication of efforts and has led to the creation of new national initiatives in countries like Germany, France, Spain, Denmark and Hungary through the dissemination of results and experience at the European level. In the first three calls of the joint programme, Member States contributed around 100 million Euros funding while the EU contributed 70 million Euros. The mid-term evaluation has found that the AAL Programme 'is an important instrument for integration of national efforts and the creation of synergies, especially as regards scientific and management integration'. The Panel concluded that AAL 'provides real added value at European level and can serve as a model for balancing international governance with national needs, by increasing critical mass and reducing duplication.' The Panel also found that the AAL JP 'is already delivering a clear European added value in the achieved balance between European efforts and national needs and inputs, and in the development of good practices.' It noted that 'national financial contributions have increased substantially above the minimally required commitment, a major success of the programme.'

Reducing fragmentation and duplication of national research efforts while increasing scientific excellence through higher competition between researchers: example of the Article 185 initiative on Metrology (EMRP)

Article 185 initiative on Metrology (EMRP)

The science of measurement - metrology - is important for scientific research, industry and our everyday lives, as the demand for measurements with high accuracies and low uncertainties continues to increase. The European Metrology Research Programme (EMRP) enables European metrology institutes, industrial organisations and academia to collaborate on joint research projects within specified fields. These collaborative efforts will accelerate innovation in areas where shared resources and decision-making processes are desirable due to economic factors and the distribution of expertise across different countries and sectors. The Article 185 initiative EMRP is implemented by EURAMET, organised by 22 National Metrology Institutes (NMIs), supported by the European Union and has a value of over 400 million Euros. It dramatically reduces the duplication of research and allows efficient use of resources by pooling 44% of overall metrology resources in one initiative. The joint research projects are selected in a competitive process with excellence as the sole selection criterion

Generating high leverage effects on coordinated research efforts and private investments: example of MANUNET

MANUNET

Manufacturing generates approximately 22% of the EU gross national product (GNP), while manufacturing-related activities represent an estimated 75% of the EU gross domestic product (GDP) and 70% of employment. Typically, manufacturing takes place in geographical centres with strong localised specialisations. MANUNET was therefore created as an ERA-NET to extract greater value from the money spent in national and regional programmes across Europe. The leverage effect of the EU support is substantial (>25): supported under FP6 with 2.7 million Euros EU funding it has generated more than 125 research projects with SME participation of around 70% that are funded out of national and regional programmes with 73 million, mobilising an overall budget for research of more than 135 million Euros. By the end of 2009 the funded projects already report the creation of 47 new jobs, 16 patent applications, 45 new products and more than 70 new processes as immediate results of the collaboration.

Achieving critical mass by pooling expertise and funding for common priorities: example of E-Rare

E-Rare

There are at least 6,000 rare diseases, which, although individually rare (by definition they affect less than one person in every 2,000), taken together affect some 20 million European citizens. Their rarity itself constitutes a real obstacle to research. The thin distribution of patients makes it hard to gather enough subjects for proper studies. Further research on rare diseases is therefore badly needed but is hampered by lack of resources at several levels. Therefore rare diseases are a prime example of a research area that could strongly profit from coordination on a transnational scale. The ERA-NET E-Rare action has developed a common European programme on rare disease research. Together with the rare diseases related calls in FP7, the three joint calls of 10 million Euros of E-Rare effectively coordinate 30 to 40% of all rare disease research in the ERA with a high EU added value demonstrating synergy between Member State and the EU.

Providing effective responses to major challenges for Europe: example of Joint Programming Initiative (JPI) 'Neurodegenerative diseases/Alzheimer's'

JPI 'Neurodegenerative diseases/Alzheimer's'

One of Europe's major societal challenges is the ageing of the European population and related increasing number of cases in neurodegenerative diseases, especially Alzheimer's. Against this background, the Council called in 2008 for a Joint Programming pilot in the area of neurodegenerative diseases. 23 Member States and Associated Countries engaged voluntarily and on a variable geometry basis to tackle neurodegenerative diseases and Alzheimer's in particular in the definition, development and implementation of common strategic research agenda. It entails putting national resources together, selecting or developing the most appropriate instrument(s) and collectively monitoring and reviewing progress. Two first pilot calls with a total volume of 14 million Euros have been launched in 2011.

Moreover, several other initiatives are fostering co-operation throughout Europe.

- The *Strategic Energy Technology* plan started in 2007 and aims to accelerate development of low carbon energy technologies and streamline national research programmes in strategic technology areas at EU level.

- *Europe INNOVA/PRO INNO Europe* (25 pilot projects since 2008, targeted at Eco-innovation/innovation in services and clusters) focuses on joint policy learning and development of better innovation support.

- Existing EU-level *Public-Private Partnership* (PPP) instruments (European Commission, 2011b): Joint Technology Initiatives (5 since 2007) aim to strengthen European industrial leadership in well-defined areas. European Industrial Initiatives (EIIs) under the SET Plan (7 EIIs since 2010) address the demonstration/market rollout bottleneck in the innovation chain of low carbon energy technologies. Recovery Plan PPPs (3 since 2008) focus on maintaining and strengthening industry sectors hit by the economic crisis. Future Internet PPP (since 2011) aims to ensure future Internet development at the service of society. COLIPA (since 2009) helps industry comply with EU legislation. SESAR aims to modernise European air traffic management.

- *European Innovation Partnerships* (EIPs - 2 up until now) aim to "act across the entire Research and Innovation cycle to ensure that ideas can be turned into successful products or services to tackle societal challenges whilst also generating growth and jobs". Knowledge and Innovation Communities (KICs - 3 up until now) are structured partnerships integrating education, research and business actors to address major societal challenges (European Commission, 2011b). Additional EIPs and KICs are in the pipeline.

- In addition there are currently 11 *INCO-NETs*, aiming to support bilateral dialogue with Third Countries in the context of FP7 (European Commission, 2011f)[80].

Initiatives on research infrastructures

ESFRI Forum

Set up in 2002, ESFRI aims at steering and enhancing EU Member States' capacity on RIs policy-making, whilst improving the use and development of facilities of pan-European interest. ESFRI acts as an informal and advisory body[81]. ESFRI develops joint visions and common strategies including regularly updated Roadmaps, reports and criteria for planning and implementing new pan-European RIs. The two key objectives of ESFRI are:

- To steer up and enhance EU Member States' capacity on RIs policy-making (general objective) by supporting a coherent and strategy-led approach to policy making on RIs in Europe (specific objective); and

[80] For a list of currently active INCO-NETs, see http://ec.europa.eu/research/iscp/index.cfm?lg=en&pg=inconet.

[81] ESFRI delegates are nominated by the Research Ministers of the Member States and Associated Countries, whilst a representative of the Commission is a member of the Forum.

- To enhance the use and development of facilities of pan-European interest (general objective) by facilitating multilateral initiatives leading to a better use and development of RIs (specific objective).

The setting up of ESFRI has filled a policy vacuum in the RI sector and the initiative is considered to be a valuable tool for addressing the weaknesses of the European RI sector. Investment in RIs of pan-European or international interest cannot be borne by a single country. The enhancement and development of such RIs requires a coordinated effort and as such appropriate platforms for Member States where priorities, needs and actions to be implemented are jointly agreed and defined. Although the ESFRI process does not cancel the relevance of national RI policies (i.e. notably the development of RIs which are less of European interest), it provides a policy framework at European level where Member States can streamline decision-making and implementation processes.

Regarding the development of policy tools for the RI sector, the joint development and continuous update of a European Roadmap for RIs - the ESFRI Roadmap - has provided an overview of the needs for RIs in Europe (i.e. first expected output). First published in 2006 and updated in 2008 and 2010, the ESFRI Roadmap has been able to support coordinated mechanisms for assessing the needs and priorities for new European RIs across Member States and scientific disciplines. The ESFRI Roadmap has also triggered similar policy development at Member States level, with a majority of Member States having adopted (18 Member States[82]) or preparing such national roadmaps (seven Member States). Available data also suggest that whilst the existence of ESFRI as a forum has facilitated enhanced cooperation between Member States, the development of a comprehensive set of criteria for evaluating and monitoring RIs (e.g. the harmonisation of evaluation procedures in particular for ageing facilities) and facilitated decision-making by Member States and by the Commission (expected results) are still a long way to go. As recognised by ESFRI, the governance framework for RIs at European level is currently missing[83].

Regarding the use and development of RIs of pan-European interest and as a result of the ESFRI Roadmap, 50 priority projects have been identified in a number of scientific fields[84] and 10 projects have already started (33% of planned projects, i.e. 44), whilst an additional 17 projects are due to be launched before the end of 2013. Funding measures within the framework of FP7 and its predecessor programmes have played a key role in supporting such a process. Considering that the expected result was to implement 60% of the Roadmap projects by 2015, it is questionable whether the current pace and efforts are sufficient to meet the expected results. Otherwise said, the implementation of the ESFRI projects remains a concern. The uncertainties linked with long-term commitments required to establish and operate key infrastructures still generate long delays. It is acknowledged by stakeholders[85] that the funding of RIs is a primary concern particularly in a context of economic austerity.

Table 8 below provides the list of projects included in the ESFRI Roadmap.

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82 Seven Member States are preparing national roadmaps (Slovenia, Hungary, Austria, Germany, Belgium, Luxembourg and Lithuania). Currently, only Portugal, Slovak Republic, Latvia and Cyprus do not have national roadmaps. Source: ESFRI (2010), Annual Report

83 ESFRI (2009), 'European Roadmap for Research Infrastructures, Implementation Report'

84 The fields are as follows: social science and humanities, environmental sciences, biological and medical sciences, physical science and engineering and energy. Most of the projects share the effort of developing effective e-tools for the management and dissemination of the produced data.

85 Stakeholders" consultation for FP7 successor programme. Source: European Commission, 2010

Table 8: List of ESFRI projects

	Project	Leading country or EIRO in PP (1)	Participation to the Preparatory Phase (2)	Host country (3)	Legal Status (4)	Funding Commitments Implementation Phase (5)	Official Commitment at Institutional level (6)	Industrial expression of support/ interest
SSH	CESSDA	NO	AT DE GR HU LT PT SI ES CH US RO FR FI NO SE	NO	ERIC 2012	NO SI FI SE	SI	
	CLARIN-ERIC	NL	AT BG CZ DK EE DE GR HU IT LV LT MT PL PT ES BE IS FR FI RO NO TR SE	NL	ERIC 2012	RO NL FI IT DK	SI	Tilde Ltd (LV)
	DARIAH	NL	CY DK DE GR IE SI FR		ERIC 2012	SI DK IE	SI FR IE	
	ESSurvey	UK	FR BE BG EE DE HU LV PL PT SI ES IS IL CH NO SE	UK	ERIC 2012	NL UK ES SI IE	UK SI SK	
	SHARE-ERIC	DE	FR AT BE DK GR IE IT PL SI ES IL CH US PT	NL	ERIC 2011	AT ES SI IT	AT PT NL SI DK IT	
ENV	COPAL		FR FI DE GR PL PT RO ES					
	EISCAT_3D	SE	NO FI SE			SE FI		
	EMSO	IT	DE GR IE IT PT ES TR UK NL NO BG PL SE		ERIC 2012	IT	IT	
	EPOS		RO NO CH NL DE FR UK DK IL IS IT ES PT SE			DK	IT	
	EURO ARGO		BG DE GR IE IT PL PT ES NO FR NL	FR	ERIC 2012	FR IT IE	FR IE	
	IAGOS		DE FR					Airlines
	ICOS	FR	BE DE HU ES CH US FR NO NL FI SE	FI	ERIC 2012	FI FR SE		
	LIFEWATCH	NL	BE FI DE GR HU IT PL SK SI ES PT RO FR NO SE	ES	ERIC 2012	ES IT SE	IT SI ES	
	SIOS	NO	DE FR NL UK PL FI KR JP CN NO SE ES	NO		NO		
ENERGY	ECCSEL	NO	DE HU CH PL NL FR ES NO	NO		NO		ALLEA
	HIPER	UK	DE PL PT ES RU US ZA FR			UK (for PP)		
	IFMIF/EVEDA		ES					
	JHR	FR	FR ES	FR	CA	FR FI EU(JRC) ES	FR	
BMS	BBMRI	AT	EE FI DE GR HU IE LT MT ES IS BE BG FR IT NO LV CH SE	AT	ERIC 2012	AT NL FI ES SE	NL ES IT	
	EATRIS	NL	DK FI DE GR ES DE FR IT NO SI	NL	ERIC 2012	FI DK ES	FI NL ES SI IT	
	ECRIN	FR	AT BE FI HU CH PL ES FR NL	FR	ERIC 2012	ES UK FR	FR ES UK	
	ELIXIR	UK	DK FR DE HU IT LT PL ES NL IS IL NO CH PT SI SE			EMBL FI UK DK ES SE	IT UK SI	
	EMBRC	IT	IT SE PT UK FR DE NO GR EMBL			EMBL UK (for PP) SE	IT EMBL	
	EU-OPENSCREEN	DE	NO DE FR ES SE CZ FI AT PL NL				FI	
	EuroBioImaging	DE	AT BE CZ DE HU IL NO PL PT SE FR ES FI IT TR, CH, Regional: Bavaria, Piemonte				IT	
	European BSL4 Labs	FR	FR IT	FR			IT	
	INFRAFRONTIER	DE	AT CZ DE GR ES FR IT FI PT SE			IT FI UK	IT UK	
	INSTRUCT	UK	AT CZ DK DE IT LT PT IL SE FR ES LV NL FI CH	UK		EMBL FI ES IT UK DK	IT UK	
MATERIALS and ANALYTICAL	EMFL		FR	FR DE NL				
	ESRF UPGRADE	ESRF	FR IT NO DK	FR		ES NO DK FR IT UK SE	IT UK FR SK CH	
	EUROFEL (ex IRUVX-FEL)	IT	DE PL IT			IT	IT SI	
	ESSneutrons	SE	DE IT LV PL CH EE FR ES NO DK SE	SE DK ES		ES SE DK NO IT	FR ES IT CH	
	XFEL	DE	FR IT ES DK CH SE	DE	Gmbh	CN DK FR DE GR IT RU ES CH SE	DE IT FR ES SI SK CH	CH: IKC
	ILL 20/20	ILL	FR IT	FR		ES FR IT UK SE	UK FR IT SI SK CH	
PHYSICS ENGINEERING	CTA		PL ES FR CH	ES US MX NB AR CL ZA				
	E-ELT	ESO	FR IT DK	CL		ESO NL DK SE	IT	
	ELI		BG DE IT LT PL PT ES FR	CZ HU RO UK		RO IT		
	FAIR	DE	FR ES GR SI SE	DE	Gmbh	CN DE ES FI FR UK IN RO RU SI SE	SI FR	
	KM3NeT	GR, IT	CY DE IE ES FR IT GR	GR IT		GR IT NL	IT	
	SKA	UK	DE ES US FR NL SE	AUS+NZ ZA		UK AUS ZA NZ IT NL CN CAN		
	SPIRAL2	FR	BE BG CZ DE HU IT PL ES IL US FR	FR		FR	FR	
CERN Projects	ILC-HiGrade	CERN	US FR ES					
	SLHC	CERN	PL US FR ES		I.O.			
ICT	PRACE (ex HPC)		AT DE GR IT NL CH BE PT BG FR ES NO DK FI SE	Distributed		FR ES IT NL DK FI SE IE	IT FR SI IE ES	

Source: European Commission, DG Research and Innovation

Notes: (1) from ESFRI Delegates only; (2) From participation to Preparatory Phase Projects; (3) Single (decided or proposed), Distributed, from the project contact persons and confirmed by ESFRI Delegates; (4) Indicates the existing or expected legal status (e.g. ERIC, MoU) and confirmed by the ESFRI Delegates CA: Consortium Agreement; (5) From ESFRI Delegates only - indicates that resources have been officially reserved for the project; (6) From the concerned Institution and confirmed by the ESFRI Delegates. Blue colour denotes projects under implementation, green colour denotes projects expected to be implemented by the end of 2012, purple colour denotes project in progress and orange colour denotes international partnership & global projects

Coordinated development and pan-European sharing of e-Infrastructure

The box below presents examples of e-infrastructures development where the Commission has been supporting and coordinating the national investments in order to develop digital research services than can be provided and accessed cross-border by different research actors and organisations.

Example of GEANT

The GÉANT network is the fast and reliable pan-European communications infrastructure serving Europe's research and education community. Co-funded by European National Research & Education Networks (NRENs) and the EC, the GÉANT network and project is entering its third generation, along with associated development activities. GÉANT's core objective is to deliver real value and benefit to society by enabling research communities across Europe, and the world, to transform the way they collaborate on ground-breaking research. Coordinating Member States investment and integrating MS research networks, GÉANT connects 40 million users in over 8,000 institutions across 40 countries.

Example of EGI

The European Grid Infrastructure (EGI) delivers integrated computing services to European researchers, driving innovation and enabling new solutions to answer the big questions of tomorrow. EGI's mission is to allow researchers of all fields to make the most out of the latest computing technologies for the benefit of their research. EGI is a federation of over 350 resource centres and coordinated by EGI.eu, a not-for-profit foundation created to manage the infrastructure on behalf of its participants: National Grid Initiatives (NGIs) and European Intergovernmental Research Organisations (EIROs). EGI.eu is governed by a Council of 35 participant countries and institutions.

Initiatives addressing the labour market for researchers, gender equality and the gender dimension in research

Initiatives at EU level

At EU-level, funding, support measures and policy coordination measures have been adopted with a view to increasing the diversity of European research teams. Relevant initiatives include:

- **Funding measures** under the FPs: Marie Curie Actions and mainstreaming of gender;
- **Policy coordination measures/soft law**: 2005 Commission Recommendation on the European Charter for Researchers and on a Code of Conduct for the Recruitment of Researchers[86], the 'European Partnership for Researchers'[87] (EPR) and the 1999 Commission Communication on 'Women and Science: Mobilising Women to enrich European Research';
- **Support measures**: Euraxess website and public information campaign attract more women to scientific careers;

The evaluation of these initiatives is presented below.

86 http://ec.europa.eu/eracareers/pdf/am509774CEE_EN_E4.pdf

87 European Commission (2008), 'Communication from the Commission to the Council and the European Parliament Better Careers and More Mobility: A European Partnership for Researchers', Brussels, 23.5.2008, COM(2008)317 final

Funding measures

The Marie Curie Actions is expected to support some 50,000 researchers[88] under FP7[89]. Based on a bottom-up approach with no pre-defined themes, the Marie Curie Actions have supported excellence of research and the internationalisation of research in Europe[90]. In particular, it is estimated that the Marie Curie actions have achieved several positive impacts[91], such as increased impact on science (i.e. the quality and quantity of research outputs are rated highly) and increased internationalisation of research, international 'brain circulation' and growing number of researchers engaging with world-class teams.

Support to **gender equality** in science has been provided through initiatives such as the mainstreaming of gender within the EU Framework Programmes and the research part of the Structural Funds (e.g. gender research, promotion of ambassadors' schemes, training, mentoring and networking activities), the development of indicators, analyses and guidelines (e.g. 'She Figures' publications[92], 'Meta-analysis of gender and science research'[93] and PRAGES project[94]). However, the long-term sustainability of some of the gender projects funded under FP5 and FP6 remains unclear[95], whilst the interim evaluation of FP7[96] further stressed the importance of continuing activities aiming at increasing female representation in research, notably in leading positions.

Policy coordination and soft law measures

Adopted in 2005, the Commission Recommendation on the **'European Charter for Researchers'** and a **'Code of Conduct for the Recruitment of Researchers'** (hereunder referred to as the Charter and Code) lays down the rights and duties of researchers, their employers and funding providers and outlines principles for the recruitment and selection of researchers. Despite some good progress (i.e. implementation of the "Human Resources Strategy for Researchers" process to support the take-up of the Charter and Code by

88 It should be noted that some 50,000 mobile researchers have been awarded a fellowship between 1996 (inception of the programme) and 2010. Source: European Commission

89 The Marie Curie actions under the programme 'People' include five actions: the individual fellowships (IxF), Initial Training Networks (ITN), Industry-Academia Pathways and Partnership (IAPP), COFUND and International Staff Exchange Scheme (IRSES).

90 European Commission (2010), 'Interim Evaluation of the Seventh Framework Programme, Report of the Expert Group', Final Report 12 November 2010

91 The Evaluation Partnership (2010), Ex-post Impact Assessment study concerning the 'Marie Curie Actions' under the Sixth Framework Programme, Final report, Deliverable D 6-2 for the European Commission, Research Directorate General, 8th September 2010

92 The 'She Figures' series have been published in 2003, 2006 and 2006. This series supports the collection of statistics with a key set of indicators, thus greatly contributing to creating a record of sex-disaggregated data at EU level. The 'She Figures' publications provide comparative statistics on the number of females, seniority, career development and decision-making aspects between women and men in research.

93 http://www.genderandscience.org/web/reports.php

94 Practising Gender Equality in Science (PRAGES) project which has resulted in the development of the 'Guidelines for Gender Equality Programmes in Science 2009'. The Guidelines provide a unique reference and tool for universities, research centres and other research entities which want to implement a modern institutional management culture and to better support gender diversity. http://cordis.europa.eu/search/index.cfm?fuseaction=result.document&RS_LANG=EN&RS_RCN=11485582&q=

95 http://ec.europa.eu/research/evaluations/index_en.cfm?pg=archive

96 European Commission (2010), 'Interim Evaluation of the Seventh Framework Programme, Report of the Expert Group', Final Report 12 November 2010

institutions), it remains difficult to assess the extent to which research institutions across the EU have implemented the Charter and Code. Moreover, the lack of a true accreditation mechanism[97] linked to the Charter and Code (i.e. which would be based on ex-ante and regular evaluation/monitoring and sanction mechanisms) has substantially limited the effectiveness of this initiative.

Within the framework of the **European Partnership for Researchers (EPR)** launched in the wake of the 2008 Commission Communication 'Better careers and more mobility; a European Partnership for Researchers'[98], Member States formally committed to adopting the necessary reforms at national level (open method of coordination) in key priority areas such as open, transparent and merit-based recruitment and portability of grants. The EPR has triggered an important number of activities and initiatives at national level and it is encouraging that a majority of Member States have been willing to engage in the partnership. However the EPR is still at an incipient stage and it is too early to provide robust conclusions in relation to the results and long-term impacts of the initiative. Due to the structural nature of planned/on-going reforms supported within the EPR (e.g. measures for increasing autonomy of universities and research institutions over hiring), the results and long term impacts of the EPR will only be visible in the long term. At the same time, it becomes increasingly clear that barriers may limit the effectiveness of the EPR. The lack of clearly defined objectives and criteria[99] in relation to the priority areas has resulted in Member States having different approaches[100] (and hence standards) to 'open, transparent, competition-based recruitment'. Moreover, indicators for monitoring progress have not been developed from the outset of the initiative[101], which may negatively impact on the implementation of the EPR by Member States. Also, it should be noted that the level of involvement varies amongst priority areas (i.e. Member States have been less active in adopting measures facilitating the advertisement of publicly-funded research positions) and amongst Member States.

Regarding gender equality in research, the **1999 Commission Communication on 'Women and Science: Mobilising Women to enrich European Research'**[102] highlighted the importance of increasing the number of women involved in the EU Framework Programmes, whilst fostering experience sharing on gender in science amongst Member States with a view to identifying relevant measures to be implemented. Although the Commission Communication contributed to mainstreaming gender into the EU FPs, it is also reckoned[103]

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97 Although the 'HR Excellence in Research' logo is awarded as part of the HR Strategy, it is not part of an accreditation mechanism, as the HR Strategy does not aim at evaluating the level of compliance amongst institutions with the Charter and Code.

98 European Commission (2008), 'Communication from the Commission to the Council and the European Parliament Better Careers and More Mobility: A European Partnership for Researchers', Brussels, 23.5.2008, COM(2008)317 final

99 For instance, the definition of 'open, transparent, competition-based recruitment of researchers' has not been clearly laid out and agreed amongst participating countries.

100 For instance, the transparency and competitiveness of the recruitment in the German higher education sector is guaranteed by the Lander Higher Education Laws, which require the involvement of external experts in the selection process. In Greece, open, transparent and competitive recruitment seems to be based on the fact that positions are advertised online and no other criteria have been reported by the Greek authorities.

101 Relevant indicators are currently under development.

102 Communication from the Commission of 17 February 1999, 'Women and Science': mobilising women to enrich European research, COM(99) 76 final

103 European Commission (2010), 'Stocktaking 10 years of 'Women in Science' policy by the European Commission 1999-2009', European Commission

that the need to support long-term structural change (i.e. changes at institutional level) in gender management has not been sufficiently addressed.

Other support measures

Several support measures aiming at increasing 'brain circulation' and female participation in science have been adopted. Launched in 2003, **the EURAXESS website** has provided researchers with information on research job and funding opportunities, working conditions and networking opportunities. Over 30,000 research-related positions were published on the EURAXESS website in 2011 (up from 4,000 in 2008), whilst the EURAXESS networks link up approximately over 6,000 European researchers working outside the EU[104]. Whilst EURAXESS has become an important tool for providing support services to researchers (e.g. growing number of users' inquiries[105]), evidence[106] shows that researchers need more customised information.

Gender-related support measures also include the launch of a two-year **public information campaign** in 2012. With a budget of approximately 2 million Euros, the aim of the campaign is to tackle stereotypes on gender and attract and retain more women in scientific careers. The key targets are young people, as well as women researchers at an early stage of their career.

Initiatives at Member State and regional level

Although Member States have been active in adopting measures addressing the issue of recruitment and portability of grants, there exist substantial differences in the way public researchers are recruited and the extent to which grants are portable cross the EU.

Regard to the recruitment of researchers, it is reported that in nine EU Member States (DE, CZ, ES, FR, EL, HU, IE, PT, SK) universities and research performing organisations face tight restrictions over hiring and cannot freely hire staff[107]. In several Member States (CZ, HU, SK, EL) the appointment of some or all senior positions needs to be confirmed by an external authority[108]. A number of Member States have recognised that (some of) their open recruitment procedures were inadequate. Spain, Estonia, Denmark, Austria and Poland have all introduced recent legislation to ensure that universities advertise their job vacancies internationally[109]. Planned and on-going reforms aiming at increasing the flexibility of career paths and related appointment have also been reported in France, Spain and Italy.

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104 The total number of members for the five EURAXESS networks is approx. 6,250 members. Source: European Commission, DG Research and Innovation

105 The EURAXESS Service Network dealt with approx. 118,000 queries in 2008, approx. 135,000 in 2009 and 2010 and approx. 65,000 in the first semester of 2011. Source: European Commission, DG Research and Innovation

106 Deloitte & The Evaluation Partnership Limited (2007), 'Euraxess-Links Abroad (ELA) Geographic, Expansion-Feasibility study', Framework Contract: RTD-C5-2005-I&C, Lot 4: Assessment of the impact of information and communication policy products, Final Report, for the European Commission, Research Directorate General. The study confirmed the importance beneficiaries attach to them, but revealed also the low awareness of the research community.

107 European University Association (2011), *University Autonomy in Europe II, The Scorecard*, by Thomas Estermann, Terhi Nokkala & Monika Steinel, http://www.eua.be/eua-work-and-policy-area/governance-autonomy-and-funding/projects/university-autonomy-in-europe/

108 European University Association (2011), *University Autonomy in Europe II, The Scorecard*, by Thomas Estermann, Terhi Nokkala & Monika Steinel

109 Source: Report by the ERA Steering Group on Human Resources and Mobility (SGHRM), 2009-2010

Box below provides selected examples of initiatives at Member State level addressing the issue of recruitment.

Selected examples of measures at Member State level addressing the issue of recruitment and employment of researchers in public institutions

Austria: according to an amendment to the University Act, universities have to post (research) job vacancies internationally or at least EU-wide. Considering that universities are autonomous, it is not possible to further specify by law the form or tool of advertisement, but EURAXESS Jobs is explicitly mentioned in the legal commentary to the amendment as a possible cost-free tool to post jobs internationally.

Denmark: following a new law in 2008, professorships and associate professorships must be advertised internationally, except under special circumstances of an academic nature. One of the stated aims is to increase competition and provide Danish universities with the best possible talent. The Ministerial Order was adjusted to give greater autonomy to universities who can deviate from certain rules, for example regarding short-term appointments.

France: the 'Higher Education and Research Careers Plan for 2009-2011'[110] is a comprehensive strategy for strengthening the management of human resources in higher education and research careers. It is expected that the plan will modernise key aspects of the research career advancement system (i.e. advancement based on performance and independent and transparent evaluation processes).

Estonia: universities are obliged to publish jobs internationally, on EURAXESS Jobs and in English. Estonian public universities have signed a new Agreement on 'Good Practice on the Internationalisation of Estonia's Higher Education Institutions'. This agreement includes guidelines on the employment of foreign research staff.

Poland: a new national law imposes an obligation on higher education institutions to publish job adverts on the EURAXESS Jobs Platform. As a result, the number of vacancies for research positions posted on EURAXESS Jobs rose from 100 in 2010 to approx. 1,000 in 2011.

Spain: published in 2011, a new law on science, technology and innovation as well as several relevant reforms require institutions to advertise positions openly. In a bid to attract foreign research talent, it also introduces derogations to the requirement of Spanish/EU nationality when applying for public roles, and allows the use of English in the selection process.

UK: the 'Concordat to Support the Career Development of Researchers: An Agreement between the Funders and Employers of Researchers in the UK' (2008)[111] is a voluntary code of practice aiming at supporting the career development of researchers. The promotion of diversity and equality in all aspects of the recruitment and career management of researchers is a key principle of the Concordat. Although the initiative is still relatively new, the Concordat has triggered significant changes at institutional level in relation to research careers management.

Source: ERA Steering Group on Human Resources and Mobility (2009-2010), ERAWATCH (2011), Technopolis (2011)

Regarding portability of grants and access to national grants, significant differences exist amongst Member States. According to the 2011 EPR Monitoring Questionnaire[112], only a small number of Member States (AT, DK, EE, UK) have reported that their national funding mechanisms provide for portability of grants, whilst grants are not portable outside the country in ten Member States (BE, CY, CZ, EL, HU, IE, MT, PL, SI, ES) or are portable to a certain extent (FI, NL, DE). In several Member States access to national grants and fellowships may be hampered for non-residents. According to the 2011 EPR Monitoring

110 http://media.enseignementsup-recherche.gouv.fr/file/2008/88/5/fiches_36885.pdf

111 www.researchconcordat.ac.uk/documents/concordat.pdf

112 Responses by Member States to the EPR Monitoring Questionnaire disseminated via the SGHRM in October 2011.

Questionnaire[113], (prior) residence in the country is necessary for accessing national grants (AT, PT). Researchers can access national grants provided that funding is linked to the Member State's research system or serves the interest of the national research system (BE, CZ, DE, EE, ES, EL, FI, NL, PL, UK), whilst non-nationals cannot access national grants in two Member States (HU, MT).

Although several regional initiatives such as the **'Money follows Researcher'** and the **'Money follows Cooperation Line'** schemes have been adopted, their impact remains relatively limited across the EU. Originally implemented in three countries (Germany, Austria and Switzerland), the 'Money follows Researcher' scheme allows researchers relocating from one country to another to take their research funding with them (27 research funding and performing organisations have now signed up to the scheme)[114]. The 'Money follows Cooperation Line' scheme, also initially implemented by the national funding organisations from Germany, Austria and Switzerland entails the opening of national funding programmes for applicants from other countries by permitting them to apply jointly with the partners from the country of the research funding organisation (other research funding organisations have now adopted the mechanism and use it without restriction to specific countries).

Initiatives to support the development of open access to scientific publications and research data

At EU level, both funding and soft measures have been adopted to support the development of open access. As a result of the Open Access Pilot in FP7 and ERC scientific guidelines for open access (ERC, 2007), scientific publications resulting from a set of EU-funded projects are now increasingly available in open access[115]. Support to coordinated initiatives on the interoperability of repositories has been provided through the Open Access Infrastructure for Research in Europe (OpenAIRE) project funded under FP7[116]. Despite their relevance, FP-funded measures concern only a very limited share of EU's overall R&D expenditure and their impact remains thus limited. The use of open access for projects supported by the Framework Programme has been based on the 2007 Council Conclusions on scientific information in the digital age (Council of the European Union, 2007) and the 2007 Communication from the Commission on scientific information in the digital age (European Commission, 2007b). The Council Conclusions invited Member States to reinforce national strategies on access to and preservation of scientific information, and to enhance policy co-ordination. The Commission Communication provided a set of actions to be undertaken by Member States. However, the successful implementation of the Commission Communication and Council Conclusions remains mixed[117]. The Commission is also planning to table a

113 Responses by Member States to the EPR Monitoring Questionnaire disseminated via the SGHRM in October 2011.

114 http://www.eurohorcs.org/E/initiatives/mfr/Pages/mfr.aspx

115 'Commission Staff Working Document, Impact Assessment, Document Accompanying the Recommendation from the Commission to the Council on Access to and Preservation of Scientific Information in the Digital Age', forthcoming

116 OpenAIRE supports the setting up of e-infrastructure for interoperable repositories accessible via a single portal. It also has set up a network of helpdesks in the MS, as well as a system to monitor and systematically gather information on the deposit of OA peer reviewed papers. Source: 'Commission Staff Working Document, Impact Assessment, Document Accompanying the Recommendation from the Commission to the Council on Access to and Preservation of Scientific Information in the Digital Age', forthcoming

117 In terms of implementation, the activities adopted by Member States are mainly bottom-up and are not yet well structured through national strategies.

Communication and Recommendation to Member States in 2012. The Communication will promote and implement open access within EU research programmes, whilst the Recommendation will suggest a concrete set of actions to be implemented by Member States (the Impact Assessment of the Recommendation is under preparation).

Member States are not equally advanced in how they support and address the issue of open access, as indicated by the 2011 questionnaire to ERAC (European Commission, 2011d). Approximately half of Member States have implemented relevant policies (mainly non-legislative measures). In many Member States, open access activities are coordinated by funding bodies, universities and/or libraries. As of 2011, open access policies were implemented by research funding organisations in 17 Member States, whilst universities or research centres have open access mandates in 22 Member States. At the same time, only eight Member States had laws or legal provisions requiring open access to publicly funded research data. Policies on open access to research data are less developed than policies on scientific publications. Several Member States have developed high level strategies for the long-term preservation of data, however these strategies have not always been efficiently put into practice. Several coordination initiatives have been developed at sectoral or regional level (e.g. 'Knowledge Exchange', Berlin Declaration, European Organisation for Nuclear Research (CERN) Sponsoring Consortium for Open Access Publishing in Particle Physics, International Coalition of Library Consortia[118]). However, their overall impact remains limited.

Moreover, the FP7 SSH VERA project indicates that "an important obstacle to an effective circulation of knowledge is the fragmented patent system. Patenting remains excessively complicated and costly in Europe, and fragmented litigation fails to provide sufficient legal certainty" (VERA, 2012).

[118] 'Commission Staff Working Document, Impact Assessment, Document Accompanying the Recommendation from the Commission to the Council on Access to and Preservation of Scientific Information in the Digital Age', forthcoming

Annex 4: Analysis of impacts: methodology and tools used

This annex presents the methodology used for the estimation of the expected impacts on growth and employment and results from studies on the performance of gender diversity in research.

The model Nemesis and the scenarios simulated

The aggregate macro-economic impacts of funding allocation to research can be assessed by making use of a mathematical model based on known, inferred, and assumed parameters. Over the past few years, the use of mathematical models for the ex-ante evaluation of policy effects increased significantly within the Commission, and also at national level. For the ERA Framework ex-ante impact assessment, use was made of the model Nemesis.

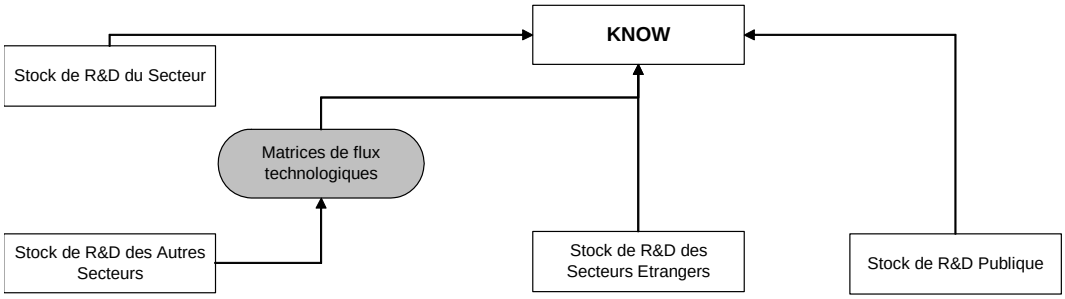
Nemesis is a macro-econometric model built by a Commission-funded consortium of European research institutes under the 5th, 6th and 7th Framework Programmes. It is a modular system for each European country. European countries are represented individually by one main economic module linked to three specific modules: energy and environment, agriculture, land use, which are interactively linked with the main economic module for these sub-modules. An additional sub-model, the regional one disaggregates the national level towards a regional one.

The model is mainly econometric, but some mechanisms are calibrated using the results of well proven econometric literature: it is the case for endogenous technical change. The econometric character of the model allows its adaptation to past conditions observed in the economy but it also allows the inclusion of alternative mechanisms of innovation, which for instance are not constrained by strict optimization conditions.

Technical progress in Nemesis is implemented (endogeneised) through a variable "knowledge" (KNOW) who, on the one side, is determined by the stock of R & D and knowledge spill-overs and, on the other hand, determines innovation which in turn, affects economic performance.

"Knowledge" depends primarily on the stock of R & D sector, stock up as a capital stock (the accumulation of R & D) to which a rate of obsolescence is applied (due to the gradual fading of knowledge.). It is further enriched by all the externalities of knowledge of all other domestic and foreign sectors. Knowledge spill-overs issued by other sectors depend on their stocks of R & D, through the technological flow matrices. These matrices identify the proportion of knowledge which has an area where innovation has occurred in any other sector. "Knowledge" also follows the stock of R & D in foreign sector and the stock of R & D public. Figure 4 summarises the approach to the construction of the variable "knowledge".

Figure 5: Stock of knowledge (KNOW)



The evolution of the stock of knowledge is reflected in process innovations and product innovations:

A process innovation increases total factor productivity and, through them, increases the supply of products and decreases the unit cost of production, and thus the price. This price reduction induces an increase in demand, in an amount that depends on the price elasticity of demand. Only a price elasticity greater than or equal to unity allows a higher demand higher than the increase in supply. However, estimates of these elasticities at industrial level show that they are generally less than one. Therefore, the impact of innovation on the supply is more important than its impact on demand. Process innovation tends to reduce the use of production factors.

Product innovation improves product quality. To understand the effects on demand, we can distinguish the effects of innovation on the demand volume (at constant quality) of those on demand volume efficiency (which takes into account the increase in quality). Improving product quality leads to a reduction in the price of efficiency unit (i.e. each product sees its relative quality decline when compared to a higher quality product and so its price would decrease). This results in an increased demand for efficiency units. Volume production then increases if the increase in demand for the new efficiency is greater than the increase in efficiency due to innovation.

While innovation in a product leads to increased employment of factors of production, a process innovation tends to reduce the use of production factors. In general, the positive effect of product innovations compensates the negative effect of process innovations, so that the increase in R & D leads to an increase in GDP and employment factors simultaneously.

To reflect the effects of ex ante innovation on GDP, we detail the formal process which, starting from an accumulation of knowledge leads to an increase in GDP:

As a result of process innovations, the accumulation of knowledge (KNOW) generates an increase in total factor productivity (TFP):

$$\frac{\Delta TFP}{TFP} = a \frac{\Delta KNOW}{KNOW}$$

This results in an increased demand:

$$\frac{\Delta D}{D} = \varepsilon \frac{\Delta TFP}{TFP} = \varepsilon . a . \frac{\Delta KNOW}{KNOW}$$

As a result of product innovations, the accumulation of knowledge (KNOW) leads to improved quality (QUAL):

$$\frac{\Delta QUAL}{QUAL} = a' \frac{\Delta KNOW}{KNOW}$$

This results in an increased demand:

$$\frac{\Delta D}{D} = \varepsilon' \frac{\Delta QUAL}{QUAL} = \varepsilon' . a' . \frac{\Delta KNOW}{KNOW}$$

The increase in output (Y) corresponds ex-ante to the increases in demand induced by process innovations and products. GDP growth therefore depends on the growth of knowledge in the form:

$$\frac{\Delta Y}{Y} = \beta \frac{\Delta KNOW}{KNOW} \text{ with } \beta = \varepsilon a + \alpha' a' .$$

Most econometric studies available do not measure the elasticity of GDP to the stock of knowledge β, but the elasticity of GDP to the stock of R & D (Mohnen (1990), Mairesse and Sassenou (1991), Grilliches (1992), Nadiri (1993), Cameron (1998), Guellec and van Pottelsberghe (2001), Bagnoli (2002). They only consider partially the multiple externalities from R & D. They estimate that the elasticity is between 0.05 and 0.2. The estimated productivity of R & D is stronger when the econometric study is conducted from a series of instantaneous cross-sectional (inter-enterprise) that when conducted with time series. This is due, among others, to the fact that innovative company grab market shares from its competitors in the same sector. Moreover, many studies agree that productivity depends on the technological advancement of the industry. It is assumed that β is the weighted sum of a constant β_0 and a function of the intensity of R & D in each sector (RD / Y) using the following equation:

$$\beta = \alpha . \beta_0 + (1 - \alpha) f\left(\frac{RD}{Y}\right)$$

The chosen parameters lead to a change of 0.075 β in 2002 to 0.124 in 2030.

The endogeneity of technical progress in Nemesis allows the study of innovation policies, such as subsidies to R & D, and their effects on the research effort and European economic performance.

The model, adapted to "structural" policies, includes 30 sectors for the core economic model, which could be detailed through the inclusion of linked modules. These details are very important: (i) at first, because the implementation of structural policies (energy, environment, agriculture, R&D, innovation) is made at a detailed level; (ii) secondly, because the macroeconomic tracks of the model is the combination of purely macroeconomic ("top-down") forces - for instance the wealth effects - and "bottom up" forces resulting from strong interactions between very heterogeneous sectors in terms of dynamics, but also in terms of composition (capital, labour, energy, etc). These interactions are not only presented in the NEMESIS model by goods and services exchanges, but they are also extended to knowledge spillovers.

Leverage effect

The leverage effect or "crowding-in" effect describes the multiplier effect of 1 Euro of research and innovation expenditures. Econometric works provide some results but mainly at a European level or a macro national one, more rarely at a sector level. This leverage effect is depending on several conditions which determine the expectations on the level and uncertainty of R&D returns. A main concern is about the comparison of the leverage effects of different sources of subsidies for instance regional, national or European.

At a European level, investments in research and innovation appear to induce higher leverage effects that the national or the regional ones because of the network effects and of the transfer of best practices, justifying the higher returns which explain the difference. Many of the new initiatives on joint technology initiatives and research policies, as the European Research Area creation, aim at increasing this leverage effect.

The Risk-Sharing Finance Facility (RSFF) uses debt-based finance, to complement the FP7 funding. Research related risk is shared between the EU and the European Investment Bank (EIB). The first evaluations of RSFF (see Soete, 2010) show since its creation in 2007 and until 2009 a very important leverage effect: 0.5 billion Euros of FP7 have induced, with the EIB support of 0.5 billion Euros, more than 16 billion Euros of expenditures in R&D. Exercises on FP assessment must take into account this RSFF outcome even if it concerns only a small part of FP7, and more generally make a sensibility analysis of results to the leverage adopted.

In the analysis of the impacts of the framework programme, a conservative leverage effect used are of 0.5 for public R&D investments (40% of the 7 billion funds) and 0.9 for the private sector. On average, these assumptions imply a leverage effect of 0.74, which means that one Euro of EU investment from the 2012 FP7 budget leads to 1.74 Euro of research and innovation expenditures, of which 0.58 financed by the private sector. This 0.74 leverage effect is compatible with the results of the econometric literature which indicates a leverage effect for the private sector between 0.7 and 1.7

A second important matter is the "knowledge spillovers". Impacts of innovation in the model depend not only on R&D expenditures of the sector, but also on the knowledge spillovers coming from others sectors, other countries and public research centres. This implies that innovation in a sector can also happen without R&D expenditures in the sector. In NEMESIS, it is then the knowledge variable of the sector that produces innovation.

The works and the literature on the knowledge spillovers are now fairly important. Starting with an adaptation of the Johnson matrix (Johnson, 2002) on technological flows based on patent data for the inter-sector spillovers and on trade flows for the external spillovers (which is a "proxy" variable). In the future, the model will update the hypothesis on the basis of contributions of the UNU-MERIT in the framework of the DEMETER project. The case of General Purpose Technologies (GPT), used by almost all the sectors, for instance the information and communication technologies, which are a main carrier for knowledge externalities, will be explicitly treated. The last mechanism is the economic performance (productivity) of knowledge that was calibrated in the NEMESIS model using the econometric works based on R&D performance.

Nemesis has been used by the Commission for the ex-ante impact assessment of FP7 and of Horizon 2020 and for assessing the macro-economic impacts of achieving the 3 percent

objective, by the OECD, by a number of French government institutions, etc. In the impact assessment of Horizon2020, the national crowding-in coefficient used was 0.7 (1 Euro of public funding attracts 0.7 Euros from the private sector), and 1.1 for EU funding of 1.1funding. For the purpose of this impact assessment the crowding-in factor (0.9) reflects the impacts of both joint calls, and the impact of international peer review evaluation for funding decisions. Moreover, pan-European research induces higher multiplicative impacts on the economy. In the impact assessment of Horizon2020 the multiplicative impacts of EU funding were estimated to be 15% better in those from national funding. For the purpose of this report, it was estimated that pan-European funding would induce a multiplier effect of 6% higher than the national one, also reflecting a possible higher openness to all Member States.

For the ERA Framework impact assessment exercise, DG Research & Innovation developed in collaboration with the DEMETER consortium running Nemesis a number of scenarios including the proposal: Business as usual, non-ERA and ERA in partnership. The DEMETER consortium produced for each of these scenarios results on GDP, exports, imports, and employment through 2030 compared to the business-as-usual scenario.

The table below presents the description of the options simulated for this report. In terms of EU and total national R%D funding, allocation and performance, the simulations use the same hypothesis as in the impact assessment of Horizon2020 (European Commission, 2011f). In the current simulations, the main difference consists in the share of national funding allocated to pan-European activities (basic and applied research), without increasing total national budget. In terms of performance, the coefficient attributed to pan-European funding is intermediate between the national and European ones used and justified in the Impact Assessment of Horizon 2020, as it is not possible to calculate better coefficients due to the lack of data on pan-European funding.

Table 9: Description of the options simulated with NEMESIS

	BAU	**Funding reallocated to transnational cooperation**
FP funding real growth rate 2013-2020	2013:8.31 2014: 10.7 2020: 15.3	2013:8.31 2014: 10.7 2020: 15.5
FP funding real growth rate 2021-2030	Increase further every year by 450 million and adjust for inflation (2%)	Increase further every year by 450 million and adjust for inflation (2%)
Share of latest available national R&D intensity competitive funding allocated to transnational bottom-up research within the ERA framework (%)	0	Increases gradually to 2% by 2020

	BAU	Funding reallocated to transnational cooperation
Share of latest available national R&D intensity competitive funding allocated to transnational top-down research within the ERA framework (%)	3.3% in 2013 gradually reaches 3.4% in 2020	3.3% in 2013 gradually reaches 5.3% in 2020
ERA Framework funding crowding-in factor private	0.9	0.9
ERA Framework funding crowding-in factor public	0.3	0.3
Multiplier for R&D resulting from ERA framework funding	6% better than national funding	6% better than national funding
Allocation of FP funding to EU Member States	Based on innovation performance	Based on innovation performance
Allocation of FP funding to basic and applied research	40% basic, 60% applied	40% basic, 60% applied
Allocation of FP applied research funding to sectors within Member States	Grandfathering	Grandfathering
FP funding crowding-in factor for the private sector (net additional funding generated)	1.1	1.1
FP funding crowding-in factor for the public sector	0.5	0.5
National funding crowding-in factor for the private sector (net additional funding generated) Non-ERA activities	0.7	0.7
National funding crowding-in factor for the public sector Non-ERA activities	0	0
Multiplier for R&D resulting from EC funding	15 percent better than national	15 percent better than national
Multiplier for R&D resulting from national funding	National	National

	BAU	Funding reallocated to transnational cooperation
Intersectorial spillovers	+	+
International spillovers	+	+

Figure 6 and Figure 7 below present the results of the simulations on GDP and employment by option, when compared with maintaining the current plurality of programmes for R&D and Innovation.

Figure 6: Additional GDP to be generated by reallocating funding to transnational activities when compared with maintaining the current plurality of programmes for R&D and Innovation (left) and additional GDP growth generated by ERA in combination with Horizon 2020, compared with the impacts on GDP of Horizon 2020 and of the non-Europe option presented in the Horizon 2020 Impact Assessment (SEC(2011) 1427 final) (right)

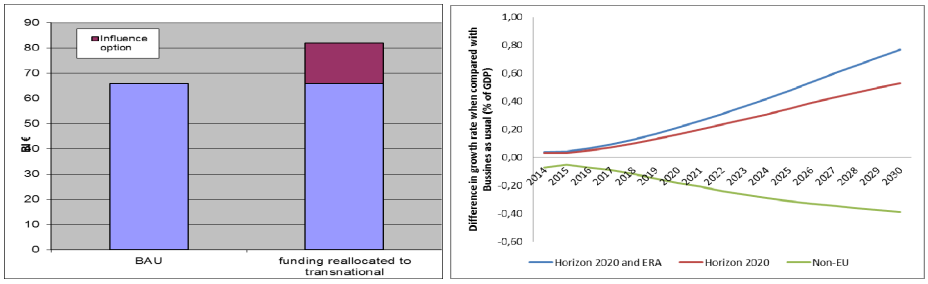
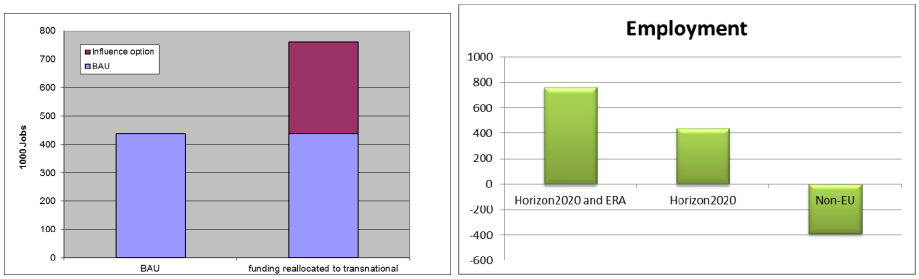


Figure 7: Additional jobs created when compared with maintaining the current plurality of programmes for R&D and Innovation (left) and additional jobs generated by ERA in combination with Horizon 2020, compared with the impacts on GDP of Horizon 2020 and of the non-Europe option presented in the Horizon 2020 Impact Assessment (SEC(2011) 1427 final) (right)



Analysis of costs linked to open, transparent and merit-based recruitment

Key assumptions

Number of vacancies affected across the EU

Precise, reliable, comparable data on the extent of open recruitment in the EU are virtually non-existent, e.g., no data for example on the number of open research positions per year, nor the number of internally advertised vacancies per country. However, a 2010 Study by Technopolis (Technopolis, 2010) estimated that out of the total number of researchers in the European Higher Education sector (1.3 million HC in 2007 (OECD)), one may calculate a

share of 15% for professors, and 85% of academic related jobs[119]. If we assume an annual turnover rate of 7%, about 96.000 positions need to be filled each year. Out of these, 10% may be positions for professors, while the majority of 90% will be for academic related positions. Affected by a possible lack of open recruitment are thus around 96.000 positions. One can estimate that the 10% of professorship positions, 9.600 jobs annually, are subject to open recruitment. One can then add another share for internally recruited researchers. If we calculate with 30% to be internally recruited, this would add another 30.000 positions annually within Europe. The professor positions are however the ones, for which in many EU countries regulations exist requiring public advertisement. Thus **about 30.000 to maximum 40.000 positions** are at stake possibly lacking open recruitment.

Cost for filling in a vacancy

As in any recruitment process, **transaction costs** occur on both sides: the hiring organisation and the individual. As a result, economic reasoning may define to some extent, which positions are required to be publicly advertised and which could also be internally advertised prior to a potential public advertisement.

While publishing posts assures greatest access to the available pool of qualified candidates, it often requires allocation of resources for outreach and advertising and may lengthen the recruitment process. There are first the search costs of the hiring organisation. Time consuming internal discussions about the job profile, ads in daily newspapers or journals, administrative follow-up, setting-up and functioning of a search committee/selection panel, these all are cost factors linked to the search. They can be substantially augmented when potential candidates are invited for an interview and their travelling reimbursed.

The costs for recruiting a single employee vary from country to country, region to region, even city to city. They vary between function groups as well as professions. Thus according to estimates that are provided by recruiting agencies, the costs can vary **between €2,000 and €50,000**. Agencies are more often used when either higher positions are offered or specialists are required. In all other cases, companies' internal human resource departments are the central unit dealing with recruitment issues (Technopolis, 2010)

Direct recruitment costs include the following items:

- Advertising
- Agency and search firm fees
- Costs associated with setting up a panel (use of valuable human resources, appointing a foreigner on the panel)
- Human resources to deal with potential large number of applicants, provide feedback, deal with appeals
- Travel costs incurred by both recruiters and applicants
- Relocation costs

[119] These shares are based on calculations using available data from a small number of universities on personnel and recruitment figures.

Technopolis (2010) calculated for the annually 9,600 university professors to be recruited average recruitment costs of **€20.000** (most of this is time spent on search, reading and assessing of documents, attending dedicated faculty meetings and selection boards, etc.) and **€5.000** for the formerly internally recruited personnel. Much of this amount is already spent on the subject given that many universities do publish most or all of their jobs and follow recruitment and selection processes. Thus the real net extra is an unknown fraction of this amount.

By and large and given that the cost for filling in a vacancy (research-related or professor position) varies from €5.000-20,000, **it can be assumed that the cost for filling in a vacancy is equal to one or two month researcher salary.**

The heterogeneity of the situation in each Member States presents a challenge. For countries such as the UK with a relatively open and transparent recruitment system, there may be (virtually) no additional costs required but for other countries at the other extreme, such as Italy, Greece, Romania, Bulgaria the costs of applying principles of open, transparent recruitment may require additional costs close to the average figures mentioned above, e.g., in institutions lacking a proper human resources strategy or with an underfunded/understaffed human resources department.

There are equally transaction costs on the side of the candidate, for example, of his or her search costs, but also mobility and social costs – the candidate may have to move, quit family and friends and encounter thus social costs.

Analysis of gender impacts

Several studies indicate that increased female participation leads to increased research and innovation performance through:

– benefitting from a wider talent pool of human resources

– diversified teams of researchers enhance the robustness of the decisions due to wider expertise, knowledge sharing and diverse points of view

The following exercises quantified the contribution of female participation on performance and economic impacts:

– McKinsey & Company (2007) found that those with the highest level of gender diversity in top management positions outperformed their sector competitors in terms of return on equity by 10%, in earnings before interest and taxes by 48%, and in 1.7 times higher stock price growth during the period 2005-2007).

– McKinsey & Company (2007) shows that the increase in female employment has been an important driver of European economic growth over the last 10 years. Closing the gap between female and male employment rates would boost US GDP by as much as 9% and the Eurozone GDP by as much as 13%

– Sáinz Ibáñez, Milagros, Beatriz López, and Ana González Ramos (2010) shows that ICT research groups in public institutions in Spain with more than 20% women have better academic performance results in terms of a higher number of (a) international competitive research projects, (b) articles published in international journals, and (c) publications with a higher impact factor

– Turner, (Air Liquide, EDF, Shell and Schlumberger) (2006; 2009) shows that a 10% increase of gender diversity at R&D teams in private companies level would lead to an increase of 0.7% in individual performance. Similarly, on the group level, more gender diverse teams scored better on the performance scale: an increase from 27% to 50% of gender diversity in teams would raise the probability of on-time delivery of priority deliverables by 8.5% and raise the probability that real costs will be smaller than anticipated costs by 15. More gender diverse teams improve individual and collective R&D performance.

– Østergaard, Timmermans, and Kristinsson (2011) found that gender diversity among 1648 Danish firms had the second strongest relationship with a firm's likelihood to innovate after educational diversity

– As Cavalcanti and Tavares (2007) contend, a greater gender pay gap discourages women from participating fully in the labour market, with negative consequences for growth per capita. According to their model, if the US were to have the same level of gender pay inequality as Egypt, its output per capita would be 42.68% below its actual level.

Analysis of costs and benefits of open access: a comparison between Denmark, Netherlands and the UK

Description of the Model

1.1. Main characteristics: A spread sheet model to estimate the impacts of increases in 'accessibility' and 'efficiency' on returns to R&D over 20 years in a 20 by 20 matrix, with three data inputs: (i) R&D expenditure, (ii) annual costs associated with the publishing model, and (iii) annual savings resulting from the publishing model (in the net cost scenarios only).

1.2. Assumptions and parameters

Key parameters include: (i) the rate of social return to R&D, (ii) the rate of depreciation of the underlying stock of knowledge, (iii) the discount rate applied to costs and benefits to estimate net present value, (iv) the rate of growth of R&D expenditure, (v) the rate of growth of costs associated with the alternative publishing scenario being explored, (vi) the average lag between publication or self-archiving and returns to R&D in years, and (vii) the average lag between R&D expenditure and publication in years.

1.3. Transition versus 'steady-state' alternative: Because of the lag between research expenditure and the realisation of economic and social returns to that research, the impact on returns to R&D is lagged (by 10 years in the transitional scenario) and the value of those returns discounted accordingly. This reflects that fact that a shift to open access publishing or self-archiving would be prospective and not retrospective, and the economic value of impacts of enhanced accessibility and efficiency would not be reflected in returns to R&D until those returns are realised. An alternative approach would be to model a hypothetical alternative 'steady-state' system for alternative publishing models in which the benefits of historical increases in accessibility and efficiency enter the model in year one. This would reflect the situation in an alternative system, after the transition had worked through and was no longer affecting returns to R&D. The model used herein focuses on the transition and

explores alternative models through a series of scenarios over a 20 year transitional period. However, the possible impacts in a hypothetical 'steady-state' alternative system are explored indicatively by introducing the estimated annual increase in returns into year one. This effectively removes the lag, but is no more than indicative because it does not include the recurring gains from historical expenditures occurring before year one.

1.4. National versus worldwide scenario: the study also distinguishes between a realisation of open access policies primarily on the national level or on the global level, where additional benefits can be reaped. However, this exercise has been undertaken for DK and NL only, not for the UK.

Cost-benefit analysis in Denmark, the Netherlands and the UK

2.1. Cost-benefit analysis Denmark

--	**Costs**	**Savings**	**Return**	**Benefit/Cost ratio**
Scenario 1: national Open Access (OA) only (unilateral)				
Transitional Model Gold OA[120]	3024	4724	1504	2.1
Transitional Model Green OA[121]	160	31	1504	9.6
Steady State Model Gold OA	3024	4724	16824	7.1
Steady State Model Green OA	160	31	16824	105.2
Scenario 2: Worldwide OA				
Transitional Model Gold OA	3024	9337	1504	3.6
Transitional Model Green OA	160	2741	1504	26.5
Steady State Model Gold OA	3024	9337	16824	8.7
Steady State Model Green OA	160	2741	16824	122.1

Comments and source: Houghton (2009a)[122] Adapted from Net costs scenario Denmark, taking figures for all gold and green OA activities (not just implementation in Higher Education). Figures in DKK millions

120 i.e. open access publishing

121 i.e. self-archiving

122 Houghton, John (2009a) Costs and Benefits of Alternative Publishing Models: Denmark. Centre for Strategic Economic Studies Victoria University, Melbourne

Interpretation: As in the previous case study, these cost-benefit comparisons suggest that the additional returns to R&D resulting from enhanced accessibility and efficiency alone would be sufficient to cover the costs of parallel open access self-archiving without subscription cancellations (i.e. 'Green open access'). When estimated savings are added to generate net costs there is a substantial increase in the benefit/cost ratios, and for both open access publishing and self-archiving alternatives (i.e. 'Gold open access' and 'Green open access') the benefits exceed the costs, even in transition. Indicative modelling of post-transition 'steady-state' alternative systems suggests that, once established, alternative open access publishing and/or self-archiving systems would produce substantially greater net benefits. For example, during a transitional period it is estimated that, in an open access world:

- The combined cost savings and benefits from increased returns to R&D resulting from open access publishing all journal articles produced in Denmark's universities using an 'author-pays' system would be around 3 times the costs;

- The combined cost savings and benefits from open access self-archiving in parallel with subscription publishing (i.e. 'Green open access') would be around 27 times the costs;

- The combined cost savings and benefits from an alternative open access self-archiving system with overlay production and review services (i.e. 'overlay journals') would be around 4 times the costs

Indicative modelling of post-transition 'steady-state' alternative systems returns benefits of around 7 to 10 times costs for open access publishing and self-archiving with overlay services, more than 100 times the costs for the 'Green open access' self-archiving.

Cost-benefit analysis Netherlands

--	**Costs**	**Savings**	**Return**	**Benefit/Cost ratio**
Scenario 1: national Open Access only (unilateral)				
Transitional Model Gold OA[123]	636	1010	358	2.1
Transitional Model Green OA[124]	124	13	358	3.0
Steady State Model Gold OA	636	1010	3737	7.5
Steady State Model Green OA	124	13	3737	30.3
Scenario 2: Worldwide OA				
Transitional Model	636	1987	358	3.7

[123] i.e. open access publishing
[124] i.e. self-archiving

Gold OA				
Transitional Model Green OA	124	631	358	8.0
Steady State Model Gold OA	636	1987	3737	9.0
Steady State Model Green OA	124	631	3737	35.3

Comments/Source: Houghton (2009b)[125] Adapted from Net costs scenario the Netherlands, taking figures for all gold and green OA activities (not just implementation in Higher Education). Figures in EUR millions

Interpretation: Similar to the results for DK and NL the comparisons for the UK suggest that the additional returns to R&D resulting from enhanced accessibility and efficiency alone would be sufficient to cover the costs of parallel open access self-archiving without subscription cancellations (i.e. 'Green open access'). When estimated savings are added to generate net costs there is a substantial increase in the benefit/cost ratios, and for both open access publishing and self-archiving alternatives (i.e. 'Gold open access' and 'Green open access') the benefits exceed the costs, even in transition. Indicative modelling of post-transition 'steady-state' alternative systems suggests that, once established, alternative open access publishing and/or self-archiving systems would produce substantially greater net benefits. For example, during a transitional period it is estimated that, in an open access world:

- The combined cost savings and benefits from increased returns to R&D resulting from open access publishing all journal articles produced in Netherlands universities would be around 3 times the costs
- The combined cost savings and benefits from open access self-archiving in parallel with subscription publishing (i.e. 'Green open access') would be around 7 times the costs;
- The combined cost savings and benefits from open access self-archiving with overlay production and review services (i.e. 'overlay journals') around 4 times the costs.

Indicative modelling of post-transition 'steady-state' alternative systems returns benefits of around 7 to 8 times costs for open access publishing and overlay services models and around 30 times the costs for the open access self-archiving.

Cost benefit analysis United Kingdom

--	**Costs**	**Savings**	**Return**	**Benefit/Cost ratio**
Scenario 1: national Open Access only (unilateral)				
Transitional Model Gold OA[126]	2079	2575	2353	2.4

[125] Houghton, John et. al (2009b)

Transitional Model Green OA[127]	237	2697	2353	21.3
Steady State Model Gold OA	2079	2575	26318	13.9
Steady State Model Green OA	237	2697	26318	122.2
Scenario 2: Worldwide OA: not provided				

Comments/Source: Houghton et. al (2009c)[128] Adapted from Net costs scenario the UK, taking figures for all gold and green OA activities (not just implementation in Higher Education). Figures in GBP millions.

Interpretation: These comparisons suggest that the additional returns to R&D resulting from enhanced accessibility and efficiency alone may be sufficient to cover the costs of parallel open access self-archiving (i.e. Green open access). When estimated savings are added to generate net costs there is a substantial increase in the benefit/cost ratios and for both open access publishing and self-archiving the benefits exceed the costs (even in transition). Indicative modelling of post-transition 'steady-state' alternative systems suggests that once established alternative open access publishing and/or self-archiving systems would produce substantially greater benefits, such that:

- For the UK nationally, in an alternative open access journal publishing system the benefits might be 14 times the costs
- And in an alternative open access self-archiving system with commercial overlay production and review services the benefits might be more than 120 times the costs.

Conclusion[129]

The cost-benefits of the open access or 'author-pays' publishing model are very similar across the three countries. In terms of estimated cost-benefits over a transitional period of 20 years, open access publishing all articles produced in universities in 2007 would have produced benefits of around 2 to 3 times the costs in all cases, but showed benefits of 5 to 6 times costs in the simulated alternative 'steady state' model for unilateral national open access, and benefits of around 7 times the costs in an open access world.

The most obvious difference between the national results relates to the self-archiving and repositories models, which while promising substantial net benefits in all countries, do not look quite as good in the Netherlands as they do in the UK, and nothing like as good as they do in Denmark. This is due to the implied number of repositories, each with operational overheads.

Notwithstanding this difference, the modelling suggests that more open access alternatives are likely to be more cost-effective mechanisms for scholarly publishing in a wide range of countries (large and small), with 'Gold open access' or author-pays publishing, the

126 i.e. open access publishing
127 i.e. self-archiving
128 Houghton, John et. al (2009c)
129 This conclusion is based on From Houghton, John (2009a)

deconstructed or overlay journals model of self-archiving with overlay production and review services, and 'Green open access' self-archiving in parallel with subscription publishing progressively more cost-effective.

Impacts of open access on the publishing market

The impact of open access on the publishing market has been documented in several studies and articles, however to date no definitive conclusion or consensus has emerged. It is worth noting that open access via the gold route or the green route may entail different impacts on the publishing market as follows:

- Gold open access entails a shift from "subscriber pays" to "author pays" model which does not imply fundamental changes to the current business models
- Self-archiving or green open access entails a potential for disruption of business model but embargo periods have been foreseen to make sure publishers can recoup their investment.

The publishing market: key features[130]

Publishers' behaviour in the market will be determined by their objectives. The objectives of any one publisher will not be one-dimensional and in some cases there are likely to be a number of complex, even mutually exclusive, reasons for engaging in the publishing market. Furthermore there are many different kinds of publisher, some of which publish large numbers of journals, each of which may contribute in different ways to the fulfilment of the publisher's objectives. Publishers of academic journals fall into three broad groups

- Commercial publishers'
- University presses;
- Learned societies.

It is not straightforward, therefore, to characterise the objectives of, say, a particular commercial publisher, which may, for example be publishing journals which it owns alongside those owned by a learned society, where the price and distribution policy of the latter are determined largely by the society. The commercial publisher wishes to fulfil its own objectives, but, in this example, must, at the same time, enable its society customers to fulfil their needs too. At the opposite end of the spectrum, a learned society may be involved in publishing solely to disseminate the work of its specialist area to a relatively small group of subscribers, or may have a very large subscription base, publishing a broadly based journal of high quality, from which it earns substantial revenue enabling it to give bursaries, put on conferences and workshops, establish small research grants and promote its discipline to the public at large.

Sources of revenue for journal publishers[131]

Journal publishers often rely on revenue from a number and variety of sources, including:

130 Wellcome Trust (2004) Costs and business models in scientific research publishing

131 From Houghton, John et. al (2009c)

- Subscription revenues from individual or institutional subscribers, by title and by 'Big Deal' package;
- Individual article, reprint and pay-per-view revenues from individual or institutional users;
- Content licensing from third-parties for access to content;
- Advertising revenues from organisations seeking to sell to the journal's readers, which can be quite substantial in areas where there are large professional readerships (e.g. medicine);
- Author-fees in the form of page charges or fees for submission and/or publication charged to authors directly or to their institutions and/or funders;
- Membership fees from society membership (e.g. membership fees that include a 'free' journal); and
- Sponsorship and support in the form of financial support for the operation of the journal.

Impacts of open access on the publishing market and on jobs

Some studies have noted the potential for availability of articles on open access archives and repositories to have a negative impact on subscriptions. RIN et al. (2011)[132] take a 10% loss of subscriptions as an underlying assumption for its green open access scenario. However, to date no definitive evidence of the impact of open access on the publishing market has been produced in the academic literature. It is worth noting that arXiv has had no obvious impact on subscriptions to physics journals despite extensive coverage and years of operation (Pinfield 2007),32 and the relationship between arXiv and journals in the areas concerned may be positive, rather than negative (Swan 2005). The same has been said of Nature Precedings (Hannay and Spencer 2008).[133] Publishers appear to have adjusted to the twelve-month embargo period required by the US National Institutes of Health (NIH) without a significant loss of subscriptions. In spite of the uptake of Open Access publishing, including more than 200 Open Access mandates worldwide, the profit and margins of scientific publishers have remained healthy over recent years.[134]

Given the fact that publisher's use a variety of income streams as well as the different categories of publishers (see above) no reliable predictions on positive or negative impact on jobs can be made. Additionally, potential job gains through non-for profit open access publishers and increased competition – hence the potential entry of new players in the market – would also need to be factored in. Due to this complex situation an estimation of the impact on jobs cannot be provided.

132 RIN et. al (2011) Heading for the open road: costs and benefits of transitions in scholarly communications.

133 Houghton, John et. al (2009c)

134 Houghton, John et. al (2009c)

Other impacts on publishers[135]

Open access publishing (especially author-pays) may well make revenue more predictable and stable, as it scales more easily to research output than have library budgets, growing with research expenditure and providing a revenue stream that is growing. This would reduce the level of risk and should, over time, be reflected in a reduced user cost of capital for open access publishers.

Open access publishers are less likely to need branded proprietary access systems, reducing the need for each publisher to develop expensive proprietary access systems, and reducing expenditure on IT skills and equipment while increasing the use of hosting services.

Open access journals are more visible and more useful, and are more likely to attract submissions and advertising revenue, thereby increasing potential revenue growth opportunities. Hybrid journals may also become more visible through offering open/author choice and grow subscriptions and subscription revenue as a result

Learned societies and associations may raise their profile, and that of their discipline, by publishing open access journals and/or hosting open access content (e.g. disciplinary open access repositories). This might contribute to membership growth and revenue growth. Learned societies and associations may also develop new revenue streams through the provision of overlay services to the open access content (e.g. peer review, specialist portals, etc.).

135 Houghton, John et. al (2009c)

Annex 5: Screening and selection of the specific measures for the policy options

1. Competitive and open national research systems

Pre-screening and selection of potential measures to address the problem

Several potential measures were considered and screened in order to identify the pros and cons of each of them:

- **Member States' reforms** for reducing barriers to allocating funding on a competitive basis with international peer review systems

Assessment of pros and cons: the advantage of this measure is that it leaves up to Member States to determine the most relevant reforms to be put in place given the national context. This is all the more important as existing evidence shows that there is no 'optimal' share of project-based funding vs. institutional funding. On the other hand, the voluntary nature of this measure means that research stakeholders or Member States not supporting the measure may not adopt the necessary reforms. This measure was retained in policy option 2 and 3.

- **Legislative measure at EU level** on the use of peer review evaluation based on international standards for all national project-based funding.

Assessment of pros and cons: the advantage of this measure is that all projects across the EU will be subject to common international peer review systems. However, since several Member States have already such peer review evaluation systems in place, a regulatory measure at EU level would entail unnecessary burden on these national systems (i.e. they will have to change existing evaluation systems) without additional benefits. This measure was included in policy option 3 and 4.

- **Peer review evaluation system at EU level for national projects**: all national bottom-up projects would be assessed through an EU peer review evaluation system based on international standards. A unique score would be allocated to each project. This system could *de facto* constitute an extension of the remit of the ERC to all national projects.

Assessment of pros and cons: the advantage of this measure is that all projects across the EU will be assessed using a unique evaluation mechanism. This would allow the comparability of projects between countries, as each project would be allocated a unique EU-wide score. This measure may act as a powerful incentive for national research teams and researchers to improve the quality of their proposals. However, this measure may encounter strong opposition amongst research stakeholders wishing to maintain the status quo (sheltered funding). It would entail heavy financial burden for the Commission. This measure was not retained for the policy options.

2. Enhanced co-operation in research between Member States through systems interoperability, synchronised calls and common international peer review system

Pre-screening and selection of potential measures to address the problem

Several potential measures were considered and screened in order to identify the pros and cons of each of them:

- **Support to Member States' reforms** to remove legal, administrative or other types of obstacles remain to the adoption of minimum rules for the interoperability of research programmes involved in cross-border operations, including joint actions, and for common international peer review

Assessment of pros and cons: the advantage of this measure is that it leaves up to Member States to determine the most relevant reforms to be put in place given the national context. This is all the more important as the type of barriers varies amongst Member States and within Member States (i.e. different national programmes may have different barriers). On the other hand, the voluntary nature of this measure means that research stakeholders or Member States not supporting the measure may not adopt the necessary reforms. This measure was included in policy option 2 and 3.

- **Support to Member States and stakeholder organisations for launching pilot call(s)** within the framework of Joint Programming or other existing transnational cooperation mechanism, with the support of the Commission for synchronising the calls and for the international peer review evaluation of proposals

Assessment of pros and cons: the measure provides an adequate level of flexibility as Member States identify the most relevant type of pilot calls and structures for implementing them. Another advantage of this measure is that new calls are implemented through existing mechanisms (e.g. Joint Programming) which are well-known by Member States and the research community. This should increase the likelihood of successful implementation. On the other hand, there is a risk of slow take-up by Member States and research actors given the voluntary nature of the measure. This measure was included in policy option 2 and 3.

- **Stakeholder organisations identify and agree on modalities and modus operandi for the organisation of joint calls based on common international peer review**

Assessment of pros and cons: the clear advantage of this option is that stakeholders can identify and set up modalities which are tailored to the characteristics of domestic research systems. No potential limit was identified for this measure. This measure was included in policy option 2.

- **Support measure for the implementation** of the voluntary guidelines on Joint Programming. This measure would entail regular peer reviews amongst Member States and a monitoring system by the Commission

Assessment of pros and cons: a clear advantage of this measure is that it would support Member States in implementing the guidelines on Joint Programming, thus leading to increased interoperability of national research programmes in the long term. However, a significant limit of this measure is that increased interoperability between research programmes will most likely not be achieved by 2014, as this would require at least a couple of years. This measure was therefore not retained for the policy options.

- **Member States co-ordinate policies** on research infrastructures and adopt measures allowing the opening of existing and new European research infrastructures to the entire user community

Assessment of pros and cons: this measure should lead to increased access to research infrastructures of pan-European interest. This option also allows Member to adopt a flexible

approach, which is in line with the current mechanisms within the ESFRI Forum. This measure was included in policy options 2 and 3.

- **Identification and setting up of harmonised monitoring, evaluation and impact assessment principles and procedures for pan-European research infrastructures**

Assessment of pros and cons: a clear advantage of this measure is that it builds on and expands on-going activities carried out by ESFRI members. Harmonised principles and procedures should support improved foresight and monitoring of both national and pan-European research infrastructures, whilst facilitating decision-making within ESFRI. A potential limit of this measure is that some Member States may not fully support the use of the proposed principles and procedures, as this remains a voluntary measure. This measure was included in policy option 2.

- **EU legislative measure requiring Member States** to increase cross-border cooperation through the adoption of minimum standards for research programme interoperability, the setting up of synchronised calls and a common international peer review system and the adoption of principles to reinforce access to pan-European research infrastructures and their evaluation and monitoring.

Assessment of pros and cons: such a measure would significantly facilitate cross-border cooperation, as standards and conditions (related to national research programmes, evaluation mechanisms) would be harmonised across Member States. However, the implementation of this measure can prove expensive. Moreover, the adoption mechanism can take too long to deliver by 2014 and probably including only principles of a limited degree of ambition. This measure was included in policy option 3 and 4.

3. An open labour market for researchers

3.1. Application of principles for open recruitment in public research systems

Pre-screening and selection of potential measures to address the problem

Several potential measures were considered and screened in order to identify the pros and cons of each of them:

- **Legislative measure at EU level:** binding measures requiring Member States to adopt open, transparent and merit-based recruitment for research positions in the public sector.

Assessment of pros and cons: the advantage of a regulatory measure is that less-advanced Member States would have to implement open recruitment. However, such a measure may prove difficult to implement given the diversity of national research systems and given the lack of precise data on the types of barriers which exist at Member State level. Moreover, recruitment and hiring policies are often linked to the level of autonomy of universities and research organisations in Member States. Moreover, the appointment of some senior or permanent positions is centrally determined in several Member States. The effective implementation of a legislative measure would entail reforms at Member State level. This measure was included in policy option 3 and 4.

- **Removal of legal, administrative and other types of barriers:** Member States adopt relevant regulatory measures for ensuring that research organisations can implement open, transparent and merit-based recruitment for public research positions.

Assessment of pros and cons: given the diversity of national research systems, this option allows Member States to identify the key barriers preventing the open recruitment of researchers. This type of measure is particularly relevant given that existing barriers are local/context specific and hence need to be addressed within the national context. The potential limit of this measure is that removing existing barriers may require regulatory changes (e.g. autonomy of universities, changes to appointment rules and processes, civil service law), which may delay the successful implementation of the measure This measure was included in policy option 2.

- **Stakeholder organisations to adopt principles for open, transparent and merit-based recruitment in the public research sector.**

Assessment of pros and cons: the advantage of this measure is that universities and research organisations would be able to draw on a larger pool of candidates, thus selecting the best profiles. This measure would also ensure equal opportunities - particularly for women and young researchers - at all stages of the selection process. Staffing autonomy and the possibility to recruit the best candidates should ultimately lead to increased scientific performance within institutions. The limit of this measure is that some institutions may not be able to implement open recruitment given the existence of barriers (legal, administrative) at national level. Moreover, the implementation of all principles and rules linked to open recruitment may prove expensive for less-endowed institutions. This measure was included in policy option 2.

- **Reinforced implementation of open recruitment within the framework of the European Partnership for Researchers (EPR)**: as part of the EPR and based on the open method of coordination, a common definition (including criteria) of open recruitment would be agreed amongst Member States. Specific targets and actions to be implemented would be then defined for each Member State linked to a regular monitoring mechanism.

Assessment of pros and cons: the setting up of this measure should be relatively smooth and straightforward as Member States are already cooperating within the EPR. However, it may prove difficult to ensure that all Member States fully commit and engage in an equal manner (Member States' involvement has been uneven within the EPR). This measure also entails lengthy procedures and consultation mechanisms amongst Member States which would not allow for quick and visible progress by 2014. Hence, this measure was not included in the policy options.

3.2. Integrated strategies to support the career development of researchers

Pre-screening and selection of potential measures to address the problem

Several potential measures were considered and screened in order to identify the pros and cons of each of them:

- **Member States develop national frameworks** to support the career development of researchers

Assessment of pros and cons: the advantage of this option is that Member States determine the most adequate measures to be put in place given the local/national context. However, a potential limit of this measure is that setting up national framework may be a lengthy process as this often entails consultation processes and consensus-building with key research actors. This measure was retained in policy option 2 and 3.

- **Stakeholders organisations develop institutional strategies** to support the career development of researchers in line with the "Human Resources Strategy for Researchers"

Assessment of pros and cons: the advantage of this option is that stakeholder organisations can identify local needs and set up tailored strategies to address the career development of researchers. The potential limit of this measure is that the implementation of such strategies may prove costly for less-endowed institutions or stakeholders located in less-advanced Member States or regions. This measure was retained in policy option 2 and 3.

- Exchange of **best practice** and peer review

Assessment of pros and cons: this measure would benefit less-advanced Member States by providing them with the required expertise and capacity building. The limit of this measure is that there is a risk of limited action and follow-up at national or institutional level, i.e. practices are exchanged but not implemented. As the exchange of best practice is already on-going and similar types of activities have already taken within the FPs, this measure was considered in the Baseline.

3.3. Innovative doctoral training linking private and public sectors

Pre-screening and selection of potential measures to address the problem

Several potential measures were considered and screened in order to identify the pros and cons of each of them:

- Member States support the setting up of "**innovative" doctoral training programmes**

Assessment of pros and cons: Member States already fund a variety of national doctoral programmes. The advantage of this measure is that funding of national doctoral programmes will be linked to the Principles for Innovative Doctoral Training. No cons were identified for this measure. This measure was retained in policy option 2 and 3.

- **Stakeholder organisations implement the "Principles For Innovative Doctoral Training"**

Assessment of pros and cons: the advantage of this measure is that stakeholder organisations are the key actors responsible for implementing the principles for innovative doctoral training. This means that research organisations and universities can reform and tailor the principles given existing needs. A potential limit of this measure is that the implementation of the principles may prove expensive for less-endowed institutions. This measure was retained in policy option 2 and 3.

- **Exchange of best practice and international peer review mechanisms amongst Member States**

Assessment of pros and cons: the setting up of this measure should be relatively smooth and straightforward as Member States are already cooperating within the EPR on this topic. However, it may prove difficult to ensure that all Member States fully commit and engage in an equal manner (Member States' involvement has been uneven within the EPR). This measure also entails lengthy procedures and consultation mechanisms amongst Member States which would not allow for quick and visible progress by 2014. This measure was not retained for the policy options.

3.4. Application of principles for cross-border portability and accessibility of national grants

Pre-screening and selection of potential measures to address the problem

Several potential measures were considered and screened in order to identify the pros and cons of each of them:

- **Legislative measure at EU level:** binding measures requiring Member States to adopt cross-border portability and accessibility of identified national grants

Assessment of pros and cons: the advantage of a regulatory measure is that it would create a level playing field between funders of research and would enable tighter cooperation between them. However, an EU-wide regulatory approach would be difficult to implement as funding systems and their underlying principles differ between Member States and may lead to brain-drain in less endowed Member States if it is undertaken without some precautions. As little is known regarding existing barriers at Member State level, there is currently not a strong case for regulatory intervention. This measure was included in policy option 3 and 4.

- **Removal of legal, administrative and other types of barriers:** Member States adopt relevant regulatory measures on cross-border portability and accessibility of identified national grants

Assessment of pros and cons: given the diversity of national research systems, this option allows Member States to identify the key barriers preventing portability of and accessibility to grants. This type of measure allows each Member State to calibrate its policy action according to the national/local situation. A challenge linked to this measure lies with the (potentially lengthy) identification of those grants which will be subject to portability at Member State level. This measure was included in policy option 2.

- **Stakeholders to adopt principles for the cross-border portability and accessibility of identified national grants.**

Assessment of pros and cons: the advantage of this measure is that it will allow stakeholders to identify which grants they want to make accessible and portable and which ones they do not. The potential limit of this measure is that some institutions may not be able to implement cross-border portability and accessibility of identified national grants given the existence of barriers (legal, administrative) at national level. This measure was included in policy option 2.

- **Reinforced implementation of grant portability within the EPR:** as part of the EPR and based on the open method of coordination, each Member State would

identify those national grants which should be subject to portability and accessibility. Specific actions to be implemented would be then defined for each Member State linked to a regular monitoring mechanism.

Assessment of pros and cons: the setting up of this measure should be relatively smooth and straightforward as Member States are already cooperating within the EPR[136]. However, it may prove difficult to ensure that all Member States fully commit and engage in an equal manner (Member States' involvement has been uneven within the EPR). This measure also entails lengthy procedures and consultation mechanisms amongst Member States. Hence, this measure was not included in the policy options.

- **EU-wide promotion and take-up mechanism** for the 'Money follows Researcher' (MfR) scheme: stakeholders, in cooperation with the Commission, adopt promotion and support measures for the further take-up of the MfR scheme.

Assessment of pros and cons: a clear advantage of this measure is that it could further build on and reinforce the existing MfR scheme agreed by an important number of institutions across Europe. However, the initiative does not address the issue of opening up national schemes to non-nationals or non-residents. The elaboration of principles and guidelines is foreseen to take a considerable amount of. For this reason, this measure was not included in the policy options.

4. Gender strategies and action plans

Pre-screening and selection of potential measures to address the problem

Several potential measures were considered and screened in order to identify the pros and cons of each of them:

- **Legislative measure at EU level:** binding measures to ensure that Member States adopt and implement gender strategies and action plans in the field of research.

Assessment of pros and cons: the advantage of a regulatory measure is that less-advanced Member States would have to adopt work-life balance measures. However, such a legislative measure could constitute an administrative and/or compliance burden for those Member States which are already well advanced. Moreover, the current state-of-play varies significantly amongst Member States and work-life balance policies are often an integral part of social and employment policies. The identification of the relevant provisions and measures to be put in place should be left with the Member States. In addition, the implementation of legislative measures may take a long time, notably if this requires transposition at Member State level. This measure was included in policy option 4.

- **Gender strategies and action plans:** set of voluntary measures which are part of a broader strategy. Action plans and strategies can be adopted and implemented at national and institutional level.

Assessment of pros and cons: given the diversity of Member States' situation, gender action plans and strategies allow national authorities and institutions to identify the most relevant measures to be implemented, this ensuring that measures are tailored to the local context and needs. The relative advantage of this measure is that institutions fully engage in the process

[136] A Working Group on Portability has already been set up with a report expected in spring 2012.

by setting up their own plans and strategies. One of the limits of this measure is that the implementation of action plans and strategies at institutional level can only succeed if existing measures and incentives are effectively implemented in the field of research (i.e. adequate work-life balance policies). This measure was included in policy option 2 and 3.

- **Exchange of best practice and peer reviews**: setting up of EU-level coordinated activities allowing for the exchange of best practice and peer reviewed amongst Member States.

Assessment of pros and cons: this type of activities would benefit less-advanced Member States by providing them with the required expertise and capacity building. The limit of this measure is that there is a risk of limited action and follow-up at national or institutional level, i.e. practices are exchanged but not implemented. As similar types of activities have already been taken within the FPs, this measure was not included in the policy options.

- **Research funding provisions** and conditions related to research implementation: calls for proposals and project funding could include provisions allowing for flexible working arrangements to accommodate career breaks. Project funding could also include provisions requiring the gender dimension to be included and assessed.

Assessment of pros and cons: this measure would allow Member States and research funders to include gender-related conditions in their funding decisions. The advantage of this measure is that Member States and research funders are free to determine the type of funding that would be subject to these conditions taking into account the local context and needs. Such provisions can be integrated into wider gender action plans and strategies (see above) or legislative measures. No cons were identified for this measure. This measure was included in policy option 2 and 3 as part of the measures and instruments included in the gender action plans and strategies.

- **Awareness raising and information measures**

Assessment of pros and cons: awareness and information campaigns are an effective tool for changing perceptions and attracting more women into science. The impact of awareness raising measures is often visible in the long term and is effective provided that related support measures and conditions are also in place (i.e. work-life balance policies). This activity is already part of the baseline scenario, therefor it was not included in the policy options.

- **Trainings for researchers on gender aware research**

Assessment of pros and cons: the advantage of this measure is that bespoke training is provided to those performing research, which means that those researchers will be more likely to include the gender dimension in research. Trainings provide researchers with hands-on experience and are likely to have a greater impact than awareness and information campaigns. No significant cons were identified for this measure. This measure was included in policy option 2 and 3 as part of the measures and instruments included in the gender action plans and strategies.

5. Free circulation of scientific knowledge and technologies

Pre-screening and selection of potential measures to address the problem

Several potential measures were considered and screened in order to identify the pros and cons of each of them:

- **Adoption and coordination of open access policies** at Member State and institutional level (stakeholder organisations) laying down common standards for repositories, access conditions, incentives for researchers and research performing organisations and open access requirements linked to funding

Assessment of pros and cons: the advantage of this measure is that it leaves up to Member States to determine the most relevant reforms to be put in place given the national context. This is all the more important as the development of open access policies and their level of implementation varies significantly amongst Member States. A potential limit of this measure is that Member States' commitment may vary given the voluntary nature of this measure. This measure was included in policy option 2.

- **Legislative measure at EU level** for the implementation of open access to all publicly-funded publications and relevant research data.

Assessment of pros and cons: the advantage of this measure is that full open access to publications would be achieved, provided that Member States fully transpose and implement the Directive. Such a measure would ensure a level playing field with regard to access to publications and data, which is particularly important for researchers located in less-advanced regions or less-endowed institutions. However, the adoption and transposition of a Directive will take at least 3 years in an optimistic scenario which will leave stakeholders in a wait-and-see mode for a considerable amount of time. Furthermore, the implementation of this Directive may entail unnecessary administrative burden on those Member States which are already well-advanced (i.e. regulatory changes would be required to in order to align the national framework with the requirements included in the Directive). This measure was included in policy option 3 and 4.

- **Setting up of an EU-wide open access network** for policy-makers and practitioners for exchanging best practices and peer reviews

Assessment of pros and cons: this measure provides Member States with a maximum level of flexibility for identifying existing gaps and potential measures to be put in place given the local context. The exchange of best practices can also help capacity-building in less-advanced Member States. However, a major limit of this initiative is that the adoption and implementation of open access policies by participating Member States may only occur over a period of several years, with no visible results in 2014. This measure was hence not included in the policy options.

5.2. Policies and measures to support the development, take up and cross-border access to digital services for data, connectivity, computing and research collaboration

Pre-screening and selection of potential measures to address the problem

Several potential measures were considered and screened in order to identify the pros and cons of each of them:

- **Legislative measure at EU level** to enforce take up of specific digital services for identification, repositories and research processes.

Assessment of pros and cons: The benefit of this approach would be that it would guarantee availability of digital research services for all researchers. However, it would require setting specific requirements for technologies and standards to be used, with additional costs in implementation and delays in take-up. In the rapidly changing technological sphere this might lead into taking up of systems which are old-fashioned when implemented. This measure was included in policy option 3 and 4.

- **Member States' network** for the development and take-up of identification services, e-infrastructures provision and development for research.

Assessment of pros and cons: With this measure, national research and education networking providers (NRENs) would proceed with supporting digital research services provision but have problems in getting the research organisations into integrating their researcher authentication systems into the federated framework or agreeing to provide external services to their researchers. This slows down the progress of cross-border access and collaboration, giving uneven access to researchers as their possibilities of participation depend on the home university/research organisation or home country. The development of digital services for research depends on the national priorities, which would result into uneven progress on European level, and slow progress in enabling cross-border collaboration with consortia including public and private research organisations. This measure was discarded.

- **Adoption of digital services policies for research and education-related public at Member State and institutional level**

Assessment of pros and cons: this measure would ensure joint progress and work towards setting up identity, connectivity, data repository, computing and research collaboration services for cross-border access in all countries and their institutions, but would allow flexibility in the implementation through different technological implementations and provision models. Common roadmap for e-infrastructures development and coordinated European progress on Digital ERA would support also the smaller MS and organisations to access research services through online sharing and access of resources across borders. This would improve the cohesion of ERA and scientific excellence in all Member States. Systematic coordination of dialogue between MS would require some specific costs, but some aspects of it are already being implemented with some Member States and the costs overall would be not be major. Stakeholder support to this solution is expected based on the results of expert groups and engagement in existing groups, such as High Level Group of scientific data, GEANT expert group, e-Infrastructures reflection Groups (e-IRG), e-Infrastructures Policy Forum (e-IPF). This measure was included in policy option 2.

5.3 Policies and measures supporting knowledge transfer between academia and industry

Pre-screening and selection of potential measures to address the problem

Several potential measures were considered and screened in order to identify the pros and cons of each of them:

- **Measures by Member States and stakeholder organisations** supporting the mobility of researchers across sectors, and strengthening the role of knowledge transfer offices.

Assessment of pros and cons: A concerted policy action at EU level will be able to promote what is not possible to attain by national action only while a voluntary agreement may be considered as an acceptable and manageable course of action that allows for flexibility in relation to the diversity of policies within the Member States. It would build on the well-established Recommendation on Intellectual Property Management (2008), and achievements already attained in this area and at the same time will provide the basis for renewed political impetus. The down side would be the potential for generating significant opposition if it is perceived as just an additional bureaucratic burden, hampering the academics' main research mission. This option has been included in policy option 2 and 3.

- **Legislative measure at EU level** on knowledge transfer objectives for researchers, e.g. minimum requirements in researchers' employment contracts and knowledge transfer and intellectual property transfer rules.

Assessment of pros and cons: this measure would increase the transfer of results to the private sector of publicly funded research by mandating the need for researchers to engage in knowledge transfer activities and also to be mobile across sectors. However, this measure has received very little support in the Open Consultation on ERA (2011) due to its perceived forcefulness and potential lack of effectiveness. Moreover, the inclusion of KT elements in employment contracts demands adaptation of employment law conditions which signifies a departure from the R&D context of the legal basis for ERA. This option was included in policy option 4.

Annex 6: Detailed description of policy option 2 and 3, comparison of delivering mechanisms and problem tree

This annex describes in detail the specific measures included in policy option 2 and 3. A summary table (Table 12) provides an overview of the different delivery mechanisms for option 2, 3 and 4. At the end of the session, the intervention logic is presented.

Description of policy option 2

The specific measures included in policy option 2 are described below and listed by specific objective. Table 10 below provides an overview of all measures and the main actors responsible for delivery.

More effective national research systems:

Member States are invited to:

- Introduce or enhance competitive funding through calls for proposals and institutional assessments as the main modes of allocating public funds to research and innovation, introducing legislative reforms if necessary
- Ensure that all public bodies responsible for allocating research funds apply the core principles of international peer review

The Commission will:

- Support through the Smart Specialisation Platform Member States and regions in using Structural Funds to develop research capacity and smart specialisation strategies, including support to joint research programmes, in line with Cohesion Policy objectives
- Support mutual learning and the exchange of good practice between Member States on the removal of national legal and other barriers to ERA for the priorities set out in this Communication
- Support ERA Chairs aimed at fostering structural change in institutions to raise their research quality to international levels of excellence

Optimal transnational co-operation and competition

Member States are invited to:

- Step up efforts to implement joint research agendas addressing grand challenges, sharing information about activities in agreed priority areas, ensuring that adequate national funding is committed and strategically aligned at European level in these areas and that common ex post evaluation is conducted
- Ensure mutual recognition of evaluations that conform to international peer-review standards as a basis for national funding decisions

- Remove legal and other barriers to the cross-border interoperability of national programmes to permit joint financing of actions including cooperation with non-EU countries where relevant

- Confirm financial commitments for the construction and operation of ESFRI, global, national and regional RIs of pan-European interest, particularly when developing national roadmaps and the next Structural Fund programmes

- Remove legal and other barriers to cross-border access to RIs

Research stakeholder organisations are invited to:

- Agree on common funding principles - eligible costs, reporting requirements, etc. to make national research programmes compatible, interoperable (cross-border) and simpler for researchers

- Pilot the use of synchronised calls with, where possible, single joint international peer review evaluation of proposals as a basis for funding decisions

- Further develop and deploy the Lead-Agency, Money-Follows-Cooperation Line, Money-Follows-Researcher and other models for cross-border cooperation

The Commission will:

- Pursue, stimulate and participate in Public-Public Partnerships to address grand challenges as set out in the Communication on Partnering in Research and Innovation[137] to co-ordinate and leverage Member States' contributions and ensure close coordination with relevant activities under Horizon 2020

- On the basis of the information supplied by Member States, map activities in agreed priority areas, with a view to identifying strengths, weaknesses, gaps and duplications

- Support Member States and research funding organisations in implementing joint international peer review evaluations and setting common funding standards - e.g. through an ERA Mark label recognising best practice in cross-border research operations

- Support through Horizon 2020 access to RIs as well as the on-going overall integration of EU RIs particularly those awarded ERIC status

- Encourage Member States to link RI roadmaps to the ESFRI roadmap and smart specialisation strategies in Structural Funds co-financed research and innovation programmes, reinforcing the capacity of less favoured regions to host and participate in RIs of pan-European and international interest

- Support training programmes for the management of such RIs

[137] COM(2011)572

- Develop in cooperation with ESFRI, e-IRG and other stakeholders a Charter of Access setting out common standards and harmonized access rules and conditions for the use of RIs

- Work with ESFRI to set priorities for implementing the Roadmap and to provide advice and guidance to Member States on overcoming legal, financial or technical obstacles to implementation

- Define with ESFRI, e-IRG and other stakeholders common evaluation principles, impact-assessment criteria and monitoring tools which can be applied in regional, national and European programmes to help combine funds from different sources

- Work with e-IRG to promote the alignment of EU and national approaches to eRI development and use

An open labour market for researchers

Member States are invited to:

- Remove legal and other barriers to the application of open, transparent and merit based recruitment of researchers

- Remove legal and other barriers which hamper cross-border access to and portability of national grants

- Support a national body to implement the Declaration of Commitment to provide coordinated personalised information and services to researchers through the pan-European EURAXES network

- Support the setting up and running of structured innovative doctoral training programmes applying the Principles for Innovative Doctoral Training

- Create an enabling framework for the implementation of the HR Strategy for Researchers incorporating the Charter & Code

Research stakeholder organisations are invited to:

- Advertise all vacancies on the EURAXESS Jobs portal using the common profiles established in the European Framework for Research Careers

- Fill research positions according to open, transparent and merit based recruitment procedures proportionate to the level of the position in line with the basic principles of the Charter & Code and including non-EU nationals

- Develop strategies to support the career development of researchers in line with the HR Strategy for Researchers

- Define and implement principles for accessibility to and portability of national grants

- Provide structured doctoral training based on the Principles for Innovative Doctoral Training

- Develop and implement structured programmes to increase mobility between industry and academia

The Commission will:

- Bridge information gaps to foster mobility and research career development by assessing and strengthening collaboration and coordination in the EURAXESS network for researchers to have direct access to personalised assistance, making it the means of accessing tailor-made assistance

- Support the setting up of a European Accreditation Mechanism for Charter & Code-based human resources management in universities and publicly-funded research institutions

- Support the work of a 'pathfinder group' of countries for the achievement of automatic recognition of comparable degrees

- Take initiatives to address social security barriers for researchers in the EU and further facilitate the entry and stay of third country national researchers by:

    - Clarifying in a Communication EU rules on coordination of social security schemes for groups of workers with a high level of intra-EU mobility, including researchers

    - Resuming work on a pension portability Directive setting minimum standards for the acquisition and preservation of supplementary pension rights

    - Supporting stakeholders in setting up pan-European supplementary pension fund(s) for researchers

    - Reviewing Directive 2005/71/EC on a specific procedure for admitting third country nationals for the purposes of scientific research.

Gender equality and gender mainstreaming in research

Member States are invited to:

- Create a legal and policy environment and provide incentives to:

    - remove legal and other barriers to the recruitment, retention and career progression of female researchers while fully complying with EU law on gender equality

    - address gender imbalances in decision making processes

    - strengthen the gender dimension in research programmes

- Engage in partnerships with funding agencies, research organisations and universities to foster cultural and institutional change on gender - charters, performance agreements, awards

- Ensure that at least 40% of the under-represented sex participate in committees involved in recruitment/career progression and in establishing and evaluating research programmes

Research stakeholder organisations are invited to:

- Implement institutional change relating to HR management, funding, decision-making and research programmes through Gender Equality Plans which aim to:
    - Conduct impact assessment / audits of procedures and practices to identify gender bias
    - Implement innovative strategies to correct any bias
    - Set targets and monitor progress via indicators

The Commission will:

- Foster gender equality and the integration of a gender dimension in Horizon 2020 programmes and projects from inception, through implementation to evaluation, including through the use of incentives
- Propose in 2013 a Recommendation to Member States with common guidelines on institutional change to promote gender equality in universities and research institutions and dedicate specific funds to reinforce collaboration between Member States

Optimal circulation, access to and transfer of scientific knowledge

Member States are invited to:

- Define and coordinate their policies on access to and preservation of scientific information
- Ensure that public research contributes to Open Innovation and foster knowledge transfer between public and private sectors through national knowledge transfer strategies
- Harmonise access and usage policies for research and education-related public e-infrastructures and for associated digital research services enabling consortia of different types of public and private partners
- Adopt and implement national strategies for electronic identity for researchers giving them transnational access to digital research services

Research stakeholder organisations are invited to:

- Adopt and implement open access measures for publications and data resulting from publicly funded research
- Implement and promote the uptake of electronic identity and digital research services

- Ensure optimal interaction and linkages and strategic partnering between academia and industry and define joint collaborative research agendas to maximize the use of research results

- Improve recognition and professionalization of knowledge transfer activities and strengthen the role of knowledge transfer offices

The Commission will:

- Establish open access to scientific publications as a general principle for all EU funded projects in Horizon 2020. For research data, develop a flexible approach that takes into account different scientific areas and business-related interests

- Continue to fund infrastructure projects related to open access

- Adopt a Communication and Recommendation to Member States on access to and preservation of scientific information in the digital age

- Propose a roadmap for e-infrastructure development to support e-Science through open access to research tools and resources

- Support activities to raise stakeholder awareness of open access and e-Science

- Promote knowledge transfer activities in Europe through networking of innovative university-business platforms, including bottom up, practitioner-led initiatives, and sectoral knowledge transfer offices

- Work with stakeholders to develop a set of model consortium agreements to enhance knowledge transfer

- Facilitate a Member State forum for regular exchange and reporting on national developments on the provision, take-up and use of digital research services

Table 10 below provides an overview of the measures and the main actors responsible for delivery.

Table 10: Overview of measures included in policy option 2 and main actors responsible for delivery (MS: Member States, SHO: stakeholder organisations; EC: European Commission**)**

	Main actors responsible for delivery		
Measures	**MS**	**SHO**	**EC**
More effective national research systems			
Introduce or enhance competitive funding through calls for proposals and institutional assessments as the main modes of allocating public funds to research and innovation, introducing legislative reforms if necessary	x		
Ensure that all public bodies responsible for allocating research funds apply the core principles of international peer review	x		
Support through the Smart Specialisation Platform Member States and regions in using Structural Funds to develop research capacity and smart specialisation strategies, including support to joint research programmes, in line with Cohesion Policy objectives	x		x
Support mutual learning and the exchange of good practice between Member States on the removal of national legal and other barriers to ERA for the priorities set out in this Communication	x		x
Support ERA Chairs aimed at fostering structural change in institutions to raise their research quality to international levels of excellence			x
Optimal transnational co-operation and competition			
Step up efforts to implement joint research agendas addressing grand challenges, sharing information about activities in agreed priority areas, ensuring that adequate national funding is committed and strategically aligned at European level in these areas and that common ex post evaluation is conducted	x		
Ensure mutual recognition of evaluations that conform to international peer-review standards as a basis for national funding decisions	x		
Remove legal and other barriers to the cross-border interoperability of national programmes to permit joint financing of actions including cooperation with non-EU countries where relevant	x		

	Main actors responsible for delivery		
Measures	**MS**	**SHO**	**EC**
Confirm financial commitments for the construction and operation of ESFRI, global, national and regional RIs of pan-European interest, particularly when developing national roadmaps and the next Structural Fund programmes	x		
Remove legal and other barriers to cross-border access to RIs	x		
Agree on common funding principles - eligible costs, reporting requirements, etc. to make national research programmes compatible, interoperable (cross-border) and simpler for researchers	x	x	
Pilot the use of synchronised calls with, where possible, single joint international peer review evaluation of proposals as a basis for funding decisions		x	
Further develop and deploy the Lead-Agency, Money-Follows-Cooperation Line, Money-Follows-Researcher and other models for cross-border cooperation		x	
Pursue, stimulate and participate in Public-Public Partnerships to address grand challenges as set out in the Communication on Partnering in Research and Innovation to co-ordinate and leverage Member States' contributions and ensure close coordination with relevant activities under Horizon 2020	x	x	x
On the basis of the information supplied by Member States, map activities in agreed priority areas, with a view to identifying strengths, weaknesses, gaps and duplications	x		x
Support Member States and research funding organisations in implementing joint international peer review evaluations and setting common funding standards - e.g. through an ERA Mark label recognising best practice in cross-border research operations	x		x
Support through Horizon 2020 access to RIs as well as the on-going overall integration of EU RIs particularly those awarded ERIC status	x		x
Encourage Member States to link RI roadmaps to the ESFRI roadmap and smart specialisation strategies in Structural Funds co-financed research and innovation programmes, reinforcing the capacity of less favoured regions to host and participate in RIs of pan-European and international interest	x		x

	Main actors responsible for delivery		
Measures	**MS**	**SHO**	**EC**
Support training programmes for the management of such RIs	x		x
Develop in cooperation with ESFRI, e-IRG and other stakeholders a Charter of Access setting out common standards and harmonized access rules and conditions for the use of RIs			x
Work with ESFRI to set priorities for implementing the Roadmap and to provide advice and guidance to Member States on overcoming legal, financial or technical obstacles to implementation	x		x
Define with ESFRI, e-IRG and other stakeholders common evaluation principles, impact-assessment criteria and monitoring tools which can be applied in regional, national and European programmes to help combine funds from different sources	x		x
Work with e-IRG to promote the alignment of EU and national approaches to eRI development and use	x		x
An open labour market for researchers			
Remove legal and other barriers to the application of open, transparent and merit based recruitment of researchers	x		
Remove legal and other barriers which hamper cross-border access to and portability of national grants	x		
Support a national body to implement the Declaration of Commitment to provide coordinated personalised information and services to researchers through the pan-European EURAXESS network	x		x
Support the setting up and running of structured innovative doctoral training programmes applying the Principles for Innovative Doctoral Training	x		
Create an enabling framework for the implementation of the HR Strategy for Researchers incorporating the Charter & Code	x		
Advertise all vacancies on the EURAXESS Jobs portal using the common profiles established in the European Framework for Research Careers		x	x

	Main actors responsible for delivery		
Measures	**MS**	**SHO**	**EC**
Fill research positions according to open, transparent and merit based recruitment procedures proportionate to the level of the position in line with the basic principles of the Charter & Code and including non-EU nationals		x	
Develop strategies to support the career development of researchers in line with the HR Strategy for Researchers		x	
Define and implement principles for accessibility to and portability of national grants		x	
Provide structured doctoral training based on the Principles for Innovative Doctoral Training		x	
Develop and implement structured programmes to increase mobility between industry and academia		x	
Bridge information gaps to foster mobility and research career development by assessing and strengthening collaboration and coordination in the EURAXESS network for researchers to have direct access to personalised assistance, making it the means of accessing tailor-made assistance	x		x
Support the setting up of a European Accreditation Mechanism for Charter & Code-based human resources management in universities and publicly-funded research institutions	x	x	x
Support the work of a 'pathfinder group' of countries for the achievement of automatic recognition of comparable degrees	x		x
Take initiatives to address social security barriers for researchers in the EU and further facilitate the entry and stay of third country national researchers by: – Clarifying in a Communication EU rules on coordination of social security schemes for groups of workers with a high level of intra-EU mobility, including researchers – Resuming work on a pension portability Directive setting minimum standards for the acquisition and preservation of supplementary pension rights – Supporting stakeholders in setting up pan-European supplementary pension fund(s) for researcher			x

	Main actors responsible for delivery		
Measures	**MS**	**SHO**	**EC**
– Reviewing Directive 2005/71/EC on a specific procedure for admitting third country nationals for the purposes of scientific research			
Gender equality and gender mainstreaming in research			
Create the appropriate legal and policy environment and provide incentives in order to: – remove legal and other barriers to the recruitment, retention and career progression of female researchers while fully complying with EU law on gender equality – address gender imbalances in decision making processes – strengthen the gender dimension in research programmes	x		
Engage in partnerships with funding agencies, research organisations and universities to foster cultural and institutional change on gender - charters, performance agreements, awards	x		
Ensure that at least 40% of the under-represented sex participate in committees involved in recruitment/career progression and in establishing and evaluating research programmes	x		
Implement institutional change relating to HR management, funding, decision-making and research programmes through Gender Equality Plans which aim to: – Conduct impact assessment / audits of procedures and practices to identify gender bias – Implement innovative strategies to correct any bias – Set targets and monitor progress via indicators		x	
Foster gender equality and the integration of a gender dimension in Horizon 2020 programmes and projects from inception, through implementation to evaluation, including through the use of incentives			x

	Main actors responsible for delivery		
Measures	**MS**	**SHO**	**EC**
Propose in 2013 a Recommendation to Member States with common guidelines on institutional change to promote gender equality in universities and research institutions and dedicate specific funds to reinforce collaboration between Member States			x
Optimal circulation, access to and transfer of scientific knowledge			
Define and coordinate their policies on access to and preservation of scientific information	x		
Ensure that public research contributes to Open Innovation and foster knowledge transfer between public and private sectors through national knowledge transfer strategies	x		
Harmonise access and usage policies for research and education-related public e-infrastructures and for associated digital research services enabling consortia of different types of public and private partners	x		
Adopt and implement national strategies for electronic identity for researchers giving them transnational access to digital research services	x		
Adopt and implement open access measures for publications and data resulting from publicly funded research		x	
Implement and promote the uptake of electronic identity and digital research services	X	x	
Ensure optimal interaction and linkages and strategic partnering between academia and industry and define joint collaborative research agendas to maximize the use of research results		x	
Improve recognition and professionalization of knowledge transfer activities and strengthen the role of knowledge transfer offices		x	
Establish open access to scientific publications as a general principle for all EU funded projects in Horizon 2020. For research data, develop a flexible approach that takes into account different scientific areas and business-related interests			x
Continue to fund infrastructure projects related to open access			x

	Main actors responsible for delivery		
Measures	**MS**	**SHO**	**EC**
Adopt a Communication and Recommendation to Member States on access to and preservation of scientific information in the digital age	X		x
Propose a roadmap for e-infrastructure development to support e-Science through open access to research tools and resources	x		x
Support activities to raise stakeholder awareness of open access and e-Science		x	x
Promote knowledge transfer activities in Europe through networking of innovative university-business platforms, including bottom up, practitioner-led initiatives, and sectoral knowledge transfer offices		x	x
Work with stakeholders to develop a set of model consortium agreements to enhance knowledge transfer		x	x
Facilitate a Member State forum for regular exchange and reporting on national developments on the provision, take-up and use of digital research services	x		x

Description of policy option 3

Table 11 below provides the list of measures included in policy option 3 and the nature of obligation imposed on Member States and stakeholder organisations (i.e. legal vs. voluntary).

Table 11: Summary of measures included in policy option 3 (MS: Member States, SHO: stakeholder organisations; EC: European Commission)

Measures	Legally binding on MS	Voluntary measures on MS and/or SHO	EC
More effective national research systems			
Removal of barriers to competitive funding allocation		x	
International peer review evaluation for national funding decisions	x		
Optimal transnational co-operation and competition			
Common principles for cross-border operations	x		
Organisation of and support to joint calls using common international peer review evaluation (incl. within Joint Programming)		x	x
Removal of barriers to cross-border access to national research infrastructures of European interest		x	
Launch of the "ERA Mark" label for best practice in cross-border research operations			x
Extend the mandate of ESFRI for implementation and prioritisation of ESFRI Roadmap projects		x	
Develop an ESFRI "Charter for Access" on principles for access to research infrastructures		x	x
Common principles and procedures for the setting up and management of pan-European research infrastructures	x		
Common principles for the monitoring, evaluation and impact assessment of research infrastructures and funding decisions	x		
An open labour market for researchers			
Common principles on open, transparent and merit-based recruitment of researchers	x		

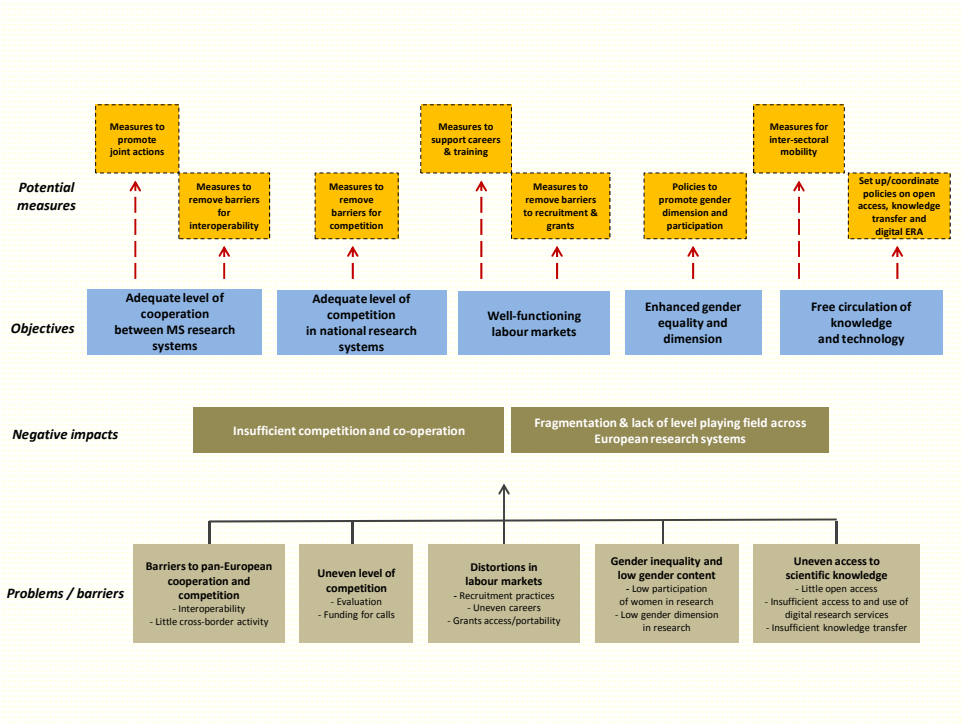
Measures	Legally binding on MS	Voluntary measures on MS and/or SHO	EC
Common principles for portability of grants and for access to national grants	x		
Institutional strategies for the career development of researchers		x	
Implementation of frameworks and strategies on innovative doctoral training		x	
Advertisement of vacancies and provision of information on national single points/Euraxess		x	x
Accreditation mechanisms for the Charter and Code			x
Adoption of relevant support measures (e.g. Communication on social security) and amendments to key EU legislation (e.g. Directive 2005/71/EC)	x	x	x
Gender equality and gender mainstreaming in research			
Integrate gender dimension into publicly funded research programmes (both upstream and downstream)	x	x	
Support to and implementation of gender action plans		x	
Recommendation on guidelines on institutional changes in universities and other research institutions (foreseen in 2013)			x
Optimal circulation, access to and transfer of scientific knowledge			
Open access to all publicly-funded scientific publications as well as for research data, when relevant	x	x	x
Specific identity provision and federation approach for researchers and scholars	x	x	
Measures for the use of publicly funded research infrastructures for research consortia with private and industrial research organisation partners	x		
Communication and Recommendation to the Council on access to and preservation of scientific information in the digital age			x

Table 12: Summary table of delivery mechanisms for policy option 2, 3 and 4

Specific objective	Operational objective for 2014	Policy Option 2	Policy Option 3	Policy Option 4
More effective national research systems	Barriers to competition removed	Communication and Specific Commitments		Framework Directive
	Barriers to use of using international peer review evaluation in national research systems are removed	Communication and Specific Commitments	Legislation	
Optimal transnational co-operation and competition	Barriers to compatibility and interoperability between national research programmes are removed	Communication and Specific Commitments	Legislation	
	Barriers to access to pan-European research infrastructures by the user community are removed	Communication and Specific Commitments		
	One pilot cross-border synchronised research call, notably on grand challenges, launched using international peer review evaluation and a single pan-European score	Communication and Specific Commitments		
	Harmonised monitoring, evaluation and impact assessment principles and procedures for pan-European research infrastructures adopted and implemented	Communication and Specific Commitments	Legislation	
An open labour market for researchers	Barriers open, transparent and merit based recruitment in public research systems, cross-border portability and accessibility of national grants are removed	Communication and Specific Commitments	Legislation	
	Frameworks supporting the career development of researchers and innovative doctoral training	Communication and Specific Commitments		
Gender equality and gender mainstreaming in research	Barriers to gender equality and the gender dimension in research removed	Communication and Specific Commitments		
Optimal circulation, access to and transfer of scientific knowledge	Policies and means for facilitating online access to publicly-funded scientific publications and data are defined and coordinated Policies to foster knowledge transfer, cross-border sharing of e-infrastructure and take up of digital services for research are defined Electronic identity services for researchers enabling transnational access to digital services (collaboration, computing, scientific information) are implemented or planned	Communication and Specific Commitments	Legislation	

The figure below presents the drivers and problems to complete ERA by 2014.

Figure 8: Problem tree for completing ERA



Annex 7: Possible indicators to be used for monitoring ERA progress

The table below presents for each of the actions proposed to be undertaken by Member States and stakeholders one or more indicators that could be used to measure progress in completing ERA. The final decision on the indicators to be retained will be drawn after comparing the value-as-indicator for reporting progress with the costs and feasibility of data collection. The level of collection (Member States or stakeholders) is indicated between brackets for each indicator.

Specific objective in ERA	Action	Progress indicator
Increased effectiveness of national systems	Introduce or enhance competitive funding through calls for proposals and institutional assessments as the main modes of allocating public funds to research and innovation, introducing legislative reforms if necessary	Share of national GBAORD allocated as project-based funding (Member States)
		Share of institutional funding allocated on a competitive basis (Member States)
	Ensure that all public bodies responsible for allocating research funds apply the core principles of international peer review	Share of institutions applying the core principles for international peer review (stakeholder organisations)
Optimal levels of transnational co-operation and competition	Step up efforts to implement joint research agendas addressing grand challenges, sharing information about activities in agreed priority areas, ensuring that adequate national funding is committed and strategically aligned at European level in these areas and that common ex post evaluation is conducted	Assessment of the implementation of joint research agendas addressing grand challenges (Member States)
		Share of national GBAORD allocated to transnationally coordinated research based on common priorities (Member States)
	Ensure mutual recognition of evaluations that conform to international peer-review standards as a basis for national funding decisions	Assessment of the implementation of mutual recognition of evaluations that conform to international peer-review standards as a basis for national funding decisions (Member States)
		Share of institutions applying international peer review standards (stakeholder organisations)
		Share of institutions mutually recognizing international peer review standards (stakeholder organisations)
	Remove legal and other barriers to the cross-border interoperability of national programmes to permit joint	Assessment of the degree of implementation of specific policies to facilitate cross-border

	financing of actions including cooperation with non-EU countries where relevant	interoperability of national programmes (Member States)
	Agree on common funding principles - eligible costs, reporting requirements, etc. to make national research programmes compatible, interoperable (cross-border) and simpler for researchers	Share of institutions implementing policies to facilitate cross-border interoperability of national programmes (stakeholder organisations)
	Pilot the use of synchronised calls with, where possible, single joint international peer review evaluation of proposals as a basis for funding decisions	Number of synchronised calls evaluated through a single joint international peer review (stakeholder organisations)
	Further develop and deploy the Lead-Agency, Money-Follows-Cooperation Line, Money-Follows-Researcher and other models for cross-border cooperation	Share of budget allocated to transnational funding, specified by model: Lead-Agency, Money-Follows-Cooperation and Money-Follows-Researcher and other models (stakeholder organisations)
	Confirm financial commitments for the construction and operation of ESFRI, global, national and regional RIs of pan-European interest, particularly when developing national roadmaps and the next Structural Fund programmes	Rate of financial commitments to the implementation (construction and operation) of the ESFRI Roadmap and to other global research infrastructures of pan-European interest (Member States)
	Remove legal and other barriers to cross-border access to Research Infrastructures	Share of non-national researchers (from Member States, Associated Countries and Third Countries) accessing RI of European Interest (Member States)
A more open labour market for researchers	Remove legal and other barriers to the application of open, transparent and merit based recruitment of researchers	Assessment of the degree of implementation of policies and measures on open, transparent and merit-based recruitment (Member States)
		Share of researchers who feel that recruitment procedures are transparent, merit-based and open (Member States)
	Remove legal and other barriers which hamper cross-border access to and portability of national grants	Assessment of degree of implementation of policies and measures to ensure grant portability/accessibility of national programmes (Member States)
	Support a national body to	Number of Member States with

implement the Declaration of Commitment to provide coordinated personalised information and services to researchers through the pan-European EURAXES network	single access points providing coordinated information and services for mobile researchers (information on vacancies, social rights, tailored information, etc.)
Support the setting up and running of structured innovative doctoral training programmes applying the Principles for Innovative Doctoral Training	Assessment of the degree of implementation (including financial commitment) of policies and measures supporting structured innovative doctoral training programmes applying the "Principles for Innovative Doctoral Training" (Member States)
Create an enabling framework for the implementation of the Human Resources Strategy for Researchers incorporating the Charter & Code	Assessment of the degree of implementation (including financial commitment) of policies and measures supporting an enabling framework for the implementation of the "HR Strategy for Researchers" (Member States)
Advertise all vacancies on the EURAXESS Jobs portal using the common profiles established in the European Framework for Research Careers	Share of total vacancies published on Euraxess Jobs Portal (stakeholder organisations)
Fill research positions according to open, transparent and merit based recruitment procedures proportionate to the level of the position in line with the basic principles of the Charter & Code and including non-EU nationals	Share of researcher´s positions in European universities and public research performing organisations filled through open, transparent and merit-based recruitment in line with the Charter and Code principles (stakeholder organisations)
	Share of non-national researchers (stakeholder organisations)
Develop strategies to support the career development of researchers in line with the HR Strategy for Researchers	Share of institutions developing or implementing human resources strategies or researchers in line with the Charter and Code principles (stakeholder organisations)
Define and implement principles for accessibility to and portability of national grants	Share of identified grants which are portable across borders (stakeholder organisations)
	Share of national grants which are accessible to non-residents (stakeholder organisations)

	Provide structured doctoral training based on the Principles for Innovative Doctoral Training	Share of stakeholder organisations implementing doctoral training programmes linking public and private sectors (stakeholder organisations)
		Share of PhD candidates participating in innovative doctoral training (stakeholder organisations)
	Develop and implement structured programmes to increase mobility between industry and academia	Share of institutions implementing mobility programmes between industry and academia (stakeholder organisations)
		Share of staff participating in mobility programmes between industry and academia (stakeholder organisations)
Gender equality and gender mainstreaming in research	Create a legal and policy environment and provide incentives in order to: – remove legal and other barriers to the recruitment, retention and career progression of female researchers while fully complying with EU law on gender equality – address gender imbalances in decision making processes – strengthen the gender dimension in research programmes	Share of female PHD graduates, researchers, senior level in academic position and in top positions (Member States)
		Assessment of adoption and degree of implementation of any legal and /or policy initiative as well as of incentives, in any of the three areas (Member States)
	Engage in partnerships with funding agencies, research organisations and universities to foster cultural and institutional change on gender - charters, performance agreements, awards	Share of institutions engaged in the partnerships and rate of financial commitment (Member States)
	Ensure that at least 40% of the under-represented sex participate in committees involved in recruitment/career progression and in establishing and evaluating research programmes	Share of under-represented sex participating in committees (Member States)
	Implement institutional change relating to HR management, funding, decision-making and research programmes through Gender Equality Plans which aim to: – Conduct impact assessment / audits of procedures and practices to	Share of female PhD graduates, researchers, senior level in academic position and in top positions (stakeholder organisations)
		Share of institutions which have adopted and implement Gender Equality Plans (stakeholder

	identify gender bias – Implement innovative strategies to correct any bias – Set targets and monitor progress via indicators	organisations)
Optimal circulation, access to and transfer of scientific knowledge	Define and coordinate their policies on access to and preservation of scientific information	Share of Member States implementing OA policies and assessment of the degree of implementation of OA policies (Member States)
	Ensure that public research contributes to Open Innovation and foster knowledge transfer between public and private sectors through national knowledge transfer strategies	Assessment of the degree of implementation of policies to support the contribution of public research to open innovation and public-private mobility (Member States)
	Harmonise access and usage policies for research and education-related public e-infrastructures and for associated digital research services enabling consortia of different types of public and private partners	Share of MS implementing jointly developed access and usage policies for public e-infrastructures (Member States)
	Adopt and implement national strategies for electronic identity for researchers giving them transnational access to digital research services	Assessment of the degree of development of MS strategies for realising digital ERA in identification services, provision of digital research services and human resources factors for supporting digital science (eScience) approaches (Member States)
	Adopt and implement open access measures for publications and data resulting from publicly funded research	Share of scientific publications and research data in OA amongst stakeholder organisations (stakeholder organisations)
	Implement and promote the uptake of electronic identity and digital research services	Share of research organisations providing electronic identification and authorisation service (stakeholder organisations)
		Share of research organisations providing research services that can be accessed online with federated researcher e-identity (stakeholder organisations)
	Ensure optimal interaction and linkages and strategic partnering between academia and industry and define joint collaborative research	Percentage of researchers in public research organisations with experience in the private sector (stakeholder

	agendas to maximize the use of research results	organisations)
		Share of doctorate holders employed in business enterprise sector (Member States)
		Rate of growth of the number of Academia-Industry research training contracts signed (stakeholder organisations)
		Rate of growth of academia held patents licensed or sold to industry (stakeholder organisations)
		Share of professors whose primary occupation is not in Higher education institutions and or research performing organisations (stakeholder organisations)
	Improve recognition and professionalization of knowledge transfer activities and strengthen the role of knowledge transfer offices	Number of research organisations having a dedicated knowledge transfer office (stakeholder organisations)
		Share of permanent staff (by category) employed in knowledge transfer offices (stakeholder organisations)

Annex 8: Glossary and acronyms

Applied research: Original investigation undertaken in order to acquire new knowledge. Contrary to *basic research*, it is directed primarily towards a specific practical aim. The results of applied research are intended to be valid for a single or limited number of products etc. The knowledge or information derived from it is often patented but may also be kept secret.

Basic research: Experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts, without any particular application or use in view (contrary to *applied research)*. The results of basic research are not generally sold but are usually published in scientific journals. Basic research can be split into two categories: 1) Pure basic research which is carried out for the advancement of knowledge, with no positive efforts being made to apply the results to practical problems. 2) Oriented basic research which is carried out with the expectation that it will produce a broad base of knowledge likely to form the background to the solution of recognised or expected current or future problems or possibilities.

BRIC-countries: Brazil, Russia, India and China.

Business Europe: Its main task is to ensure that companies' interests are represented and defended vis-à-vis the European institutions with the principal aim of preserving and strengthening corporate competitiveness. Through its 41 member federations, Business Europe represents 20 million companies from 35 countries.

The European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers (Charter and Code): The European Charter for Researchers and Code of Conduct for the Recruitment of Researchers were adopted by the European Commission as a Recommendation to the Member States. The 'Charter & Code' address researchers as well as employers and funders in both the public and private sectors. The Charter provides a framework for the career management of researchers, while the Code promotes open and transparent recruitment and appraisal procedures. Together they are aimed at developing an attractive, open and sustainable European labour market for researchers.

Code of Conduct for the Recruitment of Researchers: It aims to improve recruitment, to make selection procedures fairer and more transparent and proposes different means of judging merit: Merit should not just be measured on the number of publications but on a wider range of evaluation criteria, such as teaching, supervision, teamwork, knowledge transfer, management and public awareness activities.

Cohesion Policy: Also known as Regional Policy of the European Union, is a policy with the stated aim of improving the economic well-being of regions in the EU and also to avoid regional disparities. More than one third of the EU's budget is devoted to this policy, which aims to remove economic, social and territorial disparities across the EU, restructure declining industrial areas and diversify rural areas which have declining agriculture.

Collaborative Projects: Support to Framework Programme funded research projects carried out by consortia with participants from different countries. The size, scope and internal organisation of projects can vary from field to field and from topic to topic. Projects can range from small or medium-scale focused research actions to larger integrating projects which mobilise a significant volume or resources for achieving a defined objective.

CREST: The Scientific and Technical Research Committee (CREST), composed of representatives of Member States, is a high level advisory board to the Commission and the Council in the field of RTD. **(see ERAC)**

DEUFRAKO: DEUFRAKO is a bilateral Franco-German scientific and technical research programme, set up in 1978 as a consequence of the EU deregulation initiative. The intention was primarily to advance the planning and implementation of modern guided surface transport systems and more particularly high-speed rail. Both Germany and France are obligatory points of passage for north-south and east-west traffic, are served by very active and extensive networks. Their railway industries are among the most dynamic in the world and they are pioneers in the development of innovative rail technology. If the two systems are to be compatible, certain research activities need to be pursued together. Such co-operation is all the more necessary nowadays to develop a high-speed network throughout Europe.

DEMETER: This EU-funded project entitled aims to develop a well-validated European coupled multi-model ensemble forecast system for reliable seasonal to inter-annual prediction. A fundamental aspect is to establish the practical utility of such a system, particularly to the agriculture and health sectors.

ERAC (European Research Area Committee, formerly CREST): is a strategic policy advisory body whose function is to assist the European Commission and the Council of the European Union in performing the tasks incumbent on these Institutions in the sphere of research and technological development.

ERA-NET: The principal means for the FP to support the co-ordination of national and regional research programmes.

ERA Pacts: voluntary agreements between research funding and performing organisations and the Commission. The partnership principle would be at the core of the ERA pacts. The pacts consist of priority 'big tickets' actions involving both the collective engagement of key stakeholders to implement ERA, and increased Member States action. The pacts would assert the firm commitment of the partners to undertake a set of actions to promote ERA such as joint transnational coordinated bottom-up and top-down calls and research agendas, transnational peer reviewed evaluation systems, co-operation with third countries, open recruitment, mobility, gender action plans, access to information, etc. Each ERA pact would include a roadmap with milestones.

EU-12: The 12 countries that joined the EU since 2004 (Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia).

EU-15: Before 1 May 2004, the European Union consisted of 15 Member States (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and United Kingdom).

EURAXESS: assists researchers in advancing their careers in Europe and supports research organisations in their search for outstanding research talent. EURAXESS is a pan-European initiative, supported by thirty-seven participating countries. It provides a single access point to information from all countries including a network of walk-in centres offering personalised assistance to researchers moving to another country.

Europe 2020: Europe 2020 is the EU's growth strategy for the coming decade. Concretely, the Union has set five ambitious objectives - on employment, innovation, education, social inclusion and climate/energy - to be reached by 2020.

European Added Value: EU support to research and innovation is provided only when it can be more effective than national funding. It does this through measures to coordinate national funding, and through implementing collaborative research and mobility actions.

European Association of Research Technology Organisations (EARTO): is a non-profit international association aiming to achieve a European research and innovation system without border in which Research and Technology Organisations (RTOs) occupy nodal positions and posse the necessary resources and independence to contribute to a competitive European economy and high quality of the life through beneficial cooperation with all stakeholders.

European Partnership for Researchers (EPR): aims at creating a framework for joint priority actions for different Member States concerning the systematic opening up of recruitment, pensions and social security for mobile researchers, attractive employment and working conditions and improving training and skills.

European Research Area (ERA): A general concept proposed by the Commission and endorsed by the European Parliament and Council in 2001 to overcome the fragmentation of European research and innovation efforts. The concept comprises organising co-operation at different levels, co-ordinating national or European policies, networking teams and increasing the mobility of individuals and ideas.

European Research Area Network (ERA-NET): The objective of the ERA-NET scheme is to step up the cooperation and coordination of research activities carried out at national or regional level in the Member States and Associated States through the networking of research activities conducted at national or regional level, and the mutual opening of national and regional research programmes. The scheme will contribute to making a reality of the European Research Area by improving the coherence and coordination across Europe of such research programmes. The scheme will also enable national systems to take on tasks collectively that they would not have been able to tackle independently

European Research Council (ERC): Introduced in FP7, it will be the first pan-European funding agency for frontier research. Early stage as well as fully established investigators from across Europe will be able to compete for grants with scientific excellence as the sole criterion for funding. The independent Scientific Council will direct the ERC's scientific operations and ensure that its support is in accordance with the highest standards of science and scholarship.

European Space Agency (ESA): Established in 1975, ESA is an inter-governmental organisation dedicated to the exploration of space, with 17 Member States. Its mission is to shape the development of Europe's space capability. By coordinating the financial and intellectual resources of its members, it can undertake programmes and activities far beyond the scope of any single European country.

Framework Programme (FP): Since 1984, research and innovation activities of the EU are grouped in one big multiannual programme, the Framework Programme for Research and Technical Development. While FP1 to FP6 were conceived for a period of 4 years, FP7 is synchronised with the duration of the EU's financial perspective and covers the period 2007-

2013. The FPs are elaborated and proposed by the Commission and have to be adopted by the European Parliament and the Council in co-decision.

Gender Action Plan (GAP): The GAP intend to provide detailed information on actions to be undertaken - and monitored - to encourage women to apply for recruitment and to ensure that equal opportunities will be promoted in recruitment at all levels, in order to allow women to participate in all project's activities, and encourage women to participate in the management and scientific committees.

Government Budget Appropriations or Outlays on R&D (GBAORD): All appropriations allocated to R&D in central government budgets. Data on government R&D appropriations therefore refer to budget provisions, not to actual expenditure, i.e. GBAORD measures government support for R&D using data collected from budgets.

Grandfathering: Describes a situation in which an old rule continues to apply to some existing situations, while a new rule will apply to all future situations.

Gross domestic expenditure on R&D (GERD): Total intramural expenditure on R&D performed on the national territory during a given period. GERD includes R&D performed within a country and funded from abroad but excludes payments made abroad for R&D.

Gross Domestic Product (GDP): This aggregate represents the result of the production activity of resident producer units. It corresponds to the economy's output of goods and services, less intermediate consumption, plus taxes linked to imports. The sum of the regional values of the GDP at market prices might differ from the national values for some countries.

Horizon 2020 (H2020): Horizon 2020 is the financial instrument implementing the Innovation Union, a Europe 2020 flagship initiative aimed at securing Europe's global competitiveness. Running from 2014 to 2020 with an €80 billion budget, the EU's new programme for research and innovation is part of the drive to create new growth and jobs in Europe.

Inco-Net projects: The purpose of an INCO-NET project is to bring together policy makers and stakeholders of a given region or group of countries with the EU partners to establish a dialogue to identify S&T priorities of mutual benefit and interest, to define cooperation policy orientations together and to implement specific activities to promote and contribute to the participation of the targeted regions or countries in the Framework Programme.

Information and Communication Technologies (ICT): Information and Communication Technologies are critical to improve the competitiveness of European industry and to meet the demands of its society and economy.

Institute for Prospective Technological Studies (IPTS): The Institute for Prospective Technological Studies is one of the seven scientific institutes of the European Commission's Joint Research Centre (JRC)**.** It promotes and enables a better understanding of the links between technology, economy and society. Its mission is to provide customer-driven support to the EU policy-making process by developing science based responses to policy challenges that have both a socio-economic as well as a scientific/ technological dimension.

Intellectual Property Rights (IPR): They cover all aspects of owning, protecting and giving access to knowledge and pre-existing know how.

Joint Research Centre (JRC): As a service of the European Commission, the mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. It functions as a reference centre of science and technology for the Union. The JRC has a network of research institutes in different member countries (Belgium, Germany, Italy, Netherlands, Spain). Its activities are financed by the Framework Programme via the direct actions.

Joint Programming Initiatives (JPI): The overall aim of Joint Programming is to pool national research efforts in order to make better use of Europe's precious public R&D resources and to tackle common European challenges more effectively in a few key areas. It follows a structured strategic process whereby Member States agree common visions and strategic research agendas to address major societal challenges.

Lisbon Treaty: The Treaty of Lisbon entered into force on 1 December 2009. It provides the EU with modern institutions and optimised working methods to tackle both efficiently and effectively today's challenges in today's world

Marie-Curie Actions: The main objective of the FP's Marie Curie Actions is to strengthen training, the career prospects and mobility of European researchers in order to provide support for the development of world-class human resources.

National Reform Programme (NRP): One of the main features of the revised Lisbon strategy is that Member States are encouraged to tailor reforms to their specific needs within the overall framework of the European Partnership for Growth and Jobs. In this context, a new set of Integrated Guidelines was proposed by the Commission and adopted by the European Council in June 2005. Guidelines 7 and 8 in particular highlight the need to increase and improve investment in R&D, in particular by private business and to facilitate all forms of innovation. Member States agreed to prepare National Reform Programmes to set out their plans with reference to the Integrated Guidelines. These programmes were released from mid-October 2005 onwards.

New Econometric Model for Environmental and Sustainable Development and Implementation Strategies (NEMESIS): The NEMESIS-model is a large-scale econometric model at the macro- and sectoral levels, which has been built by a Community funded *consortium* of European research institutes. It comprises roughly 70 000 equations. The model can be used for several purposes, which include the assessment of structural (mainly R&D and environmental) policies, the study of the short- and medium term consequences of a wide range of economic policies, short- and medium-term forecasting (up to 8 years) at the macro- and sectoral levels, and building long-term baseline scenarios (up to 30 years).

Open Access: 'open access' refers to the practice of granting free Internet access to research articles. As all research and innovation builds on earlier achievements, an efficient system for broad dissemination of and access to research publications and raw data can accelerate scientific progress. In August 2008, the European Commission launched the 'Open Access Pilot in the Seventh Framework Programme (FP7)', intended to provide researchers and other interested members of the public with improved online access to EU-funded research results. The pilot aims to permit easy and free access to scientific information, in particular peer-reviewed scientific articles published in journals. Articles covered by the pilot will become accessible after an embargo period of 6 or 12 months, depending on the FP7 area.

Open method of coordination (OMC): A relatively new and intergovernmental means of governance in the EU, based on the voluntary cooperation of Member States. It rests on soft law mechanisms such as guidelines and indicators, benchmarking and sharing of best practice, not on official sanctions for laggards. Rather, the method's effectiveness relies on a form of peer pressure and naming and shaming, as no Member States wants to be seen as the worst in a given policy area.

Organisation for Economic Development and Cooperation (OECD): The OECD is an international economic organisation of 34 countries founded in 1961 to stimulate economic progress and world trade. It is a forum of countries committed to democracy and the market economy, providing a platform to compare policy experiences, seek answers to common problems, identify good practices, and co-ordinate domestic and international policies of its members.

Peer review: The *evaluation* of proposals with the help of independent external experts (peers).

Research and experimental development (R&D): R&D comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society and the use of this stock of knowledge to devise new applications. This term covers three activities: *basic research, applied research* and experimental development.

R&D intensity: Gross Domestic Expenditure on R&D (GERD) expressed as a percentage of Gross Domestic Product (GDP).

Science Europe: Science Europe is an association of European Research Funding Organisations (RFO) and Research Performing Organisations (RPO), based in Brussels.

Small and Medium-Sized Enterprises (SMEs): Enterprises having fewer than 250 employees and with either an annual turnover of no more than ECU 40 million or a balance sheet total of no more than ECU 27 million.

Spillover effect: are externalities of economic activity or processes that affect those who are not directly involved. In this particular case there are two type of spillovers: between sectors (i.e. progress in information and communication technologies have a positive impact in other sectors) and international spillovers (i.e. scientific progress in one country benefits the other countries).

Stakeholder: Any person or organisation with an interest in or affected by EU legislation and policymaking is a 'stakeholder' in that process. The European Commission makes a point of consulting as wide a range of stakeholders as possible before proposing new legislation or new policy initiatives.

Strategic Forum for International S&T Cooperation (SFIC): aims to strengthen the international dimension of the European Research Area (ERA); to improve the framework conditions for international S&T cooperation; and to promote European technologies in the world. It outlines different approaches to cooperation depending on the geographic and thematic targets, and calls for long term commitment of the Member States and the European Community.

Treaty on the Functioning of the European Union (TFEU): The Treaty of Lisbon amends the EU's two core treaties, the Treaty on European Union and the Treaty establishing the European Community. The latter is renamed the Treaty on the Functioning of the European Union.

UNU-MERIT: UNU-MERIT is a research and training centre of United Nations University (UNU) and Maastricht University (UM), based in southeast Netherlands. UNU-MERIT explores the social, political and economic factors that drive technological innovation, with a particular focus on creation, diffusion and access to knowledge.

World Intellectual Property Organisation (WIPO): The World Intellectual Property Organization (WIPO) is a specialized agency of the United Nations. It is dedicated to developing a balanced and accessible international Intellectual Property IP) system, which rewards creativity, stimulates innovation and contributes to economic development while safeguarding the public interest. WIPO was established in 1967 with a mandate from its Member States to promote the protection of IP throughout the world through cooperation among states and in collaboration with other international organizations. Its headquarters are in Geneva, Switzerland.

LIST OF ACRONYMS

AGRI (DG) European Commission Directorate General for Agriculture and Rural Development
BAU Business As Usual
BEPA Bureau of European Policy Adviser
BRIC Brazil, Russia, India and China
CERN European Organisation for Nuclear Research
COMP (DG) Competition
CSF Common Strategic Framework for Research and Innovation
DEVCO (DG) Development and Cooperation
DG Directorate-General
DIR Directorate
EAC (DG) European Commission Directorate General for Education and Culture
EARTO European Association of Research and Technology Organisations
EAV European Added Value
ECFIN (DG) European Commission Directorate General for Economic and Financial Affairs
EFTA European Free Trade Association
EMPL (DG) Employment
ELARG (DG) Enlargement
ENER (DG) European Commission Directorate General for Energy
ENTR (DG) European Commission Directorate General for Entreprise and Industry
ENV (DG) European Commission Directorate General for the Environment
EPR European Partnership for Researchers
ERA European Research Area
ERAC European Research Area Committee
ERA-NET European Research Area Network
ERA-NET EMRP Coordination of the European Metrology Research Programme
ESA European Space Agency
ESF European Science Foundation
ERC European Research Council
ESTAT Statistical Office of the European Union
EU European Union
EUA European University Association
FP Framework Programme for Research and Technological Demonstration
GBAORD Government Budget Appropriations or Outlays for Research and Development
GDP Gross Domestic Product
GO General Objective
GOV Government
GPT General Purpose Technologies
HES Higher Education Sector
HOME (DG) Home Affairs
IAB Impact Assessment Board
IASG Impact Assessment Steering Group
ICT Information and Communication Technologies
INCO International Cooperation
INFSO (DG) Information Society and Media
ISG Inter-Service Group
IPTS Institute for Prospective Technological Studies (DG JRC)
IU Innovation Union
JPI Joint Programming Initiative
JRC (DG) European Commission Joint Research Centre

MARE (DG) Maritime Affairs and Fisheries
MARKT (DG) Internal Market and Services
MOVE (DG) European Commission Directorate General for Mobility and Transport
MS Member States
NRP National Reform Programme (or Plan)
OA Open Access
OECD Organisation for Economic Development and Cooperation
OMC Open Method of Coordination
OpenAire Open Access Infrastructure for Research in Europe
PO Policy Option
PhD Doctor of Philosophy
R&D Research and Development
RFO Research Funding Organisations
RPO Research Performing Organisations
REGIO (DG) European Commission Directorate General for Regional Policy
SANCO (DG) European Commission Directorate General for Health and Consumers
SFIC Strategic Forum for International S&T Cooperation
SG (DG) Secretariat General
SGHRM Steering Group on Human Resources and Mobility
SHO Stakeholder organisations, i.e. research funding and performing organisations
SJ (DG) Service Juridique
SO Specific Objective
S&T Science and Technology
SMART (objectives) Specific, Measurable, Achievable, Realistic and Time
SMEs Small and Medium-sized Enterprises
STI Science Technology and Innovation
TFEU Treaty on the Functioning of the European Union
TRADE (DG) Trade
WIPO World Intellectual Property Organisation

EU COUNTRY KEYS

Austria (AT)
Belgium (BE)
Bulgaria (BG)
Cyprus (CY)
Czech Republic (CZ)
Denmark (DK)
Estonia (EE)
Finland (FI)
France (FR)
Germany (DE)
Greece (EL)
Hungary (HU)
Ireland (IE)
Italy (IT)
Latvia (LV)
Lithuania (LT)
Luxembourg (LU)
Malta (MT)
Netherlands (NL)
Poland (PL)
Portugal (PT)

Romania (RO)
Slovakia (SK)
Slovenia (SI)
Spain (ES)
Sweden (SE)
United Kingdom (UK)
Norway (NO)

Annex 9: Bibliography

Aghion, P., et al (2008), *Higher aspirations: An agenda for reforming European universities*, Breugel Blueprint Series, Bruegel, 2008, URL (accessed 16 April 2012),

http://www.dariobraga.it/web/uploads/doc/BPJULY2008University.pdf

Albarran, P., Crespo, J., Ortuno, I., Ruiz-Castillo, J. (2009), *A comparison of the scientific performance of the US and the EU at the turn of the century,* Working Paper 09-55, Economic Series (34), Universidad Carlos III de Madrid, Departamento de Economía, July 2009, URL *(accessed 24 February 2012),*

http://e-archivo.uc3m.es/bitstream/10016/5212/1/09-55-34.pdf

Amanatidou E. et al (2011), Annual Joint Programming Event 2011, Final report, 9-10 November 2011, Brussels, URL (accessed 28 February 2012),

http://netwatch.jrc.ec.europa.eu/static/download/jpi_2011/FinalReport_JPevent%202011.pdf

Auranem O., Nieminen M., *University research funding and publication performance – An international comparison*, Research Policy 39 Volume 6, Elsevier, pp. 822-834, July 2010, URL *(accessed 16 April 2012),*

http://www.sciencedirect.com/science/article/pii/S0048733310000764

Bagnoli P., (2002*), Developments in growth literature and its relevance for simulation models: annex 1, Working Party on Global and Structural policies*, OECD, ENV/EPOC/GSP(2002)7/ANN1, Paris, 18 April 2003, URL (accessed 18 April 2012),

http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/EPOC/GSP(2002)7/ANN1/FINAL&docLanguage=En

Batelle (2011), *2012 Global R&D Funding Forecast*, December 2011, URL *(accessed 24 February 2012)*,

http://www.battelle.org/ABOUTUS/rd/2012.pdf

Cameron, G. (1998), *Innovation and Growth: a survey of the empirical evidence*, mimeo, Newfield College, Oxford, July 1998, URL (accessed 18 April 2012)

http://www.nuff.ox.ac.uk/users/cameron/papers/empiric.pdf

Cavalcanti, T. V. de V., and Tavares, J., (2007), *The Output Cost of Gender Discrimination: A Model-Based Macroeconomic Estimate*, London, September 2007, URL *(accessed 22 February 2012)*

http://www.hec.unil.ch/deep/evenements/Seminaire-papers/2007-08/Tavares-sept07-2.pdf

Chioncel M. and Cuntz A., (forthcoming), *European Research Area Impact on Member States' policy development* – Seville, ERAWATCH2 Deliverable D1.4.6, JRC-IPTS.

Council of the European Union (2011), *Conclusions 4 February 2011*, Brussels, 8 March 2011, URL (*accessed 07 February 2012),*

http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/119175.pdf

Council of the European Union (2010), *Conclusions 17 June 2010*, Brussels, 17 June 2010, EUCO 13/10, URL *(accessed 24 February 2012)*,

http://ec.europa.eu/eu2020/pdf/115346.pdf

Council of the European Union (2008), *Conclusions on the definition of a 2020 Vision for the European Research Area,* 2891st Competitiveness Council*,* Brussels 1-2 December 2008, URL (*accessed 07 February 2012,*

http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/intm/104434.pdf

Council of the European Union (2007)*, Conclusions on scientific information in the digital age: access, dissemination and preservation*, 2832nd Competitiveness Council meeting, Brussels, 22 and 23 November 2007, URL *(accessed 24 February 2012),*

http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/en/intm/97236.pdf

Danish Agency for Science Technology and Innovation (2011), *Access to Research and Technical Information in Denmark,* Denmark's Electronic Research Library (DEFF), April 2011, URL (*accessed 07 February 2012),*

http://www.fi.dk/publikationer/2011/adgang-til-forskningsresultater-og-teknisk-information-i-danmark/adgang-til-forskningsresultater-og-teknisk-information-i-danmark-access-to-research-and-technical-information-in-denmark.pdf

Delanghe, H., Muldur, U., Soete, L. (2009), *European science and technology policy: towards integration or fragmentation?* Edward Elgar Publishing, January 2009, p.177, URL (*accessed 07 February 2012),*

http://www.e-elgar.co.uk

Deloitte (2009), *Euraxess - Links Abroad (ELA) Geographic, Expansion-Feasibility study*, Final Report Version 1.0, Deloitte, The Evaluation Partnership, for the European Commission Research Directorate General, 12 June 2009, URL (*accessed 22 February 2012*),

http://ec.europa.eu/euraxess/links/docs/ELA%20Geographic%20Expansion_Final%20Report_V_1_0.pdf

Department for Business, Innovation and Skills (2011), *Innovation and Research Strategy for Growth*, UK, December 2011, URL (*accessed 07 February 2012),*

http://www.bis.gov.uk/assets/biscore/innovation/docs/i/11-1387-innovation-and-research-strategy-for-growth.pdf

Di Pietrantonio, L (2009), *Towards a New (European Research) Deal*, *The Case for Enhanced Fiscal Policy Coordination on Research and Innovation*, Bruges European Economic Policy briefings **(**BEEP) briefing n° 20, July 2009, URL (accessed 16 April 2012),

http://www.coleurope.eu/file/content/studyprogrammes/eco/publications/BEEPs/BEEP20.pdf

Dosi G., Llerena P., Sylos Labini M. (2006), *Science-Technology-Industry Links and the "European Paradox": Some Notes on the Dynamics of Scientific and Technological Research in Europe*, Research Policy - 35:10: 1450:1464, URL *(accessed 28 February)*, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1513815

Durante, R., Labartino, G. & Perotti, R. (2011), *Academic Dynasties: Decentralization and Familism in the Italian Academia*, Working Paper No. 17572, C.E.P.R. Discussion Papers, November 2011, URL *(accessed 24 February 2012),*

http://www.nber.org/papers/w17572

Eells, W.C., Cleveland, A.C. (1999), *Faculty Inbreeding*, *The Journal of Higher Education, 70 5 Special Anniversary Issue: A Look Back*, pp 579-588, URL *(accessed 24 February 2012)*,

http://www.jstor.org/action/showPublication?journalCode=jhighereducation

Eisenberg, T., Wells, M.T. (2000), *Inbreeding in Law School Hiring: Assessing the performance of Faculty, Hired from within*. The Journal of Legal Studies 29 No. 1 Interpreting Legal Citations, pp. 369-388, URL *(accessed 24 February 2012)*,

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=231578

Elsevier (2011), *International Comparative Performance of the UK Research Base – 2011,* for the Department for Business, Innovation and Skills, 2011, URL (*accessed 07 February 2012),*

http://www2.cst.gov.uk/assets/biscore/science/docs/i/11-p123-international-comparative-performance-uk-research-base-2011.pdf

ERA Steering Group on Human Resources and Mobility (2011), *Report by the ERA Steering Group on Human Resources and Mobility,* 2011.

ERAC (2011), ERAC opinion on ERA-related instruments, ERAC 1209/11, pp. 79-82, 26 May 2011, URL (accessed 28 February 2012),

http://www.consilium.europa.eu/uedocs/cmsUpload/st01209%20en11.pdf

European Commission (2012a), *Innovation Union Scoreboard 2011, The Innovation Union's performance scoreboard for Research and Innovation*, report prepared by Maastricht Economic and Social Research Institute on Innovation and Technology (UNU-MERIT) for the European Commission, 7 February 2012, URL (*accessed 22 February 2012*),

http://ec.europa.eu/enterprise/policies/innovation/files/ius-2011_en.pdf

European Commission (2012b), *Public Consultation on the European Research Area Framework and the Survey on Scientific Information in the Digital Age*, Directorate-General for Research and Innovation, 30 January 2012, URL (*accessed 21 February 2012*),

http://ec.europa.eu/research/science-society/document_library/pdf_06/survey-on-scientific-information-digital-age_en.pdf

European Commission (2012c), *Preliminary report of the public Consultation on the ERA Framework,* Directorate-General for Research and Innovation*,* January 2012, URL (*accessed 07 February 2012),*

http://ec.europa.eu/research/era/pdf/era-summary-report-2012_en.pdf

European Commission (2011a), *Common Strategic Framework for EU Research and Innovation Funding: Outcome of the public consultation,* Green Paper, Directorate-General for Research and Innovation, 2011, URL (*accessed 07 February 2012),* http://ec.europa.eu/research/csfri/pdf/consultation-conference/summary_analysis.pdf

European Commission (2011b), *Recommendation from the Commission to the Council on Access to and Preservation of Scientific Information in the Digital Age,* draft, November 2011.

European Commission (2011c), *Innovation Union Competitiveness report*, *2011 edition*, Directorate-General for Research and Innovation, 2011, URL (*accessed 07 February 2012),*

http://ec.europa.eu/research/innovation-union/pdf/competitiveness-report/2011/iuc2011-full-report.pdf#view=fit&pagemode=none

European Commission (2011d), *National open access and preservation policies in Europe, Analysis of a questionnaire to the European Research Area Committee,* Brussels, 2011, URL *(accessed 24 February 2012),*

http://ec.europa.eu/research/science-society/document_library/pdf_06/open-access-report-2011_en.pdf

European Commission (2011e), *Commission Staff Working Paper Impact Assessment, Accompanying the Communication from the Commission 'Horizon 2020 - The Framework Programme for Research and Innovation',* SEC(2011) 1427 final, Brussels, 30 November 2011, URL *(accessed 24 February 2012),*

http://ec.europa.eu/research/horizon2020/pdf/proposals/horizon_2020_impact_assessment_report.pdf

European Commission (2011f), *Commission Staff Working Paper, Executive Summary of the Impact Assessment,* SEC(2011) 1428 final, Volume I, Brussels, 30 November 2011, URL *(accessed 24 February 2012),*

http://ec.europa.eu/research/horizon2020/pdf/proposals/horizon_2020_impact_assessment_report_executive_summary.pdf

European Commission (2011g), Partnering in research and innovation, COM(2011) 572 final, Brussels, 21 September 2011, URL *(accessed 1 June 2012),*

http://ec.europa.eu/research/era/pdf/partnering_communication.pdf

European Commission (2010a), *Framework Directive on the European Research Area.* Roadmap Version 2, Directorate-General for Research, October 2010, URL (*accessed 07 February 2012),*

http://ec.europa.eu/governance/impact/planned_ia/docs/2012_rtd_001_eur_research_area_fd_2011_en.pdf

European Commission (2010b), *Europe 2020 Flagship Initiative Innovation Union*, Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions, SEC(2010)1161, COM(2010) 546 final, Brussels, 6 October 2010, URL (*accessed 07 February 2012),* http://ec.europa.eu/research/innovation-union/pdf/innovation-union-communication_en.pdf#view=fit&pagemode=none

European Commission (2010c), *Riding the wave: How Europe can gain from the rising tide of scientific data*, Final report of the EC High Level Expert Group on Scientific Data, Directorate-General for Information Society and Media, October 2010, URL (*accessed 07 February 2012),*

http://cordis.europa.eu/fp7/ict/e-infrastructure/docs/hlg-sdi-report.pdf

European Commission (2010d), *Stocktaking 10 years of "Women in Science" Policy by the European Commission 1999-2009*, Directorate General for Research, 2010, URL (*accessed 22 February 2012*), http://ec.europa.eu/research/sciencesociety/document_library/pdf_06/stocktaking-10-years-of-women-in-science-book_en.pdf

European Commission (2010e), *Innovation Union Scoreboard 2010*, *The Innovation Union's performance scoreboard for Research and Innovation,* prepared by the Maastricht Economic and social Research and training centre on Innovation and Technology (UNU-MERIT) with the contribution of DG JRC G3 of the European Commission, 01 February 2011, URL *(accessed 24 February 2012)*

http://ec.europa.eu/research/innovation-union/pdf/iu-scoreboard-2010_en.pdf

European Commission (2010f), *Interim Evaluation of the Seventh Framework Programme, Report of the Expert Group,* Final report, 12 November 2010, URL *(accessed 24 February 2012),*

http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/fp7_interim_evaluation_expert_group_report.pdf

European Commission (2010g), *Europe 2020, A strategy for smart, sustainable and inclusive growth,* Communication from the Commission, COM(2010) 2020 final, Brussels, 3 March 2010, URL *(accessed 24 February 2012),*

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:FIN:EN:PDF

European Commission (2009-2010), *Report by the ERA Steering Group on Human Resources and Mobility (SGHRM) 2009,* Report on the Implementation of the European Partnership for researchers (EPR) 2010, URL *(accessed 22 February 2012)*,

http://www.researcherscareer2010.be/Report_EPR_2009.pdf

European Commission (2009a), *The World in 2025: Rising Asia and socio-ecological transition*, Directorate-General for Research, 2009, URL (*accessed 07 February 2012),* http://ec.europa.eu/research/social-sciences/pdf/the-world-in-2025-report_en.pdf

European Commission (2009b), *She figures, Statistics and Indicators on Gender Equality in Sciencem* Directorate-General for Research, 2009, URL (*accessed 07 February 2012),* *http://ec.europa.eu/research/science-society/document_library/pdf_06/she_figures_2009_en.pdf*

European Commission (2009c), *European Competitiveness Report*, Directorate General for Enterprise and Industry, 2009, URL *(accessed 22 February 2012),*

http://bookshop.europa.eu/en/european-competitiveness-report-2009-pbNBAK09001/

European Commission (2008a), *Better Careers and More Mobility: A European Partnership for Researchers*, Communication from the Commission to the Council and the European Parliament COM (2008)317 final*,* Brussels, 23.5.2008, URL (*accessed 07 February 2012),* http://ec.europa.eu/research/press/2008/pdf/com_2008_31_1_en.pdf

European Commission (2008b), *a Strategic European Framework for International Science and Technology Cooperation,* Communication from the Commission to the Council and the European Parliament, COM(2008) 588 final, Brussels, 24.09.2008, URL (*accessed 07 February 2012),*

http://ec.europa.eu/research/press/2008/pdf/com_2008_588_en.pdf

European Commission (2007a), *European Research Area: New Perspectives*, Green Paper COM/2007/161, Directorate-General for Research, Brussels, 4 April 2007, URL (*accessed 07 February 2012),*

http://ec.europa.eu/research/era/pdf/era_gp_final_en.pdf

European Commission (2007b), S*cientific information in the digital age: access, dissemination and preservation,* Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions on, COM(2007) 56 final, {SEC (2007)181}, Brussels, 14 February 2007, URL *(accessed 24 February 2012)*,

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0056:FIN:EN:PDF

European Commission (2006), *Study on the economic and technical evaluation of the publishing market*s *in Europe*, Final Report, Directorate-General for Research, January 2006, URL (*accessed 07 February 2012),*

http://ec.europa.eu/research/science-society/pdf/scientific-publication-study_en.pdf

European Commission (2005), *The European Charter for Researchers The Code of Conduct for the Recruitment of Researchers,* Directorate-General for Research, 2005, URL (*accessed 07 February 2012),*

http://ec.europa.eu/eracareers/pdf/am509774CEE_EN_E4.pdf

European Commission (2000), *Towards a European Research Area (ERA),* Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions, COM(2000) 6 final, 18 January 2000, URL (*accessed 07 February 2012),*

http://europa.eu/legislation_summaries/other/i23010_en.htm

European Commission (1999), *Women and Science: mobilising women to enrich European research*, Communication from the European Commission, 17 February 1999, URL (*accessed 22 February 2012*), http://europa.eu/legislation_summaries/employment_and_social_policy/equality_between_men_and_women/c10930_en.htm

European Parliament (2009), *Evaluation of European Research Area (ERA): Governance aspects*, Directorate General for Internal Policies, November 2009, URL (*accessed 07 February 2012),*

http://www.europarl.europa.eu/document/activities/cont/201106/20110628ATT22850/20110628ATT22850EN.pdf

European Research Area Committee (ERAC) (2011a), *Voluntary Guidelines on Framework Conditions for Joint Programming in Research 2010,* OPOCE, 2011, URL *(accessed 24 February 2012),*

http://ec.europa.eu/research/era/docs/en/voluntary_guidelines.pdf

European Research Area Committee (ERAC) (2011b), *Questionnaire on R&D investments and policy measures by EU Member States and Associated States*, URL *(accessed 24 February 2012)*,

http://www.era.gv.at/attach/6.2-notetoERACMembers05102011final.doc

European Research Council (ERC) (2007), *ERC Scientific Council Guidelines for Open Access, 17 December 2007,* URL *(accessed 24 February 2012,*

http://erc.europa.eu/documents/erc-scientific-council-guidelines-open-access

European University Association (2011), *University Autonomy in Europe II, The Scorecard*, by Thomas Estermann, Terhi Nokkala & Monika Steinel, 2011, URL *(accessed 27 February 2012),*

http://www.eua.be/eua-work-and-policy-area/governance-autonomy-and-funding/projects/university-autonomy-in-europe/

Felix (2011), *Cash-strapped libraries threaten to end journal subscription deals over rising costs,* Imperial College London, 18 February 2011, URL (*accessed 07 February 2012),* http://felixonline.co.uk/?article=808

Fernandez Zubieta, A., Van Bavel, R. (2011), *Barriers and Bottlenecks to Making Research Careers More Attractive and Promoting Mobility*, ERAWATCH report, JRC-IPTS 2011, 2011.

Franzoni, C., Sclellato, G., and Stephan, P. (2011), *Changing incentives to publish*, Science, vol. 333, 4 August 2011, URL (*accessed 07 February 2012),*

http://www.sciencemag.org/content/333/6043/702.short

German Federal Ministry of Education and Research (BMBF) (2010), *Scientific Careers - working conditions, professional orientation and competencies of early career researchers,* Study by BMBF and HIS (Higher Education Information System), HIS Forum Hochschule 14/2010, November 2010, URL *(accessed 22 February 2012),*

http://www.his.de/pdf/pub_fh/fh-201014.pdf

Griliches, Z. (1992), *The Search for R&D Spillovers*, *Scandinavian Journal of Economics*, Proceedings of a Symposium on Productivity Concepts and Measurement Problems: Welfare, Quality and Productivity in the Service Industries, Supplement 94n S29-47, Sweden, 1992.

Guellec, D., van Pottelsberghe de la Potterie, B, (2001), *Recherche-developpement et croissance de la productivité: analyse des données d'un panel de 16 pays de l'OCDE*, *Revue Economique de l'OCDE*, n°33, pp. 111-136, 2001, URL (*accessed 18 April 2012),*

http://www.cairn.info/revue-economique-de-l-ocde-2001-2-page-111.htm

Guy, K., Soete, L., Præst Knudsen, M. et al. (2010), *The role of community research policy in the knowledge-based economy*, Expert Group Report, 24 October 2009, URL *(accessed 27 February 2012),*

ftp://ftp.cordis.europa.eu/pub/era/docs/community_research_policy_role.pdf

Horta, H., Veloso, F., and Grediaga, R., (2010), *Navel gazing: Academic inbreeding and scientific productivity*, Management Science, Vol. 56, No. 3, 414-429, URL *(accessed 24 February 2012)*,

http://mansci.journal.informs.org/content/56/3/414.abstract

Houghton, J. (2009), *Costs and Benefits of Alternative Publishing Models: Denmark,* Center for Strategic Economic Studies, Victoria University, Melbourne, May 2009, URL, *(accessed 10 April 2012),*

http://www.knowledge-exchange.info/Admin/Public/DWSDownload.aspx?File=%2FFiles%2FFiler%2Fdownloads%2FDK_Costs_and_benefits_of_alternative_publishing_models.pdf

Houghton, J. (2009a) *Open Access – What are the economic benefits? A comparison of the United Kingdom, Netherlands and Denmark*. Centre for Strategic Economic Studies Victoria University, Melbourne, URL *(accessed 1 June 2012)*,

http://www.knowledge-exchange.info/default.aspx?id=316

Houghton, J., De Jonge, J., and Van Oploo, M. (2009b), *Costs and Benefits of Research Communication: The Dutch Situation,* Surf Foundation, 29 May 2009, URL *(accessed 10 April 2012),*

http://www.surf.nl/en/publicaties/Pages/CostsandBenefitsofOpenAccessPublicationlTheDutchSituation.aspx

Houghton, J., Rasmussen, L., Sheehan, P., Oppenheim, C., Morris, A., Creaser, C., Greenwood, H., Summers, M. and Gourlay, A. (2009c) *Economic Implications of Alternative Scholarly Publishing Models. Exploring the costs and benefits*. Centre for Strategic Economic Studies Victoria University, Melbourne, URL *(accessed 1 June 2012)*,

http://www.jisc.ac.uk/publications/reports/2009/economicpublishingmodelsfinalreport.aspx

Johnson, D.K.N. (2002), *The OECD Technology Concordance (OTC): Patents by Industry of Manufacture and Sector of Use*, Organisation for Economics Cooperation and Development, Directorate of Science, Technology and Industry Working Paper 2002/5, URL *(accessed 27 February 2012)*,

http://www.oecd.org/LongAbstract/0,3425,en_2649_33703_2069713_1_1_1_1,00.html

King, Donald W. et al. (2009), *Scholarly Journal Information-seeking and Reading Patterns of Faculty at five US Universities*, Learned Publishing, vol. 22(2), pp. 126–144, USA, 2009, URL (accessed 18 April 2012),

http://docserver.ingentaconnect.com/deliver/connect/alpsp/09531513/v22n2/s8.pdf?expires=1334757977&id=68359893&titleid=885&accname=European+Commission+Central+Library&checksum=F0D527757B148F2DC3B035716D8D6BCB

Mairesse J., Sassenou M., (1991), *Recherche-developpement et productivité, un panorama des etudes économétriques sur données d'entreprises*, *STI Revue*, n°8, pp. 9-45, OCDE, Paris, 1991

McKinsey & Company (2007), *Women Matter, Gender Diversity: a corporate performance driver,* McKinsey & Company, October 2007, URL *(accessed 22 February 2012)*

http://www.mckinsey.com/locations/swiss/news_publications/pdf/Women_matter_english.pdf

Merton, R.K. (1968), *The Matthew Effect in Science,* Science, Vol. 159 no. 3810 pp. 56-63, 5 January 1968, URL (*accessed 24 February 2012*),

http://www.sciencemag.org/content/159/3810/56.abstract

Mitsos, A., Bonaccorsi, A. et al (2012), *The socio-economic benefits of ERA*, unpublished draft, Expert Group Report to Directorate-General for Research and Innovation, European Commission.

Mohnen, P. (1990*), R&D and productivity growth: A survey of the literature*, Centre de Recherche sur les Politiques Economiques (CERPE), Cahier de Recherche No. 57, Université du Quebec, Montréal, 1990.

Nadiri, M.I. (1993), *Innovation and Technological Spillovers*, NBER Working Paper, n°4423, August 1993, Cambridge, USA, URL (*accessed 18 April 2012*),

http://www.nber.org/papers/w4423.pdf

Navarro, A. & Rivero, A. (2001), *High rate of inbreeding in Spanish universities*, Nature. 410, URL *(accessed 24 February 2012),*

http://gemi.mpl.ird.fr/PDF/Navarro_2001.pdf

NMP Scoreboard (2011), *Comparative scoreboard and performance indicators in NMP research activities between EU and third countries*, Draft version, European Commission, Directorate-General for Research and Innovation, 2011.

OECD (2008), *The Global Competition for Talent: Mobility of the Highly Skilled,* OECD Publishing 2008, URL (*accessed 07 February 2012),*

http://www.oecd.org/document/21/0,3746,en_2649_34269_41361685_1_1_1_1,00.html

OECD (2009), *Inventory of National Science, Technology and Innovation Policies for Nanotechnology 2008*, OECD, Paris, 17 July 2009, URL *(accessed 28 February 2012),* http://www.oecd.org/dataoecd/38/32/43348394.pdf

Optimat Ltd, *Examining the Design of National Research Programmes,* Final report, for the European Commission Research Directorate, December 2005, URL *(accessed 16 April 2012)*, http://ec.europa.eu/invest-in-research/pdf/download_en/final_report_dec05.pdf

Østergaard, C.R., Timmermans, B., and Kristinsson, K. (2011), *Does a different view create something new? The effect of employee diversity on innovation,* Research Policy Voume 40, Issue 3, Elsevier, April 2011, pp500-509, URL *(accessed 22 February 2012)* http://linkinghub.elsevier.com/retrieve/pii/S0048733310002398

PARSE.Insight (2010), *Insight into digital preservation of research output in Europe*, Project: FP7-2007-223758 PARSE.Insight for the European Commission, June 2010, URL (*accessed 07 February 2012),*

http://www.parse-insight.eu/downloads/PARSE-Insight_D3-6_InsightReport.pdf

Pro Inno Europe (2011), *Innovation Union Scoreboard 2011, The Innovation Union's performance scoreboard for Research and Innovation*, 7 February 2012, URL *(accessed 24 February 2012),*

http://ec.europa.eu/enterprise/policies/innovation/files/ius-2011_en.pdf

Pro Inno Europe (2009), *Comparative Analysis of Innovation Performance,* European Innovation Scoreboard (EIS) 2009, paper n° 15, URL (*accessed 07 February 2012),* http://www.proinno-europe.eu/page/european-innovation-scoreboard-2009

Publishing Research Consortium (2009), *Research Report, Access by UK small and medium-sized enterprises to professional and academic information,* Mark Ware Consulting Ltd, August 2009, URL (*accessed 07 February 2012),*

http://www.publishingresearch.net/documents/SMEAccessResearchReport.pdf

Research Information Network (2011), *Heading for the open road: costs and benefits of transitions in scholarly communications*, April 2011, URL *(accessed 10 April 2012),*

http://www.rin.ac.uk/our-work/communicating-and-disseminating-research/heading-open-road-costs-and-benefits-transitions-s

Research Information Network (2009), *Overcoming barriers: access to research information content*, December 2009, URL (*accessed 07 February 2012),*

http://www.rin.ac.uk/our-work/using-and-accessing-information-resources/overcoming-barriers-access-research-information

Roco, M.C., Mirkin, C.A. and Hersam, M.C. (2011), *Nanotechnology Research Directions for Societal Needs in 2020 - Retrospective and Outlook*, National Science Foundation, World Technology Evaluation Centre (WTEC) Report, 1st. Edition, Springer, Berlin and Boston, 2011, URL *(accessed 28 February 2012)*,

http://www.springer.com/materials/nanotechnology/book/978-94-007-1167-9

Sáinz Ibáñez, M., López, B., and González Ramos, A., (2010), *In Género y TIC. Presencia, posición y políticas*, ed. Cecilia Castaño. Barcelona: Editorial UOC, November 2010, URL *(accessed 22 February 2012),*

http://www.editorialuoc.cat/gneroytic-p-670.html?cPath=1

Swan, A. (2011), *Open Access: Impact for Researchers, Universities and Society,* Impact Briefing Paper, Research Library UK, January 2012, URL (*accessed 07 February 2012),* http://www.sconul.ac.uk/news/OAbriefing/OA_impact_briefing.pdf

Swan, A. (2010), *The Open Access citation advantage: studies and results to date. Technical Report*, School of Electronics & Computer Science, University of Southampton, February 2010, URL (*accessed 07 February 2012),*

http://eprints.ecs.soton.ac.uk/18516/

Technopolis (2010), *Study in support of an ex-ante impact assessment of post 2010 ERA policies,* for the European Commission Research Directorate-general, Brussels, 2010.

Technopolis (2011), *A study in support of the ERA Framework Impact Assessment on gathering an overview and analysis on the way research and research systems are regulated in the EU Member States*, with members of the ERAWATCH NETWORK ASBL, 22 December 2011.

Teichler, U., (2011), *Future Challenges Facing Europe's Higher Education Systems in the 21st Century*, Keynote Speech, Seminar: Youth on the move: Briefing for Journalists, European Journalism Centre, European University Institute, Badia Fiesolana, Italy, 08- 09 May 2011.

Tenopir, C. et al. (2009*), Electronic Journals and changes in Scholarly Article Seeking and Reading Patterns*, Aslib Proceedings New Information, Vol. 61 Iss: 1 pp. 5 – 32, USA, 2009, URL (*accessed 16 April 2012*),

http://works.bepress.com/cgi/viewcontent.cgi?article=1012&context=carol_tenopir

The Economist (2011), *Of goats and headaches*, Online article on Academic Publishing, May 26th 2011, URL (*accessed 07 February 2012),*

http://www.economist.com/node/18744177

The Evaluation Partnership (2010), *Ex-post Impact Assessment study concerning the „Marie Curie Actions" under the Sixth Framework Programme*, Final Report, Deliverable D6-2, for the European Commission Research Directorate General, 8 September 2010, URL (accessed 07 February 2012),

http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/ex-post_impact_assessment_of__marie_curie_actions_under_the_fp6.pdf

Turner, L. (2006), *Gender Diversity and Performance, In Women in Science and Technology - The Business Perspective,* ed. European Commission, pp 69-80, URL *(accessed 22 February 2012)*,

http://ec.europa.eu/research/science-society/pdf/wist_report_final_en.pdf

UNESCO (2010), *Science Report, The Current Status of Science around the World,* Unesco Publishing, France, 2010, URL (*accessed 07 February 2012),*

http://unesdoc.unesco.org/images/0018/001898/189883e.pdf

Van de Sande et al., (2005), *Impact assessment of the Marie Curie fellowships under the 4th and 5th Framework Programmes of Research and Technological Development of the EU (1994-2002)*, June 2005, URL *(accessed 27 February 2012)*, http://ec.europa.eu/research/fp6/mariecurie-actions/pdf/impact_fellow_en.pdf

Van Velzen, W. et al (2007), *Independent External Review Report, European and Developing Countries Clinical Trials Partnership (EDCTP Programme)*, Review conducted by the IER / EDCTP Panel: Wim Van Velzen (Chair), Adetokunbo O. Lucas, Allyson Pollock, Jean Stéphenne and Fernand Sauer (Rapporteur), URL *(accessed 27 February 2012)*, ftp://ftp.cordis.europa.eu/pub/fp7/docs/20070712-review-report-by-w-van-velzen.pdf

Veugelers, R. (2011), *A G2 for Science?* Bruegel Policy Brief, Issue 2011/03, April 2011, URL (*accessed 07 February 2012),*

http://www.bruegel.org/publications/publication-detail/publication/519-a-g2-for-science/

VERA, (2012), *ERA Fabric Map. First Edition.* FP7 SSH project "Forward Visions on the European Research Area" URL (*accessed 25 May 2012),*

http://ec.europa.eu/research/social-sciences/pdf/vera-era-project-report_en.pdf

Yamanoi, A. (2005), *The Academic Marketplace in Japan: Inbreeding, Grades and Organization at Research Universities.* Higher Education Forum 3, pp. 93-114, URL *(accessed 24 February 2012),*

http://en.rihe.hiroshima-u.ac.jp/news_topic.php?id=103