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**Ex-Post Evaluation of the Seventh Framework Programme**

**COMMISSION STAFF WORKING DOCUMENT**

**Annexes**

*Accompanying the document*

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

**On the Response to the Report of the High Level Expert Group on the Ex-Post  
Evaluation of the Seventh Framework Programme**

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## 11. IDEAS SPECIFIC PROGRAMME

### Objectives

#### Original objectives

The objective of the Ideas Programme was to support frontier research under the auspices of the European Research Council (ERC).

Its rationale was to redress Europe's perceived loss of ground in global scientific leadership in two main ways. Firstly by providing for the best researchers the resources and autonomy required to realise ground-breaking scientific ideas, in particular for young researchers. And secondly by creating a framework that promoted scientific competition, which is essential for excellent scientific ideas to emerge.

#### Evolution of objectives to respond to the crisis

In response to the financial crisis European governments and the EU undertook a comprehensive series of actions from rescuing the banks to launching a Europe-wide recovery plan. As the financial crisis turned into a debt crisis the EU responded with a twin track approach of immediate and long-term measures. The long-term measures included ensuring sound public finances and ensuring competitiveness and promoting growth.

Early in 2010, the Commission therefore proposed the Europe 2020 strategy to achieve smart, sustainable and inclusive growth building upon the earlier Lisbon Strategy. As part of this strategy the aim of the Innovation Union flagship initiative was to strengthen "every link in the innovation chain, from 'blue sky' research to commercialisation". Given this and the continuities with the Lisbon Strategy it was not necessary to alter the overall objectives of the ERC. Nonetheless the Scientific Council of the ERC introduced the Proof of Concept in 2011 to explore the commercial and social innovation potential of ideas arising from the ERC grants.

#### How did Ideas SP contribute to the competitiveness of European industry?

Following intensive study by economists over many years including Robert Solow (who won a Nobel Prize for this work), it is now accepted that technological progress is the critical factor in driving sustained growth in per capita income. This requires more than incremental improvements in current technologies and knowledge. It requires new knowledge that will create whole new sectors and industries to provide high quality jobs, and drive future productivity and growth. Allowing researchers the freedom to explore ideas at the frontiers of knowledge as the ERC does is proven to be the best way to generate radical breakthroughs.

The ERC funds frontier research. Classical distinctions between basic and applied research have lost much of their relevance at a time when many emerging areas of science and technology (e.g. biotechnology, ICT, materials and nanotechnology, and

cognitive sciences) often embrace substantial elements of both, and for sure originate from fundamental scientific ideas. Frontier research therefore often generates unexpected or new opportunities for commercial or societal application from the immediate term to the very long term.

The Ideas SP also has **important structuring effects on European innovation**. The visibility of basic research funded at European level makes it easier for actors in the European innovation system to pick up on the knowledge resulting from that research and thus reduce information-related market failures and improve the European knowledge market. At the same time, the higher quality and increased visibility of European basic research makes Europe a more attractive place to companies to carry out research in and to individual researchers to engage in scientific careers.

Data from completed ERC projects shows that around one-fifth of ERC Principal Investigators working in the Physical Sciences and Engineering and Life Sciences domains have reported at least one **patent** arising from their project as below. And those projects that do patent report on average more than one patent (see Table below).

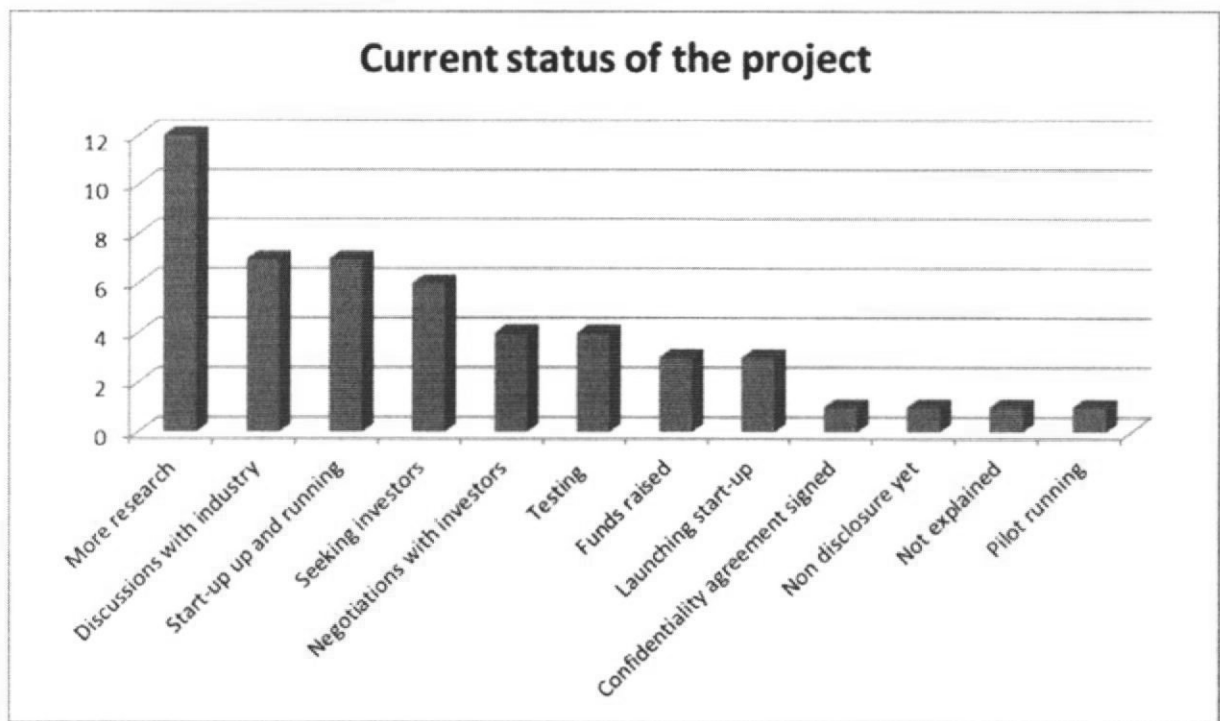
	LS			PE		
	Projects completed	Projects with at least one patent	Total patents	Projects completed	Projects with at least one patent	Total patents
StG2007	68	12		88	21	
AdG2008	39	7		68	13	
Total	107	19	30	156	34	68

**Number of ERC projects reporting at least one patent<sup>1</sup>**

<sup>1</sup> This analysis looked at 263 projects in the LS and PE domains from 314 completed projects from the first two calls (StG 2007 and AdG 2008). It counted only those reported patents which ERC was able to validate in the database of the European Patent Office. There were no reported patents from the SH projects in this sample.

The ERC Scientific Council explicitly recognised the frontier nature of ERC funded research in 2011 by creating the **Proof of Concept Grant (PoC)**. More than 170 "proof of concept" grants awarded since 2010 to explore the commercial and social innovation potential of ideas arising from ERC grants. Results from the PoC projects include verification of the innovation and market potential of the idea taken to proof of concept, raising interest from industry or other potential investors, creation of commercial ventures and the filing of international patents.

Analysis of the first 50 completed PoC projects shows that around 50% reported at least one patent application. In addition, 18% of them spun-out a new venture and 30% of them intend to use an existing or new spin-out to take forward their idea. A further 16% of them plan to license technology to an existing company and 8% to form an industrial partnership. Table below shows the status of the projects at the time of the final report. 24% required further research, 14% had initiated discussions with industry, 12% were seeking investors, 8% were already negotiating with potential investors and 6% had already raised funding.



Status of the PoC projects at the time of the final report

The Ideas Specific Programme clearly achieved its objective of creating a pan-European competitive structure leading to higher levels of excellence in Europe's basic research. This will result in a better and enlarged knowledge base for European enterprises on which the innovation of products and process can be based. This will have direct economic, societal and environmental benefits.

## How did Ideas SP contribute to increase European wide S&T collaboration and networking for sharing R&D risks and costs?

The ERC does not have the explicit aim of fostering international or intra-European collaboration, but because science at the highest levels is characterised by high levels of international collaboration the ERC has in practice supported extensive international collaboration both within and outside Europe.

As part of a study “*Comparative scientometric assessment of the results of ERC funded projects*”<sup>2</sup> the contractors examined the publications of 2,556 ERC grantees. The table below presents four types of international collaboration broken down by domain: 1) collaborations involving at least two distinct countries, regardless of where they are located, 2) intra-European collaborations involving researchers from at least two different European countries, 3) extra-European collaborations involving at least one European and one non-European country, and 4) collaborations involving at least two distinct countries, one of which is the United States.

The data shows that overall 56% of the publications of the ERC funded researchers involved international collaboration.

**Table X International Collaboration of ERC Funded Researchers After the Grant Start Year by Domain and Type of Collaboration**

Agency / Type of Collaboration	Number of Papers				Collaboration Rate			
	LS	PE	SH	TOTAL	LS	PE	SH	TOTAL
<b>European Research Council (ERC)</b>	<b>19.536</b>	<b>35.466</b>	<b>3.867</b>	<b>58.650</b>				
International Collaboration (all)	11.072	19.811	1.858	<b>32.576</b>	57%	56%	48%	56%
Intra-European International Collaboration	7.350	14.113	1.177	<b>22.493</b>	38%	40%	30%	38%
Extra-European International Collaboration	6.664	12.032	1.110	<b>19.716</b>	34%	34%	29%	34%
International Collaboration with USA	4.614	7.853	761	<b>13.151</b>	24%	22%	20%	22%

The ERC does not have the explicit aim of fostering international or intra-European mobility but one important feature of the ERC’s grants is that they allow for **portability between host institutions**. This allows researchers to find the best institutional environment for conducting their research and the movement of researchers also means that their knowledge and skills also circulate.

<sup>2</sup> RR-1221-ERC, July 2015 by RAND Europe and Observatoire des sciences et des technologies (OST)

**Table 10: ERC grantees changing host institution**

	<b>change HI during granting</b>	<b>change HI after granting</b>
<b>All grantees</b>	<b>6%</b>	<b>5.6%</b>
<b>StG</b>	<b>7.8%</b>	<b>8.4%</b>
<b>CoG</b>	<b>5.4%</b>	<b>0%<sup>3</sup></b>
<b>AdG</b>	<b>3.6%</b>	<b>3%</b>

**How did Ideas SP contribute to improve the coordination of European, national and regional research policies?**

The ERC has tried to record relevant changes in the national systems. Of the changes observed, few can be directly attributable to the effect of the ERC but certain trends are notable. Before the creation of the ERC, 12 of the current EU countries<sup>4</sup> had national research or scientific councils involved as decision making bodies in the **governance of competitive funding of basic research** (including EE and HR with science foundations). In 2014 all but five EU countries had such bodies<sup>5</sup>. In 20 countries these councils have a decision making role at strategic level and sometimes even at operational level. In BG, PT and RO these bodies have an advisory role.

Increasing competition between European countries and institutions to host ERC grantees is leading to **major reforms in the way research funding is allocated** and to more attractive conditions for the best researchers. The number of EU Member States with scientific councils involved as decision making bodies in the governance of competitive funding of basic research has increased from 12 to 23<sup>6</sup> during the lifetime of the ERC. Since 2007, 11 Member States have launched new funding schemes inspired by the ERC. The National Science Centre (NCN) in Poland, a government executive agency set up to fund basic research, was created in 2010 with the ERC as an explicit model.

The creation of the ERC also enhanced or consolidated the **priority given to basic/frontier research in some national strategies**. On 28 July 2011 the Bulgarian Parliament adopted the new National Strategy of Scientific Research to 2020. The strategy introduced for the first time officially set priorities for the development of science in Bulgaria. One of the priorities is "Development of fundamental research

<sup>3</sup> After one call in 2013.

<sup>4</sup> CZ, DK, EE, FI, HR, HU, IE, LU, SE, SI, SK, UK.

<sup>5</sup> All EU countries except CY, EL, ES, IT and MT.

<sup>6</sup> All EU countries except CY, EL, ES, IT and MT. In BG, PT and RO the scientific councils have an advisory role.



under programme and competitive principle to the amount of 15% of the public expenses on science". (*ref: National Strategy of Scientific Research to 2020*).

In Romania a full chapter of the first National RDI Strategy 2007-2013 concerned the important role of "Exploratory and frontier research". Under the influence of the European developments taking place around the creation of ERC, Romania committed to support advanced research, directed towards world-class scientific results, to encourage the development of the research career and the establishment of poles of excellence. Taking into account the significance of fundamental research for knowledge development and the training of highly skilled human resources, the strategy emphasized excellence, inter-disciplinary research and international visibility. The second National RDI Strategy 2014-2020 (to be soon approved by the Government) maintains "Fundamental and frontier research" as a national priority. (*ref: National RDI Strategies 2007-2013 and 2014-2020*).

The ERC's commitment to excellence also inspired a **focus on excellence at national level**. In Poland, the legislative act on Higher education, known as 'Partnership for Knowledge Reform' entered into force in October 2011. The reform had excellence as a focus. The five general objectives of the reform indicate a commitment to funding from the state budget "only top quality scientific research [...] according to international standards" and to concentrate funds "on the units conducting the top-level R&D activity", at the same time implementing "a system of comprehensive evaluation of the quality of R&D activity conducted by the scientific units". (*ref: Partnership for Knowledge Reform*).

ERC provided legitimacy for **increasing the level of competitive funding for basic/frontier research**. In France, amid the animated debates caused by the proposal to establish ERC as a competitive funding structure at European level, the National Agency for Research (ANR) was created in 2005 to fund fundamental and industrial research projects on a competitive basis. ANR represented a radical shift in the French research funding system and as such was heavily contested. The support given to ERC by key players in the French research system increased the acceptance of the ANR. (*ref: article Philippe Laredo, 2010*).

In 2009 the Hungarian Academy of Sciences (a major source of subsidy-based research funding) announced its Momentum Program, an instrument for competitive funding of basic frontier research.

The priorities of the Italian national research system are outlined in the triennial PNR National Research Programme. PNR 2011-2013 contains 2 long-term actions both involving basic research: support to creativity and excellence in all fields of knowledge, and support for oriented basic research towards enabling technologies. The first action resembles very close the ERC approach. It provides support for critical basic research projects, free, aimed at developing new knowledge, with long term impacts, evaluated by international peer review. The Ministry of University and Research shall allocate a share of at least 25% of the funds available for projects in knowledge-driven, to scholars

aged under 40 years. The action was implemented in 2014 with the Scientific Independence of Young Researchers (SIR) Programme. (*ref: PNR 2011-2013*).

**New funding schemes** inspired (or very likely to be inspired based on their terminology and processes) by the ERC schemes were launched in four of the seven EU countries with no investigator-driven funding schemes operational in 2006 (EL, IT, PL and RO)<sup>7</sup> and in seven of the EU countries where such schemes did exist since before 2007. Thus ERC influence at the level of the funding instruments could be seen in eleven EU member states.

One notable change which can be directly attributed to the ERC is the creation of the National Science Centre (NCN) in Poland in 2010. NCN is a government executive agency set up to fund basic research with the ERC as an explicit model<sup>8</sup>. The Council of the NCN, consisting of 24 distinguished professors selected by the Nominating Committee and appointed by the Minister of Science and Higher Education, establishes the funding strategy and the instruments in line with the country's development strategy. The NCN Council is renewed every two years. The council nominates 25 panels of experts evaluators distributed over three scientific domains which are very similar to the ERC's panels.

### **How did Ideas SP strengthen the scientific excellence of basic research in Europe?**

This is the key objective of the ERC and ERC projects are producing and disseminating a very substantial number of research findings in international, peer reviewed journals including the most prestigious ones.

As of 15 August 2014 over **29 000 publications** acknowledging ERC support have appeared in the **international, peer reviewed journals** indexed by the Web of Science database<sup>9</sup>. These publications report findings from both ongoing and finalized ERC projects. Because of the profile of the ERC's budget over FP7 the large majority of ERC projects were still ongoing as of 15 August 2014 and therefore the final number of publications from ERC projects funded under FP7 will be substantially higher than the current figure.

Table 11 below shows the number of publications acknowledging ERC funding that have appeared in two of the most prestigious scientific journals (*Nature* and *Science*). The combined number of articles in *Nature* and *Science* acknowledging ERC funding in 2008, when there were only a small number of active ERC projects, was **5**. By the end of September 2014 there were over **650**.

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<sup>7</sup> The "Fundamental Research Projects" launched by CY in 2009 and 2011, the "Researcher teams' projects" of the I.F. Research Council and the ANR non-thematic schemes (FR) were most probably not inspired by ERC's funding schemes.

<sup>8</sup> At their request NCN was able on several occasions to receive support and advice from the ERC including training and observing the ERC procedures.

<sup>9</sup> The Web of Science database maintained by Thomson Reuters covers around 12,000 peer-reviewed journals in the sciences, social sciences, arts, and humanities going back in some areas to the 19<sup>th</sup> Century.

<b>Publications acknowledging ERC funding</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014<sup>10</sup></b>	<b>Total</b>
NATURE	2	13	30	51	70	102	75	343
SCIENCE	3	11	26	46	69	90	62	307
<b>Total Nature and Science</b>	<b>5</b>	<b>24</b>	<b>56</b>	<b>97</b>	<b>139</b>	<b>192</b>	<b>137</b>	<b>650</b>
<b>ALL PUB</b>	<b>51</b>	<b>592</b>	<b>1944</b>	<b>4114</b>	<b>7041</b>	<b>10504</b>	<b>6073</b>	<b>30319</b>

### Number of publications acknowledging ERC funding in Nature and Science

While the vast majority of the ERC grants are still on-going, if one takes only 314 completed ERC projects from the earliest calls for proposals (187 projects from StG 2007 and 127 projects from AdG 2008), they have reported 10,796 publications<sup>11</sup>. This gives an overall average of 34 publications per project but with marked differences between fields and projects. Projects in Life Sciences have on average 23 publications, Physical Sciences and Engineering 48, and Social Sciences and Humanities 18.

ERC projects are not only producing and disseminating a very substantial number of research findings, but are producing a **substantial number of the most significant and high impact research findings** worldwide.

ERC grantees have an outstanding publication record with high scientific impact, notably in terms of the number of publications they have produced which are in the top 1% and 10% of the most highly cited publications in the world. Moreover, among the most cited publications arising from ERC funding, there are already a significant number that have been recognised as landmark contributions to science including the first paper to clearly show that there are different sources of myeloid cells in the body which will eventually result in new therapeutic approaches for multiple diseases and a “paradigm shattering” improvement in the efficiency of dye-sensitized solar cells, as well as work related to: resistance to chemotherapy in cancer; the discovery of the Higgs boson; the use of the new material graphene to design a functional electronic device; and the discovery of Majorana fermions in superconductors.

The ERC has carried out a number of bibliometric analyses of publications acknowledging ERC funding to try to ascertain their potential significance or impact. One analysis, using the reported publications from the 314 completed projects which could be validated in the Scopus database showed that **a significant proportion of**

<sup>10</sup> January to September 2014.

<sup>11</sup> Only those publications which were validated by a digital object identifier (DOI) and identified in the Scopus database are counted. This represents about 80 % of all publications which have been reported. The Scopus database maintained by Elsevier covers around 51 million records from 22,000 peer-reviewed journals “in the fields of science, technology, medicine, social sciences, and arts and humanities” going back to 1995.

ERC publications were in the top 1% most highly cited publications worldwide<sup>12</sup> – see Table below.

Entity	Outputs in Top 10% of the World (%)	Field-Weighted Citation Impact $\bar{x}$	Outputs in Top 1% of the World (%)
■ ERC_Completed_LS	67.6	3.42	20.6
■ ERC_Completed_SH	34.2	3.11	9.2
■ ERC_Completed_PE	41.0	2.98	7.9
■ United States	18.0	1.47	2.2
■ EU28 - European Union	14.6	1.26	1.4

**Citation percentiles of publications reported by completed ERC projects (Scopus)**

A second analysis came to a similar conclusion. The analysis, this time using the methodology of the US National Science Foundation and based on all the publications acknowledging ERC funding and recorded in the Web of Science database, showed that overall 12% of these publications were in the top 1% most highly cited publications world wide – see Table below. On the same basis, the number of the publications in the Top 10% was 855 out of 1996 or 43%.

nsf_citation_field	ERC pub in Top 1%*	All**	% in Top 1%	cit threshold Top 1% (2012)**
<b>Agricultural sciences</b>	0	1	0	11
<b>Astronomy</b>	6	115	5	31
<b>Biological sciences</b>	84	553	15	29
<b>Chemistry</b>	17	310	5	26
<b>Computer sciences</b>	4	29	14	10
<b>Engineering</b>	14	92	15	17
<b>Geosciences</b>	3	69	4	16
<b>Mathematics</b>	8	85	9	7
<b>Medical sciences</b>	22	155	14	20
<b>Other life sciences</b>	0	1	0	9
<b>Physics</b>	47	562	8	18
<b>Psychology</b>	0	11	0	16
<b>Social sciences</b>	1	11	9	10
<b>All</b>	240	1996	12	21

\*) ERC articles, notes and reviews published in NSF-classified journals in 2008-2010 cited by 2012 publications

\*\*) all ERC articles, notes and reviews published in NSF-classified journals in 2008-2010

\*\*\*) 1% thresholds considering articles, notes and reviews published in NSF-classified journals in 2008-2010 cited by 2012 publications

**Citation percentiles of publications acknowledging ERC funding (Web of Science)<sup>13</sup>**

<sup>12</sup> Out of the 10,796 publications reported by the 314 completed projects, 7003 (or 64 %) were indexed in Scopus.

<sup>13</sup> For publication window 2008-2010 and cited in 2012. Using full counting method.

What both of these analyses show, using different methods and data bases, is that a substantial fraction of ERC funded articles are among the most highly cited publications worldwide, including in the most significant top 1% category.

There are also already many discoveries from ERC funded projects which have been hailed as "landmark" or "exceptional advances" for example, selected scientific publications acknowledging ERC-funding which have been featured by editorial boards of scientific journals or highlighted in post-peer review systems such as "*Faculty of 1000*".

In only seven years a **significant fraction of the leading researchers in Europe** have applied to and been successful in the ERC calls.

To analyse whether leading researchers in Europe have applied for ERC funding schemes, the ERC identified over 14,000 individuals considered from 13 selected groups including highly-cited scientists (Thomson Reuters, ISI), elected European foreign associates of US National Academies, laureates of selected prestigious national research prizes and participants and chairs at Gordon Conferences, and then including only researchers affiliated with a European institution. These were then matched with a database of all ERC applicants since 2007. Bibliometric research has found over many years that a relatively small group of elite researchers publish the majority of the most highly cited scientific publications<sup>14</sup>.

This analysis showed that around a quarter of these "leading" researchers have applied for ERC funding schemes. Overall around 43% of the applicants from this group were funded by the ERC (some after multiple applications) meaning that 12% of the identified leading researchers have been funded by the ERC (1,647 out of 14,278). In addition, the analysis identified 1000 leading researchers from CZ, HU, PL, RO and SI (200 from each). Only 10% of the "leading" researchers identified from these less-performing Member States have applied for ERC funding schemes.

Successful applicants include up to now **11 Nobel laureates<sup>15</sup>, five Fields Medallists<sup>16</sup>** and the winners of many more internationally recognised prizes. Five of the Nobel laureates were funded by the ERC before receiving the Nobel Prize. The ERC has also received four proposals from Nobel Prize winners which it has not funded.

Over 4 300 world class starting and advanced researchers have been funded with 63 different nationalities. It should be no surprise that many of Europe's top researchers are already at some of Europe's top research institutions. On the other hand, the fact that

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<sup>14</sup> Lotka, A. 1926. The frequency distribution of scientific productivity. *Journal of the Washington Academy of Sciences*, 16(12), pp.317-324.

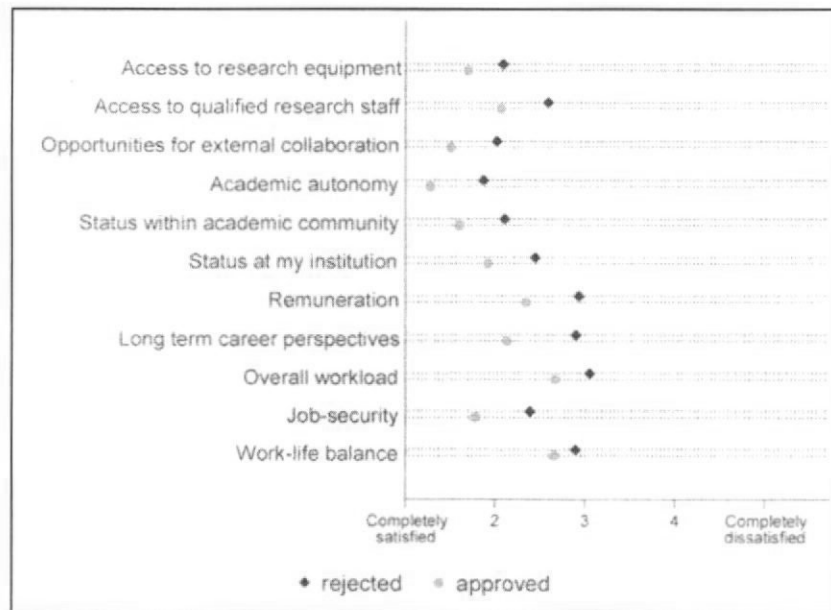
<sup>15</sup> May-Britt Moser **AdG 2010** (Physiology or Medicine 2014); Edvard Moser **AdG 2008** and AdG 2013 (Physiology or Medicine 2014); Jean Tirole **AdG 2009** (Economics 2014); Serge Haroche **AdG 2009** (Physics 2012); Konstantin Novoselov **StG 2007** and SyG 2012 (Physics 2010); as well as Ada Yonath AdG 2012 (Chemistry 2009); Andre Geim AdG 2012 (Physics 2010); Christopher Pissarides AdG 2012 (Economics 2010); Jean-Marie Lehn AdG 2011 (Chemistry 1987) James Heckman AdG 2010 (Economics 2000); Theodor Hänsch AdG 2010 (Physics 2005).

<sup>16</sup> "*Two Fields Medals 2014 awarded to ERC laureates*", August 2014; [http://erc.europa.eu/sites/default/files/press\\_release\\_files/ERC\\_Press\\_Release\\_ICM\\_2014.pdf](http://erc.europa.eu/sites/default/files/press_release_files/ERC_Press_Release_ICM_2014.pdf)

60% of the grants have gone to a further 550+ research institutions (over 200 of which host only one ERC grant) could be seen as evidence that **the ERC can recognise excellence wherever it is to be found.**

**How did Ideas SP promote the development of European research careers and contribute to make Europe more attractive to the best researchers?**

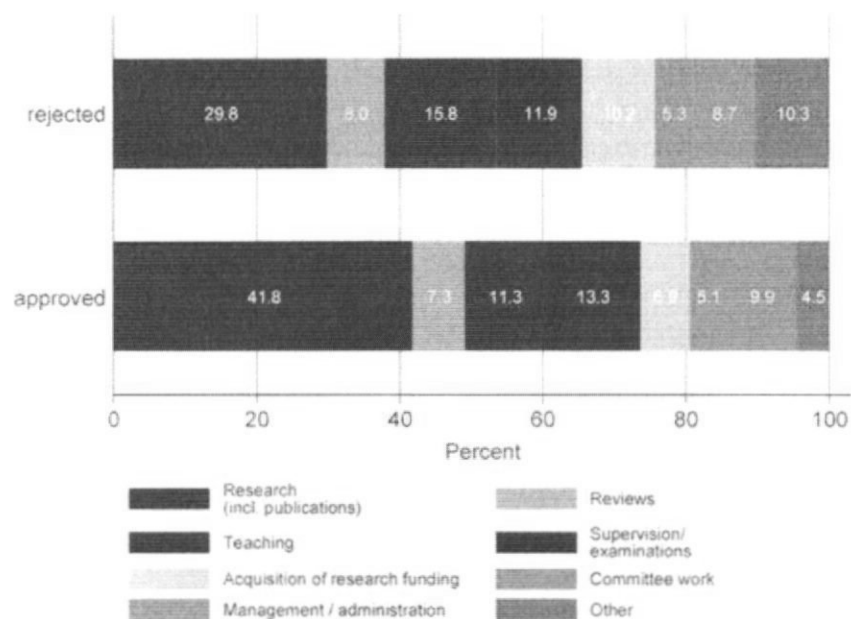
One of the key objectives of the ERC was to offer attractive funding conditions which would help to attract and retain outstanding researchers in the ERA. The ERC funded a research project from September 2009 – September 2014 designed to evaluate the ERC’s Starting Grant programme by focusing on the effects on the individual career development of young researchers. The project also aimed to analyse any wider institutional and structural effects of ERC funding<sup>17</sup>. The charts below show the changes in working situation reported by successful ERC grantees in comparison to a control group of unsuccessful ERC applicants<sup>18</sup>. The results show that the researchers funded by the ERC reported **better working conditions** across the board and in particular more time for research.



**Assessment of the working situation (MERCİ final results)**

<sup>17</sup> MERCİ - monitoring ERC's implementation of excellence.  
[http://www.research-information.de/Projekte/Merci/projekte\\_merci\\_lang.asp](http://www.research-information.de/Projekte/Merci/projekte_merci_lang.asp)

<sup>18</sup> Based on a survey which took place on average around four years into the ERC grant of each respondent.



**Assessment of the time-budget (MERCİ final results)**

Furthermore, the ERC funded a research project from February 2009 to April 2012 to explore the possible broader impacts of the ERC<sup>19</sup>. The project found preliminary evidence of impacts at several levels beyond the direct effects on the careers and research of the ERC grantees themselves. The study found that ERC success is unanimously seen as a new quality marker for research organisations across Europe, which in turn feeds back into actions by the research and university leaders. The impact of the ERC on universities and research institutes was most pronounced in the research organisations that are just below the top research performers since the existence of the ERC as well as attracting some grants is used to overhaul the organisation and develop and implement the practices conducive to research excellence. The ERC and its funding schemes have less direct impact on top research performers and on research organisations that are lagging far behind these.

Frontier research also plays a **critical role in training** new graduate students and post-doctoral researchers. Whether their final professional destination is academia or industry, research-trained graduates bring with them skills needed to perform research and to develop new ideas and skills in using advanced instrumentation and techniques.

The proportion of **ERC grantees with non-ERA nationality** is about 7.1%. However many of these were already based in Europe at time of application. The proportion of ERC grantees that were resident outside ERA at time of application is about 2.6% (most being ERA nationals in US). Researchers tend to be very mobile early in their careers but they are less likely to move at the stage when they have received tenure from their host institution which is a stage of many researchers in the ERC target population.

<sup>19</sup> EURECIA - understanding and assessing the impact and outcomes of the ERC funding schemes. [www.eurecia-erc.net](http://www.eurecia-erc.net)

For example, around 17% of the PhDs and post-docs in ERC teams (estimated at 2,700 over FP7) were from outside Europe, the largest number of whom were from China, the USA and India. This shows the potential of ERC PIs to attract talented early-stage researchers to Europe from around the world.

**Table 9: ERC grantees that were resident outside ERA at time of application**

Country of residence	International grantees	ERA nationals	Total
Argentina	1		1
Australia	1	3	4
Canada	1	2	3
India	1	1	2
Japan		1	1
Korea		1	1
Lebanon		1	1
Russia	1		1
USA	27	72	99
<b>Total</b>	<b>32</b>	<b>81</b>	<b>113</b>

#### **How did Ideas SP provide the knowledge-base needed to support key Community policies?**

The ERC does not have the explicit aim of funding studies that will make specific policy recommendations to the Commission. However the ERC funds top quality research across all fields including in the social sciences and the humanities, and so a lot of this work is relevant to analysing and contributing to key Community policies.

One obvious example is the work of influential economists funded by the ERC such as Thomas Piketty and the Nobel Prize winners Jean Tirole and Christopher Pissarides.

The usefulness of a large bottom-up programme is that it will often fund research into areas which were not seen as priorities in top-down programmes but which become priorities because of events such as the Ebola outbreak. One example is that during the volcanic events at Eyjafjallajökull in Iceland in 2010 which caused enormous disruption to air travel across western and northern Europe it was found that the ERC was already funding a number of relevant projects.



## **How did Ideas SP increase availability, coordination and access in relation to top-level European scientific and technological infrastructure?**

The ERC Scientific Council has encouraged and supported the provision of **open access** to the results of ERC funded research since the very beginning<sup>20</sup>. The ERC currently provides funding for the European PubMed Central (since 2013 with the latest round of up to €850k for up to 72 months from the ERC Work Programme 2015) initiative, arXiv (a nominal annual fee from the administrative budget) and the OAPEN initiative mainly covering open access books in the area of humanities and social sciences (50k for up to 24 months from the ERC Work Programme 2015).

Direct costs, including for equipment accounted for about 25% of total project funding awarded by the ERC during FP7. ERC PIs can request additional funding of up to one million euro per grant to cover the purchase of major equipment and access to large facilities. ERC PIs work at many of Europe's top infrastructures including 11 projects at CERN.

## **How much did Ideas SP contribute to job creation?**

The main role of the ERC in contributing to job creation is its role in creating the new knowledge that will create whole new sectors and industries to provide high quality jobs, and drive future productivity and growth.

However a large programme such as the ERC also directly supports researchers and personnel costs accounted for about 50 – 60% of total project funding awarded by the ERC during FP7.

A survey of 995 of the initial ERC grants showed that on average each ERC project employs six team members with around 63% of those having the role of PhD students or post-docs. Extrapolating these numbers to the 4 354 StG, CoG and AdG projects means that the ERC will have supported around 16 000 PhD students and post-docs from FP7.

In addition around 17% of these early-stage researchers were from outside Europe, the largest number of whom were from China, the USA and India. This shows the ERC's potential to attract talented early-stage researchers to Europe from around the world.

## **To what extent was Ideas SP coherent with other EU actions (CIP, ESF) and EU policy?**

The ERC has a significant structural impact by generating a powerful stimulus for driving up the quality of the European research system, over and above the researchers and projects which the ERC funds directly. ERC-funded projects and researchers set a

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<sup>20</sup> See the ERC Scientific Council Statement on Open Access of December 2006, and the Open Access Guidelines for researchers funded by the ERC (latest version: December 2014). Starting with the WP 2012 a Special Clause on Open Access has been systematically included in all Grant Agreements for ERC Frontier Research Grants.

clear and inspirational target for frontier research in Europe, raise its profile and make it more attractive for the best researchers at global level. The prestige of hosting ERC grant- holders and the accompanying 'stamp of excellence' are intensifying competition between Europe's universities and other research organisations to offer the most attractive conditions for top researchers. And the ability of national systems and individual research institutions to attract and host ERC grant-winners sets a benchmark allowing them to assess their relative strengths and weaknesses and reform their policies and practices accordingly. ERC funding is therefore additional to the ongoing efforts at Union, national and regional level to reform, build capacity and unlock the full potential and attractiveness of the European research system.

**Which was the added value of Ideas SP when compared with national research and innovation programmes?**

There is strong evidence for suggesting that the ERC has high EU added value.

<b>Dimensions of EU added value</b>	<b>ERC added value and its complementarity with the rest of the Framework Programme</b>
<b>Transnational dimension</b>	<p>Traditionally the Framework Programme has focussed on supporting transnational collaboration and mobility. The ERC provides for the first time a European-wide competitive funding structure based on the sole criterion of excellence.</p> <p>In economic terms this transnational competition avoids the negative effects of cross-border externalities and limited systems competition. This has far-reaching consequences:</p> <ul style="list-style-type: none"> <li>• Resources are allocated more efficiently, the best researchers with the best ideas receive funding regardless of their nationality and the availability of national funding;</li> </ul> <p>ERC peer review and funded research acts as a gold standard allowing Member States and individual research institutions to benchmark the relative strengths of their systems and policies leading to important reform of national policies and institutional practices.</p> <p>In this way the ERC funds research of the very highest quality at the frontiers of knowledge thus facilitating the major breakthroughs that are necessary to address societal challenges, to promote the creation and growth of businesses in emerging sectors and to fully develop a knowledge and innovation society in Europe.</p> <p>At the same time the ERC provides a powerful</p>

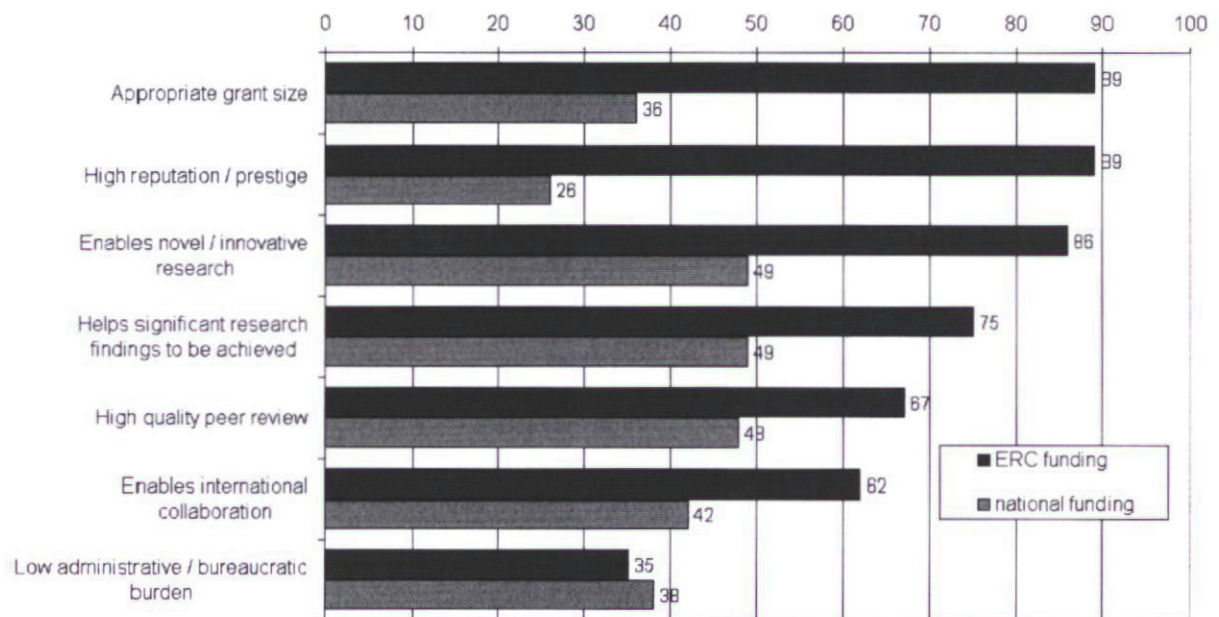
	dynamic for driving up the quality of the overall European research system. In this way the ERC supports research excellence across the whole of the European Union and associated countries.
<b>Economies of scale or scope</b>	The ERC offers a large scope for economies of scale. By deciding centrally which proposals receive funding, the risk of duplication of research is limited; and it is less costly to employ the experts needed for high-quality assessment of project proposals. The scarcity of excellent peer reviewers in particular is a major factor for all research funding bodies. The quality of the ERC's peer review has already been widely recognised by the research community as reported by a panel of independent experts <sup>21</sup> and in the interim assessment of FP7.
<b>Critical mass requirements</b>	Traditionally the Framework Programme has focussed on building up critical mass by supporting "virtual centres" and networks. The ERC, by providing generous funding to research teams in situ and by making this funding portable, reinforces existing centres of excellence and allows ambitious new centres to quickly scale up the research profiles in which they are particularly strong. The reinforcement of existing centres of excellence is an integral component of the ERC's mission given that Europe lags significantly behind the US at the highest levels of scientific research.
<b>Common preferences</b>	The diversity of R&D policies, particularly in the levels of public funding for R&D is said to show the heterogeneity of policy preferences across the EU. This is often said to be an argument against centralising EU R&D policy, or at least against centralising all public funding for R&D. However it is arguable whether all of these differences, especially in the levels of public funding for R&D, reflect genuine preferences or under-spending by some MS resulting from the presence of spillovers. And in the case of the ERC it is noticeable that all EU MS have a policy of supporting research excellence to greater or lesser degrees. See also the advantages of operating a bottom-up competition below.

<sup>21</sup>

*Review of the European Research Council's Structures and Mechanisms* (July 2009).

<p><b>Low coordination costs</b></p>	<p>The coordination costs of agreeing priorities for, setting up and managing major, transnational public-public or public-private joint ventures, joint programmes, cooperation platforms, networks or consortia can be large (though the benefits may still outweigh the costs). However by operating a bottom-up competition (soliciting investigator-driven projects on any topic) evaluated on the sole criterion of excellence the ERC's coordination costs are very low in comparison. It is unlikely that any alternate delivery mechanism such as an intergovernmental approach or system of bilateral or multilateral agreements could achieve the same objectives with the same degree of efficiency, if in fact agreement could be reached on such an approach at all.</p>
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Furthermore, evidence shows that ERC funding allows researchers **to do better research**. Further evidence comes from a study which directly asked ERC grantees whether ERC funding allowed them to carry out work which would not have been possible without ERC funding.



**Attractive features of national and ERC funding (percentage of respondents)<sup>22</sup>**

Another study, MERCI, showed that ERC grantees were able to allocate significantly more of their working time to their research. This shows that with grants which can go

<sup>22</sup> Based on survey of StG 2007 grantees by EURECIA project (understanding and assessing the impact and outcomes of the ERC funding schemes). [www.eurecia-erc.net](http://www.eurecia-erc.net)

up to 3.5 million for up to five years, researchers can really focus on the core of their research with the aim that it leads to radical breakthroughs.

### **To what extent the results of Ideas SP contribute to the achievements of the new Commission's priorities?**

The Juncker Commission's top priority is to get Europe growing again and to increase the number of jobs without creating new debt. The main role of the ERC in contributing to job creation is its role in creating the new knowledge that will create whole new sectors and industries to provide high quality jobs, and drive future productivity and growth.

The special role of ERC funding was acknowledged during the adoption process for the Investment Plan for Europe where ERC did not receive any cut to its funding from the levels agreed in the Horizon 2020 legislation along with the Marie Skłodowska-Curie and widening participation actions.

In addition in June 2015 the Commissioner for Research, Science and Innovation gave his assessment of the challenges facing Europe and his objectives and his priorities.

#### **Open Innovation**

The European Research Council funds "frontier research" in recognition that, "*classical distinctions between basic and applied research have lost much of their relevance at a time when many emerging areas of science and technology (e.g. biotechnology, ICT, materials and nanotechnology, and cognitive sciences) often embrace substantial elements of both.*" Frontier research often generates unexpected or new opportunities for commercial or societal application from the immediate term to the very long term. The ERC Scientific Council explicitly recognised the frontier nature of ERC funded research in 2011 by creating the Proof of Concept Grant (PoC) to explore the commercial and social potential of ideas arising from ERC grants. Around 50% of the first 50 completed PoC projects reported at least one patent application. In addition, 18% of them spun-out a new venture and 30% of them intended to use an existing or new spin-out to take forward their idea. The PoC call in ERC Work Programme 2016 has a budget of €20 million with three deadlines.

#### **Open Science**

ERC directly addresses the Commissioner's second strategic objective by boosting excellence in cutting-edge, fundamental research.

The ERC also supports the principle of open access to the published output of research, including in particular peer-reviewed publications as a fundamental part of its mission. It also supports the basic principle of open access to research data and data related products such as computer code. Under Horizon 2020, beneficiaries of ERC grants must ensure open access to all peer-reviewed scientific publications relating to its results. The ERC recommends that all ERC funded researchers follow best practice in their research field and be prepared to share the data they have gathered and used in their project with other researchers whenever they are not bound by copyright restrictions, confidentiality requirements, or contractual clauses. Beneficiaries of ERC frontier research grants

funded under ERC Work Programme 2016 may continue to opt-in, on an individual and voluntary basis, to the Horizon 2020 Pilot on Open Research Data.

In addition, the ERC currently provides funding for the European PubMed Central (since 2013 with the latest round of up to €850k for up to 72 months from the ERC Work Programme 2015) initiative, arXiv (a nominal annual fee from the administrative budget) and the OAPEN initiative mainly covering open access books in the area of humanities and social sciences (50k for up to 24 months from the ERC Work Programme 2015).

ERC also considers that it is essential to maintain and promote a culture of research integrity at all stages of the evaluation and granting process to make ERC competitions fair and efficient and to maintain the trust of both the scientific community and society as a whole. The Work Programme 2016 introduces a new restriction on applications for Principal Investigators whose proposals have been rejected on grounds of breach of research integrity.

### **Open World**

The ERC confers status and visibility on the best research leaders working in Europe and offers attractive funding conditions which help to attract and retain outstanding researchers in the ERA. The ERC actions are open to researchers of any nationality who intend to conduct their research activity in any Member State or Associated Country. Principal Investigators may be of any age and nationality and may reside in any country in the world at the time of the application. Under Work Programme 2016 the following features are maintained: additional “start-up” funding is available for scientists moving to Europe (EUR 500 000 for Starting and EUR 1 Million for Advanced Grantees); the ERC funded Principal Investigator can keep their affiliation with their home institute outside Europe; team members can be based outside Europe; the ERC funded Principal Investigator can move within Europe with the grant (portability).

Outside of the Work Programme the Commission has signed Implementing Arrangements with several funding agencies outside Europe to allow excellent young researchers from those countries to come to Europe and become part of ERC teams. In 2015 so far three such arrangements have been signed with the authorities in Argentina, Japan, and China in addition to existing agreements with bodies in USA and South Korea. The ERC takes part alongside the Commission in the annual meetings of the Global Research Council since its inception in 2012..

### **Ideas SP in H2020: continuity or evolution?**

Competition for ERC grants has been intense. Success rates in ERC competitions with an average of 10.5% over FP7, are around half those of any other FP7 Specific Programme, including the Marie-Curie actions (SP “People”). ERC success rates are also well below those of other comparable funding organisations. The ERC has funded a tiny proportion of the researchers in the EU but also a relatively small proportion of the best researchers in the EU. This suggests that the ERC could absorb a significantly higher budget and still fund excellent research.

In addition to the mid-term evaluation of FP7 which looked at the ERC, there was also a specific review of the ERC's structures and mechanisms in 2009 and a further ERC Taskforce in 2011. The conclusions of both these reviews fed into the Horizon 2020 legislation. In particular, the scientific governance of the ERC was strengthened in Horizon 2020 by merging the positions of President of ERC and Secretary General; establishing a full-time President based in Brussels; three Vice-Chairs elected from amongst the Scientific Council members. There were further modifications in the Horizon 2020 legislation including recognition of the ERC Board and more explicit references to the responsibilities of the ScC and where it is necessary to take into account its positions.

The documents and reports from these reviews can be found here: <http://erc.europa.eu/future-erc>

Finally, under Horizon 2020 the review and evaluation of the implementation and management of the activities of the ERC will continue *"on an on-going basis with the full involvement of the Scientific Council to assess the achievements and adjust and improve procedures and structures on the basis of experience"*.

## **12. PEOPLE SPECIFIC PROGRAMME**

### **Objectives**

#### **Original objectives**

As a prerequisite for increasing Europe's capacity and performance in research and technological development and for consolidating and further developing the European Research Area, the overall strategic aim of the People Specific Programme was to make Europe more attractive to researchers.

This was implemented by pursuing a considerable structuring effect throughout Europe on the organisation, performance and quality of research training, on the active career development of researchers, on knowledge-sharing through researchers between sectors and research organisations, on increasing partnership between industry and academia, and on strong participation by women and early-stage researchers in research and development.

The goal of increasing the human R&D potential in Europe in terms of both quality and quantity included systematic investments in people in terms of their skills and competence development at all stages of their careers, from initial research training specifically intended for young people, to career development and life-long training in the public and private sector. Mobility, both trans-national and intersectoral, was considered as fundamental to achieving these goals. Increasing the mobility of researchers and strengthening the resources of those institutions which attracted researchers internationally aimed at encouraging establishment of centres of excellence across the European Union.

#### **Evolution of objectives to respond to the crisis**

Measures to ensure competitiveness and to promote growth and jobs are part of the EU answer to the financial and economic crisis. Investing in training and skills remains therefore particularly relevant, as it enhances the employability and productivity of the workforce.

The People Programme invested in the knowledge and potential of researchers, especially at the beginning of their professional careers.

Thus, there was no need to alter the overall objectives of the programme, but rather to finetune the focus on the relevance of skills and competences for the next generation of researchers.

In this respect, in 2011, the European Commission introduced the European Industrial Doctorates (EID) for PhD candidates to get a strong insight in the industrial world and contribute directly, with their doctorate research, to the innovation potential of the European economy. The EID aimed at tackling the skills mismatch between academically trained researchers and the skills and competences needs of industry and at making researchers not only aware of the requirements and expectations of the non-academic world, but also better prepared for successful transitions from the academic world to a business environment. It also allowed European companies to take full



advantage of the creativity and innovation potential of young researcher to increase their own competitiveness.

### ***Implementation***

The People Programme was implemented through the Marie Curie Actions (MCAs) and the specific policy actions with a view to support the creation of a genuine European labour market for researchers by removing obstacles to mobility and enhancing the career perspectives of researchers in Europe.

The People Programme was implemented under five main activity lines:

- initial training of researchers;
- life-long training and career development;
- industry-academia partnerships and pathways;
- international dimension – world fellowships; and
- specific policy actions (Researchers' Night and policy activities to foster the mobility of researchers, promote their career, modernise their skills and prepare future initiatives, in particular through: the EURAXESS Researchers in Motion initiative; the Retirement Savings Vehicle for European Research Institutions (RESAVER); the Human Resources Strategy for Researchers (HRS4R); the support to the implementation of the Innovative Doctoral Training Principles (IDTPs) and data collection activities).

### **How did FP7 contribute to the competitiveness of European industry?**

Enhancing cooperation between universities and industry in terms of knowledge sharing, training and broad skills development was a key element of MCA. 6.3% of the overall FP7 MCA budget was dedicated to SMEs. 9.6% of all FP7 MCA participants were from the private sector (out of over 22 000 participations).

The involvement of the private sector was much more significant in the two main activities dedicated to academia-industry interactions (Initial Training Networks (ITN): 20.8% of participants were from the private sector; Industry-Academia Partnerships and Pathways (IAPP): 44.6% of participants were from the private sector). Together ITN and IAPP schemes constituted 50% of the People Programme's budget. Among all businesses participating in ITN and IAPP actions, more than 50% were SMEs.

Nine out of the 10 European companies investing the largest sums in R&D participated in host-driven MCA: Volkswagen, Daimler, Sanofi-Aventis, GlaxoSmithKline, Siemens, Robert Bosch, Bayer, AstraZeneca, Eads.

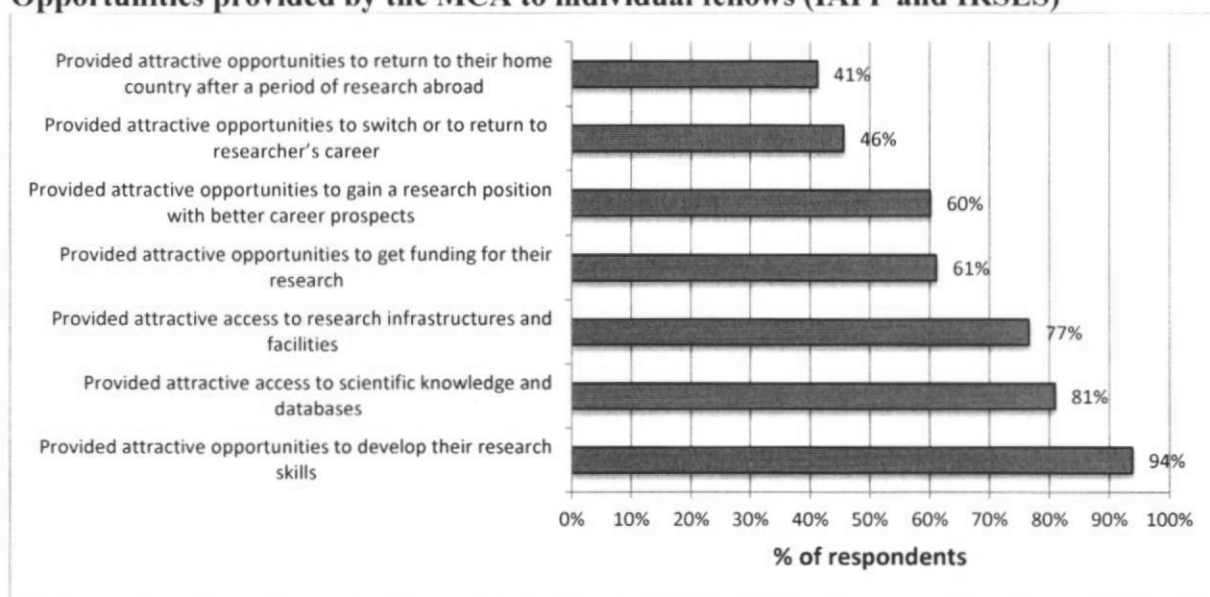
The MCA has contributed to research that could lead to improved products or processes in the future (acknowledged by 61% of IAPP beneficiaries), helped to become more aware/confident of the commercial potential of their research (45%), as well as helped to gain new commercial contacts in the project network/partnership (including industry) (41%).

Nearly 17% of all Intellectual Property Rights reported in FP7 are from the projects funded by the MCA.

Abundant and highly trained researchers are a necessary condition to advance science and to underpin innovation, as well as an important factor to attract and sustain investments. In order to make Europe more attractive to the best researchers the People programme maximised, quantitatively and qualitatively, the human potential in research and development in Europe.

Mobility of researchers was an essential element in achieving these objectives and structured training of researchers was a significant element of the action. The programme emphasised and committed participating organisations to train researchers and exposed them to industry. Such exposure was essential for fostering innovation, for making research productive and for turning research into marketable outputs. It facilitated a two-way exchange of effects in the sense that the transfer of knowledge and exchange of staff worked in both directions. As a result of such interactions, the participating researchers obtained a valuable mix of soft, transferable and specialised capabilities and skills.

#### Opportunities provided by the MCA to individual fellows (IAPP and IRSES)



Source: Survey of MC fellows, PPMI 2013.

#### How did FP7 People SP contribute to increase European and international wide S&T collaboration and networking for sharing R&D risks and costs?

In FP7, MCAs have supported some **50.000 mobile researchers**.

Promoting international research careers, networking and staff mobility is crucial to enhance global cooperation. MCA fellows represented over 140 different nationalities and their research projects were undertaken in more than 80 countries. This testifies the world-wide openness of the programme and its important contribution towards enhancing the knowledge transfer and the quality of research undertaken. Nearly 24%

of MCA fellows were researchers from countries outside the EU Member States or Associated Countries. In addition, the International Research Staff Exchange (IRSES) has promoted reciprocal exchange of research staff from Europe to third countries, increasing the share of 3rd country nationals supported by MCA to 34%. In terms of host organisations, about 12.5% of funded Marie Curie beneficiaries are localised in third countries. About a quarter of the total number of projects funded under the Marie Curie Actions has a non-European organisation involved.

81% of the MCA beneficiaries stated that the programme provided attractive international mobility opportunities for researchers in their organisation. 76% indicated that it provided more opportunities to attract researchers to their organisation from abroad. 91% of all organisation beneficiaries considered that the MCA provided attractive opportunities to create new, or join existing international research networks.

The FP7 Marie Curie funding has supported 18 000 participations of both academic and non-academic organisations in EU MS, Associated Countries and beyond, creating opportunities for intellectually stimulating exchanges and multiplying international contacts among universities, research institutions and businesses.

Social network analysis revealed the dense nature of the MCA network: the majority of organisations participating in the host-driven MCA (ITN, IAPP and IRSES) were directly or indirectly interconnected. These connections facilitated networking and knowledge transfer inside the networks. The social network analysis also revealed that research organisations from the EU-15 (e.g. Italy, Spain, Germany and the UK), as well as large third countries, such as the United States, Japan or Turkey, acted as central “gateways” for the weakest participants (those with the lowest number of connections).

Yet, despite the solid evidence of an undisputed centrality of certain research organisations representing the EU-15 countries, it was also found that the programme did not develop a closed circle of “elite” organisations, occupying the top positions in the host-driven MCA each year. On the contrary, different organisations acted as the most important intermediaries of the MCA network in different points in time, thus proving the openness of this network to new organisations willing to undertake more responsibility.

#### **How did FP7 People SP contribute to improve the coordination of European, national and regional research policies?**

MCAs had an evident structuring effect on the European Research Area by setting standards for research training, attractive employment conditions and open recruitment for all EU researchers. Through the co-fund mechanism, they have been effective in aligning national resources and influencing programmes at regional, national and international level.

The principles guiding the doctoral training offered under MCA ITN have been recognised as best practice in Europe: international, intersectoral and interdisciplinary environment created by consortia from different countries and offering to supported researchers a significant exposure to industry, the development of transferable skills, including on entrepreneurship, business skills and Intellectual Property Rights, as well as attractive working and employment conditions.

As a consequence, the MCA experiences and guidelines were translated into the EU Principles for Innovative Doctoral Training, adopted by the ERA Steering Group on Human Resources and Mobility.

Evidence shows that in some countries there was a structuring effect of ITN at the national level. It occurs in terms of expansion of doctorate curricula, by including transferrable skills, more exchanges with industry, or more focus on employability. Additionally, by implementing the ITN projects participating organisations could test new ways of managing research careers and support policy initiatives aimed at introducing new types of employment contracts or increasing transparency in the recruitment processes.

For example, in Germany the broad focus on employability enhancement of the research fellows was assessed very positively. It was acknowledged that ITN was a good example of the efforts to increase employability and collaborate with industry.

In the UK, the ITN action was seen as an innovative example of international collaboration between academia and industry. The unique added value and impact of MCA lied in its potential to attract researchers to the country and increase overall research excellence in the UK. ITN opened new avenues to exploit the potential of academia-industry interaction.

Furthermore, in Slovenia, the MCA and especially ITN were taken into account when preparing a national joint strategy for research and innovation. The aspects of human resources management were integrated in this strategy and the Slovene participation in ITN was a particularly good learning experience.

In Romania, the People Programme was an inspiration for national programmes promoting the mobility of PhD researchers within the country.

And finally, training in industry was introduced in certain national PhD programmes..

One of the novel measures under the MCA was the introduction of the co-funding mechanism for regional, national and international programmes (COFUND). COFUND objectives concerning the mobilisation and leveraging of national, regional and international resources and widening opportunities for individuals and research organisations related strongly to the European Research Area priorities on overcoming mobility barriers and addressing fragmentation in the European research landscape.

The COFUND budget during FP7 was about €530 million. With the beneficiary funding added (based on an EU contribution of 40%), the total budget of co-funded programmes eventually raised to €1.3 billion. This allowed co-financing 167 programmes and supporting over 9 700 post-doctoral researchers.

In COFUND, national, regional and international fellowship programmes were highly encouraged to apply the Charter and Code principles, in particular concerning the

quality and the transparency of the recruitment process for researchers. MCA had thus a pronounced structuring impact by aligning national resources, influencing national fellowship programme design, and by setting standards of attractive employment conditions and open recruitments for all EU-researchers.

For instance, some organisations such as the Swedish Forskningsrådet För Arbetsliv Och Socialvetenskap (COFAS programme) and the Italian Provincia Autonoma di Trento (IRENTINO programme) have transformed stipends into employment contracts due to their participation in COFUND.

### **How did FP7 People SP strengthen the scientific excellence of basic research in Europe?**

MCA foster the culture of excellence in Europe. In 2014 only, 3 Nobel Prize winners were involved in MCA projects, 30 young scientists supported by the FP7 MCA contributed to the discovery of the Higgs Boson at CERN.

MCA contribute actively to a knowledge-based economy through a coherent framework addressing European needs for more researchers, better career opportunities in all research sectors and development of key skills to meet future challenges.

50 000 mobile researchers (included 10 000 PhD candidates) have been supported under FP7 MCA, all of them receiving high-quality research training and excellent career opportunities in both the public and private sector.

The high quality of training and supervision under the MCA was highly rated by 78% of the MC fellows in terms of the amount of supervision and by 82% of the fellows in terms of the quality of supervision. 95% of the MC fellows were satisfied by the training opportunities offered during the fellowship.

The level of skills of MCA researchers improved, mostly in the following areas: new and/or advanced scientific methods in their respective research field (63%), interdisciplinary techniques (50%), public speaking and communication (49%), languages (46%) and use of specialised equipment (41%).

Interdisciplinary approach is a key to unlock knowledge and innovation potential in many scientific disciplines. The critical mass of knowledge in different scientific fields is often concentrated in different countries.

MCA developed research collaboration across disciplines and promoted interdisciplinarity in all projects – this was a key aspect of the most important criterion (S&T quality) for the majority of calls for proposals. According to the FP6 Marie Curie Ex-post evaluation, 77% of fellows reported “very high engagement” plus “high engagement” in inter-disciplinary or multi-disciplinary research.

MCA fostered long-lasting collaborations for the advancement of research. Bringing together top researchers from different background and cultures helped to create powerful synergies, boost creativity and often resulted in new perspectives and insights. MCA gave researchers opportunities to build new professional contacts and develop

sustainable research collaborations. Under FP7, MCAs have strengthened research collaborations (90% of beneficiaries), allowed the development of new project applications and/or projects among MC partners (87%), created new collaborations with academic organisations or businesses and enterprises (86%), increased the exchange of knowledge in the organisations or benefitted research and technical staff through the exchange of knowledge (84%).

When asked about their Marie Curie project's contribution to developments in their respective organisation, beneficiaries replied as follows:

	<b>IAPP</b>	<b>IRSES</b>	<b>ITN</b>	<b>Total</b>
Has enhanced/will enhance research excellence	87.5	93.1	92.9	<b>92.2</b>
Has increased/will increase the number of peer-reviewed publications (by scientists in charge, recruited/seconded fellows and other authors)	84.8	90.2	91.4	<b>90.0</b>
Has extended/will extend research dimensions through joint, multidisciplinary, intersectoral and emerging supra-disciplinary fields	85.9	88.2	89.2	<b>88.4</b>
Has contributed/will contribute to applications for patents, trademarks, registered designs, etc.	46.0	42.2	38.3	<b>40.8</b>
Has contributed/will contribute to innovation through the development of new processes and products	73.4	63.2	58.2	<b>62.2</b>

Source: Survey of MC beneficiary organisations, PPMI 2013

### **How did FP7 People SP promote the development of European research careers and to make Europe more attractive to the best researchers?**

The development of European research careers was the primary objective of the People Programme.

MCA were highly effective in attracting talent to Europe, strengthening research mobility and enhancing international cooperation and networking.

There was a spillover effect in organisations participating in the host-driven MCA from their MC projects to other organisational practices. The following practices of MC beneficiaries for managing the careers of other (non-MC) researchers were most affected: offering more mobility opportunities for researchers (48%), introducing new types of training for researchers (41%), better public advertising of research job vacancies (41%), advancing career development, advice and job placement services for

researchers (35%), introducing new methods for the supervision of researchers (31%) and introducing new welcoming or support services for researchers (also 31%). Contracts with full social security were introduced to researchers (13%), working conditions for researchers were improved and made more flexible (19%) and salaries of researchers were made more financially attractive (21%). The spillover effect of the MCA on the beneficiary organisations was quite considerable in the latter areas, taking into account the challenges faced by research institutions.

MCAs set best practice in Europe in the field of researchers' career development. Principles set out in the European Charter and Code were in-built in all MCAs and were a fundamental element during the evaluation process.

All MCAs strongly promoted and encouraged using employment contracts for researchers with full social coverage instead of fixed-amount fellowships. In this way, MCAs were setting professional standards for researchers, which the European Commission wishes to be applied all over Europe and for researchers at all stages of career, starting with a PhD level. For instance, significant impacts relating to contract permanence, salaries and working conditions were reported by fellows in the FP6 ex-post evaluation or by organisations in the FP7 mid-term evaluation of MCAs.

Some 80% of the MC fellows estimated that their fellowship experience improved their career prospects. 95.4% of MCA fellows have been in employment positions two years after the end of their fellowship. MCA fellows are also more likely (+8%) of obtaining a permanent position after the fellowship.

The MCA programme attracted international talent, opening up the European Research Area. MCA-supported researchers represented over 140 different nationalities. The research institutes hosting Marie Curie researchers were located in more than 80 countries. Nearly 34% of MCA-supported researchers were nationals of countries outside the EU Member States or Associated Countries. 76% of the MCA beneficiaries indicated that it provided more opportunities to attract researchers to their organisation from abroad.

MCA have also contributed to retaining the best researchers in Europe. 46% of researchers coming to the EU from non-European industrialised countries stayed in Europe after the end of their Marie Curie fellowship.

MCA were a good opportunity to convince researchers to take up long-term careers within enterprises, especially SMEs. Thanks to the MCAs, businesses were encouraged to be more involved in the career development of experienced researchers, as well in doctoral training, so that skills better match industry needs. Mobility of researchers also shortened the distance between the academia and the business by filling the existing gap between the two sectors. The achievement of this intersectoral cooperation has largely been accomplished through the ITN and IAPP schemes, which constitute half of the People Programme's budget. A broad spectrum of small and large enterprises was involved in the training and career development of researchers, SMEs being largely involved (50% of all businesses participating).

MCAs actively contributed to counterbalance gender inequality in all research areas. Under FP7 out of the total number of researchers nearly 40% were women. An important fact to be noticed is that success rates of male and female candidates to Marie Curie individual fellowships were statistically very similar, i.e. there was no discrimination for women applicants. In addition, family-friendly measures were set at contractual level and adopted in all Marie Curie projects. In particular, the family situation of the researcher was taken into account for fixing the amount of mobility allowance to which all Marie Curie researchers were entitled. A dedicated panel (Career Restart Panel – CAR) was introduced under the Marie Curie Intra-European Fellowships (IEF) in the 2010 People Work Programme with the aim to better ensure equal opportunities and encourage the return into the career after a break.

To further develop the skills and competences of the next generation of researchers to deliver on innovation and growth, a pilot on European Industrial Doctorates (EID) was launched in 2011. The EID proposed to enrol each doctoral candidate in industrial research for at least 50% of the time of their fellowship. The FP7 MCA supported 58 EID projects in which some 240 PhD candidates have been trained.

COFUND fellowships were contributing both quantitatively and qualitatively to the reinforcement of the human resource potential. The quantitative improvements were evident from the number of fellowships which have been created and filled. The qualitative improvements have been reported on by both individual fellows and their host institutions. This included the strengthening of research capacities, of research capabilities and of research networks. Establishing and managing a COFUND programme has affected the administrative and operational procedures of around a third of the organisations concerned, mostly in terms of increasing the openness of recruitment to trans-national mobility and the use of independent/peer review in selection processes. Improvements have also taken place in the transparency of procedures, in line with the European Charter and Code.

### **How did FP7 People SP provide support key Community policies?**

The Marie Curie Actions (MCAs) contribute actively to a knowledge-based economy through a coherent framework addressing European needs for more researchers, better career opportunities in all research sectors and development of key skills to meet future challenges.

The in-built bottom-up approach of the programme helped fund research in the areas which are not necessarily seen as priorities but may become so in the future. As a consequence, unknown future challenges are also covered and Europe will be ready to face them when they occur.

To meet major societal challenges, critical mass is needed. MCA, thanks to their focus on knowledge sharing and bridging the gap between research sectors and disciplines, contribute to this objective.



### **How did FP7 People SP increase availability, coordination and access in relation to top-level European scientific and technological infrastructure?**

To enhance dissemination and public engagement, beneficiaries of the MCAs are required to plan suitable public outreach activities. At the programme level, the Researchers' Night activities were increasing the awareness of the general public about the role of researchers and the key benefits they bring to society. Researchers' Night was organised as a unique event taking place all over Europe on the last Friday of September. The success and impact of this annual event since 2005 both in terms of number of people reached and the benefits to the Marie Curie programme justified its annual frequency. In 2013 only, nearly 1.3 million people of all ages participated in the Researchers' Night, included 600 000 children, who could take part in experiments and interactive science shows, as well as try out equipment in research laboratories that would normally be restricted.

### **How much did FP People SP contribute to job creation?**

The People Programme budget was directly funding 50 000 researchers, offering them high quality fellowships with employment contracts and full social security coverage. The training provided during the MCA fellowships enhanced researchers' skills and competences and prepared them for rewarding careers in both the public and private sector. Two years after the end of their fellowship, 95% of MCA fellows have been in employment positions.

Moreover, the programme promoted a model of open, transparent and merit-based recruitment and provided a stimulus to enter and remain in the researcher profession.

### **To what extent the results of FP7 People SP contribute to the achievements of the new Commission's priorities?**

MCA are instrumental to boost skills and jobs of the next generation of more entrepreneurial European researchers.

MCA have proved highly relevant in terms of tackling the most pressing needs and challenges related to the implementation of research and innovation policy as well as to the competitiveness and socio-economic needs of Europe: Europe's relative lack of competitiveness in attracting highly qualified researchers, insufficient funding for training and career development of researchers and a relatively small share of researchers working in the business sector.

The MCA have boosted employment of young researchers and contributed to their greater mobility and career progression. The programme promoted free movement of knowledge and opening of the ERA to the world, increasing the number of researchers in Europe and creating more attractive opportunities and preconditions to choose a research career, also in terms of promoting excellence of research training that provides adequate competences for the evolving needs of both public and private employers.

The special role of MCA funding was acknowledged during the adoption process for the Investment Plan for Europe where the Marie Skłodowska-Curie actions, together with

ERC and widening participation actions, did not receive any cut to its funding from the levels agreed in the Horizon 2020 legislation.

**To what extent was FP7 People SP coherent with other EU actions (CIP, ESF) and EU policy?**

The People Programme objectives and activities were fully coherent with the EU actions contributing towards Europe 2020 objectives and addressing three flagship initiatives "Innovation Union", "Youth on the Move", and "Agenda for new skills and jobs".

The programme helped to create strong links between the ERA and the European Higher Education Area, aiming at far-reaching changes in research and higher education systems in Europe.

Individual mobility, focus on skills and employability, networking, intensification of exchanges and cooperation between institutions were key drivers of quality, have strengthened national systems and contributed to the modernisation agenda.

Doctoral level training supported by the People Programme acted at the crossroads between higher education and research. Joint doctorates, supported by both the People and the Erasmus Mundus programme, enhanced greater structural co-operation between universities in terms of programme design and mutual recognition of qualifications.

The People Programme created regional impacts and synergies with the Structural Funds. One of the successful MCA-funded examples could be the SoMoPro fellowship programme of the South Moravian Region (Czech Republic). SoMoPro and SoMoPro II programmes were co-funded by MCA and aimed at providing training and career development for researchers and attracting skilled researchers to come to and carry out their work in the region. The programmes helped the region in developing its smart specialisation strategy and combining funding from FP7 with Structural Funds investments in research and innovation infrastructure.

**Which was the added value of FP7 People SP when compared with national programmes?**

MCAs have made remarkable progress to promote mobility, both transnational and intersectoral, and to open research careers at European and international level, with excellent employment and working conditions following the principles of the European Charter and Code. There is no equivalent in Member States as far as their scale and scope, funding and international character, as well as the generation and transfer of knowledge are concerned.

The added value of the MCA was high in terms of providing beneficiary researchers with better career development and mobility opportunities, increasing the volume and scope of research, and providing the example of good practice for national authorities.

The MCAs have strengthened the resources of those institutions able to attract researchers internationally and thereby encouraged the spread of centres of excellence around the Union.

The MCAs have brought together the best European and non-European actors in research. In FP7 all the 100 best ranked European universities in the Shanghai ranking list have been actively involved in Marie Curie projects. At the same time, 65% of the outgoing European researchers have carried out part of their research projects in the top-50 world universities. These results go far beyond those achieved by national programmes which do not have the same means and influence in terms of international openness.

MCAs have also demonstrated the capability of disseminating good practice by influencing the initiation of similar programmes at the national level and by spreading the best practices in terms of research training and career development. The bottom-up approach taken by MCAs has also allowed a large majority of institutions to train and upgrade the skills of a new generation of researchers able to tackle societal challenges.

Long-lasting research collaborations between participants from private and public sectors have been created in the programme. The MCAs allowed industry and academia to collaborate on innovative research projects at a European scale, which otherwise would have not been supported. Networking opportunities and collaboration with academic institutions, as well as with other non-competing companies in an excellent interdisciplinary environment, were highly appreciated by industrial partners. By funding companies at the European level, the MCAs also increased the competition between European companies (not always existing at the national level), leading to higher levels of quality and excellence.

As stated by one of the beneficiaries: "Compared to what is available nationally, you can have much more variety of research, more researchers moving, more countries, and more industry partners involved. The national scheme is rather limited as regards the choice of topic. In comparison, [MCA funding] is much more flexible towards this and this has to be appreciated."

As regards the additionality of the MCAs, the evidence shows that only 1% of projects rejected by MCAs due to budgetary reasons were subsequently implemented as originally planned. Some 17% went ahead with the projects after some changes to the original design. 82% of non-successful applicants have abandoned the projects.

Concerning the participants that went ahead with the projects as originally planned or with some changes, the majority of the projects were implemented using own funds (36%) or by obtaining funding from national/regional R&D funding schemes (35%). Only 6% of respondents received funding from other international R&D funding schemes. However, all of the projects financed under international R&D funding schemes were implemented with some changes to their design. The findings suggested thus that no directly comparable international R&D programme existed that could have financed the same projects.

The MCA activities tended to have broader and more long-term research objectives, ran on a financially larger scale, had stronger networking and collaboration capacity and involved a larger number of international, industry and academia partners. For a significant majority of MCA beneficiaries, the projects strengthened their ability to do research beyond short-term needs, contributed to establishing R&D as a regular part of

their day-to-day activities, and helped to achieve efficiency gains in terms of conducting research.

### **People in H2020: continuity or evolution?**

The People Programme and its MCA have been highly effective and efficient in meeting their set goals and objectives.

The average success rate for the whole People Programme was 19%, while its main funding scheme, MCA ITN, covering nearly 45% of the People Programme budget, recorded a success rate of 10% only. With 50% of the overall MSCA budget, the ITN success rate continues to decrease and has plummeted only after the second call published under H2020 to as low as 6.8%.

The overall administrative efficiency of the People Programme, measured in terms of time-to-grant (272 days), was one of the highest in FP7 and by far better than the FP7 average (313 days).

The only criticism faced by the MCAs under FP7 (and its predecessor programme under FP6) referred to the need for "a more coherent and straightforward approach within the programme, and streamlining procedures within existing actions". This issue has been addressed under Horizon 2020, where the MCA, re-named as Marie Skłodowska-Curie actions (MSCA), are part of the Excellent Science priority.

Under Horizon 2020, an important simplification effort was made, by extending the use of simplified forms of grants (unit costs), streamlining the MSCA funding schemes (from 11 to 4) and unifying the rules for:

- Innovative Training Networks (ITN): support for innovative initial training of researchers at doctoral level;
- Individual Fellowships (IF): support for experienced researchers undertaking mobility between countries, optionally to the non-academic sector;
- Research and Innovation Staff Exchange (RISE): support for international and intersectoral cooperation and transfer of knowledge through the exchange of research and innovation personnel;
- Co-funding of regional, national and international programmes (COFUND): support for fellowships at doctoral and post-doctoral level involving mobility to or from another country.

The programme continues its focus on offering excellent opportunities for the career development of researchers. The MSCA's overall ambition is to empower and attract talent and to create an excellent framework for researchers' training in Europe.

In addition to the industrial doctorates introduced under FP7, the MSCA in Horizon 2020 also support joint doctorates as well as the co-funding of doctoral programmes to increase the leverage effect on regional, national and international funding programmes, thus bringing structural change to the way doctoral candidates are trained in Europe.

The European Researchers' Night, a specific MSCA policy support action, continues financing outreach activities to communicate science to the general public, with a special emphasis on pupils and students.

8% of the Horizon 2020 budget has been allocated to the MSCA, worth EUR 6.162 billion (current prices) for the 7-year period. This represents a 30% increase compared to FP7 and is a clear sign of recognition from the Member States of a strong added value of the programme and its long-track success record – the final amount allocated to MSCA is comparable to the original 2011 Commission proposal, even though the overall budget for Horizon 2020 was decreased during the negotiations by 12%.

### **13. CAPACITIES SPECIFIC PROGRAMME**

#### **Objectives**

The main objectives of the Capacities Programme were to build the research capacities of research-performing organisations, and notably SMEs, facilitate more effective use of research infrastructures and promote more coherent development of research and innovation policies. The programme was designed to support regional research-driven clusters and at the same time unlock the research potential in the EU's convergence and outermost regions. Support was provided for horizontal actions and measures underlining international cooperation. It covered the seven following areas:

- Research infrastructures
- Research for the benefit of small and medium sized enterprises (SMEs)
- Regions of knowledge
- Research potential
- Science in society
- Support for the coherent development of research policies
- Activities of international co-operation

#### ***Efficiency***

Over the course of FP7, the Capacities Specific Programme received just over 10,000 proposals, equivalent to 7.6% of all FP7 proposals. The success rate, 19%, mirrored that for FP7 as a whole, although the average number of applicants per proposal was higher under the Capacities Programme. The average EC contribution was €1.87 million, which is close to the overall FP7 average.

The overall efficiency of the Capacities Programme, measured in terms of time-to-grant (313 days), was close to the FP7 average.

With regard to the Research Infrastructures activity, the programme managed to engage leading-edge organisations in the different fields. The programme was also efficient in achieving a relatively high participation and funding rate of organisations in smaller EU15 Member States and EU13 Member States, thus providing a sound basis for enhancing European cohesion.

The Research for the Benefit of SMEs activity proved efficient in meeting its objectives. The participation share of SMEs is in excess of 60%, with two-thirds of projects coordinated by an SME.

The efficiency of the Regions of Knowledge activity was assessed positively by project coordinators and participants. Programme management and responsiveness were considered efficient. Administrative management was considered to be more challenging, due to the complexity of a "triple helix" involvement in an EU programme

focusing on research. The definition and implementation of objectives was considered to have improved significantly during FP7, with the strengthening of the focus on excellence and enhancing existing research-driven clusters.

According to the evaluation of the Research Potential activity, it was efficient in financing research groups, departments and centres to increase their role in the European Research Area by attracting experienced researchers; improving research quality; facilitating cooperation with the private sector and serving as a basis for obtaining additional support from regional or national authorities.

The Science in Society orientation under FP7 of supporting larger and more strategic actions and this has been found to be efficient. The average number of partners in FP7 projects in this area was 40% greater than under FP6.

The Coherent Development of Research Policies (CDRP) activity has focussed on boosting innovation-related aspects. In the early years of FP7, it supported the increasing emphasis on close-to-market activities such as prototyping, testing, demonstration, demonstration and knowledge transfer. Jointly with the CIP, it has more recently provided co-financing for joint implementation of innovation procurement. The CDRP has proved an efficient means of adapting support over time to match the evolution of research and innovation activities, notably in relation to improving the coherence and impact of EU policies and initiatives.

The International Cooperation (INCO) activity has proved efficient in achieving a diversification of project partners. In total, INCO activities under FP7 brought together a total of 1326 partners.

Under the Risk-Sharing Finance Facility (RSFF), the capital contribution increased from €2 billion to €2.420 billion, which has allowed the EIB to cover the additional risk involved in lending to below investment-grade operations.

### **13.1. Research Infrastructures (including eInfrastructures)**

The enhancement of the efficiency and effectiveness of the European RI system was the primary objective of the FP7 RI programme including the optimisation of the research infrastructures landscape in Europe and the services that they offer, and the strengthening of their global relevance.

The range of research infrastructures that was supported in the FP7 RI programme is very diverse, and reflects the new opportunities that digital, and communication technologies offer in terms of designing science research. They include centralised, as well as physically distributed resources for research, covering major equipment or sets of instruments, in addition to knowledge-containing resources such as collections, archives and data banks, and ‘facilities that facilitate research facilities’, such as GRIDS and Supercomputers.

#### **How did RI contribute to the competitiveness of European industry?**

The answers to the survey launched by the evaluation study of research infrastructures<sup>27</sup> show that major outputs and outcomes of the FP7 RI projects were new or improved products in terms of scientific instruments, software, middleware, etc. for approximately 80% of respondents.

While the involvement of industry in the programme was limited to 10% in terms of funding and of participations, the programme improved technical development capabilities and enhanced research-industry collaborations but only in a minority of projects. Work towards norms and standards as well as consultation with industry created a basis for future industrial impacts.

There are a variety of channels and mechanisms through which academic knowledge can be transformed into productive knowledge – ranging from direct use of knowledge inputs to instruments, tools, techniques and background knowledge. As an example, in sectors like Materials sciences, research conducted through the transnational access action also benefits the industry community.

#### **How did RI contribute to increase European and international wide S&T collaboration and networking for sharing R&D risks and costs?**

The programme contributed to improve structuring of the European research base. The main impacts were:

- The conduct of scientific research and its effects on the advancement of knowledge and knowledge flow, within the research as well as educational components of the European knowledge society.

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<sup>27</sup> Final report Evaluation of Pertinence and Impact of Research Infrastructure Activity in FP7 EPIRIA



- To build capacity in the use of advanced research tools and technologies and the development and implementation of new research methods. An important evolution in this context is the eScience paradigm shift.
- To foster and accelerate an improved structuring of the European research base and considerably enhanced European and international cooperation in research.

The programme reached significant effects on an improved cohesion of the European RI landscape and on the breadth and quality of the RI services. All support schemes contributed to these achievements. Moreover the impacts were reached in particular through their combined efforts and the appropriate use of the policy mix. An important factor is the growing synergy and complementary role of the research infrastructure and e-infrastructure activities.

The FP7 RI projects contributed to these impacts by a broad range of actions:

An enhanced cohesion in the European RI landscape was reached thanks to the interlinking of research facilities and data infrastructures; the harmonisation, standardisation and interoperability of methodologies and tools; the delivery of transnational access; and an increasing connectivity and ease of access.

Improvement of the RI services was attained thanks to innovation in the tools and methodologies for the collection, processing and analysis of the resources, visualisation and simulation techniques, scientific instruments etc.

A major impact of the Virtual Research Communities (VRCs) projects was in the enhancement of transnational collaboration across Europe. They have contributed to bridging the gaps amongst different sub-disciplines of a research field by providing a common, standardised, interoperable and multidisciplinary infrastructure, which is still capable to address the specific needs of the single disciplines.

In FP7 the flow of knowledge was improved through the use of research infrastructures, particularly for users located in the newer Member States. There is also evidence of closer collaborations between scientists and ICT developers, as well as enhanced research-industry collaboration.

The answers to the survey launched by the evaluation study of research infrastructures<sup>24</sup> show that major outputs and outcomes of the FP7 RI projects were:

- An improved transnational access (~80% of respondents)
- New or improved simulation & visualisation facilities and techniques (~80% of respondents)

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<sup>24</sup> Final report Evaluation of Pertinence and Impact of Research Infrastructure Activity in FP7 EPIRIA

- Extension of the RI users base, from a scientific and/or research community perspective (~75% of the respondents)
- New or improved RI services in general (~75% of respondents)

Overall, the focus of the programme and the use of the different schemes in the various thematic areas (figure 7) responded to the needs in the various scientific fields that the RIs serve. This included the high focus on integrating activities in areas where research communities are still rather fragmented or where inter-disciplinary research is key (e.g. social sciences & humanities and life sciences), as well as the support for research infrastructures in areas that are facing the big data challenge or where access to global data is mandatory (e.g. energy, earth & environmental sciences).

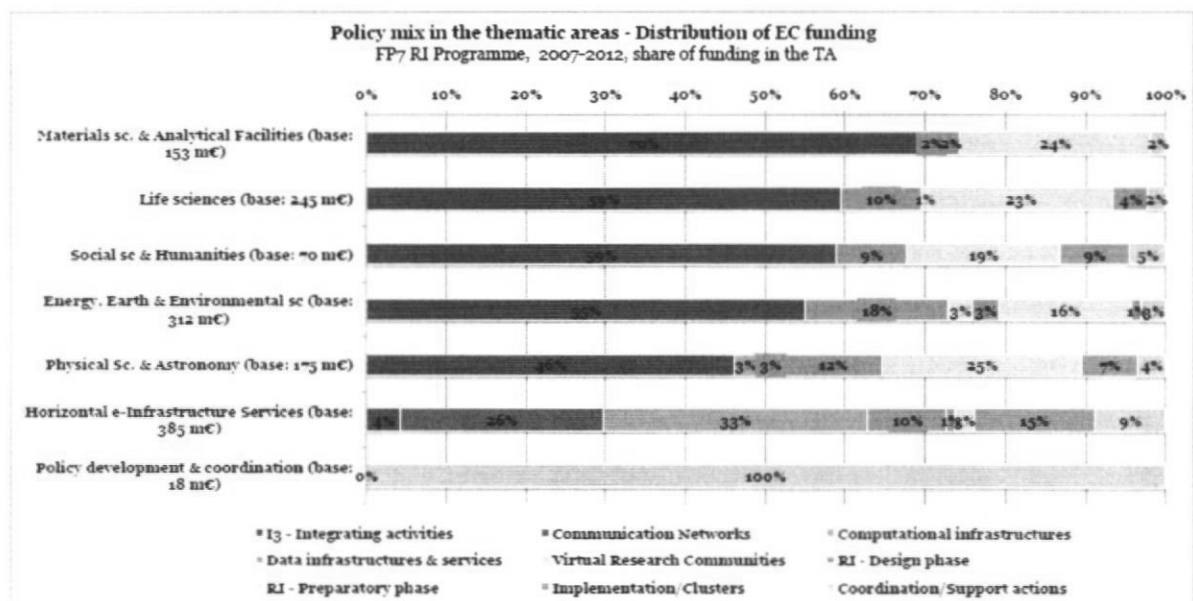


Figure 7: Use of support schemes in line with needs of RI user communities. Source: EPIRIA report

A first analysis of the users benefitting from transnational access in the framework of the IA projects was carried out on the basis of aggregated data as of end 2012. Figure 11, below, presents the geographical distribution of the users in terms of their total number of visits. Close to 77% of the visits were made by users based in the EU15, ~16% by users from the newer EU Member States.

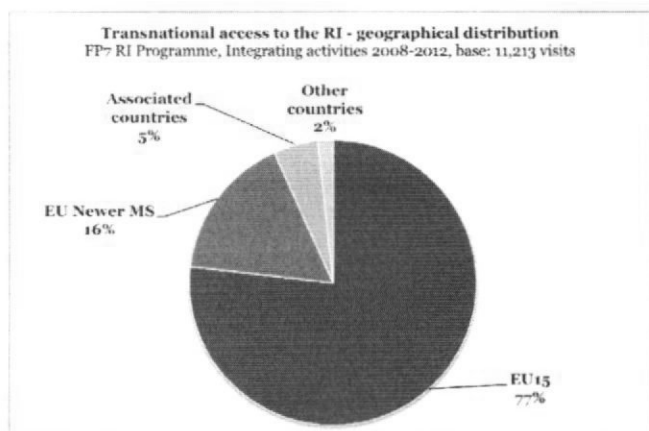


Figure 11: Geographical distribution of the RI users (nr of visits) (Source: RI users database)

If we normalise the figures with the size of the countries (in terms of total number of researchers in HE and the public sector), it appears that countries that benefit most from the EC support for transnational access to RI are the smaller EU15 Member States such as Austria, Ireland, Belgium, Finland and Greece, and newer Member States such as Hungary, Latvia, Bulgaria and the Czech Republic.

In addition to the budget spent through funding projects, the FP7 RI programme contributed with €200 million to the European Investment Bank for a Risk-Sharing Finance Facility (RSFF) for the development of RIs.

So far the EIB has signed long-term loans of over €1billion to fund research infrastructure projects such as ESO-E-ELT, the European Extremely Large Telescope for optical astronomy, a project on the ESFRI Roadmap. A loan of up to €300 million has been provided for the design, development and construction of an extreme large optical telescope. The Sincrotrone Trieste has been provided a loan of up to 20 M€ for the completion and launching of the new FERMI@Elettra light source. FERMI@Elettra is based on a newly designed free-electron laser for studying materials, which as an international laboratory will be open to the scientific community and to companies. The EIB also lent to companies supplying equipment to research facilities such as Oxford Instruments, specialised in the design, manufacture and support of hi-tech tools and systems for industry research.

### **How did RI contribute to improve the coordination of European, national and regional research policies?<sup>25</sup>**

Apart of setting the base for an ongoing strengthening of the European RI eco-system, the different sub-systems have also had other specific values and roles. The RI Design and Preparatory projects are considered a valuable addition to the national funding landscape and help to progress concepts for new RIs from the ideas stage to a stage where national funding agencies may commit to fund them.

<sup>25</sup> Please also see eInfrastructure Policy Forum (<http://www.euroris-net.eu/e-IPF>) and Digital ERA forum (<http://e-irg.eu/documents/10920/239416/RelatedPolicyGroups.pdf>)

The European Strategy Forum on Research Infrastructures (ESFRI)<sup>26</sup> constitutes the most important coordination platform of the national policy making communities. ESFRI acts as a strategic instrument to develop the scientific integration of Europe and to strengthen its international outreach. One of the means ESFRI used is the ESFRI Roadmap. The ESFRI Roadmap has raised the importance of RIs in the EU as a policy issue and has had great influence on national policies for Research Infrastructures. It also helped the EU to have a voice in the international fora. To date, the EC has supported the preparatory phase of all RIs on the ESFRI roadmap and the clustering of these ESFRI projects by scientific domains in order to help them develop common solutions in issues such as access, data stewardship and management.

A similar forum was founded in 2003 in the field of e-infrastructures, the e-Infrastructure Reflection Group (e-IRG) defines and recommends best practices for the pan-European electronic infrastructure efforts. It consists of official government delegates from all the EU countries. The e-IRG produces white papers, roadmaps and recommendations, and analyses the future foundations of the European Knowledge Society. Its delegates cover widely the areas of digital research infrastructures, ranging from NRENs and connectivity as well as HPC and PRACE to grid and cloud computing and big data infrastructures.

The collaboration between ESFRI and e-IRG has constantly intensified, with data management and internal e-infrastructures playing a constantly more important role in the functioning of the research infrastructures. This collaboration is visible in the form of various common working groups and e-IRG's active participation in the drafting of the ESFRI Roadmap, and also in the newly given responsibility to ESFRI to review the national e-infrastructures' funding models, which it aims to do in tight collaboration with e-IRG.

### **How did RI strengthen the scientific excellence of basic research in Europe?**

The R&D that was conducted to support the development of the new RI also contributed to Europe's leading-edge science and technology outputs. The RI projects have contributed to strengthening the scientific excellence in Europe because they

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<sup>26</sup>Was established in 2002, bringing together representatives of the EU Member States and associated countries, appointed by Ministers in charge of Research, and a representative of the European Commission. The ESFRI roadmap – published in 2006 and updated in 2008 and 2010 – set out a list of RIs of pan-European importance, representing the outcome of systematic consultations with scientists and users. It provided a list of 48 new or significantly upgraded RIs to be developed by 2015-2020. A conservative estimate of the total development cost of the RI projects included in the ESFRI roadmap amounts to nearly 20 B€, and, on average, 2M€ will be required annually for their efficient operation. All the ESFRI projects are funded by various groups of EU Member States and Associated Countries. The Commission plays an active role in supporting the work of ESFRI by ensuring the secretariat of the forum. In 2012, the EU Council of Research Ministers enlarged the mandate of ESFRI in order to adequately address the existing challenges and to ensure the follow-up of implementation of already ongoing ESFRI projects after a comprehensive assessment, as well as the prioritisation of the infrastructure projects listed in the ESFRI roadmap. A list of priority projects has been agreed by ESFRI in April 2014. On this basis, the Commission further defined the Horizon 2020 support for the development of new world-class research infrastructures.

[https://ec.europa.eu/research/infrastructures/index\\_en.cfm?pg\\_esfri-membership](https://ec.europa.eu/research/infrastructures/index_en.cfm?pg_esfri-membership)

provided support for the access to the best RI of the best researchers regardless of their origin. Moreover they helped improve the services provided by the RI to the users. By supporting the design and preparatory phases of the ESFRI projects, the RI programme helped ensure that the European researchers could use the most up-to-date and state of the art RI to carry out their research activities.

### **How did RI promote the development of European research careers and to make Europe more attractive to the best researchers?**

The FP7 RI programme succeeded in involving leading organisations in the different fields and made good use of the mix of funding instruments. (EPIRIA report)

As regards the positioning of the research teams in their environment, the large majority (more than 80%) of the respondents to the survey carried out by Technopolis, considered their organisation to be a lead player or highly important in their areas of work at national level. Half of them considered a similar positioning at European level and 40% at global level.

The bibliometrics data confirmed this picture of competitive strength in the FP7 RI programme constituency from a research perspective. The analysis looked into the publication history of 200 FP7 RI participants, covering their articles and reviews for the five years preceding the FP7 project. This regarded participants in research infrastructure and e-infrastructure projects. The EPIRIA finding was that in general, programme participants have better publication histories than their peers in the respective fields. They publish more in high quality journals, have higher-than-average citation rates, and have a high share of international co-publications.

### **How did RI support key Community policies?**

The distribution of the funding over the thematic areas indicates a strong focus on support for research in scientific fields that are key for the tackling of the Grand Challenges. Particular focus was set on RI supporting research in the field of Earth & environmental sciences and Life sciences (accounting respectively for 19% and 18% of the programme budget).

In the graph below (figure 8), the Horizontal e-infrastructure services include projects funded in the field of e-sciences. e-science projects performing activities aimed at a specific sector are included in the relevant thematic areas.

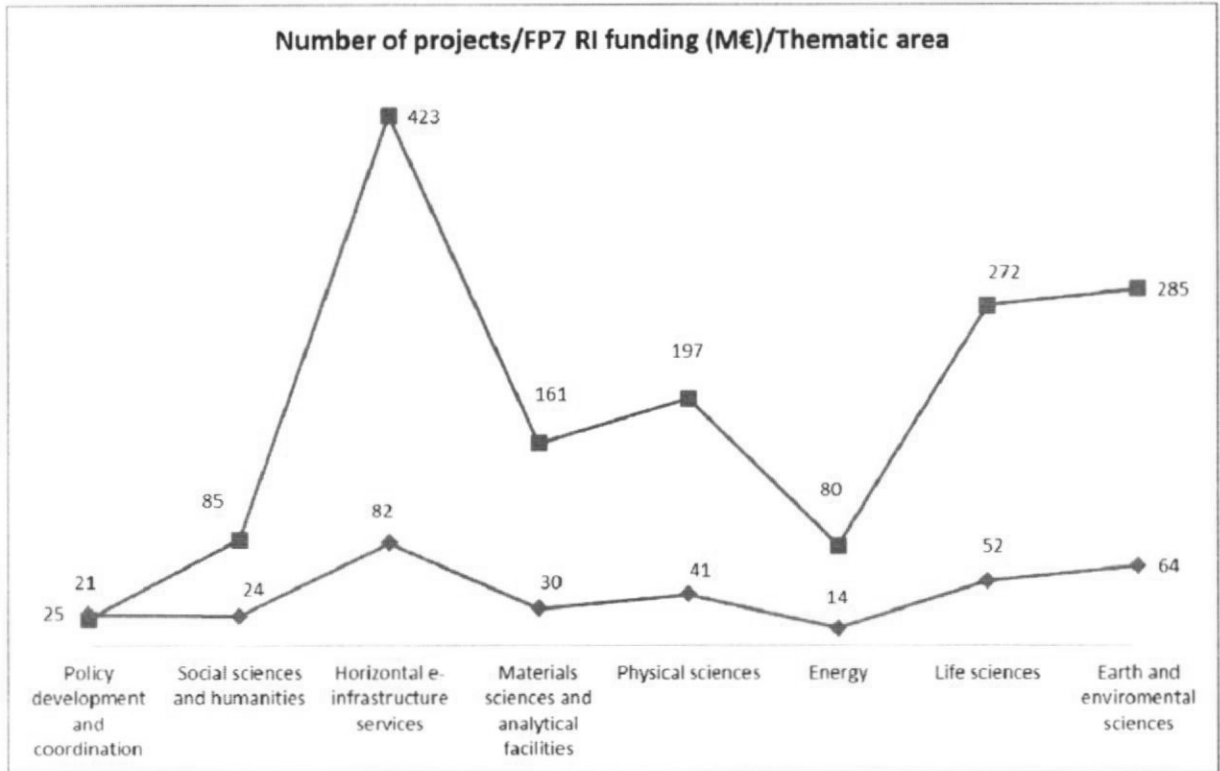


Figure 8: FP7 RI breakdown by thematic areas. Source Corda data

The relatively high level of support to RI in the physical sciences & astronomy thematic area is to be noted, in particular in the number of projects supporting the design and construction of new RI (see figure 9).

Funding was also allocated for support to research in the Social sciences, a field that provides strategic information for policy making on more general societal challenges and where significant new opportunities arise from the Big Data phenomenon. Funding for RI in the social sciences & humanities thematic area accounted for 5.5% of the budget.

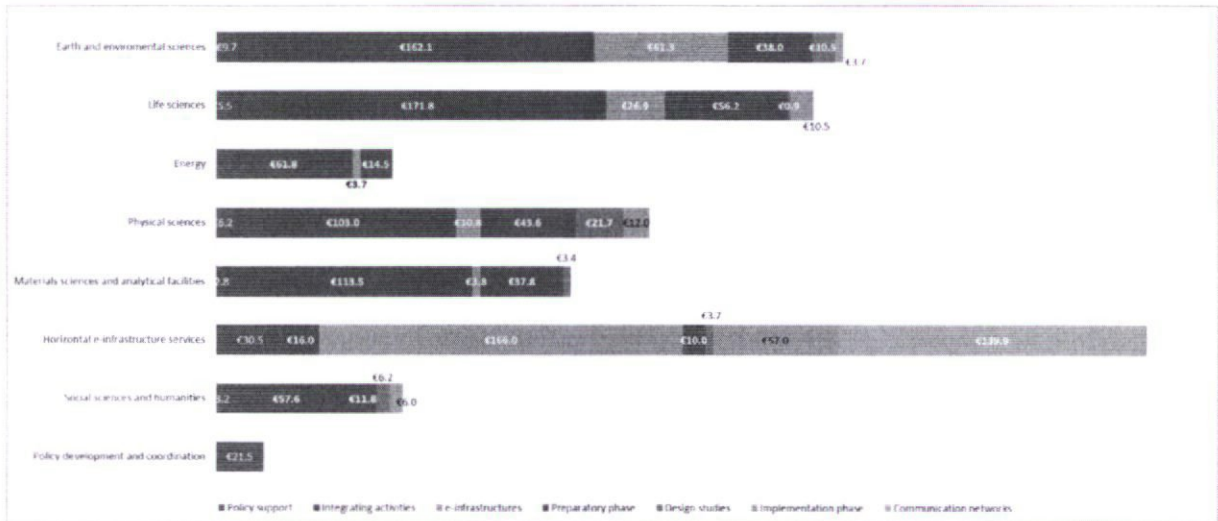


Figure 9: FP7 RI funding by thematic area/funding schemes (€M). Source Corda data

The programme fostered and consolidated coherence in RI policymaking. A major task of the FP7 RI programme was to act as a driver and coordinating force for an improved coherence of RI policies in Europe. It did so by providing platforms and instruments for an improved communication among the actors involved. Below are some examples of these mechanisms and their role and value:

- New or updated roadmaps have been developed in many scientific fields and subdisciplines during the course of this programme, bringing together all relevant research communities with the aim to develop consensus around a comprehensive strategy at the European level. These roadmaps have an important impact on an improved coordination at the policy-maker and funding agency level and can be expected to guide future policy and investments.
- FP7 RI projects, and in particular the preparatory phase activities, provided the fora that would allow R&D policy makers and funders to discuss harmonisation of concepts and key legal and ethical issues. This is a crucial topic for European RIs that has to be addressed in advance as they have an important effect in the buy-in of the different countries and in defining the technical aspects and functionalities of the RI with a view to achieving sufficient critical mass.
- The ERANet projects have been beneficial and a useful vehicle for the stimulation and development of joint strategies (e.g. Astronet) and joint work on policy areas. Other projects such as Eridwatch and Meril have created opportunities for debates. These activities have a strategic value also for the Commission in that they provide background information and the possibility to play an active role for the definition of future activities. Other examples are studies developing conceptual frameworks for the assessment of RI to the benefit of the European Commission and national policy makers, as well as the RI.

## How did RI increase availability, coordination and access in relation to top-level European scientific and technological infrastructure?

The Research Infrastructures activities addressed the fragmentation of the research infrastructure landscape in Europe, developing networks of research infrastructures in Europe and improving the way they operate, at national and European level, thus ensuring more coherent Research Infrastructures policies. They helped bringing down barriers to access to RI, playing therefore an important role in the education and training of researchers, young scientists and engineers through the use of cutting-edge equipment or the exploitation of data generated by or stored within them..

## To what extent the results of RI contribute to the achievements of the new Commission's priorities?

The potential for impacts on society at large is high in areas such as *environment*, where they feed into global issues such as climate change and the Intergovernmental Panel on Climate Change process. Close to 20% of the funding was allocated to the environmental sciences. Support has been provided to networks of RIs and development of new distributed RIs in atmospheric research, arctic, ocean and marine research, and biodiversity. The impacts are also high in the sphere of health. The programme supported the development of the European *life sciences ecosystem* of facilities and resources, from biological resource centers to medical research facilities and food and agriculture facilities. The action in the field of *social sciences and humanities*, despite its limited extend, has also high potential for achieving effects on policy making in other areas of societal importance.

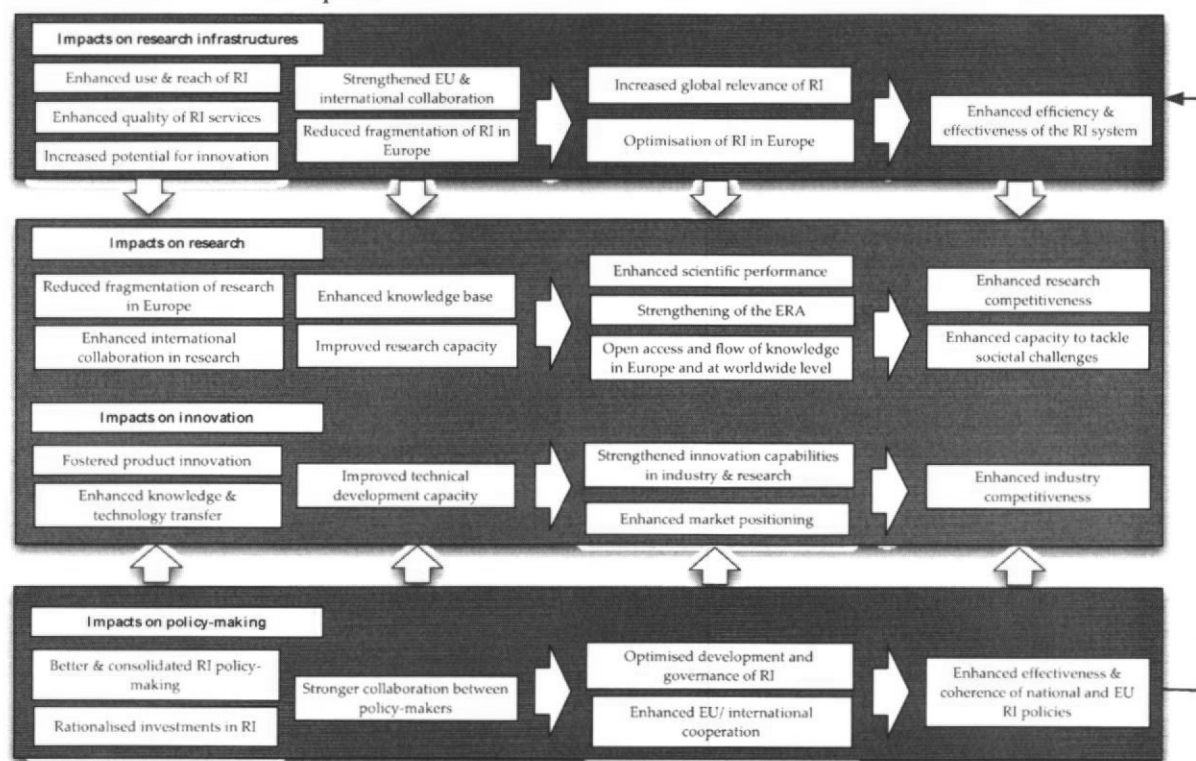


Figure 1: Expected outcomes and mid-to-long term impacts of the FP7 RI supported actions. Source: EPIRIA report



## **To what extent was RI coherent with other EU actions (CIP, ESF) and EU policy?**

In the FP7 RI programme the objectives of the supported activities had a strong alignment with the programme's higher-level policy objectives and the objectives of the ERA. In essence, this indicates a high quality in the programme design. (EPIRIA report)

### **RI added value**

The key added value of the FP7 RI programme was to strengthen the European dimension in

RI policies, activities and services. The Programme fulfilled its primary function of supporting the development of networks of research infrastructures in Europe and improving the way research infrastructures operate, evolve and interact with similar infrastructures and with their users – at European and global levels.

The ex post evaluation study of research infrastructures confirm the high level of added value of the programme: 70% of the respondents to the survey stated that their project would not have been possible without EC funding; the remaining 30% considered that it would have been possible to find alternative funding, but in close to all cases that would have implied a reduced scale or speed.

The Programme increased the cohesiveness of the European RI landscape by interlinking research facilities and data infrastructures, the harmonisation, standardisation and interoperability of methodologies and tools, the delivery of transnational access, increasing connectivity and ease of access. Innovation in the tools and methods for the collection, processing and analysis of RI resources and the use of the facilities, including visualisation and simulation techniques and scientific instruments led to a considerable improvement in the delivery of RI services. The shift to a more service oriented approach in the e-infrastructure ecosystem was a particularly important contribution.

The FP7 RI Programme has been very successful in increasing the value of research infrastructure as a tool for Science. The networking and integration of the research infrastructures helped improve the structure and cohesiveness of the European research community, enhancing European and international cooperation in research.

It fostered the creation and increase of critical mass in research and generated strong spillover potential to research and education. Funding for transnational access was especially important for small and newer Member States.

The Programme also facilitated the development and use of new and improved research methods and technologies. The eScience paradigm shift is an important development, which is changing the nature of the research process in some fields. The ability of the e-Infrastructure communities to deliver user-tailored services and the development of a multilayer e-Infrastructure ecosystem have been key in helping European researchers to stay at the forefront of scientific developments.

The FP7 RI programme has made an important contribution to increasing international collaboration in Research Infrastructure and opening up of the European RIs to the world, to the mutual benefit of the European and international research communities. It

reinforced cooperation with countries such as the United States, Japan, Australia and Canada, and was particularly active - and successful - in enhancing collaboration with emerging economies such as Latin America, Africa, China, India and the Middle East. These intercontinental RI partnerships provide important opportunities to broaden the European knowledge base.

The FP7 RI programme has shown that there is potential for impacts on industrial innovation by fostering capacity building and knowledge transfer but has so far had little impact on industrial innovation. There are in fact early examples of product innovation resulting from the involvement of industry in the RI projects, both as suppliers or users of the RIs and via the exploitation of research results. However, as little time has elapsed since the projects were undertaken, it was not possible to measure the longer-term impact of the RI action.

The programme addressed the fragmentation of RI policies at national and European level and was successful in improving coherence of RI policy making based on the ESFRI roadmap and projects.

### **13.2. Research for the benefit of small and medium sized enterprises (SMEs)**

With respect to the EU added value of FP7 for SMEs three types of EAV are distinguished in the assessment of EAV: a). Technological added value, namely the added value of a European project due to technical reasons like specialised knowledge, or equipment (high or very high in 60% of the projects analysed in more detail), b). Economic added value, namely the added value of a European project due to access to international customers, or markets (high or very high in nearly 30% of projects analysed), and c). The European funding is compensating a lack of alternative funding (high or very high in more than 70% of cases).

### 13.3. Regions of Knowledge

#### **How did RoK contribute to the competitiveness of European industry?**

The Regions of Knowledge activity set the fundamentals for future impacts to occur in terms of an enhanced regional economic competitiveness through R&D activities.<sup>27</sup>

A noticeable immediate result of the improved intra-regional communication as well as of the strategic focus of the RoK programme activities has been an improved articulation between on the one hand the clusters initiatives, R&D capabilities in the region and industry needs and, on the other hand, regional innovation strategies.

The RoK programme contributed to the competitiveness of European industry by offering a large space of cooperation to clusters in which the business component was always key. This very much appears in the ten selected case studies annexed to the final evaluation.

The impact of the RoK projects was strengthened from 2011 by asking to the partners involved to set up a Joint Action Plan by the middle of their project. This favoured a more concrete implementation in the second half of projects, and prepared the ground for possible synergies with European Structural and Investment Funds. This happened especially in 2014 and 2015 when this process coincided with the preparation of smart specialisation strategies in European regions. This enabled many regions to take advantage of "RoK success stories" in the choice of their priorities for the 2014-2020 period. The two RoK in which Aragon was involved over the last years: SoCool and We@EU encouraged for instance the Regional Authority to consider logistics and water management among their priorities when preparing their Smart Specialisation strategy. In the last call 2012-2013 a mandatory contribution to regional smart specialisation strategies was stipulated in the work programme. In 2007 and 2008 dedicated calls were launched at the benefit of emerging clusters that contributed of the development of approximately 15 new clusters.

Another concrete example of contribution comes from, the project CARE which has contributed to the aviation industry's ability to innovate and rapidly meet the demand for new airplanes in the EU. The team targeted economic and environmental priorities, while also clarifying relevant funding and international collaboration opportunities.

#### **How did RoK contribute to increase European and international wide S&T collaboration and networking for sharing R&D risks and costs?**

The Regions of Knowledge activity has had a substantial impact on networking and collaboration.<sup>28</sup> It helped establishing a critical mass between Regions of Knowledge partners for R&D projects. More specifically, RoK supported the establishment of

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<sup>27</sup> Assessment of the impact of the 'Regions of Knowledge' programme, Techopolis, 2011.

<sup>28</sup> The relationships with public authorities, universities and public research institutes have increased most significantly. SMEs represent almost 30% of participations in networks and there remains scope for higher involvement of SMEs and the private sector in general.

research-driven clusters that – in balanced partnerships, termed ‘triple helix’ actors – associate universities and research centres with enterprises and regional authorities.

The ‘number of networking, collaboration and research network with other institutions’, participation in FP7 projects’ and ‘participation in EU level research activities’ is considered to have benefitted substantially from participation in the RoK programme.

Most potential network and collaboration effects are expected at the European level. Especially partnerships with EU-level public research institutes, universities and public authorities are perceived as potential collaborators, though it should be mentioned that public authorities and SMEs are also perceived to be potential partners at a regional level. The final evaluation shows that in all the addressed areas, except for a few regions, there has been an increase in the establishment of new relationships and/or R&D partnerships – especially at a European level. The relationships with public authorities, universities and public research institutes are those which have increased the most.

The Final evaluation of the RoK programme’s (2014) impact and sustainability centres on the extent to which the research results have led to wider effects and the extent to which these wider effects are likely to last after the RoK-funded activities have terminated. The questionnaire survey results indicate that the five most important RoK impacts are:

- Enhanced knowledge of R&D needs in the sector of the cluster
- Strategic inputs to regional policy-making
- Establishment of a critical mass between RoK partners for R&D projects
- Enhanced reputation and image of participation organisations within their regions
- Enhanced public awareness on the benefits of research-driven clusters in the regions

The RoK programme sometimes enhanced cooperation beyond usual expectations. The very active and powerful ERRIN – European Regional Research and Innovation Network – was set up by the partners of a RoK project which wanted to give more sustainability to their cooperation and who had understood the need for a Brussels based network helping innovative European regions to cooperate on a permanent basis.

### **How did RoK contribute to improve the coordination of European, national and regional research policies?**

RoK has proven to be a unique and relevant programme at both regional and European level, addressing a real and previously unmet need for awareness and funding for projects, which are aligned with Smart Specialisation strategies and which are pertinent to issues of research and innovation excellence at a national and international level. Considering that Smart Specialization strategies is a fairly novel policy tool, it is also worth noting here that the final evaluation indicates how Smart Specialization has benefitted greatly from the RoK programme, both in scale and scope.

The RoK contribution in this field anticipated the need for paying more attention in our policy support to the clustering between research, business and regional authorities ("triple helix") through regional research agendas and Joint Action Plans, due to be implemented in the second phase of the projects. Many RoK projects contributed indeed to an enhanced coordination of European, national and regional research policies. The European ALICE Platform devoted to logistics was for instance created thanks to the impulse given by a RoK project in this field, which enabled their partners to move from regional project oriented cooperation to a national and European policy perspective. RoK is among the few FP 7 programmes which paid attention to the need for more cooperation between the regional, national and European components of Research and Innovation policies, taking into account the complexity of the multi-governance frame of the Member States.

### **How did RoK support key Community policies?**

The Regions of Knowledge activity has had a substantial impact on in the smart specialisation of regions<sup>29</sup>.

RoK enabled DG RTD to set up an Expert Group in order to examine the role of clusters in smart specialisation strategies in European regions. This Expert Group produced a well spread report in 2013 which identifies six leverage points for clusters and clusters policies to be used in Smart Specialisation Strategies. These relate to the need for prioritization, integrated policy mixes, smart and evidence-based policy-making, multi-level governance, cross-border cooperation and sustained stakeholders' engagement. The Expert Group findings were presented by his Chair, Mr Ketels (Harvard Business School) during the WIRE conference in Cork, Ireland, in June 2013.

RoK also had a strong political impact on the new generation of European Structural and Investment Funds as the recitals of the regulations concerning the interregional cooperation include a reference to the RoK frame which is expected to enrich the new INTERREG EUROPE programmes. An interservice cooperation was set up in order to ease concrete synergies.

The Smart Specialisation is a pillar of the EU cohesion policy for the 2014-2020 period and clusters policies played an important role in the setting up of the Smart Specialization Strategies which should be continued in the current implementation phase. The Guide on R&I Strategies for Smart Specialisation (RIS 3 Guide) includes a large section devoted to clusters and clusters policies which is very consistent with the logic of RoK.

### **How much did RoK contribute to job creation?**

Clusters increase productivity, stimulate innovation, facilitate commercialization. The RoK programme aimed at fostering regional growth and competitiveness thanks to a more active cooperation between regional research and innovation clusters. Considering the budgetary limits of this programme, the focus of the calls chosen each year took into account the most promising fields in terms of growth and jobs such as sustainable

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<sup>29</sup> The role of clusters in smart specialisation strategies, 2013.

energy and health. A strong connection with the Smart Specialization strategies also intended at choosing priorities which can be implemented by Research and Innovation stakeholders such as clusters having a sufficient critical mass.

This programme included mentoring activities which enabled excellent clusters to also boost growth and jobs in more deprived regions. This programme can be seen as a precursor as regards the need for tackling the innovative divide at a European level, with opportunities to be shared between regions and clusters with some tangible impact in terms of jobs and growth.

**To what extent the results of RoK contribute to the achievements of the new Commission's priorities?**

The RoK programme very much anticipated the move from FP 7 to HORIZON 2020 by paying a reinforced attention to the link between research and innovation from 2011. This anticipation was encouraged by the dynamics of clusters which are by nature in a good position to concretely understand this connection and contribute to a better economic output of research in fields corresponding to societal challenges.

The choice of several RoK calls can be considered as having contributed to the achievements of the new Commission's proposals. This applies in particular to the first priority of the new Commission ("a new boost for jobs, growth and investment"), considering the participation of many SMEs in clusters involved in this programme. This also applies to the need of a connected digital single market (second priority) and of a resilient energy Union with a forward looking climate change policy (third priority) which were among the thematic priorities of RoK projects.

**To what extent the results of RoK contribute to the achievements of the new Commission's priorities?**

The RoK programme is the only FP 7 programme which was positioned at a crossroad between the EU regional, research and innovation policies based on a strong cooperation with DG ENTR and DG REGIO. The programme was designed in coherence with the European policy in the field of clusters and the CIP. It also paid attention to the growing importance of the smart specialization process at the level of the EU cohesion policy.

**What was the added value of RoK when compared with national research and innovation programmes?**

While Member State and regional funding has been aimed at supporting clusters in given regions and member states, transnational cooperation of clusters as well as the integration of cluster's actors in ERA, are activities which require European programmes and support. The cooperation among clusters not only contributes to tackling pan-European challenges but can have a critical role in deploying new technologies, services and products which respond to European societal and economic challenges. International cluster cooperation can contribute significantly to pooling of resources (achieving critical mass; economies of scale and scope), to reduction of research risk / of commercial risk and – to EU scale of dissemination of research results.

Finally the cluster cooperation becomes even more relevant in supporting the cluster's actor's participation, including SMEs to global value chains.

As Figure 4 below shows there is a substantial increase in benefits and added value for the part-taking organisations, which stems from the RoK programme, compared to other initiatives and/or programmes. Especially regarding the 'exchange of best practices', 'access to complementary competences' and 'visibility', the RoK programme shows a highly significant impact, scoring an average of 70% in 'higher benefits and added value'.

**Figure 4: The benefit and added value of the RoK project compared to other initiatives**

Statements	Scores	Shares of scores		
		Technopolis	Final evaluation	Total
Establishment of a critical mass between RoK partners for R&D projects	0-1	3%	3%	3%
	2	14%	5%	10%
	3-4	79%	37%	58%
	na	4%	55%	30%
Strategic inputs to regional policy-making	0-1	3%	3%	3%
	2	15%	5%	10%
	3-4	81%	42%	62%
	na	1%	50%	26%
Creation of a new research-driven cluster within your region	0-1	10%	16%	13%
	2	20%	3%	12%
	3-4	63%	16%	40%
	na	8%	66%	37%
Enhanced knowledge of R&D needs in the sector of the cluster	0-1	3%	0%	2%
	2	10%	11%	11%
	3-4	85%	39%	62%
	na	2%	50%	26%
Enhanced knowledge on cluster management	0-1	5%	5%	5%
	2	25%	8%	17%
	3-4	68%	39%	54%
	na	2%	47%	25%
Enhanced R&D capabilities in your organisation	0-1	16%	16%	16%
	2	24%	11%	18%
	3-4	52%	13%	33%
	na	7%	61%	34%

Enhanced knowledge on markets in project partners' countries	0-1	9%	0%	5%
	2	20%	11%	16%
	3-4	68%	36%	52%
	na	3%	53%	28%
Enhanced knowledge on markets in other countries	0-1	18%	8%	13%
	2	30%	11%	21%
	2-4	48%	29%	39%
	na	4%	53%	29%
Enhanced public awareness on the benefits of research-driven clusters within your region	0-1	8%	8%	8%
	2	16%	18%	17%
	3-4	72%	24%	48%
	na	3%	50%	27%
Enhanced public awareness on the benefits of research-driven clusters at national level	0-1	6%	18%	12%
	2	34%	13%	24%
	3-4	55%	18%	37%
	na	5%	50%	28%
Enhanced reputation and image of your organisation within your region	0-1	6%	3%	5%
	2	36%	8%	22%
	3-4	53%	42%	48%
	na	5%	47%	26%
Enhanced reputation and image of your organisation at national level	0-1	3%	16%	10%
	2	37%	11%	24%
	3-4	53%	26%	40%
	na	7%	47%	27%
Enhanced reputation and image of your organisation at European level	0-1	12%	5%	9%
	2	33%	8%	21%
	3-4	51%	39%	45%
	na	5%	47%	26%
Other	0-1	5%	-	5%
	2	29%	-	29%
	3-4	57%	-	57%
	na	9%	-	9%



Source: COWI  
Notes:

and Technopolis (2010).  
Scoring system: 0 = not important, 1 = less important, 2 = neutral,  
3 = important, 4 = strong importance.

*\*All sums which differ from 100% are due to rounding of decimals.*

### 13.4. Research Potential (REGPOT)

#### **How did REGPOT contribute to the competitiveness of European industry?**

Research potential programme facilitated the unlocking and developing existing or emerging excellence of research entities in the EU's convergence and outermost regions. It aimed inter alia at establishing conditions for research entities to exploit their research potential and better cooperate with private sector. Results of research should be translated into knowledge based services and state of the art products. These may be achieved only thanks to a fruitful cooperation of well-functioning and equipped research entities with the private sector. REGPOT aimed at achieving these goals and consequently contributed to entrenching competitiveness of the EU market and to realise the European Research Area (ERA).

Specific projects such as MIMOMENS has climbed up the technology transfer ladder via the establishment of Intellectual Property rights, via collaborations with industry or via participation in other FP7 projects. Several projects such as LIFTGATE and TEMP have established technology transfer platforms for the production of future research results.

#### **How did REGPOT contribute to increase European and international wide S&T collaboration and networking for sharing R&D risks and costs?**

The Research Potential activity strengthened and expanded the collaboration of research groups in the cohesion regions with other EU research centres and thus contributed to Europe realising the full research potential of the enlarged Union.<sup>30</sup> It increased the international recognition and leadership potential of these regions, as well as the quality of their scientists. This should in turn lay the foundations for their long-term sustainable development, and increased their visibility, while facilitating their participation as equal partners in the EU and international research arenas.

REGPOT has contributed to releasing research potentials and so has led to improved research capacities/achievements<sup>31</sup>. The respondents for this question provided an average score of 2.37<sup>32</sup> (2 = average contribution and 3 = high contribution).

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<sup>30</sup> Average of 7 partnering organisations per project

<sup>31</sup> Final Evaluation's (COWI, 2014) questionnaire survey

<sup>32</sup> Table 3 (p. 18 of the COWI's Final Evaluation)

**Table 1: Impact and sustainability of REGPOT project results**

Impacts	Average scores		
	Expert Group	Final evaluation	Total
Number of patents	0.87	1.34	<b>1.11</b>
Relationship with science & technology policy-makers	1.87	2.29	<b>2.08</b>
Links to EU Structural Funds	<i>na</i>	1.96	<b>1.96</b>
Integration in the European Research Area	<i>na</i>	2.64	<b>2.64</b>
Contribution to regional research priorities /strengths	<i>na</i>	2.62	<b>2.62</b>
Contribution to worldwide competitiveness and sustainable regional growth	2.00	2.28	<b>2.14</b>
<b>Total average scores</b>	<b>1.58</b>	<b>2.19</b>	<b>1.89</b>

Source: Expert Group (2011) and COWI.

Notes: Scoring system: 0 = no impact/no sustainability, 1 = low, 2 = average, 3 = high.

Additionally,

Table 2 shows that on average there is only little difference in the impact and sustainability assessments in between the different research themes. However, for patents the impact is for example somewhat lower for the ICT sector than for physics and chemistry.

Furthermore, several respondents provide information on continued collaboration between REGPOT project partners, but also with new partners from non-Convergence regions hereunder regarding proposals for Horizon 2020 funding. Others state that the REGPOT activities have led to the establishment of formal or informal networks that via their critical mass of expertise contribute to ensuring sustainability of the research results.

Many research actors have also experienced more individual, sustainable benefits from REGPOT participation such as being recognised within the own organisations as centres of excellence.

Finally, a number of the respondents state that sustainability of the project results will be achieved through incorporation into commercial products via cooperation with local enterprises, hereunder SMEs.

**Table 2: Impact and sustainability of REGPOT project results – by research theme**

Contribution	Average scores									Total
	Agriculture	Biotechnology and genetics	Energy	Environment	ICT	Material, engineering etc.	Medical sciences	Physics and chemistry	Socio-economic sciences <sup>(1)</sup>	
Number of patents	1.43	1.36	1.00	1.25	0.85	1.67	1.35	1.75	0.00	<b>1.34</b>
Relationship with science & technology policy-makers	2.29	2.27	2.00	2.75	2.23	2.33	2.35	2.17	0.00	<b>2.29</b>
Links to EU Structural Funds	1.57	1.82	2.00	2.75	1.85	2.17	2.00	2.00	0.00	<b>1.96</b>
Integration in the European Research Area	2.71	2.64	2.67	3.00	2.54	2.83	2.53	2.67	0.00	<b>2.64</b>
Contribution to regional research priorities /strengths	2.86	2.73	3.00	2.75	2.46	2.50	2.53	2.58	0.00	<b>2.62</b>
Contribution to worldwide competitiveness and sustainable regional growth	2.43	2.18	2.67	2.25	2.08	2.20	2.29	2.42	0.00	<b>2.28</b>
<b>Total average scores</b>	<b>2.22</b>	<b>2.17</b>	<b>2.22</b>	<b>2.46</b>	<b>2.00</b>	<b>2.28</b>	<b>2.18</b>	<b>2.27</b>	<b>0.00</b>	<b>2.19</b>

Source: COWI.

Notes: Scoring system: 0 = no impact/no sustainability, 1 = low, 2 = average, 3 = high.

<sup>(1)</sup>The answers for “socio-economic sciences” are based on one response only.

### **How did REGPOT strengthen the scientific excellence of basic research in Europe?**

REGPOT contributed to a coherent upgraded RTD capacity and capability in several areas:

- Growth of human potential (in terms of the number of new researchers and training of research staff).
- Improvement of scientific experiments and measurements (based on the use of new equipment to support advanced research), as well as
- The increase of the quality of research carried out by the selected research entities. This impact was easily observed in all analysed projects. The Expert Group confirmed that this was one of the main outcomes of the “Research Potential” Activity.

Moreover, REGPOT has entrenched the European basic research by enhancing capacities of research entities in many areas such as:

Agriculture

Biotechnology and genetics

Energy

Environment

Information and Communication Technologies (ICT)

Material, engineering, space and transport

Medical sciences

Physics and chemistry

Socio-economic sciences etc

REGPOT has contributed to the development of Centres of Excellence within very specific and advance research areas in convergence regions in Europe.

**How did REGPOT promote the development of European research careers and to make Europe more attractive to the best researchers?**

The Research Potential activity contributed to enhance exchange and mobility of staff, along with support in terms of equipment helped to overcome financial barriers such as lack of national and, in particular, regional funding and resources to hire high-level staff.

The research potential activity also filled the financial gap so as to unlock and develop existing and emerging research excellence in the convergence and outermost regions<sup>33</sup> and thus contributed to strengthening the EU knowledge base.<sup>34</sup>

The findings from the Final Evaluation's (COWI, 2014) questionnaire survey confirm the assessment that REGPOT has contributed to releasing research potentials and so has led to improved research capacities achievements..

REGPOT has in particular contributed to the employment of highly-qualified and experienced researchers which is much in tune with the REGPOT aim of reducing brain drain in the EU's Convergence and Outermost regions. Furthermore, REGPOT's contribution to the development of research policies and strategies in the mid-term indicates that REGPOT has released resources which enable the research actors to see beyond the daily challenges, which is necessary in order to enter the ERA and to establish links to Smart Specialisation strategies.

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<sup>33</sup> Many proposals scored 14 and above and were rejected

<sup>34</sup> Impact Assessment of the Research Potential Programme, Expert Group 2011.

**Table 3: Contribution from REGPOT to research capacities/achievements**

Contributions	Average scores		
	Expert Group	Final evaluation	Total
Number of employed researchers (particularly highly-qualified and experienced)	<i>na</i>	2.75	2.75
Publication record (particularly in peer-reviewed journals)	2.50	2.34	2.42
Participation in conferences	<i>na</i>	2.56	2.56
Participation in other EU FP7 activities (proposals submitted, funding obtained etc.)	2.75	2.34	2.54
Participation in other national and international programmes	2.62	2.38	2.50
Participation in international research networks	<i>na</i>	2.49	2.49
Cooperation with end-users (including SMEs) and other stakeholders	2.87	2.14	2.50
Own research policy and strategy in the mid-term	2.37	2.77	2.57
<b>Total average scores</b>	<b>2.62</b>	<b>2.13</b>	<b>2.37</b>

Source: Expert Group (2011) and COWI.

Notes: Scoring system: 0 = no contribution, 1 = low, 2 = average, 3 = high.

The survey shows further that that REGPOT has contributed significantly within all research themes – most for agriculture and least for ICTs.

**Table 4: Contribution from REGPOT to research capacities/achievements – by research theme**

Contribution	Average scores									
	Agriculture	Biotechnology and genetics	Energy	Environment	ICT	Material, engineering etc.	Medical sciences	Physics and chemistry	Socio-economic sciences <sup>(1)</sup>	Total
Number of employed researchers (particularly highly-qualified and experienced)	2.71	2.91	2.67	3.00	2.38	2.67	2.88	2.83	0.00	<b>2.75</b>
Publication record (particularly in peer-reviewed journals)	2.71	2.45	2.00	2.25	1.85	1.83	2.59	2.58	0.00	<b>2.34</b>
Participation in conferences	2.86	2.45	2.67	2.75	2.23	2.50	2.65	2.67	0.00	<b>2.56</b>
Participation in other EU FP7 activities (proposals submitted, funding obtained etc.)	2.57	2.36	2.67	2.50	2.31	2.00	2.53	2.00	0.00	<b>2.34</b>
Participation in other national and international programmes	2.71	2.55	2.00	2.50	2.31	2.17	2.41	2.25	0.00	<b>2.38</b>
Participation in international research networks	2.71	2.45	2.33	3.00	2.31	2.00	2.65	2.50	0.00	<b>2.49</b>
Cooperation with end-users (including SMEs) and other stakeholders	2.71	1.82	2.33	2.50	2.08	2.17	2.12	2.00	0.00	<b>2.14</b>
Own research policy and strategy in the mid-term	2.86	2.73	3.00	2.75	2.62	2.83	2.82	2.75	0.00	<b>2.77</b>
<b>Total average scores</b>	<b>2.73</b>	<b>2.47</b>	<b>2.46</b>	<b>2.66</b>	<b>2.26</b>	<b>2.27</b>	<b>2.58</b>	<b>2.45</b>	<b>0.00</b>	<b>2.13</b>

Source: COWI.

Notes: Scoring system: 0 = no contribution, 1 = low, 2 = average, 3 = high.

<sup>(1)</sup>The answers for “socio-economic sciences” are based on one response only.

The case studies reported in COWI’s Final Evaluation do similarly point to the achievement of research results via REGPOT support. Most of the project coordinators such as for DELICE, BIOSUPPORT, and CURE emphasise lifts to research capacities via the employment of both younger and experienced researchers, and via the establishment of collaborations. Some project participants such as those participating in BIODESERT have improved their publication records, claiming that all BIODESERT publications have been cited by other authors in other scientific papers. Similarly, it is assessed that OPENGENE has led to a publication increase and that SOFIA significantly has contributed to a 200-300% increase in peer-reviewed proceedings and publications in journals with an impact factors from the period 2005-2009 to 2009-2012, while RECENT in a similar period has contributed to an increase of 63% for international publications and of 86% for publications in Polish journals.



## **How did REGPOT support key Community policies?**

The research potential initiative complements EU investments in research co-financed through the Cohesion Policy Programmes for 2007-2013. Such an approach facilitates better coordination of innovation policies at EU level including research and innovation as well as cohesion policies at European, national and regional level, both within and between these levels.

REGPOT projects in order to achieve better results in building capacities of their research entities on many occasions combined both REGPOT funding and Regional Policy tools.

There are many examples of synergies between these two policies. For example project Biocaps in biomedicine on one hand has used REGPOT sources among others to enhance its capacities through becoming more competitive and increasing the capability of technology transfer and developing the IPR expertise and on the other hand it has used Cohesion Policy funds to build new infrastructure (a new hospital building).

REGPOT was a pioneer in promoting coordinated usage of funding from FP and Regional policy. Such an approach facilitated better coordination of policies and better understanding of needs at many levels.

The Research Potential initiative is not limited to the EU's convergence and outermost regions. It promotes scientific and technological cooperation between ERA-based entities and counterparts from the Mediterranean Partner Countries (MPC- Algeria, Egypt, Jordan, Lebanon, Morocco, Tunisia, Syria, Palestinian-Administered Areas and Libya) and Albania, Turkey, Serbia, Croatia and FYROM. Several specific calls were organised to specifically target the above geographic areas. Thus, REGPOT prepared significantly contributed to the European Neighbourhood Policy.

## **How did REGPOT increase availability, coordination and access in relation to top-level European scientific and technological infrastructure?**

COWI's Final Evaluation (2014) concludes that REGPOT has helped to overcome financial barriers such as a lack of national and in particular regional funding for specialised state-of-the-art research equipment as well as for the hiring of high-level staff, hereunder foreign experts. Furthermore, many research actors consulted during the case studies did previously experience very few funds available for conference participation and networking – hereunder for younger researcher that have benefitted from increasing their mobility within the twinning arrangements between REGPOT project partners.

Hence, on this basis this final evaluation (COWI 2014) suggests that REGPOT has been an efficient programme that has helped to fill the financial gap needed to unlock and develop existing and emergence research excellence in the EU's Convergence and Outermost regions.

The Expert Group (2011) assessed that this was the case and REGPOT has had an important developing, bridging and integrating role between research and innovation capacities in less-developed regions and the research institutions in developed regions by supporting networking and cooperation. Furthermore, it states that the important capacity building activities have included acquisition of equipment, human resource development through recruitment of excellent researchers, and knowledge transfer to researchers on the spot through secondment activities. The Expert Group (2011) agrees with these findings and goes as already mentioned so far to give its executive summary the title "A success story towards a broader ERA".

### **How much did REGPOT contribute to job creation?**

REGPOT's ultimate goal is to unlock the full research potential of the EU by reinforcing and developing emerging capabilities in Europe's remote and less-developed regions. One of the aims is also to employ new experienced personnel to strengthen the scientific basis of research entities. It is estimated that 201 REGPOT projects created approximately 1000 new jobs for research and technical staff. This employment went beyond the projects' duration and belonged to the overall employment sustainability strategy of REGPOT projects. This action was also aimed at reducing brain drain in the EU as researchers were mainly employed from abroad so called 'returning researchers'.

### **What was the added value of REGPOT when compared with national research and innovation programmes?**

COWI's Final Evaluation entails Table 5 (p. 19), which describes the participant's perception on the negative consequences of not having received support from REGPOT. These research actors claim that no REGPOT support would in particular have had high negative consequences for RTD achievements, for connections with the European scientific community, and for the capacity to go from project-based research to strategy-based research.

The added value from REGPOT for the projects within biotechnology and genetics research seems to be somewhat lower. This goes mainly for the contribution to the networking capability with end-users – a topic that also scores low for the material, engineering, space and transport projects. The research actors within medical sciences and within agriculture also assess the efficiency of REGPOT to be relatively high, and this is the case for all research capacity issues.

**Table 5: Possible negative consequences of not having received support from REGPOT – by research theme**

Possible negative consequences	Average scores									
	Agriculture	Biotechnology and genetics	Energy	Environment	ICT	Material, engineering etc.	Medical sciences	Physics and chemistry	Socio-economic sciences <sup>(1)</sup>	Total
Less RTD achievements in your research domain	2.57	1.82	3.00	2.00	2.23	2.00	2.88	2.42	2.00	<b>2.38</b>
Difficulty to recruit excellent researchers	2.29	2.09	2.67	2.50	2.23	2.17	2.76	2.42	0.00	<b>2.36</b>
Less capacity to keep excellent researchers	2.71	2.09	2.33	2.75	2.15	2.33	2.65	2.08	0.00	<b>2.32</b>
Less connections with the European scientific community	2.86	1.64	3.00	2.25	2.38	1.33	2.41	2.17	0.00	<b>2.19</b>
Lower capacity to update laboratory research equipment	2.71	1.82	2.67	3.00	2.38	2.00	2.82	2.42	0.00	<b>2.42</b>
Lower capacity to go from project-based research to strategy-based research	2.29	1.64	3.00	2.00	1.92	1.83	2.53	2.17	0.00	<b>2.11</b>
Limited networking capability with end-users	2.29	1.36	2.33	2.25	2.00	1.33	2.29	2.50	0.00	<b>2.03</b>
<b>Total average scores</b>	<b>2.53</b>	<b>1.78</b>	<b>2.71</b>	<b>2.39</b>	<b>2.18</b>	<b>1.86</b>	<b>2.62</b>	<b>2.31</b>	<b>0.29</b>	<b>2.26</b>

Source: COWI.

Notes: Scoring system: 0 = no negative consequences, 1 = low negative consequences, 2 = average negative consequences, 3 = high negative consequences.

<sup>(1)</sup>The answers for "socio-economic sciences" are based on one response only.

As shown in Table 6, the efficiency question also problematizes the existence of equivalent national programmes/funding to REGPOT. Most respondents claim that there are no or only little equivalent national programmes/funding aside from REGPOT. Furthermore, the respondents provide a number of examples of financial barriers that REGPOT has helped to overcome. While the recent economic crises have put general pressure on national research and development funding sources, the examples include a lack of national and in particular regional funding for specialised state-of-the-art research equipment as well as for the hiring of high-level staff, hereunder foreign experts. Furthermore, many research actors did previously experience very few funds available for conference participation and networking.

Several respondents have also found that REGPOT has helped alleviate the financial constraints of younger researchers, which in turn has helped their career developments, herein by increasing their mobility within the twinning arrangements between REGPOT project partners.

Finally, REGPOT has for some research actors allowed the employment of Intellectual Property (IP) managers and experts with experience in international project applications

– hereunder for support from the EU Structural Funds. This has for some research actors also allowed a shift in the focus of the research towards more interdisciplinary research.

**Table 6: Existence of equivalent national programmes/funding to REGPOT**

Research theme	Average scores
Agriculture	1.29
Biotechnology and genetics	1.00
Energy	0.67
Environment	0.50
Information and Communication Technologies (ICT)	0.54
Material, engineering, space and transport	1.17
Medical sciences	0.41
Physics and chemistry	1.00
Socio-economic sciences <sup>(1)</sup>	0.00
<b>Total</b>	<b>0.78</b>

Source: COWI.

Notes: Scoring system: 0 = no national programmes/funding, 1 = little, 2 = some, 3 = much.

<sup>(1)</sup>The answers for "socio-economic sciences" are based on one response only.

### **To what extent the results of REGPOT contribute to the achievements of the new Commission's priorities?**

Specific links and synergies with Cohesion policy in the regions involved were always sought in REGPOT. Synergies with other policy areas were promoted in particular with the Regional Policy and its Structural Funds. The EC organised a stocktaking seminar in July 2013 during which Regpot project coordinators shared their experience of alignment of FP and Structural Funds. Multiple examples of such synergies were identified which is a proof of complementarity of these two policies.

### 13.5. Science in Society

#### **How did SiS contribute to improve the coordination of European, national and regional research policies?**

In ‘public engagement’, the programmes made advances in establishing new ways to engage, in particular, civil society organisations and public bodies at local and regional levels. The development of Mobilisation and Mutual Learning (MML) Action Plans have resulted in closer interaction between scientists, policymakers and CSOs in key policy areas, and provide an effective model for enhanced integration of stakeholders in European research.

The greatest impact of the SiS programme has been to raise the political importance of science in society at the European level, and thereby raise awareness of the problems and the need for all actors to work together to resolve them. However, policymakers including national officials found it difficult to engage with the large volume of work carried out across a wide number of themes, and general awareness of the key achievements of the programme remains low among key audiences. A ‘gap’ emerged in terms of efforts to appraise, aggregate and package the programme’s content and results into a digestible form and to disseminate this information widely to relevant audiences. To address this gap, a number of projects from 2012-2013 calls (e.g. RRI Tools, Responsibility, RES-Agora, Great and RRI Industry) were very active in mobilise the science/society community and to build overall capacity, in addition to providing research and support activity.

The Science in Society activity proved effective in engaging policy-makers and other societal stakeholders. It is the only programme in the EU supporting EU-wide coordination and collaboration in SiS research. It also provides a platform through which major pan-European initiatives and networks can be established and supported, leading to greater coordination of research efforts, more extensive and diverse collaborative activities, and a greater critical mass of effort to address key challenges relating to Science in Society.<sup>35</sup>

Science education projects raised significant awareness and sparked smaller initiatives at various national levels, which provide an encouraging basis for impact. One such gain has been the strong interest that a German federal body in charge of teacher training has shown in developing the materials PRIMAS project within its own context.

Table below shows the success rates achieved by each type of organisation in FP7 overall, and within SiS specifically. At the level of FP7 as a whole, Research organisations (REC), Public bodies (PUB) and Private commercial organisations (PRC) achieved the highest success rates (28%, 26% and 25% respectively), closely followed by Higher or secondary education institutions (HES) at 22%. In comparison, the “other” category (OTH) achieved very low success rates across FP7 (10%), with only one in every ten proposal participations resulting in a positive funding decision.

<sup>35</sup>

**Interim Evaluation and Assessment of Future Options for Science in Society Actions**  
Technopolis Group, in collaboration with Fraunhofer ISI and Science-Metrix.

The picture within SiS is rather different, with all organisation types achieving a success rate of at least 21%. REC achieved the highest success rate in SiS, with 30% of proposal participations resulting in a positive decision. PRC, PUB, OTH and HES achieved success rates of 24%, 23%, 22% and 21% respectively, all close to the SiS average of 23%.

Considering both demand for participation and success rates, it is notable that OTH had both a high participation rate in SiS proposals and a high success rate in SiS, when compared to the picture for FP7 as a whole. This high level of participation in proposals coupled to a high success rate means that OTH constituted 16% of the project participations in SiS, as compared to just 3% of the project participations across FP7 as a whole.

**Success rates in FP7 overall and in SiS, by organisation type<sup>36</sup>**

Organisation type	FP7 overall			SiS		
	Participations in proposals	Participations in projects	Participation success rate (%)	Participations in proposals	Participations in projects	Participation success rate (%)
PUB – Public body	23,386	6,179	26%	628	145	23%
REC – Research organisation	119,114	32,942	28%	1,272	376	30%
HES - Higher or secondary education	228,005	49,886	22%	4,034	831	21%
PRC – Private commercial	160,755	40,491	25%	777	184	24%
OTH – Other	42,179	4,118	10%	1,318	285	22%
<b>Total</b>	<b>573,439</b>	<b>133,616</b>	<b>23%</b>	<b>8,029</b>	<b>1,821</b>	<b>23%</b>

Source: FP7 participation data CORDA (December 2014)

The total number of discrete organisations participating in SiS was 1,100. SiS participants made up 3.8% of the (n=28,818) organisations participating in FP7 as a whole. The largest groups of SiS participants were HES (38% of SiS participants), followed by REC (19%) and OTH (19%). PRC made up 15% of SiS participants and PUB the remaining 10%.

Table below shows the profile of participations by organisation type, for FP7 overall and for SiS specifically. Almost half of the participations in SiS projects were by HES

<sup>36</sup> The data exclude participations in ERC proposals (n=51,628) and ERC projects as these are not categorised by organisation type.

(46%) and a further 21% were by REC. OTH made up 16% of the participations, PRC accounted for 10% and PUB the remaining 8%.

Compared to the overall FP7 profile, SiS had a higher share of participation from HES (46 versus 37%), PUB (8% versus 5%) and in particular OTH (16% versus 3%), and a lower share of participation by REC (21% versus 15%) and in particular PRC (10% versus 30%).

The very high relative participation by OTH in SiS compared to FP7 overall is due to a combination of high demand and high success rates for this group within SiS as compared to their demand and success within FP7 as a whole. The relatively low share of participations accounted for by PRC in SiS is due to low levels of demand, rather than due to low success rates (PRC success rates in SiS were in line with the FP7 average).

### Participation in FP7 overall and in SiS, by organisation type

Organisation type	FP7 overall		SiS	
	Number of project participations	Share of project participations	Number of project participations	Share of project participations
PUB – Public body	6,179	5%	145	8%
REC – Research organisation	32,942	25%	376	21%
HES - Higher or secondary education	49,886	37%	831	46%
PRC – Private commercial	40,491	30%	184	10%
OTH – Other	4,118	3%	285	16%
<b>Total</b>	<b>133,616</b>	<b>100%</b>	<b>1,821</b>	<b>100%</b>

Source: FP7 participation data CORDA (December 2014)

### How did SiS strengthen the scientific excellence of basic research in Europe?

The Science in Society (SIS) projects had significant impacts on participants, enhancing their relationships and networks, strengthening their knowledge and capabilities, enhancing their capacity and improving their reputation and image.

Within the area of ‘Open Access’, SiS had notable successes in getting open access principles piloted in FP7 and embedded in H2020. In addition, the programme has helped to raise awareness of open access issues. Of the estimated 8,000 publications

resulting from FP7 projects so far, the majority (60%) were published in open access journals or repositories.

Within the area 'gender and research' the FP7 SiS is considered to have made a major contribution to the definition of relevant indicators and collection of data on the role of women in science (She figures), and hence to a coordinated EU-wide monitoring system. According to Commission officials, this has led to significant advances in the understanding of gender imbalance in science, its impacts and the corrective measures needed. Within the area of 'science education', the programme made a major contribution to the development and piloting of inquiry based learning (IBL) techniques and their dissemination throughout Europe, in order to begin to address shortages of Science, Technology, Engineering and Mathematics (STEM) graduates at all levels.

Within the areas of 'science communication' and 'public engagement', the programmes have contributed to the development of new tools and working methods that enhance the engagement of the public, policymakers and businesses in scientific debate and improve the provision of scientific information to relevant audiences. Big advances in citizen consultation have been made for example, through the VOICES project, addressing democratic values and aspirations.

Within the area of 'scientific advice in policymaking' the SiS programme has piloted new mechanisms for linking policymakers to sources of scientific advice.

Within the area of 'research ethics' the programme has been effective in building improved networks of Research Ethics Committees. The programme also contributed to the implementation of ethics frameworks and review procedures across the EU. In addition, the programme has supported the development of new insights and practices in the areas of privacy and social impact assessment. A major policy development was the establishment of an ethical review mechanism for all framework research proposals under FP7, reviewing the potential impact of research proposed in terms of the involvement of children, patients, vulnerable populations, the use of human embryonic stem cells, privacy and data protection issues, research on animals and non-human primates, the avoidance of breaches of 'research integrity' (i.e. plagiarism and falsification), research involving developing countries or dual use.

Towards the end, SiS programme became more policy oriented with a stronger focus on triggering institutional change. In the area of ethics, originally the ELSA (Ethical, Legal and Social Aspects of the Life Sciences and Technologies) approach was used, where the most contentious sectoral issues would be identified and receive funding. This was a more reactive approach to funding. With the emergence of Responsible Research and Innovation (RRI) as a governance framework, more anticipatory actions and a move upstream "into the lab" was pursued, by supporting the development of assessment frameworks, ethics review and public engagement in institutional settings of RPOs and RFOs.

Over the course of FP7, the ethics reviews became more formalised, streamlined and professional. First, ethics reviews were only conducted at the stage of proposal evaluation. Later on, ethic audits conducted during or after the projects' lifetime were



introduced. This was of course helped by the legal developments in the area of ethics, but FP7 SiS is also said to have contributed to this development.

### **How did SiS promote the development of European research careers and to make Europe more attractive to the best researchers?**

SiS FP7 contributed to create an environment which triggers an enthusiasm for science in young people, and which provides fair and rewarding career opportunities for women and men.

In SiS 'Science education', the programme made a major contribution to the development of Inquiry Based Learning techniques and their dissemination throughout Europe, in order to begin to address shortages of Science, Technology, Engineering and Mathematics graduates at all levels. SiS 'Science education' projects contributed significantly to the development and dissemination throughout Europe of Inquiry-based learning techniques and materials. They raised significant awareness of IBL in policy, parent and business circles. It has also promoted IBL at primary level (starting very early) and to girls.

Science education projects reached hundreds of teachers and children through activities via 'multiplier' models for dissemination (e.g. Scientix) and giving direct training to teachers all over Europe (e.g. Fibonacci). Some lasting networks have emerged from the activity, independently of FP funding.

Furthermore, one third of FP7 SiS projects worked with students or school pupils and a similar proportion generated science education materials.

### **How did SiS support key Community policies?**

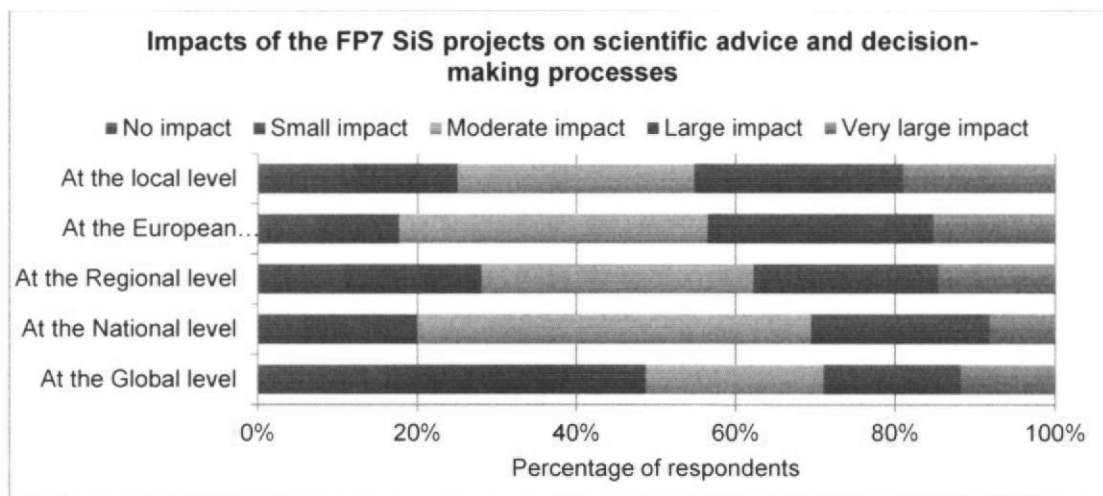
Projects funded under SiS have obviously shaped and influenced Commission's policy and approach to RRI within H2020. Specifically, based on pilots funded under FP7 SiS, the Commission has been able to embed open access principles within H2020. Similarly the Commission has been successful in introducing articles and obligations for gender under Horizon 2020. Examples can also be found of impact on national policy development. SiS had substantial influence and impact on policy-makers regarding ethics e.g. through discussions on dual use with competent authorities in Member States.

A number of projects had singular impacts on decision making, at various levels. The ETHICA project for example was seen as having a high impact on the European Commission's agenda around ethical issues in Information and Communication Technologies. The PACTIA project spread technology assessment approaches across Europe, resulting in two further Member States taking up technology assessment in their parliamentary and government processes for reviewing R&D related legislation and policy. Other impacts were identified at the local level, were for instance the EFORTT project provided a blueprint ethical framework which was taken up by a local council in the process of procuring tele-care services for up to 7,000 patients.

The survey of SiS participants were asked about the actual and expected scale of the impacts of the projects on scientific advice and decision-making processes at five levels. Figure X presents the results and shows that impacts in this area are expected to be

largest at local and European levels, with 45% and 44% of participants respectively attesting to large or very large impacts on scientific advice and decision-making. By comparison, large-scale impacts are relatively less likely to be achieved at the Global level and at the National level. Limited impacts at the Global level are to be expected, given that the vast majority of contexts and partnerships are within Europe. The lower level of expected impacts at National level is to some extent outweighed by the larger impacts at local and regional levels (presumably as a result of the direct engagement with project activity). There might be expected to be a longer time lag for the local, project related, activity to permeate to national decision-making levels.

**Participant views on the impact of the projects on scientific advice and decision-making processes at different levels (n=94)**



Source: ICF survey of SiS participants (May 2015)

Further analysis of the results reveals that the pattern of expected impacts differs to some extent by theme:

- Science Education impacts on scientific advice and decision-making are realised and expected mainly at the local and Regional levels, with relatively little impact at the National, European and Global levels. The lack of impact at National level may reflect a lack of buy-in from, or engagement with, national education authorities and ministries or the ability to bypass national levels of administration and to provide practical advice at the level of local administrations;
- Ethics projects are known and expected to impact mainly on scientific advice and decision-making processes at European level, with relatively low levels of impact expected at the other four levels. This implies that the ethics projects have been engaging with and feeding into mainly EU-level structures and processes, rather than in national systems which are known to be highly heterogeneous. Given the relatively greater development of national systems for debating research ethics, one might expect subsequent dialogue to be promoted between the EU and Member States in this area;
- Gender equality projects are expected to have a relatively high level of impact at all levels, but more so in Europe (at European, National, Regional and local levels) than

globally. Impacts are attested to be highest at local level, which in this case perhaps means at Institutional level, given the focus on organisational change:

- Governance project impacts are highest at the National and European levels, given the focus of the theme on governance structures and systems at these levels rather than at local or regional level:
- Open access projects are expected to impact on scientific advice and decision-making processes mainly at the local and European levels. This is due to the impact of the theme on individual and institutional decision making around open access (local level), and due to its influence on European Commission (FP7, H2020) rules and approaches to open access publishing; and
- Public engagement projects are also expected to exert most of their impacts on scientific advice and decision-making processes at Local and European levels, possibly due to greater engagement and influence on citizens, cities, and institutions (local level) and on the European Commission (European level), as opposed to on national science ministries and research agencies (National level).

### **SiS EU Added Value**

Over more than a decade, the greatest impact of the Commission action in FP6, FP7 and via the Science and Society Action Plan has been to raise the political importance of Science in Society at the European level, and to raise awareness of the problems and the need for all actors to work together. However, national policymakers found it difficult to engage with the large volume of work carried out. At MS level, Science in Society communities and activities are scarce, small and fragmented, and funding is limited, ad-hoc and embedded within other policy areas. Several common features can be identified across Europe, but there are also significant differences and clustering of countries in some areas. Science in society in Europe is dominated by issues related to the role of science and technology for sustainable development and issues related to the governance of science are dominant among the national debates.

While the SiS programme has a relatively limited budget, it is seen as one of the main vehicles for accelerating research efforts at the national level. Funding is the most attractive aspect of the programme from a national perspective because of the lack of alternatives, but as a result it suffers from high levels of competition and low success rates and has difficulties in involving less well-established groups.

Significant reforms of higher education institutions, combining increased autonomy and professionalization of management, have swept across Europe and stimulated a higher degree of responsiveness towards societal demands, particularly in the shape of increased science - industry interaction. But while many countries have formalized procedures and opportunities for involving citizens in priority-setting and assessment related to science and technology, the actual degree of public involvement differs significantly, and in some countries, nascent civil societies, lack of appropriate institutions, or non-inclusive political culture, form barriers for a more democratic and inclusive governance of science and technology.

The issue of 'upstream engagement', which has some resonance at the EC level, seems to have only moderate saliency in many MS. However, science and technology communication is gaining attention within governments and other institutions, particularly with regard to stimulating science communication at schools and aimed at younger people in general. Currently, there are efforts in some Member States to develop societal frameworks conditions for R&I.

For example several Member States (e.g. the Netherlands, France) have started experimenting with a 'societal challenges' oriented approach for research and innovation funding, which include award criteria that emphasise societal alignment of both research process (public engagement, ethics review) and outcomes (sustainability, industrial leadership). Also, a number of initiatives have been taken in the Member States (e.g. the UK, Germany, Denmark) to foster public dialogue within the policy making process, and furthermore encourage scientific evidence for public policy, including research on societal and stakeholders attitudes. Despite the Commission's effort, there is as of today no clear indication of significant progress at MS level, nor at pan-European level.

To address this, the Commission funded targeted FP7 projects in 2012-2013 (RRI Tools, Responsibility, RES-Agora, Great and RRI Industry) to mobilise the science-society community at MS-level and to build overall capacity. In Horizon 2020, there has been a strong shift to support institutional change in MS-level R&I to embed science and society.

Evaluation evidence found strong support from EU and national policymakers and from relevant research communities for the work of SiS.

The programme helped achieve positive benefits and impacts: a greater awareness and interest in the SiS programme itself and what it is trying to achieve; a structuring effect on the size, shape and focus of SiS communities and activities nationally; a networking effect between different countries, dispersed communities and stakeholders; a shift in attitudes as to the importance of SiS issues, pushing it up the political agenda and creating debate; plus some more limited and isolated impacts on policy. The international focus of the programme, as measured by involvement of third countries, has improved in quantitative terms from FP6 to FP7 – contrasting a general fall from FP6 to FP7 overall.

Despite these early successes there is limited knowledge and understanding at the national level of the full spectrum of activities being funded through the programme and the impacts flowing from the individual projects are generally low at this stage. Moving forward, SiS is generally regarded as important, both as a research topic and as a part of wider research activities, and national representatives are keen that the momentum and progress achieved so far is not lost. For many there is currently little or no alternative to the European programme and no likelihood of funding becoming available to fill any gap left by a reduced European focus. The SiS programme, how it is structured, and what it covers is therefore of the utmost importance for the SiS community across the continent.

### **SiS in H2020: continuity or evolution?**

There is a continuity in the sense that Science with and for Society, with its 460 MC, is ensuring that the theme remains on the agenda at the highest level in Europe. There is an evolution in the sense that the concept of Responsible research and Innovation is proposed as a transformation tool at the interface between science and society. FP7 SiS has contributed to ensuring that 'Science with and for society' and 'RRI' are both prominent features of Horizon 2020. Various successes in getting RRI concepts and issues featured in national science strategies, statements from funding bodies and foundations, in research agendas, and in research and innovation funding and selection criteria, can also be attributed to the programme.

### 13.6. Support for the coherent development of research policies

#### How did CDRP contribute to the competitiveness of European industry?

A pilot action on networks of incubators for social innovation was launched in 2013 to support two European networks to assess, support and scale up social innovations in Europe. For this action, incubators include any organisation that acts as such at local or regional level, including universities and business networks. The two networks, which started in 2013 and will receive an EC contribution of €1 million each in their 3-years duration, are assessing, providing support and scaling up hundreds of social innovations from the local communities where they get started across Europe. In parallel, the two projects will also hold a two days Social Innovation Conference, which will bring together other projects in social innovation funded by different parts of FP7.

Although still early to assess the success and impact of the two projects supported by this scheme (the projects will be completed in 2016), the monitoring of results so far has shown that there is good progress and important results already (see box below).

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Transition (Transnational Network for Social Innovation Incubation<sup>37</sup>) brings together partners from London, Paris Region, the Basque Country, Milan, Tampere and Ireland. By end of 2014 Transition has developed and applied a common framework methodology that includes a sequence of steps that lead innovators go through as part of the scaling process they enter in the project. This enables them to gain the skills and capabilities they require to grow. More than 500 social innovators across Europe took part in start-up events in six European regions. More than 90 projects entered the incubation programmes. TRANSITION also launched a **StartUp Lab**, an acceleration programme dedicated to 6 promising social innovations willing to go international.

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BENISI (Building a European Network of Incubators for Social Innovation<sup>38</sup>) started on 1 May 2013 with the objective to identify and scale up 300 most promising social innovations over 36 months. Up to mid 2014 the project has developed and applied a common infrastructure to share data among the partners and facilitate learning. More than 110 social innovations are in the process of being scaled up.

BENISI has also developed an open network structure allowing diverse stakeholders to participate and support scaling (Social Innovation Ambassadors Network). In order to increase the awareness over the role of incubation in scaling up social innovation the BENISI project organizes large events, as well as more than 150 sessions open to public across the EU, with more than 1000 innovators taking part.

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<sup>37</sup> [www.transitionproject.eu](http://www.transitionproject.eu)

<sup>38</sup> [www.benisi.eu](http://www.benisi.eu)

### **How did CDRP strengthen the scientific excellence of basic research in Europe?**

The EU Prize for Women Innovators was piloted in the CDRP WP 2011 and was continued in the CDRP WP 2013. The award was designed to address women who did research, had received either Framework of CIP funding, and founded an innovative company. The prizes reward three women following a European-wide contest who have founded or co-founded a company and who have at some point of their careers benefitted from the EU funding. Over 150 applications were received in both editions of the contest coming from women innovators across a vast range of sectors with a very diverse applicant pool in which almost all Member states and associated countries had been represented. The pilot prizes were awarded at the Innovation Convention in December 2012 and the second edition was awarded during the second Innovation Convention in March 2014.

The turn-out and impact of the two editions of the EU Prize for Women Innovators is highly successful. It shows the need for such a contest to put attention to the still untapped pool of successful women entrepreneurs in Europe and it gave evidence of the impact of DG RTD research funding since it spotlights research-driven innovations by women entrepreneurs who have benefited from EU funding in their careers.

### **How did FP7 CDRP support key Community policies?**

The Coherent Development of Research Policies (CDRP) activity<sup>39</sup> met the expectations regarding the building up of a demand-led evidence base for decision making. CDRP has been more a collector and synthesizer of existing knowledge rather than a producer of new knowledge. Part of CDRP's relative advantage comes from doing this well. One of the major strengths of CDRP was its ability to recruit, as authors of the studies and analyses, competent experts from European administrations, consulting companies, research institutes and universities, even if the same names regularly reoccur.

Under CDRP, the focus of the activities has changed over time to match the evolution in EU R&I priorities, moving from the Lisbon Agenda to the ERA and Innovation Union. In this respect, most of the activities have been designed to contribute to the improvement of the coherence and impact of the EU policies and initiatives, and have included, for example, ERAWATCH activities (providing data regarding the state of play of the ERA in Member States) and reports published by the permanent expert groups (EFFEA, ERIAB, I4G and K4G).

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<sup>39</sup> evaluation of the CDRP programme

### **13.7. International Cooperation (INCO)**

INCO has created new international partnerships between the European research community and the ENP countries, between the EU and third countries and with developing countries, and also partnerships between the EU and other regions in the world. The INCO partnerships and activities consolidate and reinforce trans-European and international networks. A further impact, less quantifiable but nonetheless essential to international cooperation, is the confidence-building that comes with participation, and the changes to mutual understanding/ knowledge and to practice that is associated with international collaboration and shared efforts – outcomes that are essential to integrating research networks.

The INCO Activity provided the framework for coordination and support actions to foster cooperation between participants in the ten activities. Direct achievements of the INCO projects range across outcomes that include participation rates (levels and types of participants), networking activities, and capacity-building actions. Many of the activities undertaken by the projects could be classified as networking and capacity-building.

Across the INCO activity, 1326 partners are involved in international cooperation, 813 from the MS/ACs and 513 from third countries. In total, 61% of the partners are from the EU (member states and associated countries), and 39% are from the third countries. The total number of projects funded is 156. Taking stock of INCO in numerical terms, the conclusion is that the critical mass in international participation has been secured.

The projects funded in the last two INCONET calls have an increased focus on involving industry in networking events in order to promote innovation. Countries have different and often distinct national systems, and the collaboration between the research community and industry can vary substantially. This is where networking activities can be useful in bringing researchers and users together, and effect a gradual change in practice.

Networking and partnership-building was facilitated through the mapping of third country research landscapes, brokerage events, fact-finding missions, and travel grant schemes. INCO projects also disseminated information on FP7 through the websites, newsletters, conferences, workshops and information sessions.

#### **How did INCO contribute to improve the coordination of European, national and regional research policies?**

INCO instruments were designed to support a policy dialogue that brings together representatives of the European Commission, the EU Member States and the third country, or group of countries in a region, for discussions aimed at promoting cooperation in science and technology, with the objective of formulating action plans and roadmaps for cooperation – particularly the BILATs (bilateral coordination between EU MS/AC and individual third countries) and INCONETs (bi-regional cooperation between MS/AC and third country regions). BILAT activities were directed at third countries that had signed an S&T agreement with the European Union, and the



objectives of the BILAT actions included providing information on programmes designed to promote cooperation between Europe and specific third countries, and identifying the mutual benefits to be derived from S&T cooperation.

Across the ten INCO activities, projects concentrated efforts on gathering information about the existing collaborations and policy support, dissemination and monitoring activities. Though the results of these efforts were varied, substantial knowledge about national research and innovation capacities and research policy priorities, national supply and demand conditions, and the identification of key researchers and research actors has proved fruitful in generating a varied data-base to support international cooperation activities into H2020.

### **How did INCO support key Community policies?**

The International Cooperation activity (INCO) succeeded in achieving a critical mass in international participation, capitalising on the links established through other FP7 programmes. At the same time, INCO participation did not guarantee access to the bigger projects in the FP7 thematic programmes. This highlights the importance of involving the other Research family DGs and DEVCO early in the process.

INCO projects contributed to the policy dialogue through intelligence-gathering activities such as documenting the S&T policies, compiling inventories on research specialists and expertise, mapping skills and infrastructure, conducting interviews with stakeholders and organising discussions. INCO-NET projects undertook activities to identify common research priorities in the participating countries, and contributed to capacity-building through the provision of training for third country Contact Points.

The R2I projects contributed to mapping third country research and innovation systems and strategies, providing industry analyses, identifying stakeholders, competencies, infrastructures, business promotion services (including business parks and incubators), as well as preparing supply and demand analyses to identify bottlenecks and barriers to research and innovation.

The INCONET activity supported bi-regional coordination with strategic partners that are key to the EU's foreign policy and external relations, including Africa, Latin and Central America, ASEAN, the Arab Gulf, the Pacific, and Western Balkans. Similarly, the BILAT activity reflected ongoing scientific and political priorities in the engagement with individual countries including (Argentina, Australia, Brazil, China, Japan, Russia, South Korea, Ukraine, US, China). The ERAWIDE activity enlisted the participation with the European Neighbourhood countries, a central component of EU foreign policy. The thematic priorities of H2020 can already be identified in ERAWIDE projects (food, agriculture, water, biotechnology, biodiversity, marine environment).

Some structural impacts took place as a result of INCO activities, including those in synergy with external funding instruments such as ENPI. For example, the building of institutional capacity to manage international research cooperation thanks to training and networking activities, the further diffusion of peer review and competitive calls due to exposure to the FP Calls and related evaluation.

## **To what extent the results of INCO contribute to the achievements of the new Commission's priorities?**

The INCO work programmes encouraged coordination with a broad range of community instruments, including these with a defined geographical focus: the Instrument for Pre-accession Assistance (IP), the European Neighbourhood and Partnership Instrument (ENPI), the Development Cooperation and Economic Cooperation Instrument (DCECI), the Instrument for cooperation with industrialised and other high-income countries and territories (ICI), Asia and Latin America (ALA), the European Regional Development Fund (ERDF), and the European Development Fund (EDF). INCO calls also emphasized instruments in the areas of science, technology and innovation.

Some DEVCO instruments are already linked with research, but only for very specific actions such as food security. However, the link between capacity building and research is now stronger and it is an essential link for developing countries. Capacity building is where the coordination with DEVCO is more visible, one example being the synergy between INCO, DEVCO and DG-CONNECT in Armenia. In this case, an ERA-WIDE project (INARMERA-ICT) and FP7 PICTURE (DG-CONNECT) projects joined forces in order to tackle the challenges of international cooperation in the field of Components, Computing Systems and Networks, supported by the Eastern Partnership (EaP) Platform IV and the multilateral part of the European Neighbourhood Policy Instrument (ENPI) in partnership with DEVCO.

The challenge of coordination with other policy instruments is illustrated by the often limited progress in taking the outcomes of priority-setting exercises forward, and there was some difficulty in utilizing the results of the priority-setting exercises. In many of the early INCONETS, it was assumed that the results could be passed on to the European Commission DG RTD thematic directorates to be used in the preparation of Specific International Cooperation Activities (SICA) calls based on such priorities. However, many projects reported difficulties in influencing the Framework Programme or in engaging with national work programmes.

Furthermore, INCO has proven consistency with EU foreign policy objectives. International cooperation is both an objective of EU foreign policy and an instrument of that policy. The contribution of EU external policies, and particularly the external dimension of internal R&D policy, is central to the delivery of the Europe 2020 Strategy. The research cooperation fostered through the INCO programme has created links with the countries and regions that are also targets of the broader EU foreign policy, and the geographic scope of the INCO activities reflects in many ways the global scope of EU foreign policy.

Eighty nine third countries participated in the INCO programme, and 39 MS/AC participants. However, there was a concentration in the participation by the MS/AC countries, with France, Germany, Italy, Spain, Greece and Austria having the highest number of projects. Among the participant third countries, there was an ENP concentration, with Egypt, Tunisia, Ukraine, Jordan, Morocco, Armenia, and Georgia with the highest number of projects. The top twenty (third country) participants

included Brazil, China, India, Japan, Mexico, Russia and South Africa— seven countries with which the EU has already concluded strategic partnership agreements.<sup>40</sup>

The INCONET activities support the inter-regional dimension of EU foreign policy. PACE-Net was one of the INCONET projects that specifically addressed foreign policy objectives, with a work package linking S&T policy to Pacific development goals and the preparation of a set of recommendations on the potential contribution of R&D to regional development. The CAAST-Net Plus project included a workpackage dedicated to "Research, technology transfer and innovation to enhance food security", one of the three strategic priorities of the EC's Food Security Thematic Programme. The activity will operate within the context of the Joint Africa-EU Strategy (JAES) and will respond to the objectives of the Comprehensive Africa Agriculture Development Programme (CAADP) of the New Partnership for Africa's Development (NEPAD). The SEA-EU-Net project organized a conference linking the R&D to development, with the objective of identifying how poverty could be alleviated so as to improve the social and economic life of the poorest countries in Southeast Asia.

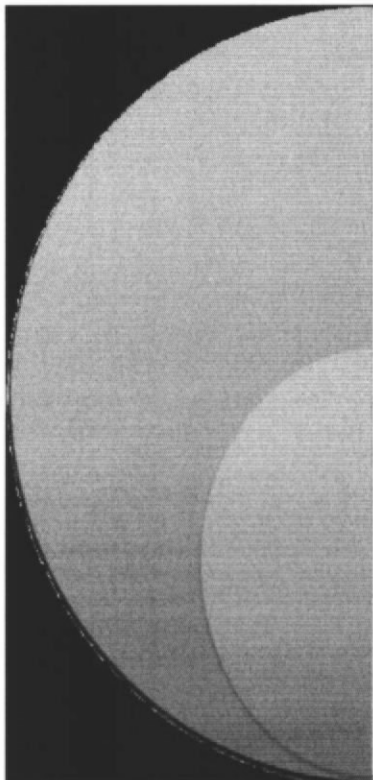
There are a number of global issues such as cyber security, climate and environmental change, health security (including epidemics), and poverty reduction where the EU can contribute to global debates and provide an input to global governance. European research programmes can provide an input to these debates in the specific research outputs, by taking a more strategic approach to policy dialogue, identifying dialogue pathways and key actors in the individual global policy arenas. In this context, the EU is already engaged in various global governance processes (in trade, environment, development) and can leverage its policy expertise in the respective areas through the EU delegations around the world so as to influence the direction of debate and policy-making in line with EU interests and with established norms and principles.

Coordination across the activities of different Commission Directorate Generals (development, external relations and research) was evident particularly in the latter stage of the INCO programme management. The global opening of the H2020 programme highlights more than ever the need for enhanced coordination, adding to the administrative and managerial responsibilities of the Commission DGs. While the European External Action Service (EEAS) is now in place to run the 141 EU delegations around the world, with a number of delegation staff on secondment from DG Research (and other 'home' DGs), the potential for coordination between research and foreign policy exists. However, the top-level division of authority between the different areas of the European Commission in the internationalizing of research policy remains unclear, and this can ultimately compromise the coordination of policies and strategic priorities.

The following figure provides an overview of EU added value of international cooperation under FP7:

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<sup>40</sup> The EU has signed ten strategic partnerships – Brazil, Canada, China, India, Japan, Mexico, Russia, South Africa, South Korea, US.



<h2>Non-EU</h2>	<ul style="list-style-type: none"> <li>• Easier access to networks and improvement of existing networks e.g.             <ul style="list-style-type: none"> <li>• <i>Increased geographical scope</i></li> <li>• <i>Greater networking opportunities</i></li> </ul> </li> <li>• Coordination of critical mass, e.g.             <ul style="list-style-type: none"> <li>• <i>Increased outreach</i></li> <li>• <i>Higher visibility for the country</i></li> </ul> </li> <li>• Increased excellence and capacity building, e.g.             <ul style="list-style-type: none"> <li>• <i>Greater market access</i></li> <li>• <i>Easier access to European STI</i></li> <li>• <i>Increased prestige</i></li> </ul> </li> </ul>
<h2>EU</h2>	<ul style="list-style-type: none"> <li>• Easier access to networks and improvement of existing networks</li> <li>• Increased excellence and capacity building, e.g.             <ul style="list-style-type: none"> <li>• <i>Enhanced European knowledge base</i></li> <li>• <i>Better connections with leading minds</i></li> </ul> </li> <li>• Coordination of critical mass, e.g.             <ul style="list-style-type: none"> <li>• <i>Concrete regional approach and speaking with 'one voice'</i></li> <li>• <i>Increased dissemination and outreach of STI</i></li> </ul> </li> <li>• Mutual learning and harmonization on cooperation, e.g.             <ul style="list-style-type: none"> <li>• <i>Improved cooperation frameworks</i></li> </ul> </li> <li>• Avoiding redundancies, e.g.             <ul style="list-style-type: none"> <li>• <i>Less fragmentation and duplication of policies and instruments</i></li> </ul> </li> </ul>

### 13.8. Risk-Sharing Finance Facility (RSFF)

Looking at the operational and intermediate objectives, the RSFF and RSSI have reached and easily exceeded almost all their operational and intermediate objectives.

The findings of the first RSFF interim evaluation<sup>41</sup>, conducted in 2010 by a group of independent experts, were largely positive. The experts concluded that the RSFF had been successfully introduced into the EU's research funding scheme within FP7, was a model example of an EU financial instrument, and should be further developed and strengthened. The experts felt that some target groups, however (SMEs, research infrastructures) needed more focused support.

Subsequent amendments to the contract between the EU and the EIB changed the risk-sharing mechanism from a project-by-project to a portfolio first-loss-piece (PFLP)<sup>42</sup> approach, with the EU assuming a higher risk. It was judged that this would optimise the leverage effect of EU funds and enhance the EIB's capacity to finance loans, especially to SMEs and research infrastructures. Three compartments were created: primarily corporate finance and project finance transactions: the RSI (see above), an SME and small midcaps guarantee facility run by the EIF; and research infrastructures. Changes were also made to facilitate lending to universities and public research institutions, and also loans to medium and large midcaps. In addition, a counter-guarantee mechanism for the RSI was also introduced.

The findings of the second interim evaluation of the RSFF<sup>43</sup>, conducted in 2013 by a further group of independent experts, were also largely positive. The experts concluded that the RSFF had proved to be attractive to RDI companies and had met or exceeded its loan volume targets, improved its geographic coverage, and enabled EIB to increase the bank's capacity to make riskier loans.

By the end of 2013, 127 RSFF operations had been approved by the EIB, with a total loan volume of €16.2 billion, and the Bank had signed loan agreements with 114 R&I promoters, with a total loan volume (active loans) of €11.31 billion. The sector diversification was broad, and the instrument had been implemented in 25 countries.

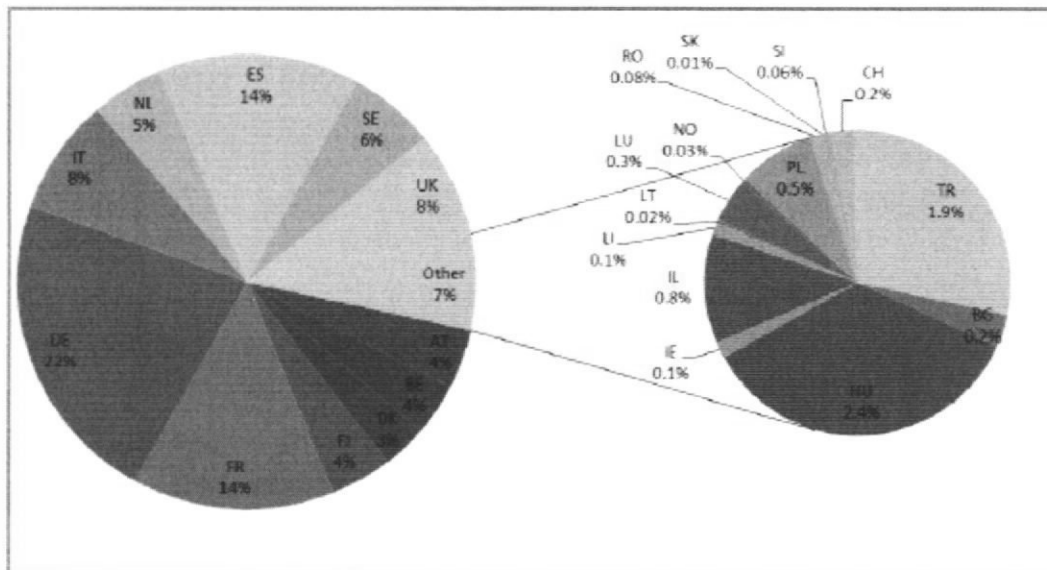
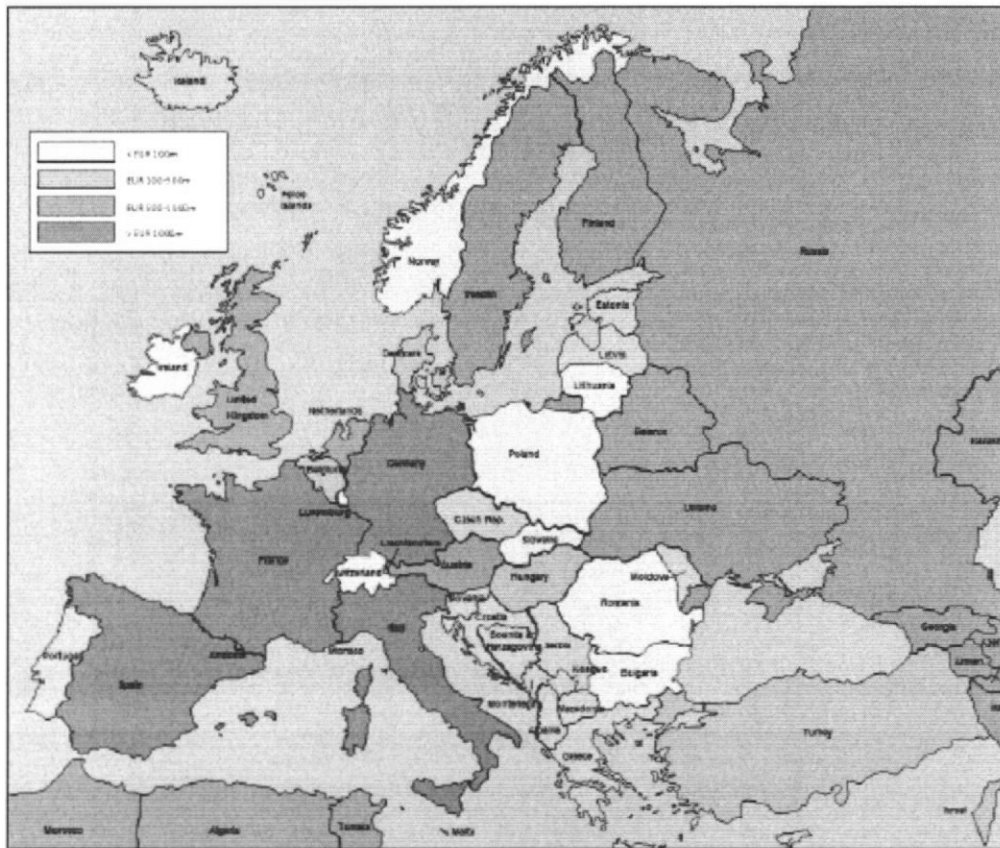
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<sup>41</sup> For the report by a group of independent experts on the first interim evaluation of the RSFF, see [http://ec.europa.eu/research/evaluations/pdf/archive/other\\_reports\\_studies\\_and\\_documents/mid-term\\_evaluation\\_of\\_the\\_risk-sharing\\_financial\\_facility\\_\(rsff\)\\_-expert\\_group\\_report.pdf](http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/mid-term_evaluation_of_the_risk-sharing_financial_facility_(rsff)_-expert_group_report.pdf)

<sup>42</sup> In the PFLP approach, the EU contribution is used first to cover any losses in a portfolio of loans, but only up to a pre-defined percentage of losses (the so-called 'first-loss piece' or cushion). If losses exceed the EU contribution, the EIB covers all further losses.

<sup>43</sup> For the report by a group of independent experts on the second interim evaluation of the RSFF, see [http://ec.europa.eu/research/evaluations/pdf/archive/other\\_reports\\_studies\\_and\\_documents/interim\\_evaluation\\_report\\_rsff.pdf](http://ec.europa.eu/research/evaluations/pdf/archive/other_reports_studies_and_documents/interim_evaluation_report_rsff.pdf)

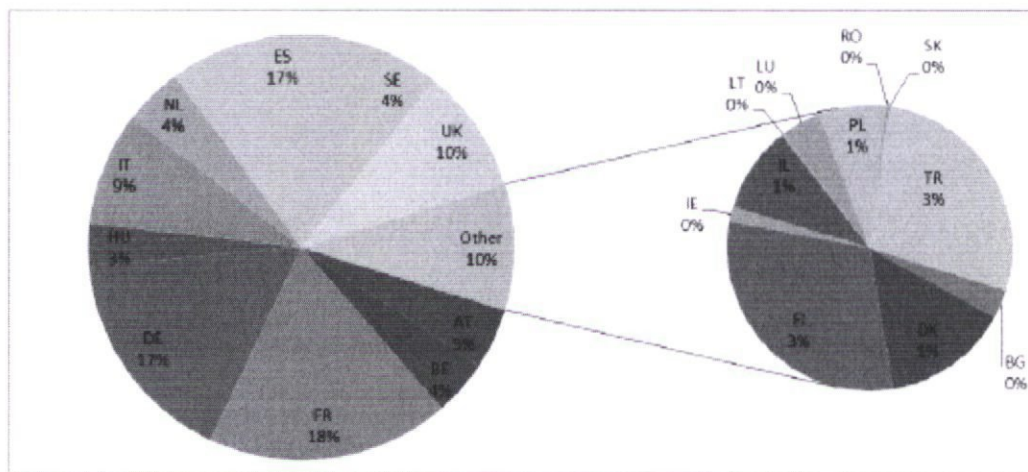
Figure 2: RSFF signatures by country as of 31 December 2013



EU-15 countries accounted for the large majority of operations. While RSFF operations have been concentrated in Germany, France, Italy, Spain, Sweden and the UK, EIB has met its geographical deconcentration target, linked to a fee-based financial incentive, of ensuring that the RSFF portfolio does not have more than 60% of its signed operations

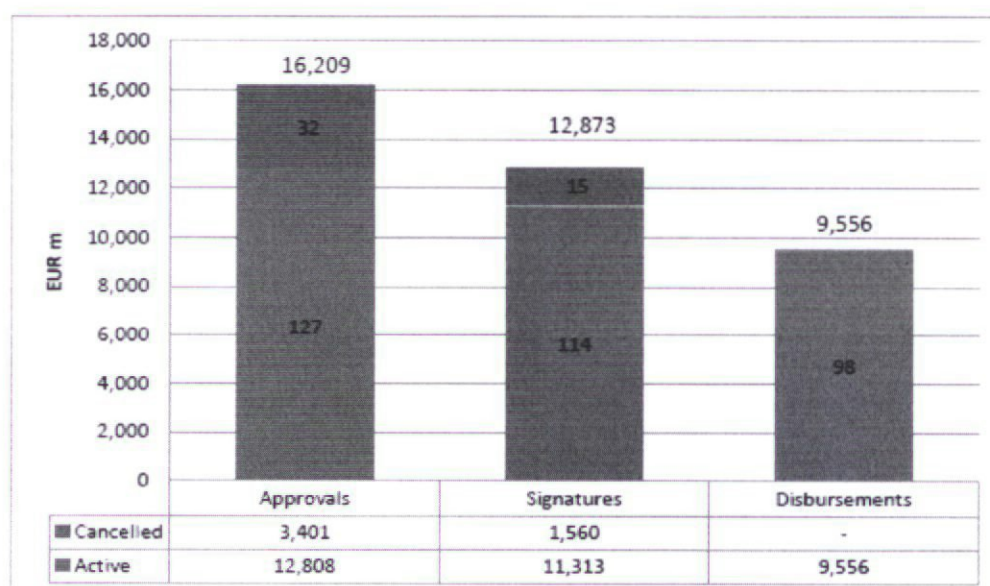
in the three Member States with the largest share of RSFF operations by volume. The relative scarcity of operations in Central and Eastern Europe appears to derive from the region's still comparatively thin technological base and infrastructure, together with a comparative underdevelopment of its financial sector and a lack of measures to foster access to risk finance.

**Figure 3: RSFF disbursement by country as of 31 December 2013**



**Figure 4: RSFF operations approved and signed by the EIB since launch of RSFF**

EUR m	Active		Cancelled		Total	
	Amount	Number	Amount	Number	Amount	Number
Approvals	12,808	127	3,401	32	16,209	159
Signatures	11,313	114	1,560	15	12,873	129
Disbursements	9,556	98	-	0	9,556	98



By the end of 2013, the RSI had been implemented in 14 countries via 23 financial intermediaries for a total guarantee amount of €1.21 bn underpinning a total loan volume of €2.4 bn. The number of final beneficiaries, 578, will continue to increase, under the terms of the pilot facility, until the end of 2016.

**Figure 5: RSI financial intermediaries**

As of 31-December-13

#	RSI - Financial Intermediary Names	Country	Guarantee Amount (EUR m)	Signature date	#	Countries covered*
1	Unicredit Bank Austria	Austria	60.0	03-Oct-12	1	Austria
2	Ceska Sporitelna (Erste)	Czech Republic	45.0	08-Nov-12	2	Czech Republic
3	ABN Amro	Netherlands	60.0	26-Nov-12	3	Germany
4	Bankinter	Spain	60.0	27-Nov-12	4	Ireland
5	AIB	Ireland	40.0	28-Nov-12	5	Italy
6	Banco Popolare (joint application - 2 FIs)	Italy	60.0	07-Dec-12	6	Netherlands
7	Cassa Di Risparmio di Cento	Italy	20.0	07-Dec-12	7	Poland
8	Deutsche Bank	Germany	60.0	23-Jan-13	8	Portugal
9	Komerční banka	Czech Republic	50.0	15-Mar-13	9	Spain
10	BPI	Portugal	30.0	17-Apr-13	10	Turkey
11	Bank Pekao	Poland	40.0	27-May-13	11	France
12	BPCE (joint application - 17 FIs)	France	125.0	24-Jun-13	12	Sweden
13	Credito Valtellinese Group (joint application - 4 FIs)	Italy	50	24-Jul-13	13	Hungary
14	Ratifeisen Leasing Polska	Poland	30	31-Jul-13	14	Bulgaria
15	Halkbank	Turkey	50	17-Sep-13	15	Slovakia
16	Bpifrance financement	France	80	25-Sep-13	16	Croatia
17	Sparbanken Öresund AB	Sweden	17.5	09-Oct-13	17	Estonia
18	Bankinter (increase)	Spain	20	15-Oct-13	18	Denmark
19	Alba Leasing	Italy	60	17-Oct-13	19	Switzerland
20	BES	Portugal	80	24-Oct-13		
21	Deutsche Bank PBC	Poland	25	29-Oct-13		
22	FiBank	Bulgaria	7.5	08-Nov-13		
23	BPI increase	Portugal	50	18-Nov-13		
24	IKB Leasing	Hungary	25	26-Nov-13		
25	Unicredit Bank Austria (increase)	Austria	20	06-Dec-13		
26	Komerční banka increase	Czech Republic	30	06-Dec-13		
27	AWS (counter-guarantee)	Austria	11.5	13-Dec-13		
<b>Total Signed</b>			<b>1206.5</b>			

\* including applications in process

In the Commission's "A Budget for Europe 2020" policy paper<sup>44</sup>, financial instruments are highlighted as a way of advancing the EU's key policy priorities, thanks to their leveraging of investment:

*By working with the private sector on innovative financial instruments it is possible to magnify the impact of the EU budget, enabling a greater number of strategic investments to be made, thus enhancing the EU's growth potential. Experience in working most notably with the European Investment Bank (EIB) Group, national and international financial institutions has been positive and will be taken forward in the next MFF. Guarantees and risk-sharing arrangements can allow the financial sector to provide more equity and lend more money to innovative companies, or to infrastructure*

<sup>44</sup> COM(2011) 500, 29.6.2011, p. 9 and p. 11 of Part I.



*projects. In this way, such financial instruments can also contribute to the overall development of post-crisis financial markets.*

The Commission considers<sup>15</sup> FIs particularly suitable for addressing sub-optimal investment situations in a wide range of policy areas whenever activities or operations are potentially capable of being financially viable, but are not yet attracting funding from market sources that is either adequate or available on reasonable terms.

EU-level intervention to improve access to risk finance is justified because of a market failure caused by significant information asymmetries and high transaction costs, exacerbated by the credit crunch associated with the financial crisis and the low supply of VC in Europe.

For debt financing, EU-level intervention is needed to increase the likelihood that loans are made and guarantees extended to help achieve EU-level R&I policy objectives. The current gap in the market between the demand for and supply of loans and guarantees for risky R&I investments, addressed by the RSFF, is likely to persist, with banks remaining largely absent from higher-risk lending. Typically, banks lack the ability to value knowledge assets, such as intellectual property, and are therefore often unwilling to invest in knowledge-based companies, which usually lack tangible assets at the early stage. In consequence, many companies — both large and small — cannot obtain loans for R&I activities, or at least not on reasonable terms. Credit constraints for small firms are also due to risks arising from information asymmetries between lenders and borrowers: lenders are not able to easily separate potentially successful businesses and projects from less successful ones without incurring high transaction costs. Another disincentive for lenders is that even if R&I activities give rise to a commercial product or process, it is not at all certain that the company that has made the effort will be able to exclusively appropriate the benefits deriving from it.

For equity financing, EU-level intervention is needed to help improve the availability of finance for early and growth-stage investments and to boost the development of the EU's VC market. During the technology transfer and start-up phase, new companies have to bridge the gap between the cessation of public research grants and the possibility of attracting private finance. Public support aiming to leverage seed and start-up funds to fill this gap is too fragmented and intermittent. Also, most VC funds in Europe are too small to support the growth of innovative companies and do not have the critical mass to specialise or operate across borders.

In both cases, however, financial instruments must be designed to operate on market-based terms in order to minimise the possibility of introducing their own distortions to the market. They must also seek to mobilise additional funding that would not otherwise have been committed, and avoid crowding-out investors.

The European Commission's right to act in the domain of access to risk finance is based on Article 173 of the Lisbon Treaty, which includes a statement that the EU should, with the Member States, encourage "*an environment favourable to initiative and to the*

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<sup>15</sup> See *A framework for the next generation of innovative financial instruments – the EU debt and equity platforms*, COM(2011) 662, 19.10.2011.

*development of undertakings throughout the Union, particularly small and medium-sized undertakings" and foster "better exploitation of the industrial potential of policies of innovation, research and technological development".*

The European added value of EU-level intervention to foster access to risk finance has six principal components:

***Helping achieve EU policy objectives:*** EU-level financial instruments can support the achievement of the EU's innovation policy objectives by addressing market failures that lead to insufficient funding being available from market sources, typically because the field is perceived as too risky by other lenders or investors.

***Facilitating the financing of cross-border projects:*** Funding conditions for cross-border projects at national level are difficult, and particularly so in the R&I domains to be covered by Horizon 2020; EU-level financial instruments can ease the fund-raising process.

***Demonstration and catalytic effects:*** In addition to their financial impact, financial instruments implemented at EU level can have important non-financial effects such as demonstration effects in the targeted markets, triggering wider application to other sectors. The expertise of the EU and the financial institutions responsible for the implementation of EU-level financial instruments can be transferred to national, regional or local authorities. Transferring skills and knowledge across frontiers could play a significant role in aligning national policies with growth and innovation-oriented measures, reducing disparities between Member State economies, and enhancing the EU's competitiveness.

***Economies of scale:*** Interventions by financial instruments at EU level generate economies of scale due to the enhanced capacity of the EU to mobilise public and private resources from the full range of Member States.

***Multiplier effect:*** EU-level financial instruments multiply the effect of the EU budget by attracting other public and private financing along the implementation chain comprising entrusted entities (such as EIB), financial intermediaries (such as banks) and final beneficiaries. Through risk coverage or risk participations, the EU intervention may induce investors to invest (or to invest more) in cases where they would have not invested at all (or invested less) without support from the EU budget. This can be achieved through co-financing by international financial institutions or through, for example, the additional debt volumes banks and guarantee institutions are requested to provide to final beneficiaries. For example, in the case of the RSFF, by end-2013 an EU outlay of just over €1 bn is expected to mobilise over €11 bn of EIB loans and support a total investment of approximately €30 bn.

***Capacity-building:*** National and local institutions can benefit from EU-level entrusted entities' knowhow about the design of financial products which otherwise would not have been available to them. An example is the European loan guarantee schemes implemented under the CIP and the RSFF's RSI in FP7. In many Member States, guarantee societies are scarce or do not exist, and a European counter-guarantee scheme is important in encouraging new entrants and in supporting newer guarantee institutions

still building up their portfolios. The presence of a European guarantee and/or counter-guarantee can either help new guarantee societies boost their volumes in their early stages of development, or facilitate the creation of such schemes, and in both case contribute to capacity-building.

## 14. EVALUATION OF EURATOM FP7 INDIRECT ACTIONS

### Programme's objectives

The Euratom FP7 Decision<sup>46</sup> defined the following objectives:

For fusion energy research: to develop the knowledge base for, and to realise ITER as the major step towards, the creation of prototype reactors for power stations that are safe, sustainable, environmentally responsible, and economically viable.

For nuclear fission research: establishing a sound scientific and technical basis in order to accelerate practical developments for the safer management of long-lived radioactive waste, enhancing in particular the safety performance, resource efficiency and cost-effectiveness of nuclear energy and ensuring a robust and socially acceptable system of protection of man and the environment against the effects of ionising radiation.

### Evolution of objectives to respond to the Fukushima accident

Following Fukushima accident, the Council decision on the Euratom Framework Programme 2012-2013<sup>47</sup> increased the focus of fission research on nuclear safety. The research in the domain of nuclear (fission) systems was redefined as follows: *While respecting the overall objective, research to underpin the safe operation of all reactor systems (including fuel cycle facilities) in use in Europe or, to the extent necessary in order to maintain broad nuclear safety expertise in Europe, those reactor types which may be used in the future, focusing exclusively on safety aspects. This includes plant life assessment and management, safety culture (minimising the risk of human and organisational error), advanced safety assessment methodologies, numerical simulation tools, instrumentation and control, and prevention and mitigation of severe accidents, with associated activities to optimise knowledge management and maintain competences.*

### What have been the main achievements of the Euratom Programme?

#### Fusion research

The fusion programme in FP7 had a number of significant achievements both scientifically/technically and in policy terms. A key milestone in the quest for developing fusion power as a credible energy source was the signature on 21/11/2006 of the ITER International Agreement, which formally entered into force on 24/10/2007 (the ITER partners are China, EU, India, Japan, Russia, South Korea and USA). ITER, which is being constructed at Cadarache in the south of France, is the fusion experiment that should demonstrate the viability of fusion at reactor scale. Thus, its significance for the future of the fusion programme cannot be underestimated. Furthermore, a domestic agency, the Fusion for Energy Joint Undertaking (F4E), was established in Barcelona, Spain, on 27/03/2007 to manage the EU contribution to ITER. The signature of the

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<sup>46</sup> Decision 2006 970 Euratom, OJ L 54 21, 22.02.2007

<sup>47</sup> Decision 2012 93 Euratom, OJ L 47 25, 18.02.2012

ITER agreement and the establishment of F4E must be ranked as the most important achievements of EU fusion policy in recent years.

An important point is that the investment in ITER must be accompanied by a vigorous fusion R&D programme in the Member States; otherwise the EU will not have the capabilities and competences to reap the benefits of ITER. Furthermore, it is necessary already now to consider the step beyond ITER, i.e. constructing a demonstration fusion reactor (DEMO), especially since there are long lead items where R&D must start early. Here the fusion programmes in the Member States also play an important role. In order to coordinate the EU fusion research activities in FP7 the European Commission used two main instruments: The Contract of Association (CoA) and the European Fusion Development agreement (EFDA). The CoA was the basis of bilateral arrangements between the Commission and some 26 fusion research institutions throughout the Member States, and had a long and successful history in coordinating and supporting activities in EU fusion laboratories. At the beginning of 2000 it was supplemented by EFDA, which was a multilateral agreement between the EU fusion research labs and the Commission. EFDA was particularly set up to manage high priority research items requiring close cooperation between EU fusion research institutions and for the collective exploration of JET (the Joint European Torus, Culham, UK). Since its first plasma in 1983, JET has been the EU flagship fusion experiment: it is still the world's largest fusion device and the closest one to ITER in most respects, especially with its currently unique capacity of being able to operate with deuterium and tritium, the same fuel as ITER and future reactors. Both CoA and EFDA saw further developments in FP7, in particular the expansion to include all the enlargement countries.

Another important policy development was the gradual re-orientation of the fusion programme during FP7, enabling greater emphasis on ITER support, education and training and expansion of fusion technology for DEMO development. This was initially driven via an evolution of EFDA, especially:

In 2011, the setting up of a PPP&T (Power Plant Physics and Technology) Implementing Agreement within the EFDA framework in order to promote joint DEMO-related R&D.

The creation of an ITER Physics Department within EFDA.

The launch of a Goal Oriented Training (GOT) programme, aimed at improving recruitment and training of professionals, especially engineers, where there is a shortfall in the EU fusion programme.

In addition, to provide additional support for education and training, an initiative outside the framework of CoA and EFDA was initiated: the FUSENET project. It was supported by the Commission through a Coordination and Support Action, which led to the establishing of a legal entity with the same name under Dutch law, with the objective of better coordinating and promoting fusion education and training across Europe, especially at Master and PhD level.

Similarly, to enhance industry involvement in fusion and encourage technology transfer between the EU fusion labs and industry, two further initiatives were taken: (i) The

formation of the Fusion Industry Innovation Forum (FIIF), which plays an important role in bridging the gap between fusion researchers and representatives of industries with an interest in fusion; (ii) the FUTTA Technology Transfer project, which was launched in 2013 and again supported by the Commission through a Coordination and Support Action, the results of which will help define the strategy in this field to be followed during Horizon 2020.

To provide evidence-based support for the required evolution in the fusion programme, two crucial in-depth reviews were undertaken during the course of FP7:

The Facilities Review<sup>48</sup>, a very comprehensive evaluation of how the resources of the EU fusion programme should be best utilised, especially in terms of experimental facilities but also generally. The report played a key role in the implementation of the FP7 fusion programme, both in terms of the use of facilities and the direction of the programme.

The independent panel of experts (the 'Wagner Panel') that assessed the future of the JET facilities and reviewed a Commission document on the strategic orientation of the EU fusion programme. The Panel issued two reports<sup>49</sup>, the first on JET was instrumental in the decision to continue JET operation into Horizon 2020 (2014-2018), while the second on overall programme strategy made a number of recommendations regarding the future evolution of the Euratom programme. In particular, it strongly advocated developing a realistic fusion roadmap, with the target of demonstration of (limited) fusion electricity generation by 2050.

Furthermore, the instruments used to implement the fusion programme (CoA and EFDA) up till the end of FP7 were fusion-specific and became increasingly out of step with the 'new management modes' being introduced in EU funding programmes for research and innovation. There were clear advantages to be gained by moving to a more streamlined structure based in joint programming between national research labs, and this became the basis of the Commission's proposal for the fusion part of the Euratom programme in Horizon 2020, as well as the focus of in-depth reflection and stakeholder consultation, starting in 2011.

As the cornerstone of this approach, and in response to the recommendations of the Wagner Panel, the Commission asked EFDA to develop, under the constraint of assuming realistic funding levels, a comprehensive roadmap for demonstrating fusion electricity production by the middle of the century. The work on the roadmap was carried out under the leadership of the EFDA Leader, Dr Francesco Romanelli, and involved key staff seconded to EFDA and in the EU fusion labs together with consultation of F4E and the FIIF. This massive task was carried out during a very short period, essentially six months in 2012. The resulting roadmap was approved by the members of the EFDA Steering Committee (heads of the national fusion labs / research

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<sup>48</sup> "R&D Needs and Required Facilities for the Development of Fusion as an Energy Source"; Report of the Fusion Facilities Review Panel October 2008; ISBN 978-92-79-10057-4.

<sup>49</sup> "Potential Contributions of the JET Facility to Fusion Research in Relation to Support for ITER", 11 July 2011; "Strategic Orientation of the EU Fusion Programme (with emphasis on Horizon 2020)", 1 September 2011.

units) in October 2012. The roadmap has been extremely influential, not least for fusion policy, and forms the basis for the new fusion Joint Programme (2014-18) implemented by the EUROfusion consortium of all national labs (ex-EFDA members) under the terms of a Horizon 2020 Grant Agreement for a European Joint Programme co-funded action.

Regarding scientific/technical achievements in FP7, there are numerous examples, though one of the most important was undoubtedly the completion of the ITER-Like Wall (ILW) upgrade of JET (2009-2011). This put the JET tokamak in a unique position as the only device worldwide that uses the same combination of plasma-facing components as those to be used in ITER. It involved replacing more than 4000 internal tiles by remote handling. The ITER-Like Wall in JET has since yielded many important results for ITER. In particular, results confirmed that ITER could be fitted with a tungsten divertor from the start of its planned operation, avoiding the need for an initial carbon divertor and representing significant cost savings for the project as a whole. Furthermore, JET experiments with the ILW have revealed many new aspects associated with operating with a metallic wall, and the lessons learned are vital for future ITER operation. In this context it should be mentioned that the EU fusion programme can boast two tokamaks with ITER-relevant geometries but of different sizes, both equipped with metallic walls: JET and ASDEX-Upgrade (located at IPP, Garching, near Munich), which started operation with a tungsten wall in 2007. This allows for a unique ability to use the 'step ladder' approach for making more reliable extrapolations to ITER.

Another project on JET with direct impact on ITER was the installation and testing of an ITER-like ICRF (Ion Cyclotron Range of Frequencies) antenna (ILA) on JET. ICRF heating is used as one of the sources for heating a fusion plasma to the temperatures required for fusion to take place at a sufficient rate. The ILA provided very valuable feedback for the design of the ITER ICRF antennas.

The construction of two further major new research infrastructures in Europe, which received significant support through the Euratom programme and were prioritised in the Facility Review, advanced significantly during FP7. Wendelstein7-X (W7-X), under construction at IPP Greifswald, Germany, is also a toroidal device but based on the stellarator rather than the tokamak concept. Though not as advanced as tokamaks, stellarators are included in the fusion roadmap as an important mitigation strategy. The first plasma in W7-X is scheduled for late autumn 2015. The other facility is MAGNUM-PSI, which is a linear plasma device for testing plasma surface interaction in a much more controlled manner than is possible in an actual tokamak. Though MAGNUM-PSI has now started limited operation, it will not reach its full specification until equipped with a superconducting coil. Both W7-X and MAGNUM-PSI are or will be exploited by EUROfusion as common facilities under the new Joint Programme.

Structural and high-heat flux materials for DEMO and fusion reactors is one of the long-lead items where research has already started. In order to guide the EU fusion programme on materials, a report by a group of experts was commissioned under EFDA on DEMO Structural and High-Heat Flux Materials ('Stork report'). The final version was delivered in December 2012, and the conclusions by the group of experts had a

significant influence on the fusion roadmap. The report makes many important recommendations and endorses the need for an 'early neutron source', which is taken up in the roadmap itself.

An important aspect of fusion research concerns theory and modelling of fusion plasmas. Highly developed simulation models will be crucial for analysing ITER results and guiding the design of DEMO. Modelling of fusion plasma has made enormous progress over the years, and complex and sophisticated simulation codes have been developed which require supercomputing facilities to run efficiently. To this end, during FP7 the Commission funded the procurement and operation of the HPC-FF supercomputer (Jülich in Germany), which was dedicated to simulations relevant for fusion research. This was a highly needed tool for the modellers, and it contributed significantly to advancing simulations of fusion plasmas.

### **Fission research (including radiation protection and medical applications of radiation)**

Fission research supported by Euratom FP7 had a substantial number of scientific achievements in all fields supported by the programme: nuclear safety, radiation protection, radioactive waste management. A substantial number of research proposals (288 proposals submitted for seven annual calls) prepared by 3352 applicants demonstrated a strong interest of research stakeholders to participate in nuclear research at European level. Stakeholders, including industry, have also shown a readiness to form consortia in response to the calls - the average consortium size in Euratom was significantly higher than across FP7 as a whole (17 compared to 12 partners per collaborative project). Moreover, total investment in funded projects was almost €660 million for a Euratom contribution of only €354 million (54% of total costs).

Euratom FP7 activities in nuclear safety have concentrated on research in severe accidents, long-term plant operation (i.e. ageing and integrity of various materials and components), plant safety simulation tools and the man-machine interface.

Euratom funded projects, such as SARNET-2, contributed to the resolving of important pending issues on postulated severe accidents of existing and future nuclear power plants (e.g. severe core damage and resulting release of radiation in the event of 'beyond design basis' events). These projects optimised use of available resources in this field and established a sustainable network to support the development of joint research programmes and a common computer tool to model and predict NPP behaviour.

Regulatory authorities in many countries are approving lifetime extensions of nuclear power plants (NPP) beyond original design lifetimes. The key consideration in granting an extension to the operation license is the degradation over time (thermal cycling, irradiation damage, other chemical / physical processes) of materials and components with a safety function. A number of Euratom FP7 projects have focused on such issues and related management of safety-related functions (e.g. PERFORM-60, LONGLIFE, STYLE, ADVANCE). These projects included partners from both research organisations and industry. In some cases, utilities were present in 'end-user' groups set up to advise the project partners regarding key issues for industrial nuclear generation.



The projects are developing and improving tools for predicting the combined effects of irradiation and corrosion on key components such as the reactor pressure vessel, and for the structural integrity assessment of the cooling circuit. Importantly, the projects are establishing a common and harmonised set of tools and methods for use in all reactor lifetime assessments and related predictions in Europe.

Several Euratom projects addressed issues raised by Fukushima accident. Specific projects have been launched addressing hydrogen issues in the containment (ERCOSAM), containment venting technology (PASSAM), modelling tools for severe accidents (SARNE12 and CESAM), PSA methodologies for assessing extreme external events (ASAMPSE), and assessment of in-vessel and ex-vessel phases of a severe accident (SAFEST and ALISA) in SAM topics. In addition, accident consequences for health and the environment, including marine radioecology, were investigated by DOREMI, STAR, PREPARE, COMET, and NERIS-IP under the topic of radiological and emergency preparedness.

In radiation protection, the Euratom Programme supported the development of a comprehensive, state-of-the-art, science-based evaluation of radiation risks in low-dose research and has had a large impact in terms of publications and training of a new generation of researchers in radiation protection. A strong scientific underpinning for regulatory framework in this domain is critical in order to adequately and appropriately protect people, whilst not penalising unduly some activities through unnecessarily protective and over-costly measures.

Euratom projects have substantially contributed to the optimisation of the use of radiation in medical applications. For example, significant advances in the use of radiation in medicine achieved by FP7 help cut down exposures to patients which reduces the recovery time and the chance that secondary cancers occur, as well as the exposure to medical staff. Because of the growing use of new medical diagnostic procedures such as computed tomography (CT) and positron-emission tomography (PET), medical exposure to radiation of the population has increased rapidly in recent years. Euratom projects have substantially contributed to the optimisation of the use of radiation in medical applications by developing innovative products and algorithms in 3D nuclear medical imaging and breast imaging (projects MADEIRA & Breast-CT), for better diagnostics, optimised patient-dose calculation and application, and higher resolution images. By enabling earlier and more accurate diagnosis, these innovations will help to increase survival rates and reduce the high costs of cancer treatment.

The most important development in the area of low-dose research was the launch the Multidisciplinary European Low-Dose Initiative (MELODI). This would not have been possible without the funding and support of the Euratom Framework Programme. This initiative, since evolving into a legal entity under French law, has developed a clear vision for future radiation protection R&D and a related Strategic Research Agenda (SRA), which brings together the full range of necessary disciplines and competencies thanks to its large stakeholder base. SRAs in related sectors such as radioecology have also been developed thanks to other Euratom projects. All these projects have helped retain European competences in technical sectors of growing importance worldwide. It is worth noting that the US House of Representatives passed, in November 2014, the

first Low-Dose Radiation Research Act with a view to increasing understanding of the effects of low-dose radiation. This underlines the importance of Europe's vision and leadership in this domain, and also highlights the potential role of and opportunities for international collaboration in this field. The Euratom support has also resulted in the development of new and improved techniques, especially regarding diagnostic and imaging techniques in the medical application of radiation, that have a clear potential for commercialisation.

Emergency management and rehabilitation have also been greatly improved in Europe as a result of Euratom FP7 projects that have integrated Member States' capabilities as well as providing practical information and documentation for improved guidance regarding post-accident response and clean-up.

Managing radioactive waste safely is a concern for all EU Member States, whether it relates to the waste from nuclear electricity production or from radiation use in research, industry and medicine. Following more than 30 years of research co-funded by Euratom, geological disposal now represents a passively safe and sustainable option for the long-term management of nuclear waste. Geological disposal relies on the capabilities of both engineered barriers and the local geology to fulfil specific safety functions in a complementary manner, thereby preventing the release and spread of radionuclides. Euratom projects launched during FP7 have contributed substantially to the overall progress in the development of geological disposal of nuclear waste. Euratom projects have redefined the state of the art in main areas: knowledge base and tools for safety assessment of waste repositories, development of repository technologies (demonstration activities by LUCOEX project), and public involvement – projects such as IPPA, INSOTEC provided a neutral forum for discussion between all concerned stakeholders, including local communities, enabling progress in actual disposal programmes. Decisions regarding disposal of radioactive waste are taken at the national level and should be based on a sound understanding of the scientific and technical issues and related risks. The aim of the Euratom programme over the past 25 years has been to support national waste management programmes in this regard. The success of the overall strategy is now evident, with the leading Member States (Finland, Sweden, France) now confidently expecting to be operating geological repositories by 2020-25. These will be the first such facilities anywhere in the world, and show the responsible attitude and determination in Europe to manage sustainably the waste from the back end of the nuclear fuel cycle. This is as much a success for the Euratom programme as it is for the countries concerned.

During FP7, Euratom supported research in the area of advanced nuclear systems and fuel cycles. While safety forms the cornerstone of Euratom nuclear research, sustainability has come to the fore during last 10 years as a key issue and is a major driver behind designs for a new generation of nuclear reactors. Currently, most of the uranium going into water-cooled reactors comes out unused. These reactors operate with 'thermalised' (slowed down) neutrons, which are less efficient than faster (more energetic) neutrons in maximising the use of the original uranium. Research on next generation (so-called Generation-IV) reactor systems is focusing more on fast neutron spectra, requiring the use of sodium, lead, helium or molten fluoride salts as coolants instead of 'normal' water. These fast neutron reactors will be able to 'burn' almost all of

the fuel, thereby extracting the maximum energetic content from the original uranium (50-100 times more than in current reactors), at the same time 'burning' a significant amount of minor actinides, which would otherwise be a troublesome constituent of the high-level radioactive waste. This has huge implications for the sustainability of nuclear energy.

Euratom FP7 projects represent the next step in the development of advanced nuclear systems, focusing on pre-conceptual designs of main options of Generation IV technologies.

Sodium Fast Reactor (SFR) - thanks to the large integrated collaborative project on European Sodium Fast Reactor (CP ESFR), Core design options to improve inherent safety and transmutation capabilities have been identified, and solutions for the improvement of SFR safety have been identified and reviewed. Finally, innovative options for the main reactor components and fluids have been identified and studied.

Gas Fast Reactor (GFR) – the FP7 project GOFASFR advanced conceptual design of GFR to the point where the viability of the system can be established. Also the conceptual design of an experimental demonstration reactor (ALLEGRO) was developed. Probabilistic safety studies and severe accident analyses were conducted for both the GFR and ALLEGRO.

Lead Fast Reactor – FP7 project LEADER resulted in the conceptual design of the demonstrator Advanced Lead Fast Reactor European Demonstrator (ALFRED), a 300 MW<sub>th</sub> pool system aimed at proving the viability of the European LFR technology for use in a future commercial power plant. The project defined also an extensive portfolio of R&D needs to be covered by future projects. Other FP7 project SILER addressed specifically the risks associated with seismic-initiated events in Generation IV Heavy Liquid Metal reactors (including MYRRHA), with a view to developing adequate protection measures.

The Euratom programme supported research on the design of the multi-purpose hybrid research reactor for high-tech applications (MYRRHA). MYRRHA, once constructed, will be a large-scale state-of-the-art research infrastructure fostering European leadership in nuclear technologies, by maintaining a high level of expertise in fission safety, management of high level nuclear waste through P&T, and cross-cutting fields. The secure production of radioisotopes for medical applications for European citizens' health and welfare will also be ensured.

**How did Euratom contributed to increase European and international wide S&T collaboration and networking for sharing R&D risks and costs?**

### **Fusion research**

Fusion research in Europe, thanks to the role played by Euratom since the 1970s, is widely acknowledged as one of the best examples of the European Research Area (ERA) in action. The cooperation between European fusion laboratories was further strengthened during FP7, and in a foretaste of what was to become widespread under

the Joint Programme in Horizon 2020, many activities within EFDA took on an increasingly projected-oriented form.

Collaboration under EFDA was expanded through the signature of an Implementing Agreement on Power Plant Physics and Technology (PPP&T) in 2011, which led to enhanced cooperation particularly on technology for DEMO. Despite the restricted budget and relatively short duration, this activity can report a number of substantial achievements during 2011-2013, undoubtedly driven by the effective cooperation and open exchange of results. The strong response of fusion labs to the research needs of ITER was also a result of the coherence of their programmes brought about by the steering and funding of the research by Euratom, especially that channelled through EFDA.

Of course, an important focus of EU-wide cooperation remained the joint exploitation of JET, though other smaller facilities supported by Euratom also generated an extensive network of bilateral and multilateral collaborations between the European laboratories.

Other successful EFDA initiatives include the taskforces on Plasma Wall Interaction (PWI-IF) and Integrated Tokamak Modelling (ITM-IF), which were complimented by a number of topical groups on high priority physics topics and have provided important results and feedback for ITER in particular (code development and validation, benchmarking, etc.).

The integration of the fusion programme into an effective European Research Area can be seen quantitatively in the number of joint publications, the level of participation in the collective exploitation of JET, and in the 'clustering' of national labs. A growing majority of publications (about 57%) originate from the joint efforts of two or more labs. These papers also have higher than average number of citations. Specifically, for CEA the number of publications co-signed with partners outside France increased from 75% in 2006 to 84% in 2009, with an overwhelming preponderance of institutes in the Euratom programme. For CCFE (UK) the fraction of joint publications (other than those generated by JET) was 65% for the years 2009/10. For IPP-Garching, publications resulting from the exploitation of ASDEX Upgrade and co-authored by IPP researchers and external co-authors (usually from another European labs) account for more than 60% of all publications since 2004. This 'Europeanisation' of ASDEX Upgrade has resulted in approximately 35% of papers now having a first author from outside IPP. For smaller labs, the Euratom programme provided the possibility to work on world-leading devices such as JET, ASDEX Upgrade and other medium-sized facilities across Europe. In the case of IST (Portugal) the fraction of journal publications being an outcome of such to 90% (2008).

## Fission research<sup>50</sup>

Improvement of ERA was one of the main objectives of Euratom projects. ERA needs well-coordinated research programmes and priorities, including a significant volume of jointly-programmed public research investment at European level involving common priorities, coordinated implementation and joint evaluation. These objectives can be achieved by the creation of interest groups, networks, consortia, and through international cooperation.

In the Euratom fission programme, one very positive initiative was to launch projects that could improve the links between such areas as basic and more applied research, or between investigations at various scales (e.g. atomic to macroscopic), or that could combine effectively modelling and experiments, experts and students, etc. A good example was the project F-BRIDGE – basic research in support of innovative fuels design for the Generation IV systems.

Special attention was also devoted to the access to experimental facilities. Projects were supported in the area of developing and running world class research infrastructures in Europe, including increased integration, networking and accessibility to research teams from across Europe and the world. One can underline the following positive examples: ACTINET-I3 (ACTINET Integrated Infrastructure Initiative), HELIMNET (Heavy Liquid Metal network) and JHR-CP (Jules Horowitz Reactor – Collaborative Project), which all brought together the key stakeholders and facility managers in Europe.

In ASAMPSA2 (Advanced safety assessment methodologies: level 2 PSA) an end-user community was set up to apply the results of the project – this same approach was also adopted in other projects. The results of SARNET2 are very positive: the project succeeded in networking R&D activities over a range of severe accident disciplines and diverse organisations, which led to the acceptance of a pan-European severe accident code as a reference and also to the updating of R&D requirements in this field, including at the international level. The project EU-NMR-An (Towards a European Competence Centre for Nuclear Magnetic Resonance (NMR) on actinides) successfully combined the efforts of experts in NMR and actinide chemistry. Similarly, EUROPAIRS (End-User Requirements for industrial process heat applications with Innovative nuclear reactors for sustainable energy supply) brought together nuclear and process heat R&D organisations.

These and several other projects made significant progress in pushing interdisciplinary research agendas in areas that were formerly quite disparate, with effective cooperation between national efforts (at least within Europe, but also internationally) being a key prerequisite. By also stressing the international dimension, these projects contributed to a widening of ERA to the world as a whole (EUROPAIRS is a good example). They also provided the basis for long-term European cooperation, which contributed to the establishing of clear European leadership in the given field, as well as reconciling

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<sup>50</sup> Source: report on *Ex-post Evaluation of R&D Actions in Nuclear Systems carried out under the Euratom 7th Framework Programme (2007-2011) and the Euratom Framework Programme (2012-2013)* by Konstantin Foskolos and János Gadó, September 2014.

differences between Western Europe and the new Member States. This was especially important in view of the Russian reactor technology in use in a number of new Member States; LONGLIFE (Treatment of long term irradiation embrittlement effects in RPV safety assessment) is a good example of such a project.

### **How did Euratom contribute to improve the coordination of European, national and regional Energy research policies?**

#### **Fusion research**

In the fusion domain, Euratom played a significant role in the definition and coordination of fusion policy and strategy in Member States. Through the bi-lateral Contracts of Association, the Commission shared equal rights with the national labs in the definition of national programmes as well as having voting powers on the Steering Committee of EFDA. Significant examples of the role that Euratom played in the coordination of the programme include: the provision of the High Performance Computer; a coordinated approach to code development and validation resulting in the licensing to the main IT platforms for ITER operation; the generation of a common understanding and strategy for the use of facilities recommended in the Facility Review report; the development of the roadmap to electricity from fusion energy and the unanimous agreement of all the European stakeholders.

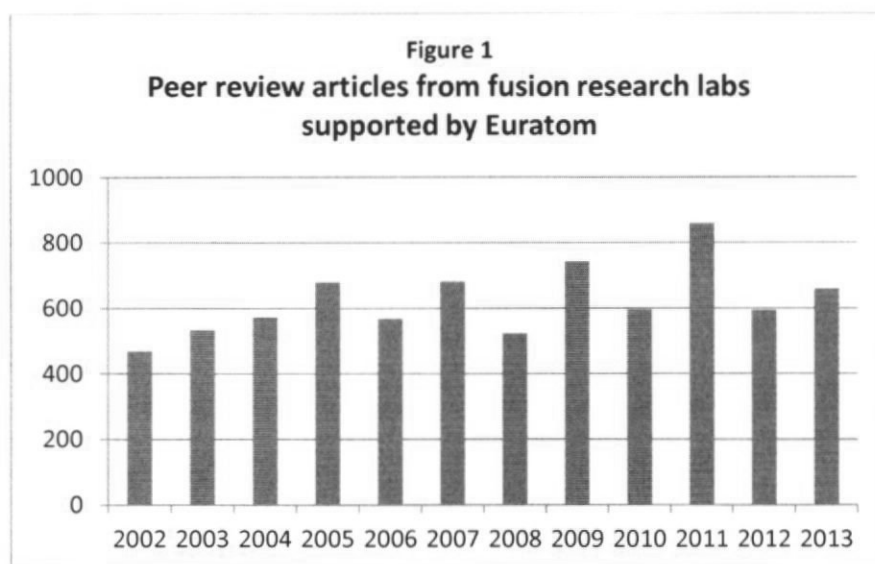
#### **Fission research**

In the fission field, Euratom supported the creation of area-specific Technology Platforms and, in the context of the SET-Plan, European Industrial Initiatives. The period 2007-2010 saw the launch of key technical forums that brought together all key nuclear research and industrial stakeholders across Europe. These are the Technology Platforms in Sustainable Nuclear Energy and Implementing Geological Disposal (SNETP, IGDTP) and the joint programming initiative the Multidisciplinary European Low-Dose Initiative (MELODI). None of these achievements would have been possible without the funding and support of Euratom FP7 through projects such as SNF-TP, CARD (establishing of SNETP and IGDTP) and HLEG & DoReMi (for MELODI). All three technical forums came together around agreed visions for future R&D in their respective fields, and all have defined Strategic Research Agendas (SRA) and Deployment Strategies, implemented jointly by sharing resources or even joint programming. SNETP and IGDTP were closely aligned with the objectives of the SET-Plan, and all three forums continue to be used by the Euratom programme as a source of priority topics for inclusion in calls for proposals. This ensures that the Euratom programme remains focused on the issues of most widespread interest and importance in Europe.

## How did Euratom strengthen the scientific excellence of basic research in Europe?

### Fusion research<sup>51</sup>

Scientific outputs of the Euratom Programme in fusion research have been substantial. There is a steady flow of results from Euratom-funded research in internationally peer-reviewed scientific articles in high impact scientific journals. Results have been published in more than 5000 internationally reviewed articles as shown in figure 1 below.



Source: Scopus

The average number of peer-reviewed publications per annum in journals from European fusion associations (at least one author) over the FP7 period is 665. This represents an almost 20% increase over the FP6 period, when an average of 565 papers per annum were published. The total number of citations – a measure of the impact of the work – has increased even more strongly: an average of over 8600 citations per annum during FP7 compared with around 2200 under FP6. Indeed, the number of citations rose more or less steadily over the FP7 period, almost doubling between 2007 and 2013.

These papers are in leading international journals. The greatest number (over 1000) appear in “Fusion Engineering and Design”, an indicator of European scientists’ role at the forefront in the technology, operation and design of current and future devices – this journal publishes many papers on ITER, DEMO and longer term reactor studies. Over 100 papers have also been published in the leading journals in the field “Nuclear Fusion” and “Plasma Physics and Controlled Fusion”, focusing more on physics, with the strong research efforts into materials and plasma-wall interactions represented by

<sup>51</sup> Source: *Ex-post evaluation of fusion research funded from the Euratom 7th Framework Programme*, by Philippa Browning and Arto Timperi, September 2015.

over 800 papers in “Journal of Nuclear Materials”. European leadership in the crucial field of plasma wall interactions is evidenced by a key paper summarising the outcomes of the PWI task Force with relevance to ITER<sup>52</sup>, which already has over 240 citations. European work on ELM mitigation has also had notably high impact, with, for example, two papers receiving respectively over 220 and 150 citations<sup>53</sup>. Many of these papers have won prizes. Much other European work has featured as invited talks at leading international conferences, notably the biennial IAEA Fusion Energy conferences.

### Fission research

In nuclear fission, 73 completed projects (out of 134 in total during FP7) resulted in 563 publications in peer-reviewed journals, of which 128 were published in high impact journals (see tables 1 and 2 below)<sup>54</sup>.

<b>Table 1</b>		
<b>Publications from fission related projects</b>		
	<b>No. of publications</b>	<b>No. of publications in high impact peer-reviewed journals</b>
<b>Management of Ultimate Radioactive Waste</b>	<b>109</b>	<b>29</b>
<b>Reactor Systems</b>	<b>207</b>	<b>48</b>
<b>Radiation Protection</b>	<b>94</b>	<b>15</b>
<b>Infrastructures</b>	<b>56</b>	<b>11</b>
<b>Human Resources and training</b>	<b>1</b>	<b>-</b>
<b>Cross-Cutting Actions</b>	<b>65</b>	<b>12</b>
<b>Cooperation with Third Countries</b>	<b>31</b>	<b>13</b>
<b>Total</b>	<b>563</b>	<b>128</b>

*Source: European Commission*

<sup>52</sup> J Roth et al, Jour. Nuc. Mat. 390-391, 1, (2009)

<sup>53</sup> Y Liang et al, Phys. Rev. Lett. 98, 265004 (2007); T E Evans et al, Nuc. Fus. 48, 024002 (2008); A Kirk et al, Plas. Phys. Cont. Fus. 55, 124003 (2013)

<sup>54</sup> High impact journals are defined to be the top 10% (in terms of SJR index) of all journals within a given scientific category. Data retrieved on 14 September 2015



**Table 2 Top 20 Peer Reviewed Journals by Number of Publications submitted by Euratom FP7 fission projects**

Journal title	SJR <sup>55</sup>	Number of publications	% of all publications
Chemical Reviews	15.9	1	0.18%
Science	11.2	1	0.18%
Nature Reviews Cancer	9.3	1	0.18%
Proceedings of the NAS of the United States	5.4	1	0.18%
Journal of the American Chemical Society	4.4	1	0.18%
International Journal of Plasticity	3.7	2	0.36%
Energy and Environmental Science	3.1	3	0.53%
Materials Today	3.1	2	0.36%
Acta Materialia	2.9	6	1.07%
ISME Journal	2.9	1	0.18%
Environmental Science and Technology	2.7	2	0.36%
European Physical Journal C	2.7	1	0.18%
Physical Review B - Condensed Matter and Materials Physics	2.7	17	3.02%
Geochimica et Cosmochimica Acta	2.5	6	1.07%
FASEB Journal	2.4	1	0.18%
Chemical Communications	2.3	1	0.18%
Chemical Geology	2.3	1	0.18%
Physical Review C - Nuclear Physics	2.3	4	0.71%
Radiotherapy and Oncology	2.3	5	0.89%
British Journal of Cancer	2.1	1	0.18%
Total		58	10.30%

*Source: European Commission*

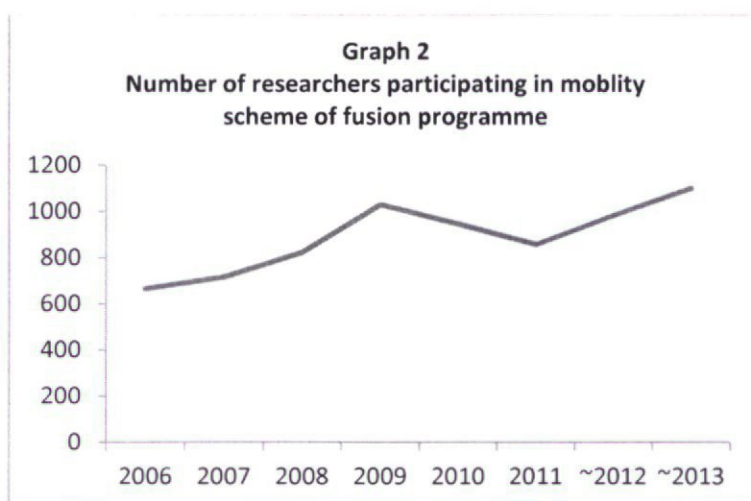
<sup>55</sup> SJR - Journal Rank Indicator, it is a measure of journal's impact, influence or prestige. It expresses the average number of weighted citations received in the selected year by the documents published in the journal in the three previous years (2011)

## How did Euratom promote the development of European research careers and contribute to make Europe more attractive to the best researchers?

Knowledge creation and competence building are at the heart of the Euratom research and training programme since its origin (Euratom Treaty, Article 4.1). Effective transfer of knowledge, skills and competences from the current generation of experts to the next is indispensable, but the recruitment of young talent is increasingly difficult across the full spectrum of scientific disciplines. This has not been helped by the decline in the nuclear sectors in several Member States. Ironically, even these Member States will still require expertise for many years to come, e.g. in the areas of decommissioning and waste management, and must continue to ensure high levels of safety across the sector as a whole. The Euratom programme has been very much aware of these issues, in particular in the fission disciplines, and has targeted a number of projects in key areas.

### Fusion research

The Goal-Orientated Training (GOT) programme and researcher fellowships funded by Euratom have successfully contributed to supplying fusion research with urgently needed new fusion engineers (160) and researchers (24). Fusion research depends heavily on a transnational pool of skills and expertise. The European programme has operated a Mobility Agreement since 1983, facilitating movement of researchers across Europe. In Euratom FP7, the number of researchers participating has generally increased from around 600 in 2006 to 1100 in 2013 (see graph 2 below).



*Source: European Commission*

JET has provided a key focus for mobility of scientists and European integration, operating as a truly international collaboration with participation from across the EU and beyond. During FP7, 958 scientists made visits to JET to undertake research, many of these visiting more than once. This collective use of JET allowed scientists to participate based solely on the quality of their experimental proposals, and facilitated access to the world's leading fusion experiment by all European fusion labs and institutes without exception.

## Fission research

In nuclear fission, 73 completed projects (out of 134 in total) involved 520 PhD students (see table 3 below), of which 33% were female. This indicates that on average, each project supported more than seven PhD students.

<b>Number of PhD students in nuclear fission and radiation protection participating in Euratom FP7 projects</b>	
Management of Ultimate Radioactive Waste	95
Reactor Systems	176
Radiation Protection	68
Infrastructures	54
Human Resources and training	44
Cross-Cutting Actions	54
Cooperation with 3rd countries	29
Total	520

*Source: European Commission*

### **How did Euratom provide the knowledge base needed to support key Community policies?**

Activities supported under Euratom FP7 have reinforced EU energy policy by contributing to the triangle of EU energy and climate policy objectives: sustainability, security of supply and competitiveness. It underpins the EU '20-20-20-10 targets' for 2020, the new set of targets for 2030 and the EU Energy Roadmap 2050 which calls for an almost totally decarbonised European energy system. In addition, Euratom supported structuring of stakeholders at European level and facilitating the definition of common objectives and Strategic Research Agendas that have become the basis for European priority-setting and also influence national R&I agendas. Policy impact is difficult to estimate for participants, as it is often only an indirect consequence of the project activities and is not easily traceable unless a proper follow up is made (which is often not the case). According to the survey of project coordinators carried out regarding Euratom FP6 and FP7 fission projects, in 63% of the projects the research had impacts

on national or EU policy in nuclear safety, radiation protection or radioactive waste disposal.

### **How did Euratom increase availability, coordination and access in relation to top-level European scientific and technological infrastructure?**

Euratom Programme had taken on high risk, high cost, long-term infrastructures beyond the reach of individual Member States, thereby sharing the risk and generating a breadth of scope and economies of scale that could not otherwise be achieved.

The scientific and technological feasibility of fusion has to be demonstrated at very large scale (ITER) and cannot be broken down into smaller projects that could be handled at national level. Only by pooling financial resources and sharing risk with six international partners will Europe be in a position to prove the feasibility of fusion as an energy source.

Another example is JET, which is the largest fusion device currently in operation worldwide and the closest in design to ITER. The total expenditure for construction, upgrade and exploitation of this European facility during the period 1978-2014 amounts to ca. €2 billion. The contribution of JET to the development of fusion cannot be underestimated: (a) it is the only current fusion device which can operate with the fuel mixture of genuine fusion reactors; (b) it holds all the records for peak and sustained production of controlled fusion power; (c) it is the most ITER-relevant machine for studies in preparation for ITER technology and operations; (d) it is the only present fusion device in which the essential fusion technology of remote handling has been developed and used for major interventions; (e) it is the most useful experiment for the training of future operational staff for ITER.

The High Performance Computer for Fusion (HPC-FF) was an invaluable new tool for the fusion programme. Fusion modelling requires powerful computer resources; increasingly realistic simulations that are able to take into account the full ITER plasma will be essential for the safe and efficient operation of ITER. The HPC-FF computer, hosted and operated by the Jülich Supercomputing Centre at the Forschungszentrum Jülich, Germany, was among the 30 most powerful computers in the world. Euratom capital investment amounted to around €7.4 million, while the total budget including the capital investment and exploitation over the four years was around €16.8 million, with contributions from the entire European fusion community.

In nuclear fission, Euratom was essentially directed at facilitating and supporting transnational access to infrastructures, through traditional Euratom collaborative research grants and some more dedicated Euratom activities (Transnational Access to Large Infrastructures - TALI). For example:

The ACTINET-13 Network aimed at reinforcing the networking between existing European infrastructures in actinide sciences, and to facilitate their efficient use by the European scientific community. Five internal calls for proposals for Joint Research Programmes (JRP) were issued. Out of 91 submitted proposals, 59 were selected and funded. A number of improvements and additions to the available instrumentation and infrastructure of the different pooled facilities were identified.

The ERINDA co-ordination and support action aimed at coordinating European efforts to exploit up-to-date neutron beam technology to gain nuclear data for advanced concepts of nuclear fission reactors and the transmutation of radioactive waste. The ERINDA consortium grouped all relevant neutron data facilities (time-of-flight facilities for fast neutrons, charged-particle accelerators and experimental nuclear reactors) in Europe that could offer part of their available beam time to the project. In three years, 3015 beam time hours have been delivered in 26 experiments, in which 27 young researchers (within 6 years of obtaining their PhDs) participated.

The EUFRAT coordination and support action, a transnational access programme at the Institute for Reference Materials and Measurements of the JRC (IRMM) aimed at facilitating the access of outside users to the nuclear data facilities of its Unit Standards for Nuclear Safety, Security and Safeguards. The IRMM facilities delivered within 5985 hours of beam-time for a total of 33 experiments on nuclear data, development of experimental set-ups and techniques needed for data measurements and advanced methods in nuclear technologies, safety and security.

A forward looking investment was also made in buying access rights for Euratom researchers to the Jules Horowitz Reactor (JHR), a high performance materials testing research reactor under construction in France that should become operational by 2019.

## **How much did Euratom contribute to job creation?**

### **Fission research**

The Euratom programme has been contributing to job creation within the participating organisations directly by offering job opportunities for researchers and, indirectly, as a result of technological advancement and of training. In fission research, the completed FP7 projects (73) had a total workforce of 5100, of which 30% were female (see table 4 below). In some areas such as radiation protection, participation of female researchers is equal to male, while in waste management it reached 38%. During the implementation of these projects, an additional 354 researchers had been recruited.

<b>Table 4</b>			
<b>Workforce in fission projects supported by Euratom FP7</b>			
<i>(73 projects completed by September 2015)</i>			
	<b>Work force reported</b>	<b>Additional researchers recruited</b>	<b>Total workforce</b>
<b>Management of Ultimate Radioactive Waste</b>	966	47	1013
<b>Reactor Systems</b>	1864	62	1926
<b>Radiation Protection</b>	497	110	607
<b>Infrastructures</b>	299	4	303
<b>Human Resources and training</b>	352	10	362
<b>Cross-Cutting Actions</b>	496	84	580
<b>Cooperation with Third Countries</b>	270	37	307
<b>Total</b>	4746	354	5100

*Source: European Commission*

Regarding broader impacts on growth and jobs, it is important to note that the Euratom fission programme is structured around technological research but also supports projects addressing issues of public concern. The economic impacts of the latter are more difficult to assess, but are present nonetheless. In more technology-oriented activities, Euratom funding often plays the role of catalyst, and the limited budget means the focus is mainly on pre-commercial research. Specific patents have been produced only in projects that develop technology close to the market. From a survey, six projects (EVOL, JHR-CA, Genepi-Entb2, ARCHER, ACSEPT, CARBOWASTE) covering all main areas of R&D in the fission programme, resulted in the filing of new patents. About 46% of project coordinators expect improved competitiveness of one or more partners as a result of the project. New companies were also indicated in the case of SAPIER2 and NULIFE (though also true for SARNET2 and HLEG), and the project coordinators reported that new jobs were created in 21 projects (17%).

Indirect economic impacts of Euratom research could be summarised as follows:

Euratom projects looking at material degradation and related safety issues support plant lifetime extension of currently operating light-water reactors. Similarly positive impacts stem from the implementation of sustainable waste management solutions. Projects in P&T and other techniques to reduce waste (e.g. PUMA, LWR-DEPUTY) can lead to increased fuel utilisation or reduced volumes / toxicity of final waste for disposal. In view of the high cost of geological repositories, the economic impacts are potentially enormous.

Reducing uncertainties enables nuclear plants to be run more efficiently. Projects such as EFNUDAT/ERINDA and ANDES contribute to improvements in neutron cross-section data for present and future reactors. Projects on fuel materials and related properties (e.g. F-BRIDGE) enable fuel performance to be optimised while maintaining safety margins. These improvements lead directly to increased competitiveness of nuclear plants.

Euratom also supported major infrastructures and therefore contributes over the long-term to the positive economic impacts these can bring, not only locally but also to the EU as a whole. Only two 'fission' infrastructures of pan-European importance were identified and retained by ESFRI, and both have been supported through the Euratom programme. They are the Jules Horowitz Reactor, under construction at CEA Cadarache, which benefited from support through the JHR-CA and CP-JHR projects, and MYRRHA, to be constructed at SCK.CEN in Belgium, which had been supported by a number of FP6 and FP7 projects (EUROTRANS, CDT, MAX, FREYA).

Advanced nuclear systems using Generation-IV designs are not expected to be deployed at an industrial scale in Europe before 2040. However, development times for these types of technologies are long, and demonstrator reactors are already being built in other countries (China, Russia, India, Japan). The size of the potential market in this technology is huge, and it is critical for Europe is to remain a major player in the mid to long term. Euratom contributes by pooling know-how in a number of pre-conceptual design projects and by stimulation education and training in key disciplines.

As Euratom supports nuclear research which in turn has impact on nuclear sector in general, it is important to look at the broad economic impacts of this sector as a whole. Nuclear energy generates important investments and therefore one has to underline the socio-economic role of nuclear energy to growth and jobs in the EU: 131 operating NPPs in 14 Member States; 28% of EU's electricity supply; ~2/3 of EU low carbon electricity; four reactors under construction (FI, FR and SK); new reactors planned in BG, CZ, FI, FR, HU, LT, PL, RO, SW and UK; more than 800 companies covering all the activities of power production and of the fuel cycle; about 900,000 jobs; and potential investments of €70 billion/year.

## **Fusion research**

In European fusion research laboratories supported by Euratom, the total workforce in 2014 was about 3318 (female accounted for 19%), including 2159 professionals (engineers and physicist) and 1159 support staff<sup>56</sup>.

Turning to the EU investment in fusion, 75% of the EU funding for ITER construction (i.e. around EUR 4.5 billion) is for components and activities that result in the creation of new knowledge and cutting-edge technology, offering European high-tech industries and SMEs an excellent opportunity for innovation. Over the period 2007-2020, F4E should spend EUR 6.6 billion (in 2008 values) on the construction of ITER. To date, more than EUR 3 billion has already been committed by F4E, resulting in more than 300 procurements and contracts with high-tech European companies in key industrial areas (civil, mechanical, electrical, materials and nuclear engineering). In addition, around EUR 100 million has been committed on more technical and research-based work carried out by European research laboratories. F4E estimates that through all these contracts, industry is creating over 15,000 person-years of employment in Europe and will create many more during the remainder of ITER's construction phase. ITER work is more labour and knowledge intensive than conventional industrial manufacturing owing to the high content of R&D and engineering tasks. Thanks to its leadership in fusion research and the construction of ITER, Europe will be in a privileged position to reap the benefits of constructing and operating the first generation of fusion power plants in the future.

### **To what extent do the results of Euratom contribute to the achievements of the new Commission's priorities?**

Establishing a Resilient Energy Union with a Forward-Looking Climate Change Policy is among the top priorities of the new Commission. According to the Commission Communication on Energy Union (COM(2015)80), the EU must ensure that Member States respect the highest standards of nuclear safety, security, waste management and non-proliferation. The EU should also ensure that it maintains technological leadership in the nuclear domain, including through ITER, so as not to increase energy and technology dependence. Euratom FP7 projects have been contributing to these priorities by enhancing safety of nuclear technologies, funding state-of-the-art research for a new generation of fission reactors and for preparation of ITER. In the long term, fusion energy could provide a safe and abundant energy source. In the near term the fusion programme is answering to the Commission's priority of innovation through enhanced technology spin-off to other sectors and through technology transfer to industry, which will enhance competitiveness for growth and jobs.

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<sup>56</sup> Preliminary draft data from 2015 survey carried out by EUROfusion.



### **To what extent was Euratom coherent with other EU actions (CIP, ESF) and EU policy?**

Euratom FP7 was the main instrument for implementing the nuclear part of technology pillar of the EU's energy and climate policy – the Strategic Energy Technology (SET) Plan. By addressing key technological bottlenecks, Euratom FP7 contributes directly to the EU's energy and climate policy's targets in the long term. Equally important, Euratom research in the fission area supported EU policy objectives concerning nuclear safety, radiation protection and waste management. In this respect research contributes to the implementation of European law in these areas, such as Council Directive 2009/71/Euratom of 25 June 2009 establishing a Community framework for the nuclear safety of nuclear installations (and subsequent amended Directive), the Council Directive (2011/70/Euratom) of 19 July 2011 establishing a Community framework for the responsible and safe management of spent fuel and radioactive waste, and the Council Directive 2013/59/Euratom laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation.

### **What was the added value of Euratom when compared with national Energy research and innovation programmes?**

The Euratom programme mobilised a wider pool of excellence, competencies and multi-disciplinarity than is available at national level. The achievements of the fusion programme, in particular resulting from joint exploitation of JET, rely on the collective endeavours of researchers and engineers from across Europe (about 350 persons per year), supported by Euratom funding for mobility. Euratom finances two mobility schemes, one used generally for short visits to JET and between Associations (ca. EUR 5 million per year) and the other aimed mainly at longer-term participation in the collective exploitation of JET (up to 4 years).

In the fission area, projects such as STAR, DoReMi and SARNET-2 ensured that competences in key technical sectors can be retained in Europe, requiring the bringing together of expertise from many Member States, and the establishing of legal entities to ensure sustainability in the long term.

The Euratom programme helped to generate an optimum programme of activities and maximise knowledge sharing and information dissemination, lowering the overall costs of achieving a given objective – for example the Euratom projects in the field of Partitioning & Transmutation represent a comprehensive and integrated programme of research on ADS<sup>57</sup> and related lead-cooled technology. This programme is also notable for the involvement of large numbers of PhDs (about 170) and post-docs and the interaction with other research in Generation-IV systems. All this, including the decision by the Belgian Government to construct MYRRHA<sup>58</sup>, would not have been possible without Euratom involvement

Euratom had a strong leverage effect on coordinating national efforts, through the use of funding instruments that promote the European Research Area, for example:

<sup>57</sup>

Accelerator Driven Systems

<sup>58</sup>

<http://myrrha.sckcen.be/>

These effects are well demonstrated in case of the European fusion programme where Euratom contributes to the costs of national laboratories (ca. EUR 54 million per year): (a) national funding agencies accepted a limitation of their independence by allowing the scientific assessment of the programme and proposals for its evolution to be done collectively by representatives of Euratom associated laboratories and Member States with strong input by the Commission; (b) all the most important fusion facilities have been built with financial support from Euratom, which requires that their operation be open to researchers from all laboratories in Europe; (c) smaller laboratories can concentrate on a limited range of scientific topics or subsystems and still make important contributions while maintaining visibility; (d) in addition to formal training activities, the extensive exchanges of personnel between the national labs ensure a Europe-wide dissemination of expertise; (e) in some cases the management of the programme of these facilities is shared with the other participating labs.

Structuring effects of technology platforms in fission R&D: All major stakeholders in fission and radiation protection research are now grouped in technical forums: SNETP, IGDTP and MELODI, thereby promoting strategic planning, sharing resources and even joint programming, with a strong participation of industry in the two former forums.

The Euratom programme increased the willingness of research stakeholders to release capital for projects with particular importance for nuclear safety. The SARNET-2 project is an excellent example of the leverage effect of Euratom funding – the total budget was almost €39M but the Euratom contribution is just €5.75M (i.e. less than 15% of total costs). The project supported the efforts of a number of European R&D organisations, including safety authorities, industry and universities, to network their research capacities in the area of severe reactor accidents, thus enhancing the safety of existing and future nuclear power plants. This Network of Excellence defined joint research programmes and developed common computer tools and methodologies for safety assessment of nuclear power plants, and ultimately supported efforts for sustainable integration of the key R&D organisations in this sector.

## **Nuclear research in Horizon 2020: continuity or evolution?**

### **Fusion research**

In fusion research the programme has continued to evolve. Under Horizon 2020, Euratom support is focussed on the priorities of the fusion roadmap. The management of the programme has been revised with the Contracts of Association and EFDA agreement being replaced by a single Grant Agreement for a Joint European Programme in fusion research. All the fusion laboratories in Member States have come together to form the EUROfusion Consortium. The description of work defines the activities that are prescribed in the 'Roadmap to electricity from fusion energy'. In addition to this grant agreement, the Commission has signed a bi-lateral contract with the UK fusion research centre, CCFE, to continue to operate JET over the period 2014-18. EUROfusion is tasked with the scientific exploitation of JET. Both the grant and this bi-lateral contract are for a duration of 5 years, providing continuity for the whole joint programme. Roughly 80% of the research programme and budget is focussed on achieving successful commissioning and operation of the ITER project. The remainder

is dedicated to the pre-conceptual design of the first demonstration reactor (DEMO) that will produce electricity for the grid around mid-century.

### **Fission research**

In fission research, the Euratom programme is also evolving. With respect to generation II and III reactors, during Horizon 2020 Euratom will further target its support on safety research through a careful assessment of the critical remaining gaps, in close partnership with industry and the regulators' Technical Support Organisations (TSO). This will be undertaken through focused innovation actions covering areas such as reactor safety upgrades, safe lifetime extension, accident prevention and accident mitigation strategies. With respect to generation IV reactors, Euratom will aim at stimulating the developments of the three systems currently considered as a priority by European stakeholders: the sodium-cooled fast neutron reactors (SFR), the lead-cooled fast reactors (LFR), and the gas-cooled fast reactors (GFR). Euratom will support accompanying research actions notably with respect to front-end engineering and conformance of the project to the highest possible European safety standards. In the field of radioactive waste, Euratom-funded research will help during Horizon 2020 to resolve some last remaining scientific and technical issues for Europe's first-of-the-kind repositories, expected to become a reality in the next 5-10 years. Euratom will also further support research on societal and public involvement in this area, building on lessons learned with public engagement regarding site selection for example. In the field of radiation protection, Euratom support will also evolve regarding the support in the area of exposure to low doses of radiation. A strong scientific underpinning for the regulatory framework in this domain is critical in order to adequately and appropriately protect people, whilst not penalising unduly some activities through unnecessarily protective and over-costly measures. In this respect Euratom will further consolidate the European Joint Programme (EJP) in low-dose research launched in 2015 on the basis of actions funded during FP7.

## 15. JOINT TECHNOLOGIES INITIATIVES (JTIS) UNDER FP7

The Joint Technology Initiatives (JTIs) were a novel instrument of FP7 and the first experience in setting up public-private partnerships in research at the European level. Established under Article 171 of the Treaty, they aimed to create long-term public-private partnerships to support large-scale multinational research activities in areas of major interest to European industrial competitiveness and issues of high societal relevance. The JTIs were also designed to perform better than the traditional instruments of the Framework Programmes which had proven not adequate<sup>59</sup>.

Implemented under the FP7 Cooperation Specific Programme, the Joint Technology Initiatives were managed within dedicated structures based on Article 187 TFEU and projects were funded by match funding between the European Commission and industry and Members States for at least an equivalent amount.

Five JTIs were set up, in the following areas<sup>60</sup>: public health, Aeronautics and air transport, embedded computing systems, Nanoelectronics, Fuel cells and hydrogen.

### 15.1. Innovative Medicines Initiative (IMI)

IMI was implemented under the FP7 Cooperation Health theme.

**Objective:** To foster Europe as the most attractive place for pharmaceutical R&D, thereby enhancing access to innovative medicines for patients: “It shall have the objective of significantly improving the efficiency and effectiveness of the drug development process with the long-term aim that the pharmaceutical sector produces more effective and safer innovative medicines”<sup>61</sup>.

**Key deliverable:** To provide new tools and methodologies to remove major bottlenecks in drug development.

Through the Innovative Medicines Initiative (IMI) JU, Europe has succeeded in establishing a new model for open innovation in the pharmaceutical research area, which unites research strengths across European pharmaceutical industry<sup>62</sup>, academia, patient

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<sup>59</sup> Commission Staff Working Document, *Joint Technology Initiatives: Background, State-of-Play and Main Features*, SEC(2007) 692, 15.05.2007. See the rationale in the Commission Staff Working Document, *Report on European Technology Platforms and Joint Technology Initiatives: Fostering Public-Private R&D Partnerships to Boost Europe's Industrial Competitiveness*, SEC(2005) 800, 10.6.2005.

<sup>60</sup> The Cooperation Specific Programme identified six Joint Technology Initiatives, including apart from the five which were launched, the Global Monitoring for Environment and Security (GMES) under the Space research theme. However GMES has been implemented not as a JTI but through an agreement with ESA and research grants, on the basis of a decision taken after the launch of the FP.

<sup>61</sup> COUNCIL REGULATION (EC) No 73/2008 of 20 December 2007 setting up the Joint Undertaking for the implementation of the Joint Technology Initiative on Innovative Medicines, Official Journal of the European Union, 4.2.2008

<sup>62</sup> European Federation of Pharmaceutical Industries and Associations (EFPIA).

organisations and SMEs. The consortia formed carry out focussed research addressing problems of immediate relevance to industry and future public health. IMI has proved that the different partners can be brought together in open innovation networks to participate along the long and risky biopharmaceutical innovation chain. To have formed and embedded this new, applied, research environment is a significant achievement for Europe. Taken as model for how to invigorate research and investment in this key growth industry, it is being copied across the globe.

Financial resources available to the IMI JU, totalling € 2 billion, make it the largest public private partnership in health research in the world. IMI constitutes a novel model for implementing the concept of "open innovation". No other European programme has enabled cross-company collaboration within the pharmaceutical sector on the scale that has been achieved with IMI<sup>63</sup>.

IMI has already produced important breakthroughs such as simpler path for conducting clinical trials, or new biomarkers and models of disease, all of which directly contribute to the goal of quicker development of new treatments<sup>64</sup>. Thanks to IMI a large European network of 261 clinical centres in 32 countries has been created and several compounds are in various stages of clinical development.

IMI has played a major role in consolidating the European pharmaceutical research base by acting as a "one stop shop" for biomedical research and development in Europe. This has contributed to reinforcing Europe's attractiveness for pharmaceutical R&D, stemming the flow of investment away from Europe to the USA and Asia.

IMI has already (in 2013) generated twice as many jobs per euro spent compared to FP7 projects. Projects funded by IMI have contributed to creating approximately 1.500 new direct jobs so far, with an average cost per job of € 200,000 compared to € 400,000 per job in FP7 projects.

By supporting a better alignment of R&D strategies, IMI will in the long run increase the innovative capacity of the sector as a whole.

The second Interim Evaluation of the IMI concludes that:

- IMI has demonstrated the feasibility of large, multi-stakeholder PPPs for research and development in biomedicine. It has become recognised as a world-leading PPP in healthcare.

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<sup>63</sup> The findings are extracted from the *Second Interim Evaluation of the Innovative Medicines Initiative Joint Undertaking*, 2013.

<sup>64</sup> Another example illustrates IMI's impact: EU-AIMS is currently the largest world study on autism spectrum disorders. It has developed an animal model replicating a form of autism and demonstrated that the condition can be reversed with specific therapy. This is crucial for clinical development of new treatments for autism. It has also demonstrated the 'father's age effect' as a risk factor for autism.

- This unique model of funding and interaction between the pharmaceutical industry and other key stakeholders has proved to be effective and efficient in delivering projects of relevance to healthcare challenges and building trust between participants. Specifically: on-going IMI projects have already demonstrated scientific excellence:

IMI-funded projects are effectively addressing key challenges and barriers in the field of biomedical research and development:

IMI's operational implementation and efficiency has significantly improved over the past years.

- IMI's specific governance structure has proven to work well overall and has been kept for IMI2 under Horizon 2020.

The following recommendations were made:

- IMI needs to finalise and implement an articulated communication strategy with clear and measurable goals and objectives, addressing both the key stakeholders and a wider audience.

- Alongside the existing Key Performance Indicators (KPI), aggregated KPIs need to be developed and measured in order to quantitatively demonstrate the IMI impacts and socioeconomic benefits.

- IMI should make an additional effort to increase engagement from a wider range of industry stakeholders.

- The IMI Executive Office should seek further ways of reducing bureaucracy and ensure that it has the optimal organisational structure for the tasks ahead.

- IMI should seek to maximize the potential of its advisory bodies to gain support for the remaining calls and other activities at all levels.

- IMI needs to plan for and design new and more flexible funding mechanisms to ensure the sustainability of current and future projects, where appropriate.

## 15.2. Clean Sky

Clean Sky was implemented under the FP7 Cooperation Transport theme.

**Objective:** To develop environmentally-friendly and cost efficient aircraft<sup>65</sup>.

In aeronautics and air transport, the identification of certain needs within the research agenda lead to establishing the Clean Sky Joint Undertaking (CSJU). CSJU is a PPP between the European Commission and the aeronautics industry. The founding members of the Clean Sky JU are the European Union, represented by the European Commission and 12 Integrated Technology Demonstrator (ITD) leaders and their Associates. They represent 86 organisations in 16 countries, among which 54 industrial partners (including 20 SMEs), 15 RTOs and 17 universities. The total budget of Clean Sky is € 1.6 billion, half of it comes from the EC. Between 2009-2013, 14 calls have been published, covering more than 550 topics, funding 410 projects and involving more than 800 participants overall. The success rate of Clean Sky calls is of the order of 35%.

Since its establishment, the Clean Sky JU is successfully stimulating developments towards the strategic environmental targets. The programme provides ground for radical new technological concepts that would otherwise be beyond the manageable risk of the private sector and gives the necessary financial certainty and stability to the aviation sector and investors to develop and introduce game-changing innovations in timeframes otherwise unachievable. Clean Sky has established also links with the SESAR Joint Undertaking which develops Air Traffic Management (ATM) technologies in line with the "Single European Sky" initiative of the Commission.

The first Interim Evaluation report of Clean Sky acknowledged that the programme was highly successful in attracting a high level and wide participation from all EU key industries and a large number of SMEs. The report underlined that Clean Sky has led to new collaborations and the participation of new organisations thus enhancing European integration.

Its Second Interim Evaluation concludes that:

- The Clean Sky JU has successfully demonstrated the principle of Public-Private Partnership in aeronautics, and has become a central element of the European aeronautic landscape.
- The JU has marked satisfactory progress towards meeting the objectives set. Notably, the technical development of the demonstrators is making satisfactory progress. The Panel believes that by the end of Clean Sky, the demonstration programmes will allow to provide evidence of integration of several technologies and to indicate the potential benefits in a relevant operational environment.

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<sup>65</sup> COUNCIL REGULATION (EC) No 71/2007 of 20 December 2007 setting up the Clean Sky Joint Undertaking, Official Journal of the European Union, 4.2.2008

- Clean Sky is tackling a major gap through the commitment of a critical mass of public and private resources towards the development of demonstrators. More lessons-learned from Joint Technology Initiatives will be needed to support strategic discussions.
- Overall, the large Clean Sky research and demonstrators portfolio is of high quality.
- While there is no doubt about the quality and the relevance of the technical activities carried out within Clean Sky, the problems of resource allocation together with "slipping" schedules may jeopardize this quality in some cases.
- The Clean Sky governance is efficient in the management of the programme and delivery of calls and projects. However, efforts for increasing the organisational efficiency, reducing the administrative burden and enhancing internal and external communication are still required.

The following recommendations were made:

- Clean Sky has a lot of ground and flight demonstrations at programme end.
- Significant attention should be paid towards the most critical and success factors for the programme. Careful monitoring and prioritization of available resources vs. remaining work and vs. technology environmental benefit towards demonstration is recommended.
- Progress towards environmental targets The Panel recommends a more transparent traceability between the ACARE goals and the specific contributions from Clean Sky.
- It is recommended to deepen the existing relationship with both SESAR Joint Undertaking and ACARE aiming to reach a better view within the JU at large about the airlines, Air Navigation Service Providers and other stakeholder communities.
- The Panel notes that, in some cases, the inappropriate choice of subcontractors has led to poor results relative to the project they are related to. The Panel therefore recommends the JU to investigate possible ways of improving the selection process of subcontractors.

Many projects will need a phase of technological development before they eventually result in an innovative marketable product or a service. Although it is still a very new initiative, our analysis of Clean Sky suggests that Joint Technology Initiatives are a very promising tool to fill this gap, bringing results up to the demonstration stage. Clean Sky is tackling a major gap through the commitment of a critical mass of public and private resources towards the development of demonstrators. More lessons-learned from Joint Technology Initiatives will be needed to support strategic discussions.



## **Objectives**

### **Original objectives**

Clean Sky objectives for the whole programme at the aircraft level are to reduce CO<sub>2</sub> aircraft emission by around 20-40%, NO<sub>x</sub> by around 60% and noise by up to 10dB compared to year 2000 aircraft. These objectives have been identified as a sum of different objectives by aircraft type.

### **Evolution of objectives to respond to the crisis**

During the Clean Sky JU lifecycle some changes in aircraft fleet replacement strategy were introduced in the sector. In 2007, when the CS objectives, key demonstrators and relevant schedules were defined, the fleet replacement for 'single aisle' aircraft was scheduled for 2018-2020. Due to the steep increase of oil prices, the introduction of new generation of single aisle aircraft was postponed to 2025 and beyond and a new intermediate generation of aircraft is introduced bringing ca 15% fuel efficiency over the current year 2000 generation. The future R&D investment in the sector will be benchmarked against the performance of this new generation. This market change has also led to slight modifications in the Clean Sky technical programme without changing the overall objectives.

### **How did Clean Sky contribute to the competitiveness of European Transport industry?**

The European aeronautics sector is one of the world leaders in terms of production, employment and exports but despite this leadership, the sector evolves in a complex international environment and the EU aeronautics industry is increasingly confronted with strong international competition from traditional or emerging competitors. Today, the fuel efficiency is the major competitive differentiator and the constant high fuel prices will drive the demand for more efficient aircraft in the future. Clean Sky succeeded in increasing European competitiveness in the aeronautics sector by developing new technologies integrated at system level addressing environmental goals that greatly enhance EU industry competitiveness, since greater energy efficiency implies reducing operating costs and result in higher demand.

### **How did Clean Sky contribute to increase European and international wide S&T collaboration and networking for sharing R&D risks and costs?**

The Clean Sky programme has achieved critical mass bringing together all partners and complementary knowledge resources required to achieve its objectives. In total, more than 500 participants took part in the programme and more than half of the beneficiaries were newcomers in European funded research programmes.

### **How did Clean Sky contribute to improve the coordination of European, national and regional Transport research policies?**

The Clean Sky Programme worked in coordination with the national funding schemes for research. The scale and scope of the research agenda for greening of aircraft go beyond the borders and the capacity of individual Member States. Clean Sky supported the coordination of research policies by addressing in full the major technological advances due to the Pan-European nature of the aeronautics industry and bringing all relevant European stakeholders cooperate in developing and maturing the most promising key technologies.

### **How did Clean Sky strengthen the scientific excellence of basic research in Europe?**

Clean Sky aimed mainly at applied research with high levels of TRL. However, it stimulated new collaborations and the participation of new organisations into the EU Framework Programme.

### **How did Clean Sky promote the development of European research careers and contribute to make Europe more attractive to the best researchers?**

The nature of the Clean Sky programme, focused on demonstrators validating technologies at high TRL, helped to strengthen the synergies between researchers and industry.

### **How did Clean Sky provide the knowledge-base needed to support key Community policies?**

Clean Sky supported the objectives of climate policy and resource efficiency. Since its establishment, the Clean Sky was successfully stimulating developments towards the strategic environmental targets. The programme allowed maximising technological innovation which will help to address more ambitious objectives for air transport regarding not only environmental impact but also passenger mobility, following the Europe 2020 strategy, the Transport White Paper and the Europe's Vision for Aviation, Flightpath 2050.

### **How did Clean Sky increase availability, coordination and access in relation to top-level European scientific and technological infrastructure?**

The success of the Clean Sky technological programme strongly relied on the availability and use of the first class aeronautics research infrastructure; therefore, all the main European research infrastructure providers in the sector have been strongly involved in the design and the implementation of the Clean Sky programme. That has helped already from the early stages to ensure that the infrastructure capabilities, access and availability will be secured and contribute to the full implementation of the programme and the achievement of its objectives. From the infrastructure side it has helped to develop further the existing infrastructure and to use for testing the state of the art technologies.

### **How much did Clean Sky contribute to job creation?**

At this stage, it is difficult to quantify exactly the impact of Clean Sky on job creation. However, on a macroeconomic scale Clean Sky did contribute to the economic growth of Europe as the European air transport industry generates 3.1% of the European GDP directly and supported 5.1 million jobs in 2010 in Europe. Due to the growth forecast in the air transport industry, this contribution is growing and therefore has an impact on the generation of new jobs through the better performance of the industry with more successful products resulting in a higher demand.

**To what extent do the results of Clean Sky contribute to the achievements of the new Commission's priorities?**

Clean Sky contributed to the environmental and societal challenges by developing less polluting air transport and supported the competitiveness of the European aeronautics industry that depends on the quality of products it delivers and in particular on the fuel efficiency of the proposed technologies.

**To what extent was Clean Sky coherent with other EU actions (CIP, ESF) and EU policy?**

Clean Sky set-up has allowed a good coordination with the Members States and regions using the European Structural funds. Although, the responsibility of using the Structural Funds lies with national representatives, these representatives were actively involved in the Clean Sky programme governance through the National States Representatives Group. This allowed them to coordinate their ESF investments with the Clean Sky programme and among themselves. Therefore, in a number of occasions additional and complementary work to the Clean Sky programme towards the same ambitious objectives of accelerating the introduction of energy efficient aircraft technologies has been done in a coordinated way. In addition, ESF investments have been instrumental in raising the capacity and capabilities of the stakeholders in less performing aeronautics regions to participate in the Clean Sky implementation and have contributed to the success of Clean Sky in bringing together more than 500 participants from more than 20 countries.

**Which was the added value of Clean Sky when compared with national transport research and innovation programmes?**

The national programmes funding is allocated at national level and programmes address individual national technology developments. However, the European aeronautics industry is a cross-border industry and achieving ambitious objectives and addressing major challenges in the sector can be achieved only at level higher than the individual members States actors with strong collaboration between major aeronautics players and other participants. In this context, the Clean Sky programme allowed strengthening the collaboration at European level and enhancing European integration by bringing stakeholders together and achieving jointly agreed roadmaps.

### **Clean Sky in H2020: continuity or evolution?**

Clean Sky 2, established under the Horizon 2020, will enable a natural continuation to the progress achieved in the first Clean Sky Programme and will bring a step further to the integration with full aircraft demonstrators so as to understand the full impact, including risks and synergies of the combination of innovative technologies. This would allow maximising technological innovation which will help to address more ambitious objectives for air transport regarding environmental impact and passenger mobility, following the Europe 2020 strategy, the Transport White Paper, Flightpath 2050 and is in line with the Horizon 2020 objectives.

### 15.3. Fuel Cells and Hydrogen Initiative (FCH)

The FCH JI was implemented under the FP7 Cooperation Energy theme.

**Objective:** To speed up the development of fuel cells and hydrogen technologies in Europe in order to enable their commercial deployment between 2010 and 2020<sup>66</sup>.

The three members of the Fuel Cells and Hydrogen Joint Undertaking (FCH JU) are the European Commission, fuel cell and hydrogen industries represented by the NFW Industry Grouping and the research community represented by Research Grouping N.ERGHY.

The EU contribution to the FCH JU was EUR 470 million (2008-2013) in cash, of which EUR 20 million are for administrative purposes. The budget was contributed by the FP7 Themes "Energy" (accounting for 2/3 of the total budget), "Nanosciences, Nanotechnologies, Materials and New Production Technologies (NMP)", "Transport (including Aeronautics)", and "Environment (including Climate Change)". The overall total budget of the FCH JU was EUR 940 million, including the private contributions.

The FCH JU has launched 7 calls for proposals between 2008-2013 (one per year, except 2 in 2013). Success rates for applicants were between 33% and 50% which is above the average for the FP7 Energy Theme.

Almost two third of all unique participants came from industry, accounting for around 60% of the total EU contribution (SMEs benefitted from 27% of the total funding). Research centres account for almost 15% of the total participations but received more than 20% of the total EU contribution because their participation rate has been particularly high (on average, one single research centre participated in more than 5 projects). Universities represent slightly above 15% in terms of total participations and unique participants receiving around 11% of the total budget. Public bodies received by far the highest EU contribution per participation (because they were mainly involved in transport infrastructure demonstration projects), followed by industry participants.

(Given the fact that the JU launched its first call only in 2008, the following report on achievements can only draw from a small sample of well-advanced/finished projects).

As of 2013, FCH JU-funded projects have produced almost 70 research publications in peers reviewed journals with high citation index (from 9 finished projects) and 12 patent applications (from 4 finished projects)<sup>67</sup>.

FCH transport demonstration projects will see 150 cars and 45 buses deployed through projects financed over the 2008-2013 period. In addition, at least 20 hydrogen refuelling stations will be realised through FCH JU-funded projects.

<sup>66</sup> COUNCIL REGULATION (EC) No 521/2008 of 30 May 2008 setting up the Fuel Cells and Hydrogen Joint Undertaking, Official Journal of the European Union, L26/2008

<sup>67</sup> Data taken from the FCH JU Annual Report 2013

In the stationary applications sector, deployment of micro-CHP (residential) units through the FCH JU programme alone is expected to exceed the EU 2015 target of 1000 units.

In terms of material handling vehicles (MHVs), over 400 MHV units or 25% of the EU 2015 target, will be met through FCH JU projects under the 7<sup>th</sup> Framework Program.

The creation of the FCH JU has been an achievement as such because it has served as a signal of EU commitment and policy direction in the way of FCH technologies, while also providing stable funding – even in times of economic crisis – to support research and cost reductions in the sector.

Although it is difficult to separate the commercial and technical progress in the sector from influences other than the FCH JU, a survey<sup>68</sup> of companies involved in FCH showed that the FCH JU has had significant real impact<sup>69</sup>:

Respondents estimated the number of jobs had been increasing by about 6% per year since 2007, to around 4,000 full-time equivalents in 2013;

The number of patents granted in the EU to European companies for FCH showed a 16% annual increase compared to the average annual growth for all EU industries of 1.5%;

Annual turnover of respondents increased by 10% per annum;

R&D expenditures of respondents increased by 8% p.a.,

Market deployment expenditures of respondents increased by 6% p.a.

Furthermore, respondents expected that turnover would increase on average by 35% per year towards 2020 and research expenditures by 12% per annum; the fact that turnover is outpacing RD&D expenditures is an indication of impending commercialisation.

The main achievement in transportation and refuelling is the coordinated deployment of vehicles and infrastructure generating a base for further development. In this manner, the FCH JU has helped Europe to a leading position in fuel-cell technology for the automotive industry. Other areas have proved more challenging and innovation has mainly been incremental and at the level of components.

The FCH JU has succeeded generally in maintaining Europe in a satisfactory position compared to international competitors, but the positioning varies by application areas: it is strongest in mobility and good in hydrogen production and storage.

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<sup>68</sup> The survey was carried out by the FCH JU in March 2013 among 458 companies that are liaised to the FCH JU (154 people responded). The results of the survey are presented in the report “Trends in investments, jobs and turnover in the Fuel cells and Hydrogen sector”

<sup>69</sup> It should be born in mind that hydrogen and fuel cells are a disruptive technology that works with novel devices requiring new manufacturing lines and infrastructure. Penetration is inevitably slow as is the build-up of jobs that can be clearly identified with the sector.

The second independent interim evaluation of the FCH JU concludes that:

- The FCH JU has successfully demonstrated the viability of the PPP concept for research in FCH. It has realised an adequate governance structure, created an effective dialogue between industry and research around a common strategic agenda, and has successfully implemented that agenda.
- The expression of a long-term political commitment by EU institutions that is manifest in the FCH JU, coupled with stable funding has given confidence to industry and helped the sector through the difficult times caused by a shifting emphasis to Battery Electric Vehicles and the economic crisis.
- The FCH JU has helped to stimulate new relations including trans-national linkages between the public sectors and private sectors of different Member States and strong communities within the Industry- and Research Group. In the latter case, formerly dispersed actors have been brought together to formulate a collective position on research priorities and to debate that position between the two communities.
- A strict assessment of effectiveness against the requirements of the Regulation establishing the FCH JU shows a few deficiencies, but in some cases the objectives go beyond what might reasonably be expected. The FCH JU has demonstrated successful depot-based applications of vehicles and to some extent has contributed to automobile applications, but its impact is limited in the latter case by the need for specialised infrastructure if a mass market is to develop. Concrete results pertaining to the energy theme are relatively few at this stage in the programme, and there is little sign of an impact on policy.
- Technological developments as a consequence of the work programme have ensured that the market position is stronger than it was at inception and demonstration projects, particularly in transport, have strengthened knowledge of the technology among potential developers and reduced perceptions of risk, but it needs policy interventions and strategic planning by the competent authorities to deliver a real impact on policy and on welfare.

The following recommendations were made:

- Governance of the programme needs to ensure that decision-making is more prompt;
- That more resources are assigned to programme and knowledge management and that the private sector's commitment continues to be comparable to the EU's effort.
- SME participation should be further strengthened through a scheme of financial guarantees as in the Framework Programme and linkage between research projects and venture capital funding from the RSFF to generate new and innovative European companies and businesses.

-The research strategy for the continuation of the FCH JU should focus more sharply on three main principles: alignment on EU policies; areas where Europe has or can achieve leadership; adaptation to changing needs of the sector.

- Finance of future deployment and capacity build-up projects is vital and will require new financial arrangements. The Commission should investigate whether Hydrogen infrastructure can be made eligible for funding within the new National Strategic Reference Frameworks for Structural Funds.



#### **15.4. ARTEMIS and ENIAC Joint Technology Initiatives (JTIs) and Joint Undertakings (JUs)**

The ARTEMIS and ENIAC Joint Technology Initiatives (JTIs) and Joint Undertakings (JUs) were established in February 2008 in order to devise and implement strategic research programmes in the areas of, respectively, embedded systems and nanoelectronics. The ARTEMIS and ENIAC JUs are public-private partnerships jointly funded by industry, research organisations, participating Member States and the Commission's own ICT programme.

In the period 2008-2012, the two JTIs supported altogether more than 100 projects for a total cost in excess of €2.8 billion with a public funding of €1.126 billion (EU + Member States), involving more than 2000 organisations (1260 unique participations) of which around 40% are SMEs, 30% large enterprises and 30% research and higher education organisations.

ENIAC and ARTEMIS JTIs provided a major opportunity to cooperate across Europe, create critical mass and leverage investments. This capability has been demonstrated by the ENIAC JU's success in jump-starting the implementation of the Key Enabling Technologies recommendations in nanoelectronics with five manufacturing pilot lines worth €730 million and by the ARTEMIS JU's first launch of two large-scale innovation pilot projects worth €150 million.

The largest project in the ARTEMIS portfolio is CESAR - Cost-Efficient methods and processes for SAfety Relevant embedded systems. For key transportation domains (automotive, aerospace and rail) it developed ultra-reliable embedded systems in order to meet societal demands for increased mobility and safety. For ENIAC a clear success is the E3Car, which overcame the main challenges regarding the electrical vehicle using advanced semiconductor components. An increase in energy efficiency by 35% in certain components has been achieved.

A second Interim Evaluation of ARTEMIS and ENIAC was carried out in 2012 and concluded that the original objectives of the tripartite JTI instrument for ARTEMIS and ENIAC were still valid, and many such objectives had been achieved. Projects funded by the ARTEMIS and ENIAC JTIs were considered all justifiable in the strategic context of the needs of EU industry. The significant value and achievements of the ARTEMIS and ENIAC JTIs were confirmed by the panel.

The panel found that:

- The relevance of the ARTEMIS and ENIAC programmes remained high, and both JTIs continued to address the key European technological and industrial sectors in their respective domains (with some exceptions). However, the panel found that to ensure continuing relevance into the future it was essential to link the JTI research, development and innovation agendas in to a wider European ECS strategy based on a coherent and common vision and common goals. This strategy would determine a clear, coherent European view on the appropriateness of JTI research agenda, on the

prioritisation of projects for funding, and would be the basis for any related review procedures.

- The level of effectiveness of the JTIs/JUs in achieving their objectives was also in general high, but effectiveness would be improved by increasing the coherence of programmes and funded project portfolios within and between JTIs, by strengthening exploitation of project results and by a greater involvement of, and strategic leadership by, the respective Industrial Associations and Governing Boards.

- The efficiency of administrative processes was in general found to be good, but the panel considered that it would be considerably improved by various changes in current practice, in particular in relation to the harmonisation and simplification of Member State practices, by allowing a greater flexibility in funding arrangements, by streamlining JU administrative and governance structures.

- The quality of projects funded by the JTIs was found to be high, and in many instances world-leading, but that steps should be taken to increase inter-project co-operation and avoid potential duplication and overlap in content, to improve the quality of project management and to devise reliable metrics for measuring the impact and success of projects.

The panel also identified a number JTI structural changes that would significantly improve the efficiency and effectiveness of the programmes and bring much welcome strategic coherence. In particular the integration of ENIAC & ARTEMIS JTIs, along with the European Technology Platform (ETP) on Smart Systems Integration (EPoSS), into a single organisation (one legal entity - an ECS JTI), although the broad scope of such an integrated JTI would mean that some continuing differentiation (e.g. via separated, but linked, SRAs, workplans, budgets, IAs etc.) might be appropriate.

In 2013 the Commission made the proposal for a JTI bringing together the EU and Member States in Electronic Components & Systems (ECSEL). ECSEL is operating since 2014 and will run for 10 years, replacing ENIAC and ARTEMIS JUs in the fields of nanoelectronics and embedded systems. This merging builds on their respective strengths while unlocking additional synergies. The ECSEL JTI will support an integrated European strategy in electronic components and systems allowing the development of a sustainable electronic components and systems industrial ecosystem, and providing effective means for European stakeholders to keep pace with technology, to get access to advanced components and to consolidate their leadership in electronic systems for key economic sectors.

## **16. JOINT EUROPEAN RESEARCH PROGRAMMES UNDER FP7**

### **16.1. Eurostars**

The Final Evaluation of the Eurostars Joint Programme concluded that the Eurostars Joint Programme has succeeded in accelerating the growth and innovative outputs of R&D-performing SMEs. However, several aspects of governance and managerial implementation need to be improved.

The expert group studied the Eurostars interim evaluation of 2010 and the uptake of its recommendations. In contrast to the interim evaluation, the expert group was able, due to the considerably higher numbers of applications, applicants and funded projects, to make quantitative calculations and carry out extensive econometric analyses.

The results of the final evaluation provide evidence that Eurostars is relevant for the growth of R&D-performing SMEs in Europe. The employment growth rate of R&D-performing SMEs funded by Eurostars was nearly twice as high as that of applicant SMEs which were not funded. This can be causally attributed to Eurostars funding. Given the still relatively small number of completed projects, this estimate will become more precise in future. In addition, the market impact of Eurostars projects has not completely manifested itself yet. The programme has accelerated the development and roll-out of new and improved products, processes and services. The econometric evaluation established a positive and significant impact on the patent portfolio of funded firms relative to unfunded applicants. The programme has stimulated new cross-border collaborations that the members of the funded consortia intend to continue beyond the Eurostars funding period.

At the same time, the final evaluation reveals the need for improvement in harmonising funding rules and synchronising national processes. The effectiveness of central governance, administration and operations also needs to be improved. National resources are still too scarce, though some countries have increased their Eurostars budgets significantly above the originally agreed levels. The maximum rate of funding for the same type of partners varies between countries. Insufficient resources in some of the consortia's partner countries have resulted in the exclusion of selected projects from funding. With the increasing number of applications, the success rate - measured as share of eligible project proposals which were approved for funding - has fallen from 48% in 2008 to 20% in 2013. The time elapsed from submission deadline to evaluation, signing of grant and consortia agreements and activation of funding have gone down significantly, but is still too long and varies between partner countries, causing delays in starting projects. The High-Level Group has repeatedly discussed these issues, but so far failed to translate them into binding decisions and actions.

## 16.2. European Metrology Research Programme (EMRP)

Interim evaluation results<sup>70</sup>:

The EMRP is performing well in relation to most of its original expectations:

There are significant gaps between expectation and reality in relation to three qualitative impact indicators: capacity building, interaction with the wider scientific community and mobility.

## 16.3. Ambient Assisted Living (AAL)

Among the innovative initiatives which have been included in the FP7, the *Ambient Assisted Living (AAL) Joint Programme (JP)* represented a new joint R&D funding activity implemented by 20 EU Member States and 3 Associated States with EU support. The AAL Joint Programme aimed at using intelligent products and providing remote services in order to extend the time elderly people can live independently in their home environment. The Programme over the years 2008-2013 had a budget of €700 million, half of which was public funding (split between Partner States and the European Commission). Over 150 projects were funded over 6 calls, the last of which closed in Spring 2013. Each project involved at least 3 Member States, one research body, one user organisation, and an SME participant.

As the Programme came to a completion in December 2013 a high level expert group produced a final evaluation report<sup>71</sup> that highlighted its key achievements:

The high participation rate of SMEs (over 40%; far higher than average in FP7 projects), attracted by the opportunity to work within familiar national rules and procedures.

The launch of a number of commercial products and services originating directly from the first projects: nearly 50% of the projects from the first two calls have secured IPR results and a number of first commercial results have also emerged.

The shaping of a new innovation 'ecosystem' around a dynamic AAL community of stakeholders (user organisations, care professionals, research bodies, industry and government). Around 1200 of them participate in the annual AAL Forum.

The creation of a critical mass of research, development and innovation activity in AAL systems and services at European level.

Strong network effects and the seeding of pan-European communities that bring the AAL field closer to the market.

A leveraging of national efforts for the European good under the Article 185 approach, through the pooling of national resources.

A strong catalytic effect on national initiatives and activity in ICT for ageing.

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<sup>70</sup> *Interim Evaluation of the European Metrology Research Programme, 2011.*

<sup>71</sup> Busquin, P., Aarts, E., Dózsa, C., Mollenkopf, H., Uusikylä, P., & Sharpe, M. (2013). Final Evaluation of the Ambient Assisted Living Joint Programme. Brussels: European Commission.

A diverse and interesting portfolio of projects that well address the 2-3 years to market time horizon.

A high participation of users, with around 30% of project participants having some form of user role.

Stimulating industrial leadership, with around two-thirds of projects (67%) led by industry.

Effective governance and management, with the management overhead within accepted norms.

The main findings of the evaluation were the following:

The objectives were appropriate and well targeted and the Programme had made meaningful advances. The objectives continues to be strategically relevant for Europe but requires strengthening and reinterpretation in certain areas to reflect emerging opportunities and trends.

Given the growing importance of demographic ageing - a shared and urgent challenge across Europe - the AAL JP was considered to be very well justified. In forging new forms of collaboration among various stakeholders and stimulating the creation of new markets, it occupied a unique position in the policy landscape and well matched the specificities of the European situation. As European activities in this domain expand, the panel found that the Programme must continue to assert its uniqueness and to show leadership within an increasingly crowded policy space.

The AAL JP operated as a coherent framework that delivered clear added value for Europe. In acting as a bridge between research and innovation, the Programme showed strong complementarity with other initiatives and programmes, both EU and national. The fact that Member States have made contributions significantly beyond the required minimum is strong evidence of their commitment and interest.

Research, development and innovation activity associated with the Programme was found to be reaching critical levels. New networks and communities are being created that together significantly enhance the prospects for European players in taking AAL innovations to market. The strong participation of SMEs was particularly noteworthy. Although users are well represented within projects, they were not sufficiently integrated and overall effective user involvement was still sub-critical.

Activities aimed at improving conditions for industrial exploitation had expanded significantly since the Interim Evaluation. To ensure sustainability and impact, scalability and integration needed to be more strategically addressed, however. In addition, the knowledge and insights from projects needed to be better shared across the Programme so as to assist market penetration.

The Programme was found to be well managed and to have well-functioning governance arrangements. The panel recommended that under AAL JP2, the Member States should take steps to further improve operational performance by building on the trust established and by analysing carefully possible bottlenecks and improvements.

Opportunities should be sought to further optimise the respective governance roles (including the role of the CMU), workflows and procedures.

Progress under the Programme was found to be encouraging, although large-scale social and economic impacts had yet to emerge. The main outcomes were found to be a shared vision, the creation of a new innovation ecosystem of stakeholders and a demonstrated promising potential for exploitation of results within a new rapidly evolving field, one of great strategic relevance, economic potential and societal importance. These justify the Programme's continuation under AAL JP2, where further contributions can be expected.

The European Commission welcomed the final evaluation report and committed to address its recommendations. In July 2013 the Commission launched a proposal for a follow-up that in May 2014 was adopted by the Council in a compromise text. The Active and Assisted Living JP will be further optimised for rapid decision-making and new types of support (like prizes and innovation grants) to further lower entrance barriers. Moreover, it will support the implementation of the European Innovation Partnership on Active and Healthy Ageing by aligning to the ICT-based innovation: from independent living and integrated care (including telehealth and telecare) to fall prevention, medication adherence and age-friendly environments and communities.

#### **16.4. Bonus**

The Baltic Sea is a unique and semi-land locked inland sea, surrounded by eight EU Member States and Russia. The sea is degraded by many pressures both natural and man-made which seriously impact on the Baltic Sea's capacity to provide the sustainable goods and services upon which the region depends. For example, the world's largest oxygen depleted dead zones are within the Baltic Sea, covering an average area of 49,000 km<sup>2</sup>.

Solutions to the Baltic Seas challenges can only be achieved through collaborative action undertaken by all of the coastal Baltic states so as to jointly establish innovative solutions and develop common understandings. This is the role of the Baltic Sea Research and Development programme BONUS which together with the EU has enabled all coastal Baltic Sea Member States to jointly establish and implement an integrated research and innovation programme for the Baltic Sea.

Implementation of BONUS commenced in 2012 and is foreseen to continue for at least 5 years until 2017. An interim evaluation was undertaken in 2014 and the Commission's conclusions following this evaluation were adopted in March 2015<sup>72</sup>. The evaluation was positive, concluding that BONUS successfully establishes an integrated research and development Programme for the Baltic Seas which overcomes the fragmentation of national research programmes, brings together a variety of skills and focusses these on creating the essential knowledge and innovative solutions necessary to address the

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<sup>72</sup> COM(2015) 34 final: REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL: Interim Evaluation of the Joint Baltic Sea Research and Development Programme, BONUS

Baltic Sea's environmental problems. The evaluation also noted that the agreement of the participating states to a structure which enabled greater centralisation of the management of national funds would further improve the programmes administrative efficiency.

## **17. EMERGENCE OF CONTRACTUAL PPPs AS A RESPONSE TO THE ECONOMIC CRISIS**

Launched in November 2008, the research public private partnerships (PPPs) were set up as a response to the economic crisis with a view to supporting research, development and innovation in the manufacturing, construction and automobile industries, which had seen demand plummet. Although originally envisaged as a short term measure, the ongoing crisis, linked with a better understanding of the need for a long-term perspective on the support for these strategic industries, has led to a call from industry for a long-term commitment to these economically important industrial sectors and to these PPPs.

Factory of the Future (FoF) PPP: About 13% of the projects and of EC contribution are devoted to this PPP. Funding by NMP theme is € 400m out of € 600m EC funding; industry and EC each contribute 50%.

Energy efficient Building (EEB) PPP: This PPP accounts for about 7% of the projects and for 8% of total EC funding in NMP. Funding by NMP Theme is € 250m out of total of € 500m EC funding, industry and EC each contribute 50%.

Green Car (GC) PPP: It comprises just 2% of the total number of NMP projects and 2.5% of EC funding in the NMP Theme. Funding by NMP Theme is € 60m out of total of around € 500m EC funding; industry and EC each contribute 50%.

The Final Evaluation concludes that:

The PPPs have proved useful in strengthening the European value chains and in particular in giving a role to SMEs. The PPPs have all been successful in engaging top industrial companies, SMEs and research organisations within Europe, increasing significantly the large industry and SME participation.

Research PPPs have strong potential for a good overall leverage effect for private investment, and have boosted industrial participation (57 % in PPPs vs 34 % in FP7 Cooperation).

The three research PPPs have facilitated a closer working relationship between the Commission and industry in the setting of goals and longer-term research programme objectives. This has allowed industry to commit to longer-term strategies for research investment.

The stable funding of the research PPPs throughout their 4 years of implementation, as well as the competitive process of distributing the funding without the use of direct beneficiaries gives increased confidence to industry to invest in participating in these projects.

Research PPPs have moved forward in the latest calls to enlarge their coverage of the innovation chain closer to the market.

The PPPs have not achieved a regionally balanced engagement as it has been shown that sector specificities have a stronger role in defining funding opportunities than geographical parity.

The following recommendations were made:

The governance model of the research PPPs should be underpinned by a higher degree of formalisation, particularly with regard to the roles and duties of the private and public parties to the agreement.

The research PPP model should be further used, developed and expanded in scope within Horizon 2020 and provided with sufficient funding to achieve a significant industrial effect.

The PPPs should work under the Horizon 2020 common rules, but its procedures need to be further streamlined and simplified to increase ease of entry into PPP projects for industry, especially SMEs.

In order to maximise the benefits and widen participation in the research PPP activities and results, awareness about the research PPPs needs to be strengthened, particularly among the often hard-to-reach SMEs.

Furthermore, the ex-post evaluation of NMP demonstrates that:

The introduction of the PPPs has contributed to a better balance in FP7 NMP in terms of supporting different phases in the innovation chain. Such balance between activities at all TRL levels should also be kept as NMP enabled innovation is driven by strong interaction between scientific activities and innovative activities; there is no short cut to innovation.

PPP participants - especially the PPPs Factory of the Future and Energy efficient Buildings, are relatively more productive in terms of economic outputs than participants active in other areas.

Three quarter of the participants from PPP projects reports that they already have reached the development of a new or significantly improved product.

participants of on-going projects (that include relatively more PPPs) report consistently higher numbers for high and medium impact as compared to the participants of finished projects (such as for the number of patent applications that is already done and expected by the end of the project).

It was a good decision of EC to change the strategy during the programme. The EC has been successful in pushing the programme, to some extent, towards higher TRL levels.



## **18. EVALUATION OF THE EURAXESS PROJECT (2008-2012)**

The EURAXESS portal has been effective in boosting researcher career development, notably by providing information that assists in overcoming barriers to relocation, such as visa, residence permit, social security, as well as speeding up procedures. Promoted through EURAXESS Rights, the Human Resources Strategy for researchers (HIRS4R), which supports research institutions and funding organisations in the implementation of the Charter and Code, was also successful. Since the adoption of the Commission Recommendation on the Charter and Code in 2005, over 1200 institutions from 35 countries in Europe and abroad have endorsed it, and 102 have obtained the Commission's "HR Excellence in Research" badge. The implementation of the 40 principles of the Charter and Code by research institutions will render them more attractive for researchers worldwide. The diffusion of the resulting improvements in the management of Human resources within research organisations will also benefit to the attractiveness of the ERA at large.

- The level of awareness of EURAXESS Services and Jobs among the researchers' community has slightly increased. Among the different branches, awareness is higher for the EURAXESS Jobs portal than EURAXESS Services.

- Coordination of Information and Communication activities within national EURAXESS networks and with the EC is considered to be effective.

- Training provided at European level within the current framework is considered of good quality and relevant but frequency should be increased. There is also a demand for covering topics not included so far (from issues linked directly to researchers' mobility to others more related to management of staff and use of communication tools).

- The main risk identified for the EURAXESS network is the sustainability of the network. Stronger political support at European and national level are considered crucial for ensuring the sustainability of the initiative.

- A stronger involvement of industry partners in EURAXESS Jobs was very much praised by the stakeholders encountered. In particular, allowing industry partners to publish their vacancies on the portal was deemed as a good way to increase opportunities for researchers and to strengthen cooperation with private sector.

- Evidence collected for the evaluation of EURAXESS links in the period 2008-2012 pointed out that EURAXESS Links responds to most of researchers' needs in the US, Japan and China.

- Many researchers expressed their problems in permeating the vast array of local institutions in the countries where they are based, due to intrinsic complexity, the multiplicity of actors and, in the case of China and Japan, the relevance of language skills that European researchers often lack.

- Awareness of EURAXESS Link is varied. It appears to be higher in Japan and China than in the US.

- Among good practices worth implementing across the EURAXESS Links network, it is worth considering the high level of collaboration between the IO and EU Delegation, especially in China and in Japan. Networking events in all three countries have also received nearly universal praise, as has the European Funding Guide, which has already been adopted elsewhere after initial success in Japan.

## 19. OPEN ACCESS TO SCIENTIFIC PEER REVIEWED PUBLICATIONS IN FP7

Open access (OA) can be defined as online access to the results of publicly funded research at no charge to the end user. Over the last years, an increasing number of governments, research funding bodies and research performing institutions world-wide have therefore developed open access policies to improve the access to the scientific publications resulting from the research they fund. Two main business models for open access to scientific peer reviewed publications have been developed:

**Self-archiving** (also referred to as 'green' open access) means that the published article or the final peer-reviewed manuscript is archived (deposited) by the author - or a representative - in an online repository before, alongside or after its publication. Repository software usually allows authors to delay access to the article ('embargo period'). Some publishers request embargo periods, arguing that these protect the value of the journal subscriptions they sell.

**Open access publishing** (also referred to as 'gold' open access) means that an article is immediately provided in open access mode when published. In this model, the payment of publication costs is shifted away from readers (paying via subscriptions) to the author, through a one-off charge, a so called 'Article (sometimes 'Author') Processing Charge' (APCs). These can usually be borne by the university or research institute to which the researcher is affiliated, or to the funding agency supporting the research. In other cases, the costs of open access publishing are covered by subsidies or other funding models.

The Commission has been leading by example by promoting open access to scientific peer reviewed publications in FP7. For green open access it is running a pilot action in 7 areas of FP7<sup>73</sup>, mandating green open access on a 'best effort' basis (embargo period 6 months for natural sciences and 12 months for social sciences and humanities).<sup>74</sup> A 2011 survey of projects participating in this pilot found no major difficulties for projects to comply with these provisions.<sup>75</sup> Furthermore, the Commission also supported open access in all areas of FP7 by making relevant costs for gold open access (APCs) eligible for reimbursement as part of the overall project grant.

### 1. Uptake of open access in FP7

#### 1.1. Data Source

The EU funded project OpenAIRE ([www.openaire.eu](http://www.openaire.eu)) promotes open scholarship and substantially improve the discoverability and reusability of research publications and data. OpenAIRE and its successor projects *inter alia* assist in monitoring FP and Horizon 2020 research outputs. OpenAIRE computes statistics based on data retrieved

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<sup>73</sup> Energy, Environment, Health, Information & Communication Technologies [only cognitive systems, interaction & robotics], Research Infrastructures [only e-Infrastructures], Science in Society, Socioeconomic Sciences & Humanities – see also other relevant annexes

<sup>74</sup> This green open access mandate was implemented through special clause 39 in the Grant Agreement.

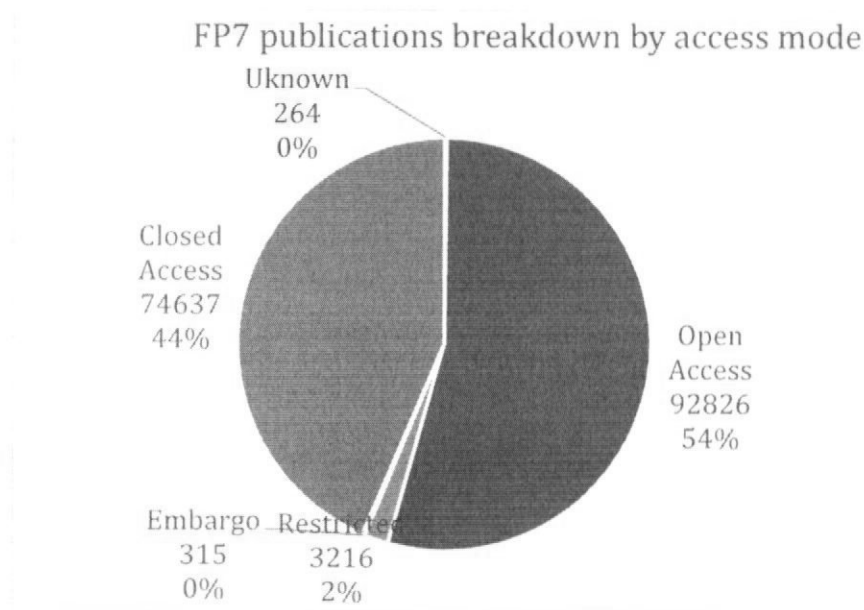
<sup>75</sup> European Commission (2012) Survey on open access in FP7.

from a range of sources: OA repositories and journals (literature and data), CRIS systems, library databases and end-user feedbacks. They also employ a variety of deduplication, cleaning, and text-mining processes on the metadata, as well as on the actual content.

### 1.2. Overall uptake of open access

From the total of 171,258 FP7 publications 92,826 are OA, 3,216 are restricted (i.e., OA but with a more restrictive license or restricted to specific groups), while 315 are still in embargo. This translates to a 54,2% success rate. It should be also noted, however, that not all FP7 projects have yet ended. At the time of writing and that, furthermore, publications are also published after the end of a project. The figure of 54.2% is therefore provisional. Furthermore, looking at individual years (see table 1 below), open access publications have significantly increased in recent years, reaching 67% in 2014 and 80% in 2015. This could be seen as an indicator of the growing support towards open access in the scientific community.

#### Overall FP7 OA evaluation.



**Fehler! Verweisquelle konnte nicht gefunden werden.** shows the breakdown of FP7 publications from 2007-2015 broken down by their access state. The overall data is somewhat biased to closed access as a) we cannot easily define OA articles in hybrid journals, and b) there is still a large number of not fully OpenAIRE compliant repositories (i.e., no funding information attached to the publication metadata) so FP7 publications may have been deposited but not yet identified.

Table 7. FP7 publications 2007-2015 by access status

Year	Open Access	Closed Access	Embargo	Restricted	Total	OA success rate
2007	142	14		8	164	87%
2008	783	295		52	1,130	69%
2009	3,179	1,992	1	147	5,319	60%
2010	7,039	5,063	3	291	12,400	57%
2011	11,385	9,534	14	502	21,438	53%
2012	17,271	14,345	37	567	32,237	54%
2013	23,035	18,245	49	673	42,019	55%
2014	21,911	10,276	106	478	32,797	67%
2015	5,871	952	102	239	7,319	80%
<b>Total</b>	<b>90,616</b>	<b>60,716</b>	<b>312</b>	<b>2,957</b>	<b>154,82</b>	<b>59%</b>

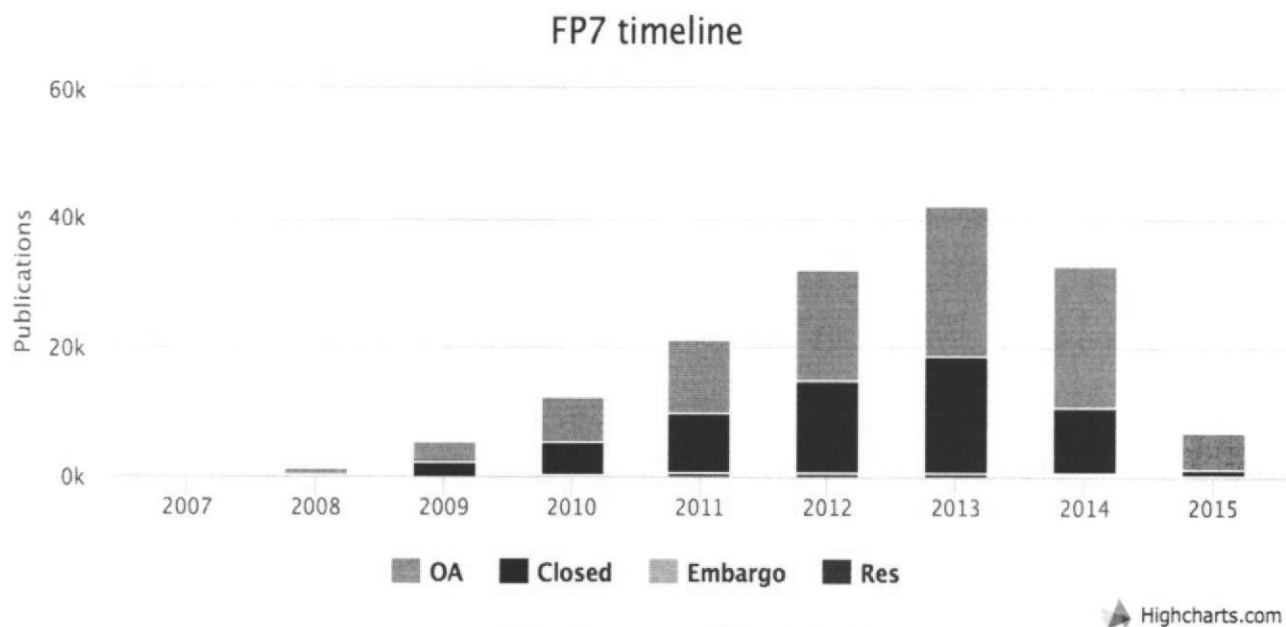


Figure 1. FP7 timeline, including OA status.

Table 2. FP7 publications by scientific area by access status.

Scientific Area	Total	Open Access	Closed Access	Embargo	Restricted	OA success rate
COH	3	3	0	0	0	100%
ENERGY	1,914	715	1,108	52	34	37%
ENV	7,774	4,162	3,219	193	55	54%
ERC	63,385	38,565	24,271	466	44	61%
Fission	625	196	401	21	6	31%
Fusion	7	3	4	0	0	43%
GA	307	127	176	3	1	41%
HEALTH	21,456	11,730	9,395	282	45	55%
ICT	32,445	12,854	18,235	1,303	19	40%
INCO	107	37	66	3	1	35%
INFRA	8,803	5,816	2,805	148	26	66%
KBBE	6,220	3,109	3,005	91	14	50%
NMP	6,712	2,112	4,354	219	23	31%
PEOPLE	21,871	14,767	6,734	303	45	68%
REGIONS	24	16	5	3	1	67%
REGPOT	1,889	1,017	849	22	2	54%
SEC	840	399	399	40	2	48%
SME	567	224	319	22	0	40%
JTI	939	562	366	11	0	60%
SPA	2,125	1,433	659	28	5	67%
SSH	1,153	990	123	31	7	86%
SIS	205	138	53	11	0	67%
TPT	1,134	438	610	78	4	39%
<b>Total</b>	<b>180,505</b>	<b>99,413</b>	<b>77,156</b>	<b>3,330</b>	<b>334</b>	<b>55%</b>

## 2. Supporting open access to scientific publications published after the end of the FP7 grant

According to current OpenAIRE data, most publications are published within the project lifetime (136.872), but an overall 13% (21.810 publications) are published after the project ended. The European Commission therefore decided to launch a dedicated separate pilot fund for covering gold open access charges (APCs) arising from completed FP7 projects. The fund – 4 million euros – is administered and run by OpenAIRE. It will last for a maximum of two years (i.e. until Apr 30th, 2017) or until its budget is exhausted. Its success will be evaluated to ascertain whether further action is needed.

OpenAIRE has, in consultation with the community, established the following eligibility criteria<sup>76</sup> for applying to the fund:

A maximum of three publications will be funded per eligible FP7 project as a means to ensure a fair distribution of the funding across projects;

Publications eligible for funding must be peer-reviewed;

Funding requests must be submitted once the publication has been accepted;

Publications submitted to hybrid journals will not be funded, but only those accepted at fully Open Access journals;

Funding caps of €2,000 for research articles and €6,000 for monographs apply for this Pilot;

The final version of the funded output must be deposited in an OpenAIRE-compliant Open Access repository.

The pilot started its operation on June 1, 2015. It is therefore too early for a statistically significant analysis. At the time of writing (August 2015) 20 eligible funding requests have been collected so far, 16 for journal articles and 4 for books. 11 requests have been approved and six publications have already been published as a result of the pilot fund.<sup>77</sup> The currently available data shows that an average of € 1356 per article was paid to the publishers in article processing charges.

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<sup>76</sup> <https://www.openaire.eu/postgrant/fp7-post-grant/pilot>. Central Application portal at <https://postgrantoapilot.openaire.eu/#home>

<sup>77</sup> See <https://zenodo.org/collection/user-fp7postgrantoapilotoutputs>

## 20. THE RECOMMENDATIONS FROM FP7 INTERIM EVALUATION AND THEIR FOLLOW UP

<p>Recommendations from the Expert Group November 12, 2010</p>	<p>a) Commission response in the Communication in 2011 b) Further measures taken since 2011</p>
<p>1. To advance ERA and Innovation Union objectives, integrating the research base by overcoming fragmentation in research is vital, while simultaneously achieving a sharper division of labour between what is done at EU level and what is undertaken in national programmes. European research and innovation efforts must concentrate on themes where critical mass is vital for success and where breakthroughs require cross-border solutions, while also allocating sufficient resources to R&amp;D topics which promise radical innovations. Addressing the 'Grand Challenges' confronting the European Union should increasingly be at the heart of EU research policy, starting in the last three years of FP7, but more emphatically so in a successor programme. This process could be structured according to who sets the research agenda and to take account of the 'smart, sustainable, inclusive' leitmotif for Europe 2020, although they will need to work together to address the 'Grand Challenges' as follows:</p> <ul style="list-style-type: none"> <li>- Science for science - the researchers set the agenda</li> <li>- Science for competitiveness - industry sets the agenda</li> <li>- Science for society - civil society actors set the agenda</li> </ul>	<p>a) The need to overcome research fragmentation and build critical mass in research, both public and private, are still major issues despite the many achievements such as JIIs, ERA-NETs, article 185 activities, co-funding mechanism in the Marie Curie training activities and now first steps towards Joint Programming. Future EU research programmes must provide a clearer focus on the major research items for science, technological leadership and industrial competitiveness and focus on the large societal challenges. In turn this will provide multiple benefits, including more coherent priority setting, a better capacity to leverage private sector investments, enhanced European added value and a stronger base for measuring impact. Such an approach needs to be developed within the framework of the European Research Area, identifying areas of common or convergent interest, while ensuring better alignment of research capacities. The Innovation Union sets out how the Europe 2020 objectives of smart, sustainable and inclusive growth can be achieved through a strategic and integrated approach to research and innovation. The forthcoming Green Paper on a Common Strategic Framework for EU Research and Innovation funding will launch a wide public debate on the key issues to be taken into account in future programmes.</p> <p>b) In the context of FP7, the work programmes covering the last years of this programme acted as a bridge to its successor. They introduced the integration of research with innovation to tackle societal challenges by providing more support than ever before for activities that helped bridge the gap between research and the market, for example by demonstrating that new technologies have commercial potential or can work on a sufficiently large scale to be industrially viable (close-to-market activities such as piloting, demonstration, standardisation and technology transfer have been proposed). This market-linked approach is also central to the European Innovation Partnerships</p>



(EIPs), set up under the Innovation Union action plan.

Horizon 2020, the biggest ever EU Research and Innovation programme with nearly €80 billion of funding available over 7 years (2014 to 2020), has been launched in December 2013. Aimed at spurring economic growth and creating jobs, it represents a radical change from the previous research framework programmes, as it brought together in a single strategic framework formerly separate research and innovation programmes, introducing major reforms, like a most important increase in budget, coupling research to innovation with support at every stage to bring research results 'from lab to market' and a challenge-based approach through which the bulk of Horizon 2020's investment will be made in solving major societal challenges, requesting a problem-solving approach. Further to these, Horizon 2020 has a simple architecture, centred on three pillars, which makes it easy for participants to identify funding opportunities: 'Excellent Science', which aims to reinforce and boost the excellence of the EU's science base and to consolidate the European Research Area in order to make the Union's research and innovation system more competitive globally; 'Industrial Leadership', which aims to speed up the development of the technologies and innovations that will underpin tomorrow's businesses and help innovative European SMEs to grow into world leading companies; and 'Societal Challenges', through which Horizon 2020 reflects the policy priorities of the Europe 2020 strategy and addresses major concerns shared by people in Europe - a challenge-based approach will bring together resources and knowledge across different fields, technologies and disciplines. The "three pillar" structure is complemented by the specific objectives 'Spreading excellence and widening participation' and 'Science with and for society'. Part of Horizon 2020's budget also goes towards funding the European Institute of Innovation and Technology (EIT), research activities carried out under the Euratom Treaty and research carried out by the Joint Research Centre. Overall, in the implementation of Horizon 2020, account is taken of the need to build appropriate synergies and complementarities between national and European research and innovation programmes.

The Joint Programming Process, addressing societal challenges jointly between Member States, was supported in the last years of FP7 by providing support to the 10 JPIs in

establishing structures and developing their Strategic Research Agendas and Implementation Plans. Furthermore transnational calls implemented by JPIs have been cofunded with ERA-NET Plus actions in two cases, paving the way to a broader support under Horizon 2020. Joint Programming and EC-co-funded Public-to-Public Partnerships (ERA-NET and Art. 185) have been redesigned in a way for H2020 which allows for more strategic cooperation between the national and EU level and to speed up this cooperation. Under H2020, the lessons learnt from FP7, have been put in place for ERA-NETs (ERA-NET and ERA-NET plus were merged, making it obligatory to launch a call under the new ERA-NET scheme). Art. 185 initiatives were brought closer to the Framework Programme, meaning that these initiatives are required to apply the Rules for Participation and Dissemination of the FP (derogations are only possible where operating needs so require). Also, H2020 more explicitly spells out the 3 needed levels of integration for an Art. 185. Finally, alignment with the objectives of H2020 is a basic condition for an Art. 185. Under FP7, the contribution to societal challenges was not a criterion for Article 185 Initiatives. Joint Programming in ERA was further spurred at the start of H2020 with the introduction by the Commission of the concept of alignment in order to increase interoperability between national science systems and align national priorities towards the JPI's SRA.

The Commission committed itself in the ERA Communication of 2012 to continue stimulating P2Ps, to map activities in agreed priority areas and to support MS and funding agencies to apply joint international peer review evaluations and setting common funding standards. Where EC funding is not involved, the EC has very little influence on developments. E.g. commitment to Joint Programming remains completely voluntary for MS. The EC is a member in the GPC (Groupe de Programmation Conjointe) set up by the Council. More could be done in this group (however not on EC initiative) to define minimum conditions for JPI establishment and also for elaborating strategies for future joint priority areas for societal challenges.

A major task only partially tackled at the start of H2020 is the better concentration and deployment of synergies of national, transnational and EU-programmes. A true European research policy, taking full account of Art. 13 of the H2020 regulation (Synergies with national programmes and joint programming), is a difficult task and being established only slowly. In the EC point of view, societal challenges should guide

	<p>the process as the vehicle to facilitate alignment of MS (and the EU level) towards common goals in the ERA.</p> <p>The 2nd ERA progress report was published in September 2014. Although considerable progress has been made, further implementation efforts are needed. It was decided by the Council in February 2014 that an ERA roadmap should be developed by mid-2015 which should serve the purpose of facilitating and reinforcing the efforts undertaken by the Member States. These will have to be translated in National Action Plans before mid-2016. The Council also decided in May 2015 that ERAC will propose by the end of 2015 a set of core indicators and, where appropriate, qualitative methods allowing monitoring the implementation of the ERA Roadmap.</p> <p>According to the 2014 Progress Report further work is also needed on the ERA monitoring mechanism (EMM) to identify and fine tune essential indicators of progress in ERA. To this end recently a study by ICF on ERA monitoring has been completed.</p> <p>The Innovation Union flagship initiative (EU2020 Strategy) was a comprehensive strategy addressing a wide range of elements that impact Europe's innovation ecosystem. The strategy includes 34 commitments across a number of areas crucial for fostering innovation capacity in Europe. The main results are highlighted in the Staff Working Document (published in June 2014), e.g. p90 with a summary table of progress reached until 2014 : <a href="http://ec.europa.eu/research/innovation-union/pdf/state-of-the-union/2013/state_of_the_innovation_union_report_2013.pdf#view=fit&amp;pagemode=none">http://ec.europa.eu/research/innovation-union/pdf/state-of-the-union/2013/state_of_the_innovation_union_report_2013.pdf#view=fit&amp;pagemode=none</a> and Eurostat monitoring of the EU2020 indicators in research and development: <a href="http://ec.europa.eu/eurostat/statistics-explained/index.php/Europe_2020_indicators_-_research_and_development#How_much_is_the_EU_investing_in_R.26D.3F">http://ec.europa.eu/eurostat/statistics-explained/index.php/Europe_2020_indicators_-_research_and_development#How_much_is_the_EU_investing_in_R.26D.3F</a></p>
<p>2. To develop and implement high quality research infrastructures. Research infrastructures (RIs) are pivotal for the Knowledge Triangle, and as such are a pillar for implementing the ERA, but there needs to be coherence</p>	<p>a) The Commission recognises that infrastructure funding will be improved through better alignment of the FP, with funding from the European Investment Bank and Structural Funds. FP7 support for new research infrastructures targets the preparatory phase for projects in the ESFRI Roadmap and for some of these projects possible</p>

between what is funded by FP7 under the heading of Capacities, the ESFRI and capacity building undertaken as part of Cohesion policy and what is being considered in the context of Joint Programming. More effort should be made to boost RIs during the latter stages of FP7, especially the Integrated Infrastructure Initiatives (I3) that have the greatest scope for added value at European level. In addition there should be a focus on promoting their impact by establishing synergies between training instruments and utilisation of RIs and by stimulating industrial and third country access

synergies with Cohesion Policy have been worked out and information disseminated to project consortia. The Commission is confident that synergies should bring results before the end of FP7. Support for Integrating Activities (I3) will continue to be provided for the last years of FP7. The reinforcement of training related to research infrastructures in the People programme is an interesting possibility to be considered. Following the Europe 2020 Strategy a work package on innovation could be included in all research infrastructure projects thereby favouring greater involvement of industry. The work programme 2012 will better highlight the possibility for researchers from third countries to benefit from access to European research infrastructures. The development of e-Infrastructures will connect researchers, instruments, data and computation resources throughout Europe, creating a seamless "online ERA". As an integral part of the Digital Agenda flagship initiative, this work will continue in the second half of FP7 including development of online services for computation and data-intensive research, the upgrade of the GÉANT network and further development of the PRACE supercomputing infrastructure.

b) The Integrated Infrastructure Initiative (I3) was devised for the integration of existing research infrastructures as one of the key actions under FP6. In FP7 "Integrating Activities" this activity has been implemented through both bottom-up and targeted approaches to support the integration of and access to national research infrastructures of pan-European and regional interest, corresponding to the follow-up of the FP6 initiative.

Under FP7, each funded project was a combination of three mandatory types of activities:

- a) Trans-national access and/or services Activities, to provide trans-national access of researchers or research teams to one or more infrastructures among those operated by participants, and/or to provide access to scientific services freely available through communication networks.
- b) Networking Activities, to foster a culture of co-operation between research infrastructures, scientific communities and other key stakeholders, and help developing a more efficient and attractive European Research Area.
- c) Joint Research Activities, to improve, in quality and/or quantity, the services provided

	<p>by the infrastructures.</p> <p>In Horizon 2020, the aim of these "Integrating Activities" is to provide a wider and more efficient access to, and use of, the research infrastructures existing in EU Member States, Associated Countries and at international level when appropriate. Funding will be provided to support, in particular, the trans-national and virtual access activities provided to European researchers (and of researchers from Third Countries under certain conditions), the cooperation between research infrastructures, scientific communities, industries and other stakeholders, the improvement of the services the infrastructures provide, the harmonisation, optimisation and improvement of access procedures and interfaces.</p> <p>Some Research Infrastructure projects under the ESFRI Roadmap have been supported by both FP/Horizon 2020 and ESIF and they illustrate concrete synergies. For instance, one example is the Extreme Light Infrastructure (ELI) project which aims to create the latest laser equipment in the world as a distributed infrastructure in the Czech Republic, Hungary and Romania. Another example is the European Spallation Source (ESS) project which aims to build a powerful neutron facility of the next generation in Sweden.</p>
<p>3. The level of funding should, at least, be maintained. Although the straitened budgetary conditions following the severe economic crisis will mean tough choices have to be made in public spending, the competitive challenges that the EU faces require sufficient investment in long-term economic development and there should be no reduction in funding for FP7 in its latter stages. There is a compelling case for continued substantial funding of research in the Eighth Framework Programme, not least as one of the key tools to achieve the Europe 2020 goals. A reasonable level of funding per year could be that reached in the last year of FP7. In relative terms, this would mean that the percentage</p>	<p>a) The Europe 2020 strategy acknowledges very clearly that research and innovation are the key engines of societal progress and economic prosperity. In order to meet the objectives of this strategy, the key challenges which need to be addressed at EU level and the challenge laid down by our competitors planning huge and ambitious investments for Research, Development and Innovation (RDI), there must be a credible funding level provided to the research and innovation framework. As proposed in the Budget Review, a common strategic framework will ensure a more efficient use of the EU's research and innovation funding by enhancing its EU added value, making it more results oriented, and by leveraging other public and private sources of funding.</p> <p>b) The annual budget of FP7 steadily increased over the years, reaching a level of funding that was almost double in its last year in relation to the first one.</p>

<p>of the total EU budget that FP7 will have when it ends should be regarded as a minimum. Funding at this rate would help to overcome the problem that many individual proposals adjudged to be excellent are not funded which, coupled with the substantial effort needed to prepare a proposal, may deter some of the best researchers from applying.</p>	<p>With total funding of €80 billion, Horizon 2020 is one of the few areas of the EU's budget for 2014 to 2020 to see a significant increase in resources, even if it was not as high as the budget foreseen in the Commission proposals. The first wave of the calls for proposals totals €15 billion for 2014/15.</p>
<p>4. A well-articulated innovation strategy needs to ensure that instruments and priorities encourage participation from a broad spectrum of small and large enterprises, universities and research and technology organisations. The research and innovation strategy also has to take into account the need to support European enterprises' efforts to integrate in global innovation networks. The open, international character of the FP7 could therefore be expanded. Specific actions should be taken in the context of the evolving financial crisis to channel financial support for research and innovation to areas of crucial importance for European competitiveness. An increased emphasis on monitoring progress in FP7 projects is needed if the intended impact is to be achieved. Innovation also requires more attention to the distinctive needs of industry, among which reductions in administrative burdens are vital.</p>	<p>a) The Commission agrees with the recommendation which is convergent with the orientations provided in the Communication on Innovation Union within the context of the Europe 2020 Strategy. In recent years, the approach to align FP funding priorities with the technology needs of industry, namely through encouraging European Technology Platforms and the support to Joint Technology Initiatives and Public-Private Partnerships, have not only increased the industrial relevance of FP research but also, more fundamentally, have helped whole industry sectors to align behind shared research strategies. As set out in the Innovation Union, future EU programmes should strengthen this, along with stronger knowledge transfer mechanisms and the launch of European Innovation Partnerships to bridge the gap with demand-side measures (such as standard setting, procurement and regulatory frameworks). While Innovation Union commitments will only be fully implemented in the next generation of spending programmes, the Commission is already investing significant effort in enhancing the innovation impact of the current Framework Programme. This will be achieved in the remaining FP7 work programmes, including through funding for projects which take research results closer to market (e.g. demonstration projects) and additional emphasis on innovation impacts in evaluating proposals. In addition, further funding will be provided for both SME specific projects and topics which are attractive to SMEs or organisations that are 'new comers' to FP7.</p> <p>b) Under the FP7 two interim evaluations took place to monitor the implementation of the Joint Technology Initiatives Joint Undertakings (JTI JUs), highlight their first achievements and identify potential weaknesses. In particular the second interim evaluations, which were run in 2013, report on the very promising participation of industry, including SMEs, to the JTI JUs. The evaluations also confirmed that PPPs are</p>

a successful cooperation model to address in a pre-competitive way R&I challenges in specific technologies and JTI JUs are capable of creating and maintaining strong communities across industry, research organisations and academia. PPPs also created a critical mass of expertise to address the most complex problems and deliver high-quality scientific output. At later stage, the analysis of data on participation showed that large industry and SMEs accounted for about 30% of the participations each in the calls launched by the JTI JUs established under the FP7 (i.e. Clean Sky, FCH, IMI, Artemis and Eniac), which overall resulted in about 850 Grant Agreement signed.

Under H2020, apart from excellent science and fundamental, pre-competitive research (low TRL technologies), the full innovation cycle from research to retail is covered through calls for demonstration actions (more mature technologies, higher TRL levels), pilot and market replication projects, industrial scaling. Strategic investment decisions in key technologies underpin innovation across existing and emerging sectors through investment in Future Emerging Technologies, and Key Enabling Technologies, as well as investing in the Joint Technology Initiatives (public-private partnerships) in key industrial areas and through the European Institute of Technology (EIT) funding Knowledge and Innovation Communities that cover the 'knowledge triangle' (i.e. industry, research and education) to tackle some of the EU's toughest challenges. Specific measures are taken to coordinate national funding and collective agenda-setting between specific Member States and between public and private actors (e.g. Article 185 initiatives, ERA-NETs, public procurement of innovative products and services) to provide additional leverage for funding research and innovation activities.

Furthermore, Horizon 2020 funds high-potential innovation through a dedicated SME instrument, supporting high-potential SMEs in developing ground-breaking ideas for products, services or processes that are ready to face global market competition. Funded research under H2020 takes a problem-solving approach focussing on grand (societal) challenges that know no national borders, and encourages and supports all types of innovation (e.g. service, product, process, social, business, organizational, etc.). European Innovation Partnerships bring together all relevant actors at EU, national and regional levels and focus on societal benefits and a rapid modernization of the associated sectors and markets in order to achieve targets quicker and more efficiently in addressing societal challenges e.g. in the area of health, urban development, agriculture,

water and materials shortage.

By the end of 2013, 127 RSFF operations had been approved by the EIB, with a total loan volume of €16.2 billion, and the Bank had signed loan agreements with 114 R&I promoters, with a total loan volume (active loans) of €11.31 billion. The sector diversification was broad, and the instrument had been implemented in 25 countries. Also by the end of 2013, RSI, the pilot loan guarantee instrument, had been implemented in 14 countries via 23 banks and other financial intermediaries for a total guarantee amount of €1.21 bn, underpinning a total loan volume of €2.4 bn. The number of final beneficiaries will continue to increase, under the terms of the pilot facility, until the end of 2016. The figures as of January 2015 show loans of around €1.06 billion to some 1800 companies employing about 116 000 people. The RSFF and RSSI reached and easily exceeded almost all their operational and intermediate objectives, while three evaluative assessments showed that RSFF (RSI was not within their scope) is well on its way to realising longer-term objectives and wider achievements. These assessments (two interim evaluations and a special report by the Court of Auditors), coupled with an ex ante evaluation of potential financial instruments under H2020, formed the basis for the design and launch in 2014/2015 of a new generation of 'InnovFin' financial instruments targeting a wide range of firms and other entities: large firms, midcaps, SMEs, universities and research institutes, public-private partnerships, and special-purpose vehicles or projects. InnovFin offers access to loans, guarantees, counter-guarantees and hybrid, mezzanine and equity finance.

5. Simplification needs a quantum leap, and the Expert Group calls for all Directorates-General and agencies rapidly to implement the short-term simplification measures recently put forward in a Communication by the Commission and to ensure that they are applied rigorously from 2011-2013. Coherence of procedures and approaches between Commission Directorates General and the Executive Agencies responsible for administering FP7 is of crucial importance. The Expert Group proposes that the

a) The Commission has acknowledged the need for further simplification. The Commission Communication (COM(2010)187) on simplifying the implementation of the FPs, presenting a set of short term and longer term options, has triggered an intensive inter-institutional debate. While there is also a strong plea for stability and continuity as regards the applicable rules for FP7, a broad consensus emerges that fast progress should be made on three potential wins already on FP7:

A re-definition of the criteria for the acceptance of average personnel cost methodologies, removing the criteria for acceptable deviations between average costs in a personnel category and the actual costs related to the individual persons working in the



Commission consider the upcoming revision of the Financial Regulations as an opportunity to create more flexible conditions for research in subsequent FPs. In addition the Group pleads for the Commission to switch from its present low-risk/low-trust attitude to a more trust-based and risk-tolerant approach.

projects. This would allow for the acceptability of majority of average personnel cost methodology actually applied as usual accounting practice by beneficiaries, in particular in industry, including the cost-centre based methods;

Provision of a possibility for owners of SMEs and natural persons not receiving a salary registered in the accounts to reimburse the value of their work brought into FP7 projects by way of a flat rate based on the allowances for Marie Curie fellowships in the People specific programme;

Establishment of a clearing committee between the Directorates-General in the Commission implementing the research framework programmes, in order to achieve a uniform interpretation and application of the rules and procedures for implementing research grants;

The Commission has on 24 January 2011 adopted the required implementing decisions to set the above simplification measures in operation without further delay and with retroactive effect for ongoing FP7 grants. The issue of interest on pre-financing is addressed in the Commission proposal (COM(2010)815 for the revision of the Financial Regulation. The revision of the Financial Regulation, as proposed by the Commission, is also essential for achieving more radical simplification ('quantum leap') in the next research and innovation funding programmes.

b) The revised Financial Regulation was adopted, comprising the simplifications proposed by the R&I DGs; abandoning the obligation to report interest on pre-financing; eligibility of non-recoverable VAT.

Major simplification ("quantum leap") was introduced with the basic legal acts of FP2020, in particular via the complete overhaul of the cost reimbursement approach:

- the principle of "One project - one funding rate", replacing the complex matrix of funding rates by organisation categories and types of activities
- the replacement of the 4 methods for charging indirect costs by a single flat rate

Moreover, the administrative burden is reduced by a lower number of ex-ante financial capacity checks and certificates on financial statements. Administrative rationalisation is achieved by a fully electronic grant management process through the Participant Portal as the one-stop shop for all interactions with applicants and beneficiaries. Ex-post audit

	<p>is rationalised via the creation of a single audit service and the reduction of the period for ex-post audits from 5 to 2 years after project closure.</p> <p>As an example, the MCA under Horizon 2020 were better streamlined – four main actions instead of big number of different actions.</p>
<p>6. The mix of funding measures in FP7 and successor programmes should strike a different balance between bottom-up and top-down approaches to research, with greater emphasis in the specific programme Cooperation during 2011-2013 on more open calls. It is also important to ensure that education does not become the forgotten side of the Knowledge Triangle and thus that the linkages between research and innovation are adequately complemented by research training.</p>	<p>a) Significant parts of FP7 already provide bottom-up approaches to research. These include the Marie Curie Actions (MCA) for researcher training and mobility and the European Research Council (ERC) for curiosity-driven research. Also noteworthy is the Future and Emerging Technology (FET) scheme which, through top-down thematic calls combined with bottom-up open calls is supporting multidisciplinary exploratory research in ICT. The move towards more bottom-up funding is set to continue, with the Commission proposal for further open, challenge-driven calls for proposals in the final years of FP7. Beyond this, the Innovation Union has committed to strengthen the role of the ERC and the issue of bottom-up versus top-down approaches will feature strongly in the orientation debate on the next FP. What is most important for the FP as a whole however is to ensure a proper balance between bottom-up and top-down approaches. Further to the comments concerning future activity strongly focused on major challenges, it is important to remember that this will only succeed if it allows creativity and ingenuity to flourish at the projects' and researchers' levels. The Commission reaffirms its support for the knowledge triangle concept and points to the ongoing work under the European Institute of Technology as also providing a major boost for the education component. Also, important will be the 'university-industry' forum and the 'knowledge alliances' announced in the Innovation Union Communication, as well as the development of appropriate skills for researchers to innovate as provided by the MCA.</p> <p>b) Horizon 2020 continues with the bottom-up schemes known under FP7, such as the Marie Skłodowska-Curie actions (MSCA), the European Research Council activities (ERC) and the Future and Emerging Technologies (FET). New schemes were added to them under the specific objective 'Leadership in enabling and industrial technologies' and under the priority 'Societal challenges', such as the SME instrument that provides staged and seamless support covering the whole innovation cycle to innovative SMEs.</p>

	<p>showing a strong ambition to develop, grow and internationalise and the Fast Track to Innovation Pilot (FTI) that aims to attract newcomers and supports innovation actions on the basis of a continuously open call. In a way that transcends bottom-up and top down schemes, a novel strategic programming approach in the preparation of the biennial work programmes under Horizon 2020 ensures focus on areas where EU-level action has greatest impact, with a coherent set of actions from research to innovation and less prescriptive calls with fewer and broader topics to encourage new ideas, with more emphasis on impact and greater interdisciplinarity.</p>
<p>7. A moratorium on new instruments should be considered until the existing ones have been sufficiently developed and adequately evaluated, and care should be taken to avoid a confusing proliferation of instruments.</p>	<p>a) The remainder of FP7 will continue to work with the current legal base and the existing set of instruments. However, the Commission will examine the current portfolio of instruments to identify areas for simplification, possible redundancy and potential gaps. Novel approaches such as prizes or innovative procurement schemes should also be considered. This work will be supported in a number of ways including discussions within the European Research Area Committee (ERAC) and the forthcoming 'Communication on Partnerships'. The resulting ideas will be reflected in the Commission's proposals for the next FP. Making the best possible use of the EU budget will require gearing funding towards more European added value, stronger impact and enhanced leveraging. A common strategic framework as mentioned earlier will aim to ensure that all EU research and innovation funding works towards common goals and according to a shared strategy. This will in itself necessitate a development of a coherent and streamlined portfolio of instruments.</p> <p>b) Radical simplification is one of the major features of Horizon 2020, the main aim being to make the programme more attractive to the best researchers and most innovative companies and to minimise financial errors. Simplification is fully reflected in its design, rules, financial management and implementation. Horizon 2020 aim to attract the strong participation of universities, research centres, industry and specifically SMEs and is open to new participants, as it brings together the full range of research and innovation support in one common strategic framework, including a streamlined set of forms of support, and uses rules for participation with principles applicable to all actions under Horizon 2020.</p>

Horizon 2020 supports actions through one or several of the forms of funding provided for by the Financial Regulation (EU, Euratom) No 966/2012, in particular grants, prizes, procurement and financial instruments, without adding any unnecessary variations of them.

8. Further steps to increase female participation in FP7 should be taken in its remaining years, in particular:
- Measures to boost female participation should be reinforced throughout project life-cycles, paying particular attention to overcoming gender-specific obstacles which women face.
  - The Commission should reinvigorate its approach to promoting female scientists and should aim to galvanise Member States to address gender gaps, especially where female researchers face specific obstacles, while ensuring that it redoubles its efforts to achieve gender balance with a specific strategy for the remainder of FP7. It should accept its responsibilities in a leadership role, with the support of the Member States, to use positive measures for the training of female scientists, including a dedicated scheme under the Marie Curie actions.
  - The 40% target for female participation in Programme and Advisory Committees should be sensitively but rigorously implemented.

- a) The Commission attaches great importance to this issue although notes, since the FP is only a small part of total European research activity, the limits to what it can achieve on its own. Real progress necessitates a common approach actively supported by funding agencies and researchers across the European Research Area. In this context, the Commission accepts the challenge of taking a leading role. Further to the current activities - notably the 40% target, monitoring, awareness and promotion activities; and successes under the Marie Curie Actions - a series of additional activities are proposed. The Commission will:
  - fully implement the target to achieve 40% female participation in all evaluation and advisory committees - it will also seek the support of Member States to achieve this target for Programme Committees;
  - launch new analyses with the support of Member States and research institutions to identify, by end 2011, the cultural and situational factors which help shape female researcher participation, as well as measures to overcome these;
  - reinforce monitoring in all stages of the project life-cycle;
  - under the Marie Curie Actions, reinforce the role of a dedicated Career Restart Panel, helping those who wish to resume a career in research after a break, for example due to maternity leave.

- b) The EC has continued its effort in pursuing gender equality in Research and Innovation within the ERA and in the EU funding Programmes (FP7 and H2020). According to the Communication 'A Reinforced European Research Area Partnership for Excellence and Growth', the Commission is committed to 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. In H2020 three main objectives have been set: gender balance and equal

opportunities in research teams at all level, gender balance in panels and advisory groups and integration of the gender dimension in research and innovation content. The Commission raised the target of the advisory groups to 50%.

In FP7 a target of 40% of the under-represented sex was set for experts' panels and other groups. The overall proportion of women evaluators was slightly higher than the target (40.4%). The European Research Area Board (ERAB) reached 45,5%, (higher than the FP6 European Advisory Board –EURAB- at 33%). The proportion of women in Advisory Groups, was overall 33%, with four of them ranging from 40 to 43%, three ranging from 37 to 39% and three lower than 30% (Space, NMP and ICT). Participation of women in Programme Committees increased from 2009 and almost reached the target (38 %).

The Commission published an expert report on 'Structural Change in research institutions - Enhancing excellence, gender equality and efficiency in research and innovation' in 2011. In 2014 the Commission published a report on 'Gender Equality Policies in Public Research' based on a survey among the members of the Helsinki Group, the Commission's advisory group on gender, research and innovation. It gives a detailed analysis of the current state-of-play of EU Member States' and associated countries' initiatives for promoting gender equality in research and innovation. The Commission published the 2013 ERA Progress Report, presenting an overview of the political context, steps taken and first achievements. It was followed by the 2014 ERA Progress Report, which presented the new and updated measures adopted at national level, and for the first time compared them with the implementation of ERA actions at national level by research funding and research performing organisations. The monitoring in all stages of the project life-cycle has been enhanced and since the 6th FP7 Monitoring Report new indicators have been added: ie. for the Cooperation Programme the types of Gender Equality Actions implemented or the association of the gender dimension with the research content; projects workforce and gender of scientific staff for Cooperation, Capacities and Euratom Programmes.

9. To pave the way for increased participation from Member

a) A specific example of progress already being made is the Synergies Expert Group

States that are under-represented greater prominence should be given to improved connections between the Structural Funds and the FP. Moreover, within the FP, the importance of the People programme for developing the potential for scientists from EU 12 should be stressed, as should the scope for using infrastructures.

(SEI), set up to find synergies between FP7, the Structural Funds and the Competitiveness and Innovation Framework Programme. With members from academic, policy and practical backgrounds, as well as the education corner of the knowledge triangle it will advise on both the current programming period (2011-2013) and into the next one, as well as on the future of FP7 regional actions. The SEI will benefit from recent analysis of synergies undertaken by the ERAC (European Research Area Committee). The Europe 2020 flagship initiatives on Innovation Union and the Digital Agenda have significant implications for achieving a better alignment of EU policies and activities, including research, innovation and cohesion funding. The Structural Funds should provide support for capacity building, such as for research infrastructures and actions to deploy high-speed internet across Europe, thereby broadening the base of EU research and innovation and building capacities for a knowledge-based society.

b) In its final report in 2011, the Synergies Expert Group made comprehensive recommendations on the development of synergies during the remainder of the 2007-13 programming period and the next (now current) programming period and on the future of the FP7 regional actions: Regions of Knowledge (RoK) and Research Potential (RP). Subsequently, in order to assist in the process of promoting synergies between European Structural and Investment funds and I2020, the Commission services have produced guidance to the relevant authorities through a staff working document (SWD (2014)205 final) which contains explanations on the basic rules and principles for obtaining synergies and combining the different funds, and contains recommendations to the relevant actors as well as Commission support to facilitate synergies. In addition, a short guide for the final beneficiaries has been produced. Since 2011 the Commission has invested more than EUR 250 million into the programmes Research Potential and Regions of Knowledge. Research Potential helped to build capacities in terms of infrastructure and human resources for research organisations in less favoured regions that often prepared the ground for significant investments from the structural funds. Regions of Knowledge helped to upscale regional research intensive clusters to European partnerships and to align their research agendas with regional smart specialisation strategies.

Horizon 2020 includes for the first time a clear legal mandate to maximise synergies with the European Structural and Investment Funds (ESIF).

Horizon 2020 allocates around EUR 800 million for the period 2014-2020 through the specific Part IV dedicated to 'Spreading Excellence and Widening Participation'. These 'Widening actions' of Horizon 2020 are also aimed to fostering synergies: the excellence of beneficiary institutions will be stepped up through Horizon 2020 whereas the necessary physical infrastructures of these institutions are expected to be built up through ESIF. Part IV also contributes EU 150 million to the Intergovernmental Framework COSI in order to develop and connect pockets of excellence in less research performing countries.

The Marie Curie Actions are perceived as a good entry point into collaborative research. The process of raising awareness of the EU-13 research organisations and researchers about the possibilities of funding is in place. Working more closely with the National Contact Points from the EU-13 Member States, sharing best practices and organising specialised workshops are important elements of ensuring broader participation of EU-13 in the Framework Programme.

Under FP7, 11 ERA Chair projects have been funded to enable institutions to attract top academics so that they can compete with centres of excellence elsewhere in the European Research Area (ERA) and in the world. The selected institutions have to award ERA Chairs to outstanding academics who have the capacity to raise standards and attract more high level staff as well as money from other sources, such as EU research funding or regional funds. ERA Chair holders can come from anywhere in the world. Currently, under H2020- Spreading Excellence Widening Participation, 13 projects have been selected for funding and the grant agreements will be signed soon.

10. Opening of the FP7 to international cooperation is of great value. As other regions rapidly strengthen their research and innovation capacities (with Asia perhaps being the most notable example), but also as the urgency to address

a) FP7 is already very open to international collaboration and involves participants from more than 160 countries. But both in finance and total numbers of participants the scale of this collaboration is relatively small, notably with the leading and emerging research nations. This is a serious missed opportunity which must be addressed. Building on the

global challenges grows, the ability of European research and innovation to link up with other regions, markets and research and innovation agendas and to meet global needs for innovative solutions to 'Grand Challenges' becomes increasingly important. A review based upon a thorough analysis of the current strategy towards international cooperation is needed. The international perspective must be integrated into all programmes and instruments.

experience of existing initiatives such as EU bilateral S&T agreements and coordinated calls there is an urgent need for a more strategic approach.

To this end the Commission will carry out a major review - to report by the end of 2011 - of its strategy for international collaboration. This will examine how to build critical mass and specialisation, in areas of European need and comparative advantage, taking into account the proposal above (2.1) for a future focus on major challenges. In this context, it will also be essential to better define the common and respective roles of Member States and the Framework Programme as well as the means, such as through the Strategic Forum for International S&T Cooperation, to identify areas of common interest and approaches.

b) In September 2012 the Commission adopted a Communication on 'Enhancing and focusing EU international cooperation in research and innovation: a strategic approach' aiming at strengthening the Union's excellence and attractiveness, tackling global societal challenges, and supporting the Union's external policies. The dual approach proposed (openness and targeted international cooperation activities) has been applied while ensuring coordination with EU MS and AC and devoting growing attention to address framework conditions.

A first two-year implementation report with roadmaps for eleven countries and regions published in autumn 2014 acknowledged the implementation of the strategy and recommended to better integrate international cooperation in the work programme development and to refine the communication strategy.

However the preliminary results of the first Horizon 2020 calls have shown a sharp decline in the participation of International Partner Countries compared to FP7. This is also due to the fact that BRIC-M partners are no longer systematically funded. Redress measures will be implemented through the 2016-17 work programmes to be published in autumn 2015.



## 21. THE ASSESSMENT OF IMPACT OF FP7 AT NATIONAL LEVEL

### I. Summary of the evidence base

The evidence base concerning the assessment of the impact of FP7 participation at national level is summarised in the table below:

Item	Country	Literature reference	Methodology employed
1.	Sweden	Impacts of the Framework Programme in Sweden <sup>78</sup>	Impact analysis based on bibliometric analysis, longitudinal analysis dating back to 1990 participation statistics and interviews
2.	Austria	Evaluation of Austrian Support Structures for FP 7 & Eureka and Impact Analysis of EU Research Initiatives on the Austrian Research & Innovation System <sup>79</sup>	Mixture of quantitative and qualitative methods based on surveys, interviews, literature review, logical framework analysis and secondary data analysis.
3.	Denmark	Firm Participation: Descriptive Statistics and Impact Assessment ( <i>to be published by Danish Agency for Science, Technology and Innovation in September</i> )	Quantitative method
		The evaluation of Danish participation in FP6 and FP7 <sup>80</sup>	Survey, interviews and statistical analysis
		Bibliometric performance analyses of publications from Danish researchers linked to FP6 and FP7 ( <i>to be published by Danish Agency for Science, Technology and Innovation in September</i> )	Bibliometric analysis

<sup>78</sup> <http://www.vinnova.se/upload/EPiStorePDF/va-08-11.pdf>

<sup>79</sup> <http://www.technopolis-group.com/?report=evaluation-austrian-support-structures-fp-7-eureka-impact-analysis-eu-research-initiatives-austrian-research-innovation-system>

<sup>80</sup> [https://ec.europa.eu/research/evaluations/pdf/archive/fp7-evidence-base/national\\_impact\\_studies/evaluation\\_of\\_danish\\_participation\\_in\\_fp6\\_and\\_fp7\\_-\\_main\\_report.pdf#view=fit&pagemode=none](https://ec.europa.eu/research/evaluations/pdf/archive/fp7-evidence-base/national_impact_studies/evaluation_of_danish_participation_in_fp6_and_fp7_-_main_report.pdf#view=fit&pagemode=none)

4.	Czech Republic	The 6 <sup>th</sup> Continuous Report on the CZ Participation in the FP7 <sup>81</sup>	Statistical methods including regression analysis and network analysis
5.	United Kingdom	The impact of the EU RTD Framework Programme on the UK <sup>82</sup>	A mixture of quantitative and qualitative methods including desk research, survey and interviews
6.	Slovenia	Participation in the EU FP – Policy implications <sup>83</sup>	Advanced statistics including correlation analysis (Pearson's) and cluster analysis
7.	Switzerland	Impact of Swiss Participation in the Seventh European Framework Programme for Research <sup>84</sup>	Survey and statistical analysis
8.	Norway	Norwegian Research Barometer 2013 <sup>85</sup>	Participation statistics and international benchmarking based on indicators
		An evaluation of the Norwegian participation in FP6 and FP7 <sup>86</sup>	A combination of quantitative and qualitative methods based on survey, interviews, case studies and bibliometric analyses
		On motives for participation in the Framework Programme by Technopolis <sup>87</sup>	Desk research, survey and interviews

<sup>81</sup><http://www.tc.cz/cs/storage/52d3b3922fa7db203f933bea1b168c36f55e3912?uid=52d3b3922fa7db203f933bea1b168c36f55e3912>

<sup>82</sup>[https://ec.europa.eu/research/evaluations/pdf/archive/fp7-evidence-base/national\\_impact\\_studies/impact\\_of\\_the\\_eu\\_rtd\\_framework\\_programme\\_on\\_the\\_uk.pdf](https://ec.europa.eu/research/evaluations/pdf/archive/fp7-evidence-base/national_impact_studies/impact_of_the_eu_rtd_framework_programme_on_the_uk.pdf)

<sup>83</sup><http://www.arhiv.mvzt.gov.si/fileadmin/mvzt.gov.si/pageuploads/pdf/7OP/UNDERREPRESENT-STUDIJA.pdf>

<sup>84</sup> [www.sbf.admin.ch/impakt-en](http://www.sbf.admin.ch/impakt-en)

<sup>85</sup><https://www.regjeringen.no/globalassets/upload/kd/kampanjer/forskningsbarometeret/2013/research-barometer-2013.pdf>

<sup>86</sup>[https://ec.europa.eu/research/evaluations/pdf/archive/fp7-evidence-base/national\\_impact\\_studies/evaluation\\_of\\_the\\_norwegian\\_participation\\_in\\_the\\_eu\\_6th\\_framework\\_programme\\_\(2003-2006\)\\_and\\_the\\_first\\_part\\_of\\_the\\_eu\\_7th\\_framework\\_programme\\_\(2007-2008\).pdf#view=fit&pagemode=none](https://ec.europa.eu/research/evaluations/pdf/archive/fp7-evidence-base/national_impact_studies/evaluation_of_the_norwegian_participation_in_the_eu_6th_framework_programme_(2003-2006)_and_the_first_part_of_the_eu_7th_framework_programme_(2007-2008).pdf#view=fit&pagemode=none)

<sup>87</sup><http://www.technopolis-group.com/?report=motives-participation-framework-programme>

## **II. Main findings and policy implications based on evidence aimed at assessing the impact of FP7 participation at national level. (see evidence in order of reference above)**

### **1. Impacts of the FP participation on Sweden**

The study suggests that the FPs have had some important impacts in Sweden and that some of the areas of limited impact result from a lack of strategic direction from the Swedish side. The FPs have had limited strategic impact because there are not many strategies to impact. This is a vicious circle: in the absence of national strategy, it is difficult to articulate how the FPs' strategies should change in order to serve the national interest. Partly as a result of this, the FPs' ambition to structure' research in Sweden has not been realised at all.

The FP resources have added a little scale but not changed the structure of the higher education and research sector – and certainly not helped address the long-standing problem of fragmentation. In principle the FP resources could be used to support restructuring, but only in the presence of national strategies.

It appears likely that the FPs have had a positive influence on research quality.

Where there are strong industrial lobbies or groupings, it has helped generate agreement about technical directions and influenced standards – and this has been very beneficial for major Swedish companies. It has more broadly supported industrial innovation in both small and large firms.

The analysis also points to circularities. Where there is a national strategy or an industry strategy, the FPs can be recruited to this cause. The openness of the FPs to strategic ideas means that where there are powerful lobby groups, their ideas are likely to be adopted, and the vehicles industry example shows that this can have very positive industrial effects.

While the FPs have tended (with varying degrees of success) to conserve existing strong industrial structures (vehicles) and even to build on success (telecommunications) they have had no visible industrial effects in the science-based life sciences and health industries. For example, they have not significantly been able to encourage the needed industrial risk-taking in sustainable energy

The study showed that the effect of the FPs in the universities is – with some modest exceptions – to magnify national efforts and strategies. In the absence of such strategies (formal or de facto), it is hard for the FPs to add value in their present form. European-level, redistributive instruments such as centres of excellence and competence centres would probably be needed in order to overcome such national constraints on the FPs' mission to restructure research within the ERA.

*From the Swedish perspective, the most urgent policy implications are:*

- An acute need to develop strategies for thematic and institutional concentration in the ERA
- A need to communicate about strategy and needs to the Commission and with the research and industrial communities
- A requirement to support increased Swedish participation in the Technology Platforms and other new structures such as the JTI's – not least because it is not clear that the FPs will continue in their present form
- A need to maintain a fully independent set of national strategies and programmes tuned to national needs but more deliberately to consider how to use the complementary resources available from the FPs. A slavish reproduction of the FP priorities is in the interests neither of Sweden nor of Europe
- A need to find policy mechanisms that can compensate or substitute for the Framework Programme's weakness as an instrument to tackle fragmented SME- and technology-based industries
- A need for new mechanisms that can go beyond R&D support to tackle some of the key innovation risks in radical technological change in areas like energy and climate change, where there is not necessarily time available to wait for a market solution to emerge but where risk-sharing between equipment supply and major users is a requirement for transition.

## **2. Impacts of the FP participation on Austria**

Researchers generally consider national programmes, such as the FFG General Programmes, FWF support or fiscal support, more relevant to their needs than European programmes. Of the European programmes collaborative FP projects were considered the most relevant. The newer FP instruments such as JTI's and ERA-NET's barely figure on the agendas of even the most experienced FP participants.

Researchers participate in the FP primarily to get research funding. The FP is very complex, with high administrative barriers and low success rates. However, if researchers want to obtain public funding for international research projects there are few alternatives. Further, the FP is by far the most important programme that funds international cooperative research.

Participants consider follow-up projects the most important result of FP projects, though these need not necessarily be FP projects or even be tied to a funding programme. They consider research outputs more important than innovation outputs. This is because the FP is a pre-competitive programme in which universities and research institutes are the major players.

The most important impact of the FP are new and improved relationships, R&D collaborations, and the building and maintaining of research partnerships. Other important impacts are enhanced reputation, increased scientific and technological capabilities and the capacity to conduct R&D.

Radical innovations are not an important impact of FP projects. In fact, most participants felt that the FP *could* not systematically produce radical innovations due to programme design and the selection procedure employed.

International research collaboration has become an everyday occurrence. The control group shows that a substantial amount of international R&D cooperation takes place outside international R&D programmes, mainly funded from own sources. However, the FP remains the most significant *public* funding source for this type of activity. Researchers participate because it suits the needs of themselves or their organisation – not for idealistic reasons. It is important to note that training of young researchers not only occurs in the human resources oriented measures (People Programme and ERC Starting Grant) but also in the „traditional“ cooperative FP projects.

Almost two thirds of Austrian FP users reported that the benefits of participation outweighed the costs. Interestingly, researchers from different types of organisations (universities, institutes, companies) gauged the costs and benefits in similar ways. This is also true for SMEs, suggesting that Austrian SMEs know how to position themselves in the FP.

*The analysis implies the need for three significant changes in strategic direction for Austrian research and innovation policy:*

- Rejecting the idea of FP participation as a goal in itself and therefore abandoning the goal of maximising participation
- Mainstreaming internationalisation in research and innovation policy and re-conceiving it as „globalisation“ rather than just „Europeanisation“
- Unlocking and adapting the internationalisation support apparatus to focus on promoting behavioural additionality: that is, learning how to understand and participate in new international activities, rather than subsidising the continued performance of activities that have (or should have) been learnt or that should be taken over by other actors.

### **3. Impacts of the FP participation on Denmark**

The main findings are that most of the outputs sought and produced through FP projects are research outputs (publications, conferences, trained personnel, etc.), and there is far less activity in relation to innovation outputs such as new products, patents, licenses and so on. This is to be expected given the pre-competitive nature of the research carried out within the FPs.

It is notable, however, that a significant proportion of participants do rate innovation outputs as important but the projects appear far more likely to deliver them at a level below expectations, while the research outputs are generally delivered in line with or above expectations. With regards to the benefits of participation, a comparison of the motives and goals of the participants with the benefits actually realised indicates that FP projects do tend to deliver the kinds of impacts that the participants are seeking.

The main positive benefits realised include new relationships and networks, increased understanding and knowledge, increased scientific and technological capabilities, and enhanced reputation and image. The vast majority of participants report medium-high impacts in each of these areas.

One of the major impacts of the FPs has been to increase the level of collaboration and networking between scientists and technologists at an EU-level, and based on our analyses we have estimated that during FP6 Danish participants were exposed to some 10,000 new partners, almost half of which are expected to endure in the future. This level of networking and partnership formation simply could not be achieved in the absence of FPs.

The study shows that more than two-thirds (68 per cent) of Danish FP6/7 participants have realised a positive benefit to cost ratio, with the remainder split between those who stated that the costs and benefits were evenly balanced, and those who stated that the costs of participation had outweighed the benefits.

Those reporting a *negative* benefit to cost ratio pointed to problems associated with the high levels of administration and bureaucracy involved the limited amount of funding received, difficulties in securing cofunding to support their participation, and failure to achieve the scientific objectives of the projects.

The study identified in relation to the execution of FP projects concerned the very high administrative and reporting burden that falls particularly on project coordinators.

There is, however, a potential issue with regard to the level of support available for SMEs during the projects. It is not clear that SMEs enjoy the same level of support as their university counterparts, and while the EuroCenter is very good at encouraging participation and helping to explain how the whole process works, it is not clear that it is able to provide the same level of support to SMEs as can be assigned by the universities to their own researchers. Danish industry participation rates are in line with the FP averages as a whole, but companies receive a far lower share of the funding than might be expected, given their level of participation.

The study recommends among others that efforts are made to develop a stronger mapping of Danish research strengths in both the public and private spheres, in order to (i) improve understanding of areas where Danish FP participation can be strengthened, (ii) improve partner-matching services, both within Denmark and across the EU, and (iii) improve promotion of Danish research capabilities.

#### **4. Impacts of the FP participation on the Czech Republic**

An international comparison shows that the CZ is consistently among the five member states with the lowest participation in FP7. The CZ's low rate of participation is partly caused by the fact that in the long term, Czech teams have been involved in preparations of significantly fewer project proposals (in international comparison) than what the size of the Czech population or the capacity of the Czech research and development system would suggest.

However, an important role is also played by the success rate of submitted proposals. The CZ's participatory success rate has reached 19.5%, which was lower than the success rate of the old member states (21%) but higher than that of the new member states (17.7%). The differences are even greater if we are to consider financial success rates. Analyses suggest that the CZ's financial success rate has been significantly degraded by teams that worked as project coordinators.

Czech teams cooperated with more than 14 000 foreign teams during FP7. This means that FP7 provided Czech institutions with an unprecedented opportunity to develop international cooperation in research and development. Almost 700 Czech teams have been given a chance to collaborate with teams from the most important European scientific and research institutions on FP7 projects. The report provides evidence that Czech teams have made more use of this opportunity than teams from the other new member states.

The most common participants in FP7 are teams from universities. However, in the case of the CZ, participants from private enterprises and organisations are almost as numerous as Czech university teams, and the private teams expend significantly greater amounts for their participation than do the university teams.

FP7 enabled Czech teams to cooperate with the most important European research institutions. The ten institutions that received the highest amount of contributions from the FP budget, aka TOP10, are undoubtedly among the most prestigious European R&D institutions. Cooperation with the TOP10 significantly increases participatory success rates of all EU-28 states.

## **5. Impacts of the FP participation on the UK**

### *Impacts on research*

The FP has had a big impact on the nature and extent of UK researchers' international relationships and networks, as well as on their knowledge base and scientific capabilities. Other notable outcomes include increased scientific reputation, an improved ability to attract and retain worldclass researchers and a positive impact on researcher careers. Lastly, FP has had a positive impact on the attitudes, outlook and connectedness of individual researchers, as well as serving as a training ground for project management and administration.

### *Impacts on business*

The FP has yielded important commercial benefits. UK business participants had made or gained access to new or significantly improved tools or methodologies and other forms of intellectual property. Participation had contributed to the development of new products and processes and increased income and market share.

Framework would appear to have been of especial importance to UK intermediaries, private laboratories and technology consultancies. One might reasonably expect these 'knowledge carriers' to be sharing the benefits of FP-derived know how and methods with their clients. Lastly, company interviews suggested that FP participation had made a significant contribution to the competitiveness of leading players in several niche technology markets, from inkjets to photonics.

### *Impacts on policy*

There is scant evidence of specific impacts on UK policy, however UK government departments and agencies have benefited from the FP in various ways, but in particular from:

- Stronger relationships with their counterparts around Europe
- An increase in the volume of research funded in some areas of policy interest
- An increase in awareness regarding overseas colleagues' priorities
- An ability to more readily address questions one might struggle to progress nationally

### *Impacts on international relationships*

The FP has had a large, positive impact on UK researchers ability to work successfully with universities or businesses outside the UK, however knowledge exchange might not be as strong as the statistics suggest, with a tendency for work to be conducted in a somewhat fragmented fashion as largely discrete, smaller projects.

### *Impacts and instruments*

The study was unable to establish a line between particular FP instruments and the scale of their respective impacts. Participants and stakeholders did express strong preferences for particular instruments, although this tended to reflect 'fitness for purpose' and administrative efficiency to a much greater extent than the fruitfulness of the instrument in question. On balance, it seems that UK stakeholders – officials and participants alike – value two things above all else from amongst the FP's portfolio of instruments: they like the scale and scope of the work that can be supported through the FP; and they like the growing number of bottom-up instruments.

### *Opportunities for change*

The biggest challenge would seem to relate to the issue of widening participation outside the areas where UK universities and research institutes have been so successful: life sciences, ERC, Marie Curie, Research Infrastructure. This relates to business engagement in particular, with whole swathes of businesses seemingly unaware of or indifferent to FP. Moreover, comparing participation data with income statistics suggests UK businesses have been playing secondary or otherwise less intensive roles than their counterparts elsewhere in Europe.

## **6. Impacts of the FP participation on Slovenia**

Based on availability of data, the following factors, which might affect performance in FP were considered: number of inhabitants, scientific, technological excellence and innovation of a member state, investments in RD and time of accession to EU. It is evident that the year of accession to EU ("learning effect") has no effect on FP indicators. However, the R&D expenditure, which highly correlates with RDI excellence, as well as the population in member state account for 92% of differences between Member states in their financial contributions per retained project.

### *Recommendations:*

Firstly, performance of member states in FP is strongly related to the investment in RD in a country. In order to improve their participation, the countries therefore need to invest more.



Secondly, population of a country matters. In case of big countries this is likely due to the existence of internal networks of actors, which collaborate on national scale, and continue with the partnerships on EU scale. In fact, a recent survey in ICT area demonstrated that the coordinators choose their research team in 49% from previous collaborations and 27% on the suggestion of other consortium members.

This means that for a collaborative research, networking and cooperation skills may be as important as research expertise, which represents a barrier for newcomers from smaller countries who are not well connected to European networks. Of course, little can be done to increase the size of population of a country in order to offer more possibilities for networking on a national level, but it can virtually grow in size by opening its programmes to collaborations across borders and thus contribute to stronger integration of its research community in ERA. Lastly, measures can be established in Member States, which will stimulate researchers to take leading roles in projects. With this, their visibility, impact as well as financial participation is likely to increase.

### **7. Impacts of the FP participation on Switzerland**

The positive net financial return or financial return coefficient is thanks to the very competitive nature of the Swiss research community. This community boasts internationally top-level players in many disciplines, who are above average in successfully attracting framework programme funding.

The framework programmes are an important source of funding for research and development (R & D) activities in Switzerland. Overall, participants in FP projects stated that 62% of these projects would most certainly not have been realised without FP funding. Participation in the FPs has a positive impact on the economy and creates jobs.

Currently available data suggest that each time a Swiss company or institution participates in a framework programme project, this leads to the creation of two jobs on average, although these are temporary in two out of three cases. Jobs are also created indirectly when start-up companies are generated as the result of participation in an FP project. There is also an economic benefit from project participation when this leads to new patents and other forms of intellectual property (e.g. copyright, trademark registration etc.) and frequently as a result of commercialisation. Furthermore, in many cases companies were able to increase turnover as a result of participating in an FP project.

The study shows that participation in FPs has an impact on knowledge and skills production. FPs provides access to international R&D and the FPs complement national research funding.

## **8. Impacts of the FP participation on Norway**

### *Project impacts.*

The FP6 participants report extensive impact of their projects on their R&D capabilities and activities, and significant long-term effects are found. The EU projects explore new research areas of significant importance for the participants' future research/innovation activities. A substantial proportion of the projects have had positive effects on research and innovation capabilities, and long-term cooperation links. The FP6 participants' research activities are becoming more collaborative, international and organised in larger projects. Moreover, Norwegian researchers participate in more European collaboration also outside the FPs. In other words, the behavioural additionality of participation in the Framework Programme is high.

### *Limited synergies with national priorities.*

The data suggest a potential for increasing the alignment of national research with participation in the Framework Programme, in particular within the thematic priorities of Health and ICT, and also Ideas and People. There are indications of substantial synergies and integration of Norwegian research with the Framework Programme: a high number of Norwegian researchers are involved in the Framework Programmes (the FP6 survey alone, accounting for 42 per cent of the Norwegian participations, report 2499 involved researchers). About 18 per cent are PhD students indicating potential for long-term synergies and integration. Moreover, 72 per cent of FP7 applicants report that the project was an integrated part of their organisation's internationalisation strategy.

### *National policy measures.*

Norway's participation in EU research involves a number of organisations and measures. For the Norwegian research community, two issues are critical for their participation and for this reason need to be improved: better advice on how to combine national R&D funding with FP activities, and more assistance with financial rules and regulations, audits and financial reporting.

### *Recommendations:*

- Internationalisation as a comprehensive national research strategy
- Ease the administrative and economic burdens
- Ensure increased participation of the large enterprises
- Improving conditions and participation of SMEs – improve dissemination of results
- Transferring the skills of successful participation and experts

## 22. COST (CO-OPERATION IN SCIENCE AND TECHNOLOGY)

COST is an intergovernmental framework that funds the networking of nationally funded research in an intergovernmental structure since 1971. The Commission finances the networking and the operations of the secretariat (COST office) but not the underlying research itself. In FP7 a grant totalling 250 Million € was allocated to the European Science Foundation (ESF) as the host organisation for the Framework. Evidence for the impact and effectiveness of the Framework has been provided by the final report submitted by ESF (1) FP7 final review (2) and an impact assessment commissioned by ESF to the Technopolis Group (3).

According to the impact assessment (3) COST was effective on networks and network building, capacity building, structuring and agenda setting and had an overall impact on wider economy and society. The impact on networking is to some extent expressed by the sustainability of the actions leading to follow-up funding. E.g. 473 successful follow-up projects in the Framework Programme were initiated and COST participants attracted 22 ERC and 35 ERA-NET grants. In addition COST participants were successful in other instruments such as Lifelong Learning Programme, Life Programme, the Structural Funds, Artemis, Clean Sky or IMI. Successful capacity building in FP7 e.g. was achieved by 8981 participations in training schools and 5069 short term scientific mission whereby approximately 50% of the participants were Early Stage Researchers (ESR). The impact on structuring and agenda setting at an international level was assessed by a survey where the most frequent answer (36%) stated a moderate impact. At the level of individual actions more favourable answers were given in terms of enabling more effective collaboration and faster, dissemination and the provision of a platform for coordination of scientific work. Impacts on wider economy and society could be identified in case studies e.g. by addressing climate change, cultural heritage and contributions to standardisation.

The FP7 final review (2) highlights the added value of COST for scientific networking and acknowledges the contribution of COST for the career development of early stage researchers (45 % participation) and scientists from new member states. They state a considerable leverage effect of the COST networks attracting on average per year 650 million € of national funding. In addition, COST managed to extend the range far beyond its 35 member states by collaborating with 17 Near Neighbourhood Countries around Europe and further 27 global partner countries. Interviews with stakeholders revealed a high level of satisfaction. However, some room for improvement for governance and management is stated while acknowledging the progress already made by the deployment of new electronic workflow management and the envisaged reform of the Committees and the evaluation system.

The ESF final report for the FP7 grant (1) highlights the achievements in terms of scientific networking (370 actions carried out), inclusiveness policy, internationalisation and dissemination (more than 300 publications funded). A high demand from the scientific community is expressed by the submission of more than 8000 proposals at stage 1.

In conclusion the intergovernmental framework had a significant impact on overcoming the fragmentation of nationally funded research activities, promoted transdisciplinary

research strands, built capacities for researcher careers and expanded the range of the European science community globally.

### 23. EX-POST EVALUATION OF FP 7 USING THE NEMESIS MODEL

A first attempt of retroactive or ex post evaluation of FP 7 was carried out using the NEMESIS model which was used for the "ex-ante" impact assessment. For this assessment, actual figures were used in the simulations, reflecting funding allocation and responses.

#### The actual data of the 7th FPRD

Data provided by the DG-RTD consisted of FP7 funding by starting date, country, type of institution, EC contribution and total R&D expenditures. It was assumed an average duration of 3 years for each project, and an allocation of 50 % the first year and 25 % the next two.

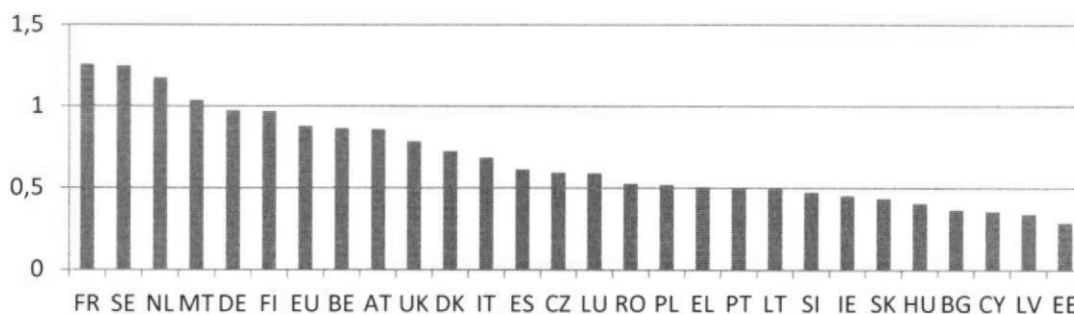
These assumptions are quite different from the ones used in the ex-ante evaluation.

#### The actual amount of financing over the period 2007-2016

The total EC contribution used in the simulation was EUR 40.8 billion<sup>88</sup> over the period 2007-2016, for a total amount of R&D of 58.2 billion. This amount was lower than the one used in the ex-ante evaluation.

The annual EC contribution by country was estimated taking into account the assumptions about average duration of the projects and the real yearly allocation of funding (Figure 1).

Figure 1 Distribution of amounts financed and total per year (EUR million)<sup>2</sup>

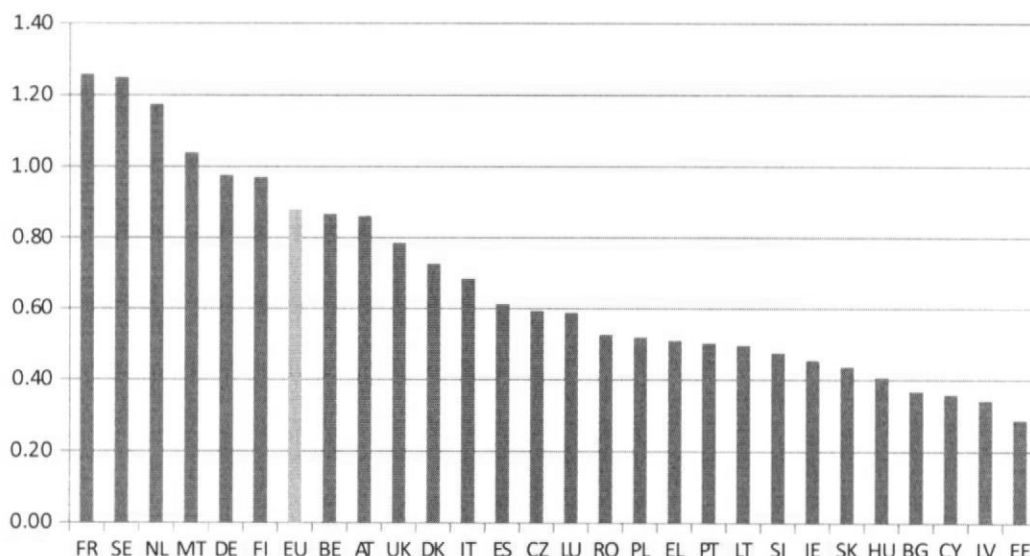


<sup>88</sup> This amount does not include the expenditures by ERC.

### The breakdown of public/private finance

In the ex-ante evaluation, the hypothesis was that the private sector would receive 60 % of the EC funding, whilst the public sector would receive 40 % of it. However, in the actual situation it seems that the ratio is closer to 25 % for the private sector and 75 % for the public on average, albeit with significant differences between Member States (see Figure 2). This difference between the assumptions and the actual situation is important and will in particular affect the average leverage.

**Figure 2:3 Share of private companies in the financing fp7 between Member States**



### EC contribution allocation between Member States

In the ex-ante assessment, two different kind of EC funding allocations were used. The first one consisted on a proportional allocation according to their R&D expenditure, called "grand-fathering". The second one was based on performance using the Innovation scores. In the ex-post simulation, the actual allocation was used. It varies quite significantly from the ones used in the ex-ante simulation (see Table 1).

**Table 1 Distribution of funding by Member State (% of total)1**

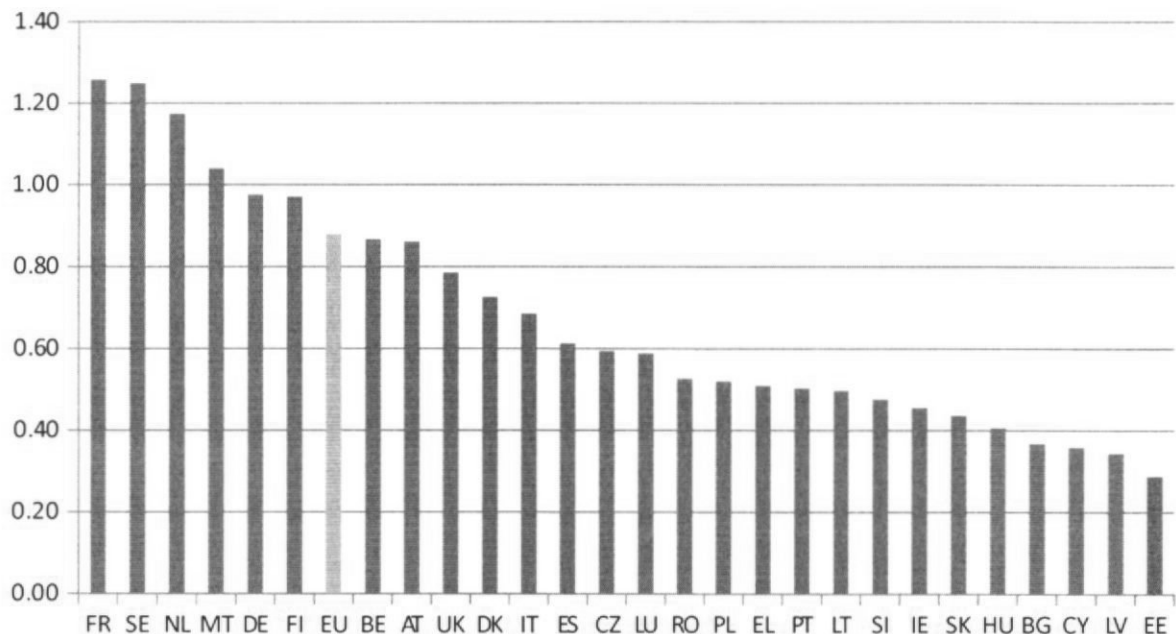
Country	FP 7	Grandfathering	Performance
DE	17.63 %	29.56 %	25.71 %
UK	17.24 %	12.09 %	15.55 %
FR	12.86 %	17.39 %	15.64 %
It	8.94 %	7.45 %	9.65 %
NL	8.31 %	4.70 %	5.01 %
ES	8.14 %	4.80 %	6.14 %
BE	4.78 %	3.32 %	3.18 %
SE	4.36 %	5.31 %	3.84 %
At	2.92 %	3.35 %	2.46 %
DK	2.66 %	2.85 %	2.54 %
GR	2.49 %	0.54 %	1.24 %
FI	2.17 %	2.46 %	1.84 %
IE	1.55 %	1.00 %	1.33 %
PT	1.29 %	0.86 %	1.11 %
PL	1.09 %	1.27 %	1.46 %
HU	0.72 %	0.52 %	0.48 %
CZ	0.71 %	1.11 %	0.89 %
If	0.42 %	0.34 %	0.26 %
RO	0.35 %	0.21 %	0.43 %
BG	0.24 %	0.10 %	0.12 %
EE	0.24 %	0.12 %	0.10 %
CY	0.23 %	0.03 %	0.13 %
SK	0.19 %	0.23 %	0.26 %
LU	0.15 %	0.19 %	0.34 %
LT	0.13 %	0.12 %	0.09 %
LV	0.12 %	0.05 %	0.05 %
MT	0.05 %	0.02 %	0.03 %

The EC contribution by thematic priorities does not correspond to the 30 economic sectors used in NEMESIS. Therefore, the allocation across sectors was done using the grandfathering method (R&D intensity in each sector) in the ex-post simulation.

### Leverage

In the ex-ante assessment, the leverage effects (additional direct and indirect expenditure per EUR 1 million funding) selected were 0.3 for the public and 1.1 for the private sector. The analysis of the direct contribution (co-funding) by the stakeholders in FP7 shows an average leverage effect of 0.85 for the private sector and 0.28 for the public sector, with differences in time and space. As a result, the average leverage effect for Europe and over the whole period is 0.42 instead of 0.74 as used in the ex-ante assessment.

**Figure 3 Average leverage effect on private by Member State<sup>4</sup>**



### The results

The differences between the initial assumptions and the actual data led to a significant change of the results of the simulation. First, the total R&D expenditure considered in the simulation is estimated to be 58.2 billion euros, below the one originally simulated. Second, the higher contribution to the public sector modifies the spill-overs in the economy and in particular delay the maturity of research results reaching the real economy. Third the allocation of EU contribution between the Member States is significantly different than the one previously used. Fourth, no additional EU R&I spending is simulated after the end of FP7, in order to isolate its impacts.



It is estimated that the impacts of FP7 will take place during and after the conclusion of the projects, therefore the simulation considers the period 2007-2030 (24 years). On this period:

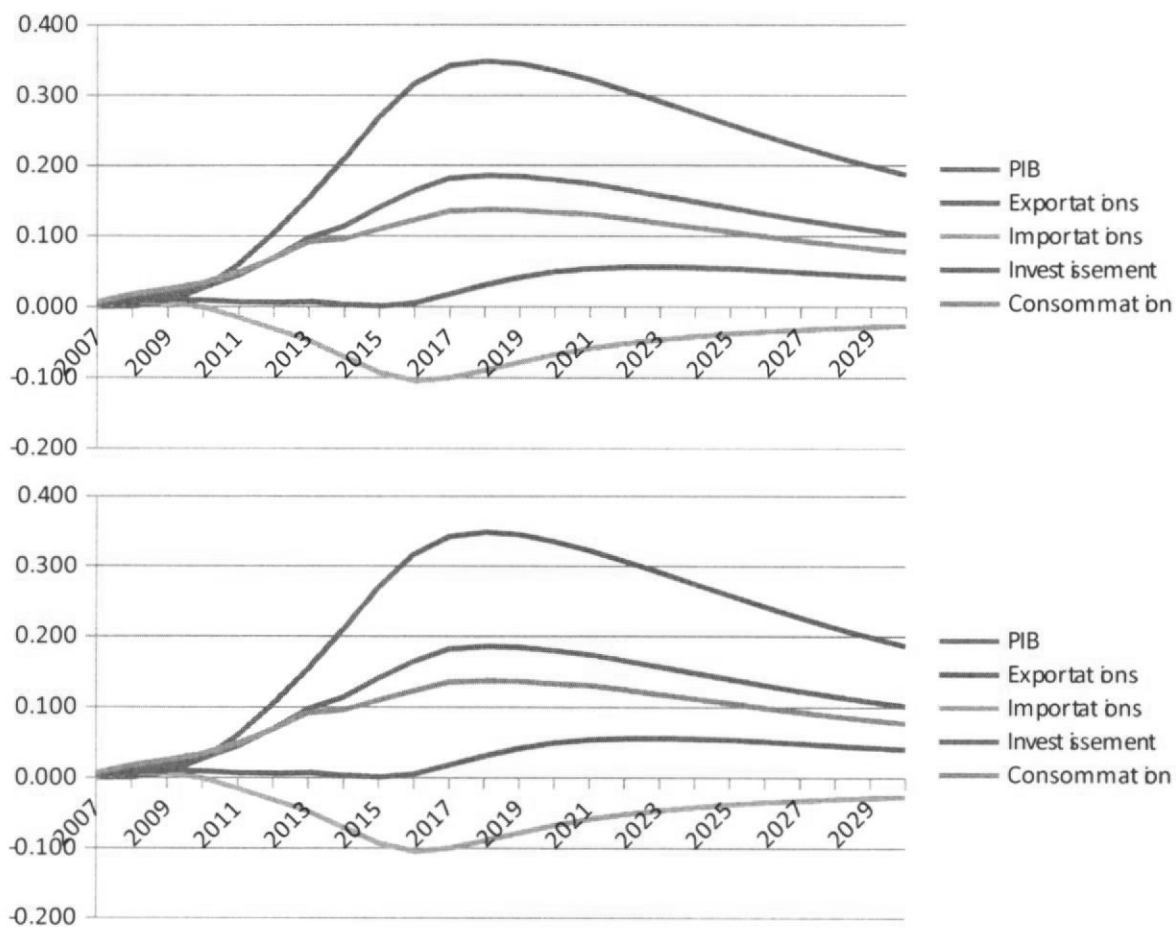
- FP 7 will cumulatively generate a total of additional 398 billion of GDP over the whole period, i.e. 16.6 billion per year, an additional 0.12 % GDP growth.
- FP 7 will create 950,000 Full Time Equivalents in research, and a total employment of 2.9 million Full Time Equivalents, equivalent to an average increase of 121,000 jobs/year

The original results obtained in the ex-ante Impact Assessment with the NEMESIS model for the same period were the EUR 560 bn of additional GDP and 4 million jobs. The difference is mainly explained by the reduced financing of the initial shock. A detailed analysis of the results also shows a lower multiplier of GDP in the first 15 years of the simulation, but growing faster at the end of the period, due to the more fundamental nature of the research carried out by public partners, which requires longer maturation periods to be economically efficient but also creates more externalities.

## **Annex 1**

The comparisons of the cumulative multipliers between FP7 ex-ante and ex-post shows:

- The multiplier of GDP in the ex-ante evaluations is on average 6.3 to 15 years between 2012 (median of the temporal dimension of FP 7, and 2027.
- In the ex-post evaluation, the multiplier is 6.03, below, for the reasons indicated above. However, in 2027 the aggregate multiplier tends to increase more quickly than what was observed in the ex-ante simulation, probably because of the long-term impact of public innovation



Top Graph: Results of the ex-ante simulation. Bottom Graph: results of the ex-post simulation

## **Annex 2: NEMESIS**

### **General characteristics of NEMESIS**

Nemesis is a system of sectoral detailed models for every EU-28 countries, and less detailed models for the rest of the world.

NEMESIS distinguished 30 production sectors and decomposes households' final consumption into 28 different consumption sub-functions. The public sector is very detailed, and the model can give a precise description of the evolution of the public accounts, as the debt to GDP and deficit to GDP ratios.

The core of the economic mechanisms results from the choices of representative private agents, that have imperfect expectations of the evolution of prices, incomes and demand, to make decisions on investment and consumption, and from public decisions, that influence trade-offs of private actors through taxation, public investment and expenditures, and of welfare payments.

The particularity of NEMESIS, compared to the other large scale simulation models for Europe, is that it is not a general equilibrium model, and all the behavioural equations of NEMESIS include econometrically estimated coefficients. Nemesis is therefore well adapted for the description of short to medium terms dynamics, and for the analysis of the impacts of structural policies, such as R &D and innovation policies. Nemesis, that is principally governed in short term by its demand side, has a long term trajectory never properties coming from the new theories of growth.

### **Endogenous technical change in NEMESIS**

The endogenisation of technical progress in nemesis is derived from by the new growth theories where innovations result from the investment in R &D by private firms. For a country, at a sectoral level, three main phenomena are involved in the assessment of R &D policies:

- I. The R &D decision that increases the R &D stock of the sector;
- II. The knowledge externalities, which following the accumulation of R &D stocks, flow towards other sectors', and, what is important for European policies, towards other countries;
- III. The economic performance resulting from all these spillovers and R &D expenditures, that, in NEMESIS, come from the innovations provoked by the variation of the knowledge variable at the sectoral level.

The innovations that appear in each sector are process and product innovations. This distinction between process and product innovation is crucial as the econometric studies show that process innovations alone have a negative, or only a slight positive impact, on economic performance and employment, whereas the impact of product innovations is always positive. Therefore, in NEMESIS, innovations enhance competitiveness, by price and quality improvement. They impact simultaneously on internal demand, notably on final consumption, in reason of an increased price to quality ratio, and of course on external demand by increased competitiveness. All these sectoral evolutions

are articulated by the input-output tables of the model, and by the knowledge spillovers matrices. The result of sectoral interdependencies impulse a movement that is partially 'bottom-up'.

The pure macroeconomic feedbacks pass by the decrease in unemployment that enhances wages, consumption, and, at the end, the prices that will lower the competitiveness gains. These pure macroeconomic feedbacks are combined with the preceding bottom-up dynamic, to give a macroeconomic track of which characteristics are 'hybrid', combining macro and bottom-up forces.

Objectives and activities mentioned in Decision concerning the Seventh Framework Programme

Objectives and activities mentioned in DECISION No 1982/2006/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 December 2006 concerning the Seventh Framework Programme of the European Community for research, technological development and demonstration activities (2007-2013)

Objectives and activities

1. The Seventh Framework Programme shall support the activities set out in points (i) to (iv). The objectives and the broad lines of those activities are set out in Annex I.

(i) Cooperation: supporting the whole range of research actions carried out in transnational cooperation in the following thematic areas:

(a) Health;

(b) Food, Agriculture and Fisheries, and Biotechnology;

(c) Information and Communication Technologies;

(d) Nano-sciences, Nano-technologies, Materials and New Production Technologies;

(e) Energy;

(f) Environment (including Climate Change);

(g) Transport (including Aeronautics);

(h) Socio-economic Sciences and Humanities;

(i) Space;

(j) Security.

(ii) Ideas: supporting 'investigator-driven' research carried out across all fields by individual national or transnational teams in competition at the European level.

(iii) People: strengthening, quantitatively and qualitatively, the human potential in research and technological development in Europe, as well as encouraging mobility.

(iv) Capacities: supporting key aspects of European research and innovation capacities such as research infrastructures; regional research driven clusters; the development of a full research potential in the Community's convergence and outermost regions; research for the benefit of small and medium-sized enterprises ('SMEs') (11); 'Science in Society' issues; support to coherent development of policies; horizontal activities of international cooperation.

2. The Seventh Framework Programme shall also support the non-nuclear direct scientific and technical actions carried out by the Joint Research Centre ('JRC') as defined in Annex I.

## 24. FP7 PUBLICATION DATA

### 24.1. Basic information

OpenAIRE has identified **171,258** publications linked to **12,680** FP7 projects<sup>89</sup>. Note that each publication can be attributed to more than one programme, which is why the total publication per programme is higher, than the total number of publications.

	Publication pr. programme
- Cooperation:	81,993 publications (47.83% of total); 37,948 Open Access
- Ideas:	63,417 publications (36.99% of total); 38,577 Open Access
- People:	21,867 publications (12.76% of total); 14,769 Open Access
- Capacities:	11,598 publications (6.75% of total); 7,260 Open Access
- Euratom:	631 publications (0.37% of total); 198 Open Access

### 24.2. How did we identify them?

- Through our extensive network of National Open Access Desks in 33 European countries that advocate for Green OA so researchers deposit print/post print publications in institutional or thematic repositories, and for Gold OA so that they use FP7 funds to publish in OA journals. Fully OpenAIRE compliant repositories automatically identify and report these publications.
- Integration of EC's reporting databases (SESAM) into OpenAIRE data, after this is cross checked with existing OpenAIRE data and CrossRef.
- Claims on the portal from researchers or project coordinators: 5,254 publications claimed by 323 users over a period of 2+ years.
- Text mining for FP7 grants in the full text of publications which mostly come from thematic repositories (arXiv, PMC Europe), IRs with which OpenAIRE has bilateral agreements (CNR-PUMA, Fraunhofer, etc.), and one scholarly society (ACM).

### 24.3. Where did this data come from?

OpenAIRE retrieves its data from a variety of data sources: institutional and thematic repositories, OA journals, EC databases from project reporting, claims by researchers or project coordinators on the OpenAIRE portal, and various publishers databases. Some of this metadata is ingested into the system in a periodic manner (e.g., harvesting) and some in a once-off manner (e.g., delivery of EC databases). Once we retrieve the metadata we apply an intensive and continuous cycle of cleaning, enriching, de-duplication and re-cleaning processes in order to increase the quality that leads to meaningful statistics.

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<sup>89</sup> OpenAIRE report DEC 2015

Table 8. Publications from OpenAIRE data sources.

Data source type	Total publications	OA publications
Publication Repository	140798	64317
Publication Catalogue	89947	55868
Information Space	65512	40475
Thematic Publication Repository	55936	35842
Institutional Publication Repository	40971	29865
Journal Platform	9060	8988
Aggregator/Publisher of Journals	8473	8473
Other Source	2615	1322
Aggregator of Publication Repositories	1276	956
Data Repository	388	195
Scholarly Communication Infrastructure	129	124
Entity Registry	53	46
Aggregator of Data Repositories	5	5

We have noticed a clear upward trend in institutional and thematic repository deposition. **Fehler! Verweisquelle konnte nicht gefunden werden.** shows the figures for institutional repositories with data recorded from the past two years of OpenAIRE operation, while **Fehler! Verweisquelle konnte nicht gefunden werden.1** shows the most “active” repositories.

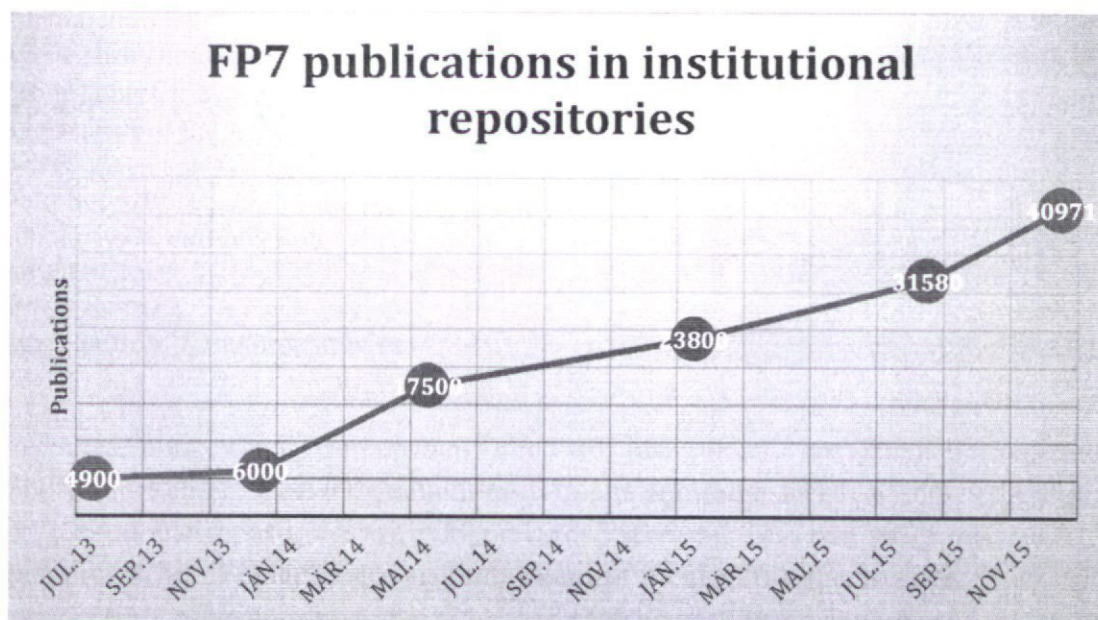


Figure 5. FP7 publications in institutional repositories over time.

#### 24.4. What type of publications?

The typology in Table 9 is based on the OpenAIRE guidelines vocabulary<sup>90</sup>. A new vocabulary for publication/resource types is under discussion under the umbrella of COAR<sup>91</sup>.

Table 9. FP7 publications by type

Type	Publications
Article	151751
Conference object	7024
Unknown	3315
Review	2843
Part of book or chapter of book	1608
Report	1290
Research	976
Preprint	975
Other	437
Doctoral thesis	413
Book	343
Master thesis	122
Software	39
Contribution for newspaper or weekly magazine	34
Lecture	33
Dataset	22
External research report	15
Data Paper	11
Bachelor thesis	3
Annotation	1
Patent	1

<sup>90</sup> [https://guidelines.openaire.eu/en/latest/literature/field\\_publicationtype.html](https://guidelines.openaire.eu/en/latest/literature/field_publicationtype.html)

<sup>91</sup> <http://purl.org/coar/igcv/deliverables>



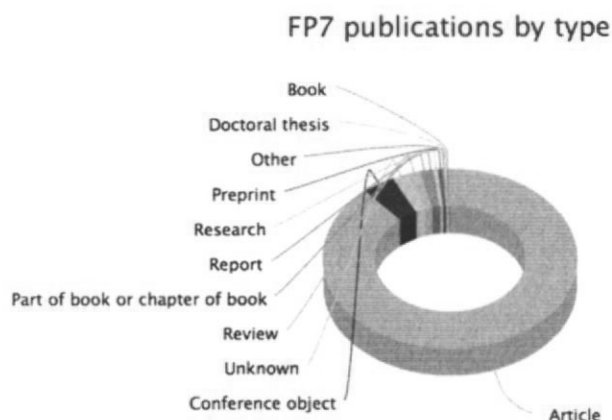


Figure 2. FP7 publications by type.

#### 24.5. Overall observations and statistics

171,258 FP7 publications have 126,159 a DOI and 112,416<sup>92</sup> have links to the Scimago (<http://www.scimagojr.com>) database. Even though these numbers can be further increased and refined via queries to CrossRef, we need to pay special attention and do further processing (disambiguation, de-duplication) as CrossRef's generic APIs does not allow for specialized/advanced queries.

**Fehler! Verweisquelle konnte nicht gefunden werden.** and **Fehler! Verweisquelle konnte nicht gefunden werden.** show the FP7 publications over the years. 16,282 publications do not have a valid publication date.

Table 10. FP7 publication timeline

Year	Publications
2007	164
2008	1,130
2009	5,319
2010	12,400
2011	21,438
2012	32,237
2013	42,019
2014	32,797
2015	7,254
N/A	16,500
<b>Total</b>	<b>171,258</b>

<sup>92</sup> There are some cases that even if a DOI is not present, the journal is known.

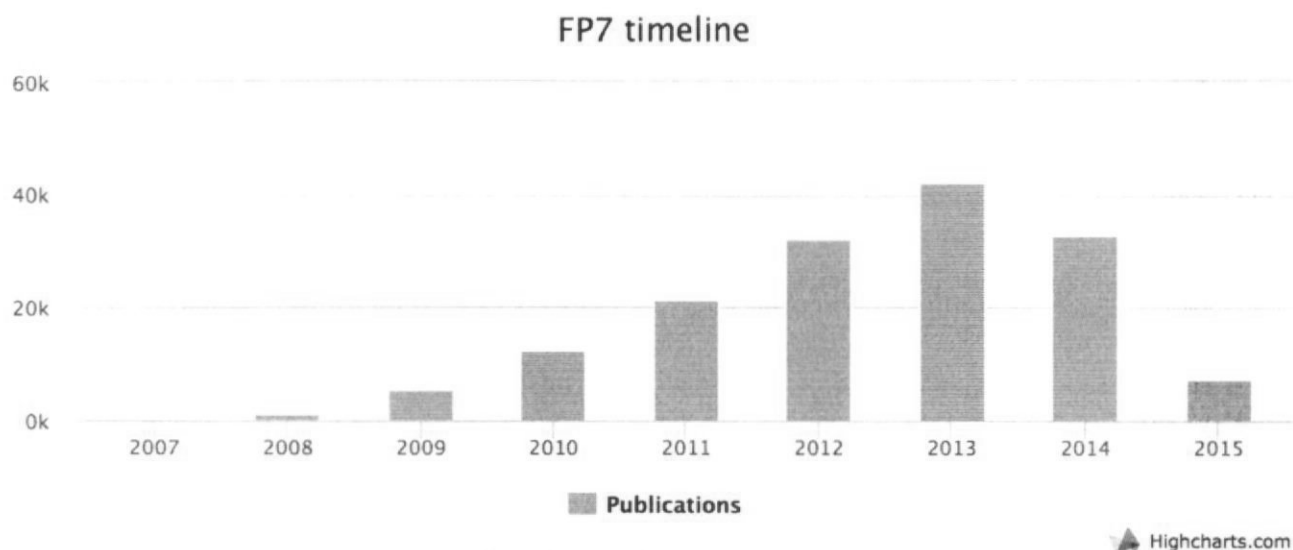


Figure 3. FP7 timeline diagram.

#### 24.5.1. Publications during-after the lifetime of projects

Most publications were published within the project lifetime (136,872), but an overall 13,74% (21,810 publications) were published after the project ended (published from 4,759 projects out of 11,571 completed projects).

The average number of publications per project within the project lifetime is 11,8 publications per project, while the average number of publications per project after the project ends is 1,88+ publications per project.

Table 4. Post grant publication rate.

Year after end of project	Publications	% from total post grant publications
+1	12,881	69%
+2	4,243	23%
+3	1,145	6%
+4	272	1%
+5	45	0%
+6	4	0%
<b>Total</b>	<b>18,590</b>	

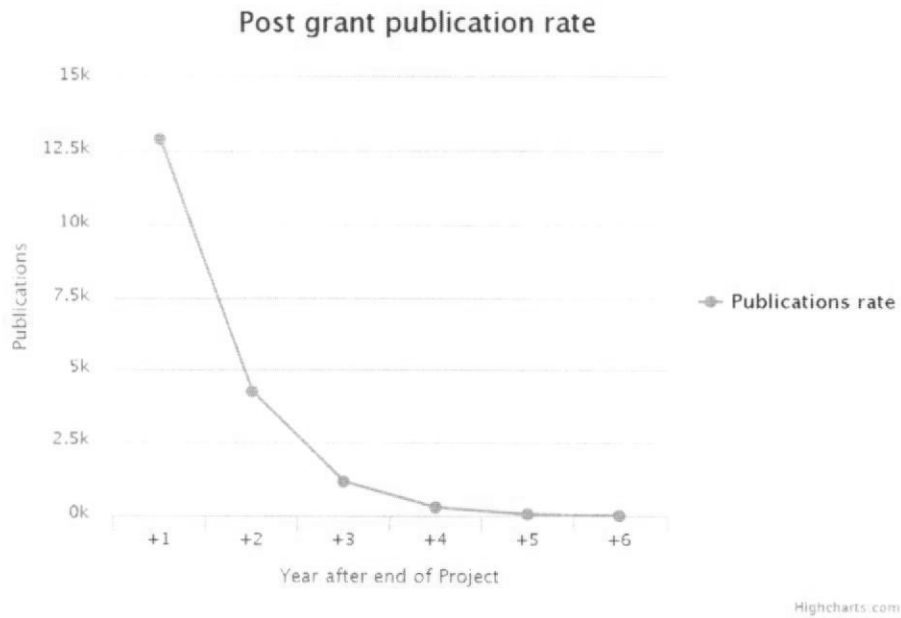


Figure 4. Schematic view of post grant publication rate.

#### 24.6. Open Access Evaluation

From the total of 171,258 FP7 publications 92,826 are OA, 3,216 are restricted (i.e., OA but with a more restrictive license or restricted to specific groups), while 315 are still in embargo. This translates to a 54,2% success rate.

FP7 with SC39 clause (OA pilot) - 1,907 projects – 1,533 (80,3%) of them have ended. 21,535 publications from 1,203 projects - 12,740 are OA which is about 59% success rate.

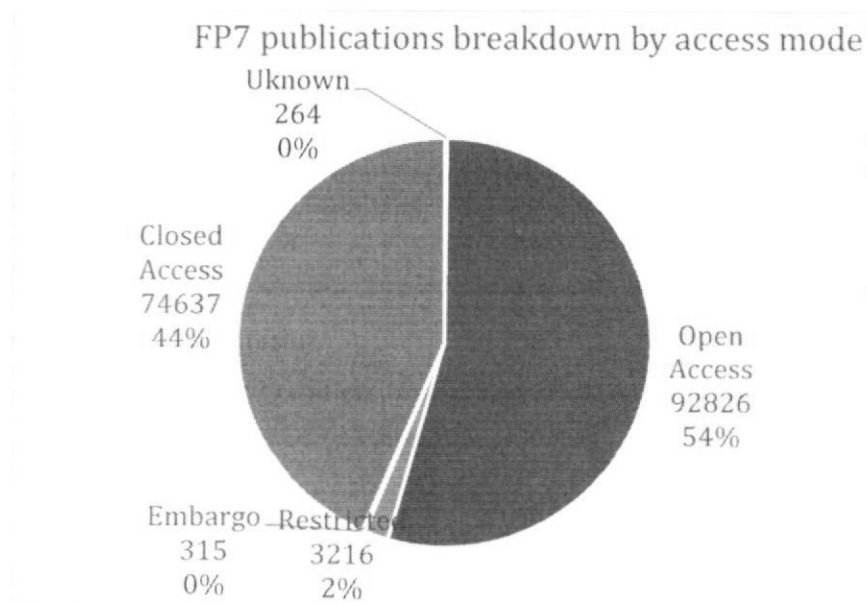


Figure 5. Overall FP7 OA evaluation

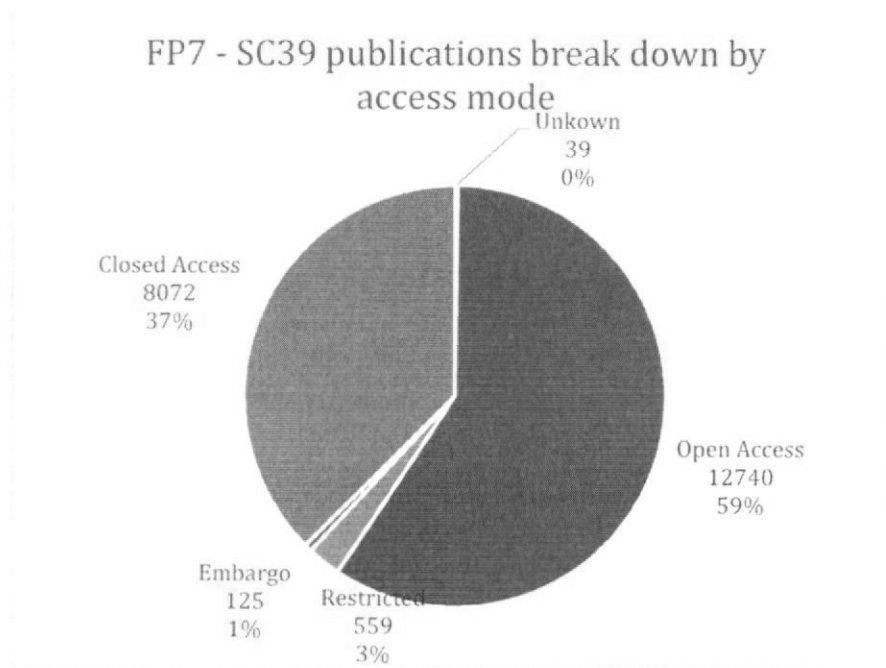


Figure 5. FP7 OA pilot (SC39) evaluation.

**Fehler! Verweisquelle konnte nicht gefunden werden.**5 shows the breakdown of FP7 publications from 2007-2015 broken down by their access state. The overall data is somewhat biased to closed access as a) we cannot easily define OA articles in hybrid journals, and b) there is still a large number of not fully OpenAIRE compliant repositories (i.e., no funding information attached to the publication metadata) so FP7 publications may have been deposited but not yet identified.

Table 5. FP7 publications 2007-2015 by access status

Year	Open Access	Closed Access	Embarg	Restricted	Total	OA success rate
2007	142	14	0	8	164	87%
2008	783	295	0	52	1,130	69%
2009	3,179	1,992	1	147	5,319	60%
2010	7,039	5,063	3	291	12,400	57%
2011	11,385	9,534	14	502	21,438	53%
2012	17,271	14,345	37	567	32,237	54%
2013	23,035	18,245	49	673	42,019	55%
2014	21,911	10,276	106	478	32,797	67%
2015	5,871	952	102	239	7,319	80%
<b>Total</b>	<b>90,616</b>	<b>60,716</b>	<b>312</b>	<b>2,957</b>	<b>154,823</b>	<b>59%</b>

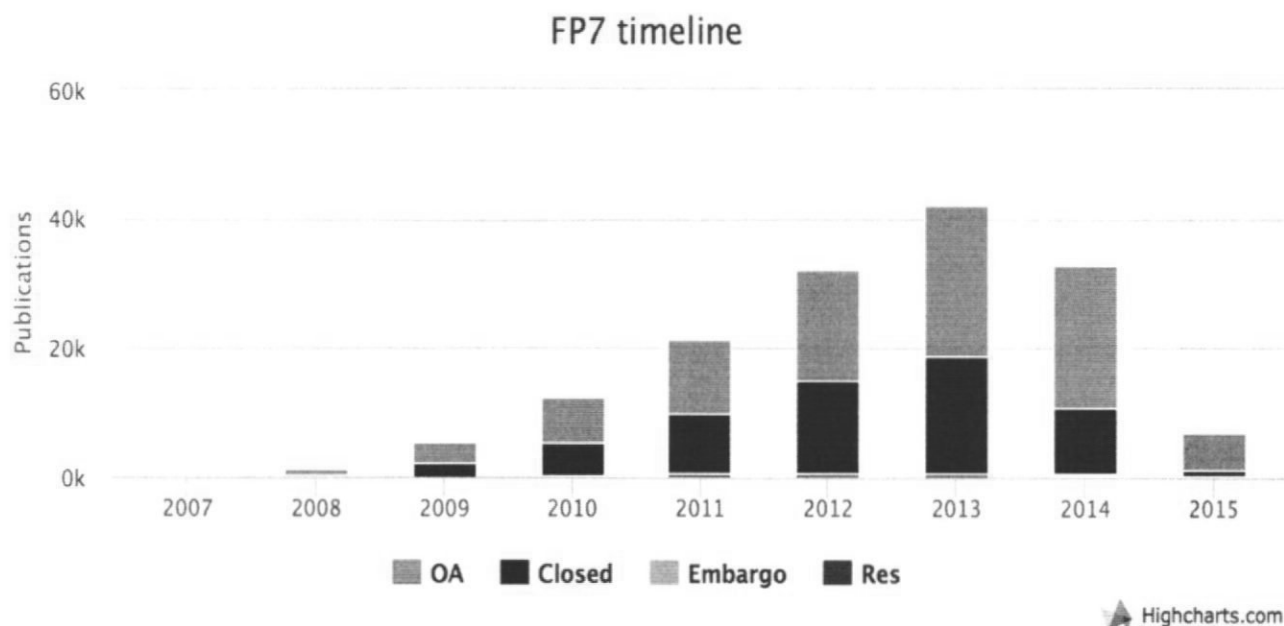


Figure 66. FP7 timeline, including OA status.

## Advanced statistics

### 24.6.1. Impact

After we cross-matched the OpenAIRE data to Scimago's latest web files, we were able to come up with the data in **Fehler! Verweisquelle konnte nicht gefunden werden.** "High impact" journals are statistically computed for each thematic area by retrieving journals with the top 25% higher citation factors.

Table 6. Impact of FP7 articles from Scimago citation factors.

Funding Area	Articles in 'peer-reviewed journals'	Articles in 'peer-reviewed high impact journal'	High impact success rate	OA articles in 'peer-reviewed journals'	OA articles in 'peer-reviewed high impact journal'	Overall OA success rate
ENERGY	1,505	1,050	70%	477	309	32%
ENV	5,794	4,213	73%	2,638	1,984	46%
ERC	39,788	26,858	68%	27,077	17,857	68%
Fission	507	222	44%	128	62	25%
Fusion	7	2	29%	3	2	43%
GA	258	94	36%	97	41	38%
HEALTH	18,601	15,579	84%	10,277	8,785	55%
ICT	14,347	6,988	49%	6,732	3,279	47%
INCO	74	24	32%	21	10	28%

INFRA	6,025	3,052	51%	3,723	1,791	62%
KBBE	5,209	3,812	73%	2,524	2,003	48%
NMP	5,436	3,839	71%	1,577	1,026	29%
PEOPLE	17,136	10,463	61%	11,171	6,302	65%
REGIONS	14	7	50%	9	6	64%
REGPOT	1,488	864	58%	748	450	50%
SEC	371	217	58%	112	66	30%
SME	423	263	62%	138	86	33%
SPA	1,398	961	69%	828	620	59%
SSH	242	178	74%	170	123	70%
SiS	62	31	50%	33	17	53%
TPT	688	374	54%	167	92	24%
<b>Total FP7</b>	<b>119,373</b>	<b>79,091</b>	<b>66%</b>	<b>68,650</b>	<b>44,919</b>	<b>58%</b>

#### 24.6.2. Author statistics. Author networks.

Table 11. Statistics on authors of FP7 publications.

Scientific area	Number of Authors		
	Average	Min	Median <sup>93</sup>
COH	1.67	1	2
ENERGY	5.16	1	5
ENV	6.85	1	5
ERC	5.78	1	4
Fission	6.66	1	5
Fusion	9.00	5	6
GA	5.48	1	5
HEALTH	11.46	1	7
ICT	4.43	1	4
INCO	6.90	1	6
INFRA	8.47	1	5
KBBE	7.03	1	6
NMP	6.18	1	6
PEOPLE	12.64	1	4
REGIONS	4.28	1	4
REGPOT	8.06	1	5
SEC	5.30	1	4
<b>FP7</b>	<b>7.05</b>	<b>1</b>	<b>4</b>

<sup>93</sup> The median value X on authors means that more than 50% of publications have at least X number of authors.

In addition we did some calculations and comparisons (simple network analysis) to see how authors collaborated during FP7 and whether these collaborations existed before and how they continued after (structuring and network effects). Table 127 shows the values of author collaborations (in pairs) before the beginning, during the FP7 project, and after the a project for all projects that have finished by 31/12/2014. The overall numbers indicate that there is a clear increase in collaborations after the end of the corresponding FP7 projects: 158K author pairs having collaborated before and after they have co-authored at least one FP7 publication; 204K author pairs had collaborated before they co-authored at least one FP7 publications and have not collaborated (yet) afterwards, whereas 524K author pairs have collaborated for a publication after their initial collaboration for an FP7 publication.

Column explanation in Table 12:

Author pairs during: number of author pairs that collaborated for an FP7 paper

Author pairs before: author pairs that have collaborated before an FP7 paper

Author pairs after: author pairs that have collaborated after an FP7 paper

Author pairs before only: author pairs that have collaborated before an FP7 paper, but not afterwards

Author pairs after only: author pairs that have collaborated after an FP7 paper, but not before

Author pairs before and after: author pairs that have collaborated before and after an FP7 paper

Table 12. Author networks before, during, after FP7.<sup>94</sup>

Scientific Area	Author pairs					
	During	Before	Before only	After	After only	Before & after
ENERGY	2,571	727	461	1,926	1,660	266
ENV	35,466	9,284	6,541	27,528	24,785	2,743
ERC	234,905	67,247	39,572	87,971	60,296	27,675
Fission	14,218	6,922	2,911	11,106	7,095	4,011
Fusion	21	1	1	20	20	0
GA	516	98	47	469	418	51
HEALTH	194,918	36,308	22,581	156,128	142,401	13,727
ICT	33,541	8,927	5,543	23,544	20,160	3,384
INCO	354	229	187	166	124	42
INFRA	176,203	70,014	22,936	134,655	87,577	47,078
KBBE	28,222	14,273	11,467	12,478	9,672	2,806
NMP	14,971	4,441	3,103	9,942	8,604	1,338
PEOPLE	292,002	131,843	82,627	177,865	128,649	49,216

<sup>94</sup> The data in this table is based on OpenAIRE July data and should not skew the conclusions, as i) it was calculated as an estimate based on full text, and ii) calculated distinct authors (by-passed deduplication).

REGIONS	15	8	4	11	7	4
REGPOT	36,065	8,596	3,778	31,537	26,719	4,818
SEC	801	231	169	483	421	62
SME	1,153	288	165	908	785	123
SPA	16,005	3,305	1,946	6,038	4,679	1,359
SSH	780	81	50	177	146	31
SiS	358	23	17	180	174	6
TPT	681	295	207	390	302	88
<b>Total FP7</b>	<b>1,083,766</b>	<b>363,141</b>	<b>204,313</b>	<b>683,522</b>	<b>524,694</b>	<b>158,828</b>

Fehler! Verweisquelle konnte nicht gefunden werden. illustrates the results to show the trends in a schematic form.<sup>95</sup>

### Author collaborations before, during and after FP7 projects

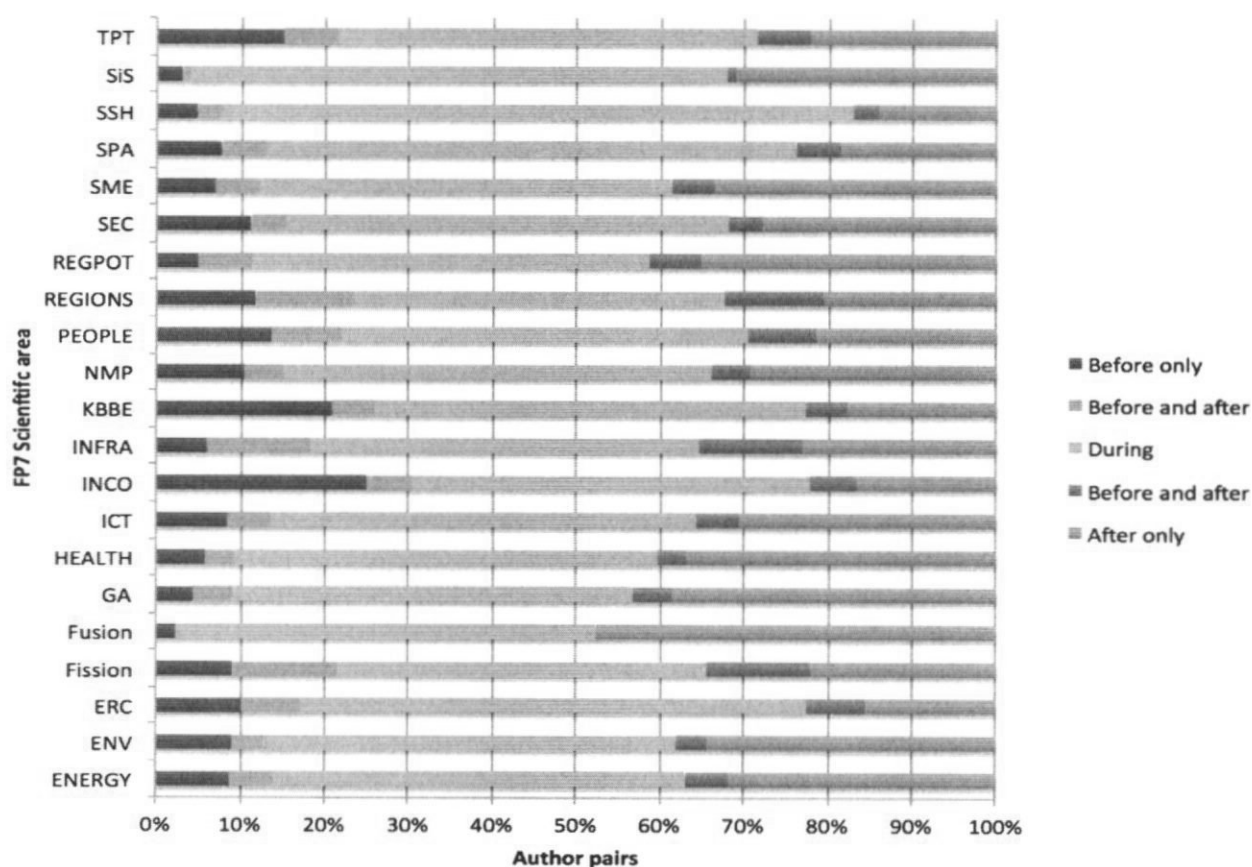


Figure 7. Author collaborations affected by FP7.

<sup>95</sup> The data in this table is based on OpenAIRE July data and should not skew the conclusions, as i) it was calculated as an estimate based on full text, and ii) calculated distinct authors (by-passed deduplication).



### *Classifications*

Bubble diagrams of classifications of all FP7 and broken down by FP7 scientific area. Select most fitting classification schemes.

#### **Analysis details:**

We applied a multi view probabilistic topic modeling based on:

- Full text publications, project descriptions and SESAM Health related project reports related to FP7
  - 76.422 (total publications & reports)
  - Alphabet count: 224.274 (distinct words)
  - Max tokens per entity: 12.542
  - Total tokens: 136.978.231
- Grants per publication
  - 64.771 links to 2.874 distinct grant ids
- Research Areas per publication (based on above mentioned Grants)
  - 85.665 links to 20 distinct FP7 scientific areas
- Venues / Journals (whenever available)
  - 59.931 references (links) to 797 distinct journals

#### **Parameters:**

We identified 320 topics based on 4 modalities over 1200 iterations.

#### **ExportTopics\_FULLText.csv:**

Describes top (max 20) Phrases, words, related grants, related research areas & Venues per topic. Also contains related counts.

**ResearchAreasPerTopic.csv:** Describes related research areas per topic giving related weight (topic activation). Category1 is related to FET/NON\_FET projects, and Category2 is related to FP7 research area. Thus, one can see, order or filter topics per research area, research areas per topic, topics per FET areas etc.

Topic evolution (per scientific area) over time (snapshot from 2000-today) with focus on 2007-today – Sept 2015

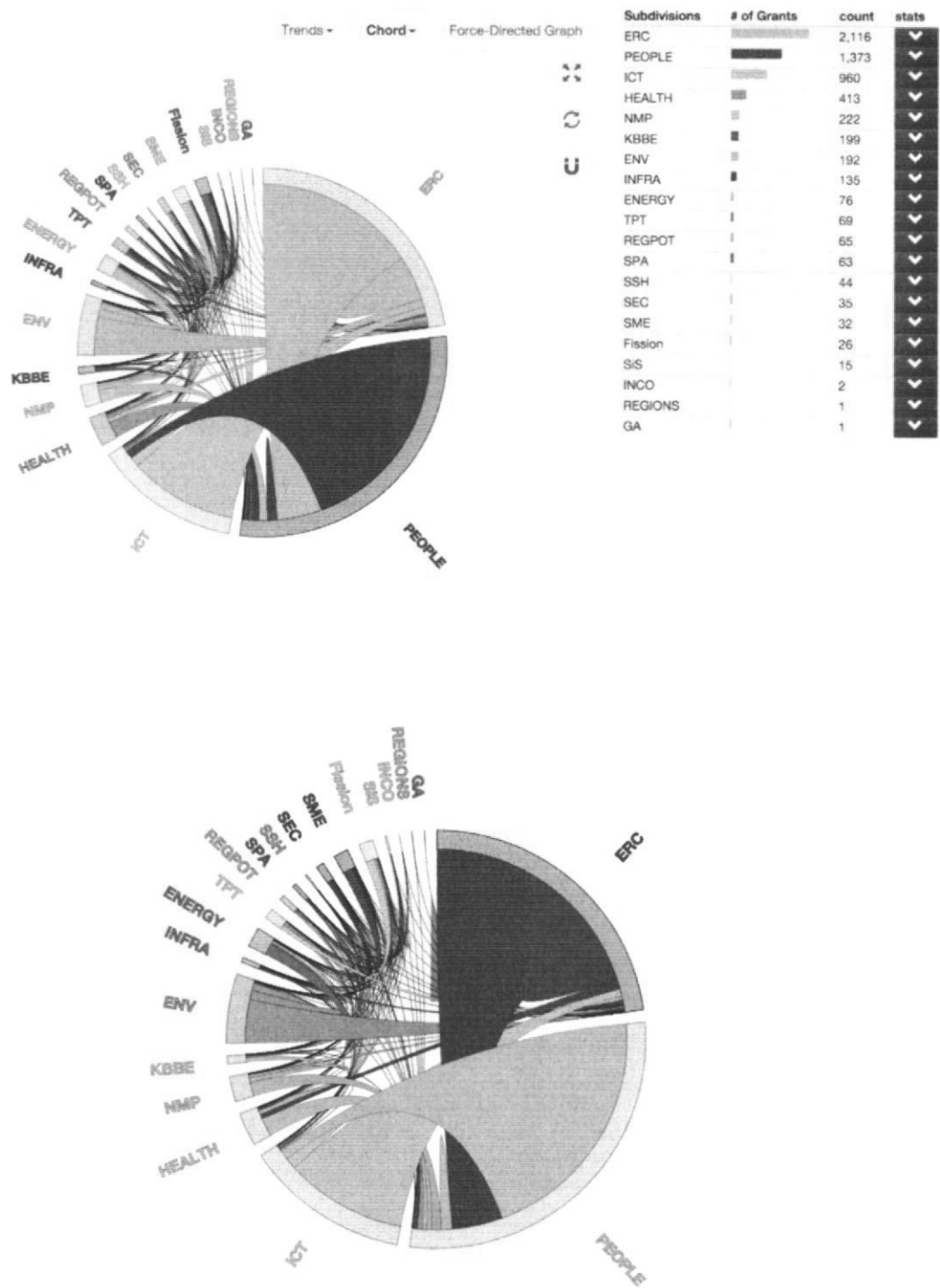


Figure 8. Interconnection of FP7 scientific areas based on common topics.

## 25. THE COMMUNITY INNOVATION SURVEY AND FP7 INNOVATION PERFORMANCE

### The Community Innovation Survey (CIS)

The CIS is a survey of innovation activity in enterprises, carried-out by Eurostat and the national statistical institutes in a harmonised way. It provides information on the innovativeness of sectors by type of enterprises, on the different types of innovation and on various aspects of the development of an innovation, such as the objectives, the sources of information, the public funding, the innovation expenditures etc. The CIS provides statistics broken down by countries, type of innovators, economic activities and size classes<sup>96</sup>.

The CIS is carried-out every two years. It covers most Member States and Norway, with very large samples (more than 160,000 enterprises interviewed in the 2008 and 2010 editions, more than 140,000 in CIS 2012).

The CIS questionnaire includes a question that allows the identification of innovative enterprises that received financial support from the EU, and more specifically from the Framework Programmes. Therefore the CIS data permits to compare the innovation performance of companies that were involved in FP7 with those that did not receive such funding (i.e. counterfactual analysis). This requires analysing the results of the CIS raw data for its editions 2008, 2010 and 2012, in the Eurostat's Safe Centre in Luxembourg.

### CIS caveats

The CIS' design presents some caveats:

– **Geographical coverage:** Neither all FP7 associated countries, nor all EU member states are covered by the CIS 2008, 2010 and 2012. Amongst member states, Belgium, Denmark, Greece, Croatia, Austria, Poland and the UK did not participate in CIS 2008 or their data are not available. There are no data for the CIS 2010 for Belgium, Denmark, Greece, Malta, Austria and the UK, and Denmark, Ireland, Greece, Netherlands, Austria, Poland and the UK are absent for CIS 2012. Amongst associated countries, only Norway is present in all three editions.

– **Time coverage:** The CIS 2008 covered the years 2006-2008; the CIS 2010, 2008-2010; and the CIS 2012, 2010-2012. This implies three kinds of issues:

- (i) The CIS 2008 data include one year before the start of FP7 (2007-2013);
- (ii) the CIS 2012 data include one year after the end of FP7; and
- (iii) there is an overlap of one year between one CIS edition and the next.

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<sup>96</sup> See: <http://ec.europa.eu/eurostat/web/microdata/community-innovation-survey> and

**Identification of enterprises that participated in FP7:** The CIS questionnaire includes a question about "public financial support for innovation activities" from the EU, and notably from the Framework Programme. However, due to the filters of the questionnaire, this question is asked to enterprises that declared having introduced product, service or process innovations. This means that:

(i) The CIS allows to identify FP7-supported product, service and process innovators, i.e. companies involved in FP7 that introduced such kinds of innovations. FP7-supported enterprises that developed organisational and/or marketing innovations cannot be identified.

(ii) It is not possible to identify enterprises that received financial support from FP7 and did not introduce any product, service or process innovation. This is the main issue of the CIS: it does not allow to analyse to what extent FP7-supported enterprises introduced more or less innovations than those not financed by the framework programme. The analysis can only compare the performance (i.e. products, services or processes new to the market or new to the firm, and the turnover obtained) of innovators, with or without FP7 support.

The data from the different editions of the CIS cannot be aggregated in a single file, because of the time overlaps mentioned above, and because some enterprises (especially, large ones) are surveyed in each edition. Such aggregation would imply a double-counting. Each CIS dataset has to be analysed independently.

Despite these caveats, the CIS data provides very reliable information about the performance of FP7-supported innovators.

### **Innovation results**

Comparing the performance of innovative enterprises financially supported by FP7 (and one year of FP6, for CIS 2008) with those not funded by the Framework Programme. They show that:

Innovative companies supported by FP7 are more likely to introduced product or service innovations new to the market or the firm, and processes new to the market.

Those FP7-supported innovative enterprises obtain on average higher proportions of their total turnover from such exploited innovations.

It is important to clarify that the correlations does not imply causality. Statistics do not demonstrate that the better innovation performance is *due to* FP7 participation. For example, it is also possible that FP7 attracted the best players in terms of innovation, which expected results are logically better. In any case, the results from the CIS analysis a better efficiency of innovators, in terms of market innovation, when they have been supported by FP7.

26. CONTRIBUTION OF FP7 THEMES AND ACTIONS TO OVERARCHING AND SPECIFIC OBJECTIVES

Objectives (what did we want to achieve)/ expected impacts	How did we want to achieve it?	What happened? (output/ real impact)
<p><b>Overarching objectives</b></p> <p>To contribute to the Union becoming the world's leading research area</p>	<p>Implementation of the whole FP7</p>	<p>FP7 has generated large number of publications and patents:</p> <ul style="list-style-type: none"> <li>- Number of patents per million inhabitants increased in the EU bridging the gap in the ratio in the US;</li> <li>- filled weighted citation impact of FP7 publication is above EU average and in most cases above US average</li> </ul>
<p>To support progress towards the target of spending 3 percent of Europe's GDP on R&amp;D by 2010, two-thirds of it financed by the private sector</p>	<p>Implementation of the whole FP7</p>	<p>Considering the fact that FP7 represented 6,4 % of GBAORD, its influence on EU research spending was limited.</p> <p>Despite the economic crisis, FP7 contribution has helped maintaining research activities at national level.</p>
<p>To support the creation of the European Research Area</p>	<p>Implementation of the whole FP7</p>	<p>FP7 supported the completion of ERA in 2004</p>

<p>To contribute to the development of a knowledge-based economy and society of Europe.</p>	<p>Implementation of the whole FP7</p>	<p>FP7 resulted in a probable cumulative increase in GDP of € 398,000 million until 2030, an extra 0.12% annual growth in GDP.</p> <p>The probable cumulative job creation of FP7 would be of 2,900,000 jobs.</p> <p>The probable increase in extra-European exports will be by up to an extra 0.19 percent by the year 2030, and imports to be reduced by up to 0.03 percent.</p>
<p><b>Specific objectives</b></p> <p>To enhance the competitiveness of European industry by the common technology initiatives;</p>	<p>Implementation of the FP7 Cooperation Programme, notably by:</p> <ul style="list-style-type: none"> <li>• thematic research, also benefitting SMEs;</li> <li>• launching Joint Technology Initiatives.</li> </ul> <p>Implementation of the FP7 Capacities Programme, notably the</p> <ul style="list-style-type: none"> <li>• Risk Sharing Finance Facility</li> <li>• Research for the Benefits of SME Programmes</li> </ul> <p>Implementation of the FP7 Ideas Programme, notably the</p> <ul style="list-style-type: none"> <li>• European Research Council (ERC) to foster frontier research</li> </ul>	<p>Overall, € 1 of FP7 contribution mobilised a direct contribution of € 0.85 by the private sector (co-funding)FP7</p> <p>70% of FP7 participants reported improved competitiveness.</p> <p>17% of the FP7 Cooperation Programme contribution was allocated to SMEs</p> <p>5 JTI launched which reached a critical mass of financial, organisational and human resources in areas critical for the EU competitiveness.</p> <p>The RSFF mobilised € 16.2 billion in total loan volume.</p>

	<p>After the economic crisis, launching contractual Public-Private Partnerships.</p> <p>Implementation of the People Programmes, notably the Marie Curie Actions (MCAs) and after the economic crisis the support to the European Industrial Doctorates and Industry-Academia Partnerships and Pathways.</p>	<p>SMEs participating in FP7 increased employment and operating revenue (38% higher than the control group).</p> <p>Frontier research is expected to generate radical breakthroughs.</p> <p>cPPPs have leveraged private investment, engaging top industrial companies, SMEs and research organisations securing overall funding.</p>
<p>To increase European wide S&amp;T collaboration and networking for sharing R&amp;D risks and costs;</p>	<p>Implementation of the FP7 Cooperation programme, notably through:</p> <ul style="list-style-type: none"> <li>• Collaborative projects</li> <li>• ERANETs; ERANET+</li> <li>• Art. 185 initiatives</li> </ul> <p>Implementation of the FP7 People, MCA network</p>	<p>FP7 created durable, inter-disciplinary, cross-sectoral networks.</p> <p>Number of participating organisations in FP7 grew compared to FP6. 72% of the organisations were new to FP7.</p> <p>FP7 mobilised 600,000 collaborations of which 450,000 were new.</p> <p>FP7 fostered inter-disciplinary knowledge generation. In most thematic areas, FP7 co-publications between private sector and academia are higher than EU average.</p> <p>More than 60% of co-publication patterns in FP7 continued after the project ended.</p>

<p>To contribute to an increase in the level of research investment (contribute to the realisation of the 3% Barcelona objective by more than doubling Community investment in R&amp;D);</p>	<p>Implementation for whole FP, notably the JTI, cPPPs and the RSFF</p> <p>Implementation of the Capacities Programme – Research Potential</p>	<p>The overall FP7 leverage effect was 0.42.</p> <p>The leverage effect of cPPPs was 0.5.</p> <p>The RSFF had a leverage effect of 6.6 and multiplier effect of 28.</p>
<p>To improve the coordination of European, national and regional research policies;</p>	<p>Implementation of the FP7 Cooperation Programme, in particular the ERANETs, ERANET+ and the Article 185 initiatives.</p> <p>Implementation of the FP7 Capacities, Regions of Knowledge Programme (RoK)</p> <p>Implementation of the FP7- Ideas – ERC programme</p> <p>Implementation of FP7 – People- MCAs</p>	<p>FP7 effectively improved the coordination of European, national and regional research policies.</p> <p>ERANETs mobilised € 2 billion national funding.</p> <p>Art. 185 initiatives had a leverage effect 1:1.5</p> <p>MCAs leverage effect was 1:2.5</p> <p>ERC model adopted by 11 Member States</p>
<p>To strengthen the scientific excellence of basic research in Europe through increasing coordination and competition at the European level;</p>	<p>Implementation of the FP7- Ideas – ERC programme</p> <p>Implementation of FP7 – People- MCAs</p> <p>Implementation of the FP7 Cooperation Programme – thematic actions on collaborative research</p>	<p>FP7 publications in top 1 and 5% journals were above EU average.</p> <p>FP7 cross-border co-publication patterns were above average of the EU, US, and world.</p> <p>Increased participation in FP7 is highly correlated with patent applications, publications and number of PhD graduates employed.</p>



<p>FP7 attracted a high number of Nobel prize and Fields Medallists winners.</p> <p>MCA mobilised the 100 best ranked EU universities.</p>		
<p>FP7 – People - MCA supported the development of scientific careers of 50,000 researchers (including 10,000 PhD candidates), representing over 140 different nationalities, located in more than 80 countries.</p> <p>46% of researchers from industrialised countries stayed in Europe after the end of their fellowship.</p> <p>FP fostered long term mobility (39% in FP7 vs 26% among non-participants).</p> <p>FP7 contributed to more transparent and merit-based recruitment (30 – 40% of beneficiaries).</p> <p>FP7 contributed to more long-term researchers recruitment (43% of researchers stayed in the team after the end of the project).</p>	<p>Implementation of FP7 – People- MCAs</p> <p>Implementation of the FP7- Ideas – ERC programme</p> <p>Implementation of the FP7 Cooperation Programme – thematic actions on collaborative research</p> <p>Implementation of the Capacities Programme – Research Potential</p>	<p>To promote the development of European research careers and to make Europe more attractive to the best researchers;</p>

<p>To provide the knowledge-base needed to support key Community policies</p>	<p>Implementation of the FP7 Cooperation Programme thematic actions on collaborative research</p> <p>Implementation of the FP7 Capacities, Coherent Development of Research Policies (COH) and Regions of Knowledge Programme (RoK);</p> <p>Implementation of the FP7 Cooperation Programme – INCO</p> <p>Implementation of the FP7 Capacities – activities of international cooperation</p>	<p>FP7 Cooperation Programme supported key Community policies.</p> <p>FP7 Capacities Programme RoK contributed to smart specialisation strategies. INCO contributed to a broad range of Community instruments.</p>
<p>To increase availability, coordination and access in relation to top-level European scientific and technological infrastructure.</p>	<p>Implementation of the FP7 Capacities – research infrastructures</p>	<p>FP7 fostered the integration of around 900 research infrastructures in networks, which provided access and services to more than 20000 users so far and another 20000 potential users in the next years.</p>

**27. FP7 ACHIEVEMENTS ACCORDING TO THE HIGH LEVEL EXPERT GROUP ON THE EX-POST EVALUATION OF FP7**

1. Encouraged scientific excellence on individual and institutional level. FP7-IDEAS demonstrated its ability to attract excellent researchers and become a benchmark of individual excellence. FP7-PEOPLE has set a European standard for doctoral training of a new generation of excellent scientists. FP7-COOPERATION facilitated transnational collaboration and thus provided a platform for the best minds to work together in order to contribute to solving major societal challenges. FP7-CAPACITIES supported the involvement of excellent organizations from the SME sector, civil society, new EU Member States and developing countries in European research.

2. Promoted ground-breaking research through a novel programme FP7-IDEAS (ERC). The focus on supporting frontier research which, by definition, can be a risky endeavour, was enhanced. The number of publications in top rated scientific journals that acknowledge ERC funding, Nobel Prizes and Fields medals received by ERC grantees all attest to ERC grants becoming a mark of scientific excellence.

3. Engaged industry and SMEs strategically. Both, large corporations and SMEs have been involved extensively through increased public-private-partnerships, in particular the development of JTI, and through a range of SME specific programmes. This has underlined FP7's intended role of fostering Europe's innovation-based competitiveness.

4. Reinforced a new mode of collaboration and an open innovation framework. This was achieved through a more decentralized approach to the design, structure and direction of projects across the ERC, JTI and the EIT. During the FP7 period, the European Commission has adapted the programme to the economic crisis and has responded to the a more generalised pursuit of open innovation.

5. Strengthened the European Research Area by catalysing a culture of cooperation and constructing comprehensive networks fit to address thematic challenges. A unique capability of cross-border and cross-sector cooperation was promoted, with organisations from on average of 6 countries collaborating in projects funded by FP7-COOPERATION and FP7-CAPACITIES.

6. Addressed certain societal challenges through research, technology and innovation. FP7-COOPERATION included society-relevant themes, such as Health, Energy, Transport and Security, whilst FP7-CAPACITIES included a specific sub-programme that was dedicated to "Science in Society". Furthermore, the focus on gender equality evolved from exclusively promoting individual female scientists to facilitating structural change in institutions.

7. Encouraged harmonisation of national research and innovation systems and policies. In most EU Member States FP7 contributed to scientific excellence, focused on addressing societal challenges, and set standards for research funding mechanisms and selection processes. Through the sub-

programme FP7-ERA-NET the cooperation and coordination of research activities carried out at national or regional level in the Member States and Associated States were intensified through networking of research activities, and the efforts to coordinate research programmes.

8. Stimulated mobility of researchers across Europe. FP7-PEOPLE has created the necessary conditions for an open labour market of researchers and supported their geographical mobility. Achievements during the FP7 period included fellowships gaining recognition as the best practice of doctoral training and the creation of attractive working conditions for geographically mobile researchers.

9. Promoted investment in European research infrastructures. A combination of the support for the European Strategy Forum Initiatives for Research Infrastructures (ESFRI) and FP7-CAPACITIES helped to achieve a more coherent and coordinated development and use of European research infrastructures.

10. Reached a critical mass of research across the European landscape and worldwide. Human and financial resources were made available to attract many organizations and individuals to collaborate with or work at European research institutions. Furthermore, a research programme of such scale has helped to put research on the public agenda and to show that research can be an instrument for economic and social development.

## 28. LIST OF ACRONYMS

COFUND: Co-funding of Regional, National and International Programmes  
COST: Scientific and Technological Cooperation  
EIB: European Investment Bank  
ETI: European Institute of Technology  
EIF: European Investment Fund  
ERA: European Research Area  
ERC: European Research Council  
ETP: European Technology Platform  
EU: European Union  
EURATOM: European Atomic Energy Community  
FP: Framework Programme  
GHG: Greenhouse Gases  
GMES: Global Monitoring for Environment and Security  
IA: Impact Assessment  
IAPP: Industry-Academia partnerships and pathways  
IMI: Innovative Medicines Initiative  
INCO: International Cooperation  
IPR: Intellectual Property Rights  
JTI: Joint Technology Initiative  
KBBE: Knowledge Based Bio-Economy  
MCA: Marie Curie Actions  
MPC: Mediterranean Partner Countries  
NCP: National Contact Point  
RI: Research Infrastructures  
R&D: Research and Development  
R&I: Research and Innovation  
RTO: Research and Technological Organisation  
RSFF: Risk-Sharing Finance Facility  
SESAM: On-line Submission Tool  
SME: Small and Medium-sized Enterprise  
SP: Specific Programme  
SPP: Strategic Planning and Programming  
SSH: Social Sciences and Humanities  
WP: Work Programme